Alfred Bader fonds

Correspondence

Chemical Heritage Foundation. 1992-2003

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FILE 33

Subject: CHF on the Move: News That Makes History
From: "CHF on the Move" <chfonthemove@chemheritage.org>
Date: Wed, 27 Aug 2003 10:46:00 -0400

CHEMICAL HERITAGE FOUNDATION (CHF)
CHF on the Move: News That Makes History
Volume 1, Number 11
28 August 2003

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ALFRED BADER TO PRESENT THE 2003 ULLYOT PUBLIC AFFAIRS LECTURE AT CHF, 18 SEPTEMBER AT 6 P.M.

Art collector, entrepreneur, scientist, Bader to discuss building a billion-dollar company from a small start-up

Renowned art collector, entrepreneur, and scientist Alfred Bader will present the 2003 Ullyot Public Affairs Lecture at the Chemical Heritage Foundation on Thursday, 18 September. The talk, "Learning from Experience: The Aldrich Story, the Rocky Road to Success," begins at 6:00 p.m. and will be followed by a reception at 7:00 p.m. The talk is free and open to the public; registration is requested. To register for this lecture, please visit www.chemheritage.org and click on "Events & Activities."

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CHF HOSTS JOSEPH PRIESTLEY SOCIETY (JPS) MEETING, BIOTECHNOLOGY SYMPOSIUM

The September JPS speaker is Carl Feldbaum, president of the Biotechnology Industry Organization (BIO). The meeting and luncheon will begin at 11:30 a.m. on 11 September.

A biotechnology symposium, "Partnering in Industrial Biotechnology: Opportunities at a Historic Turning Point," will begin at 2 p.m. (immediately following the JPS meeting). Speakers from three biotechnology ventures will describe their innovations and experiences in the field, then a panel discussion with representatives from established chemical companies will examine the current status and near-term future of joint ventures and partnerships in biotechnology. Following the symposium, CHF will host a reception for all attendees.

The JPS meeting and the biotechnology symposium are both free and open to the public; registration is required. To register for these events, please visit www.chemheritage.org and click on "Events & Activities."

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CHF LAUNCHES NEW WEB SITE

The new CHF Web site, www.chemheritage.org, is fully searchable, readable, well organized, fast, and easy to use. Online ordering, conference registration, links to related organization, news, and much more join the great educational content and access to the Othmer Library catalog that draw tens of thousands of virtual visits each month. Visit www.chemheritage.org and see state-of-the-art technology that preserves the history and heritage we all share.

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If you prefer not to receive this newsletter, simply reply to this e-mail with UNSUBSCRIBE in the subject line.

Please visit our new Web site: www.chemheritage.org

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FOUNDATION

315 Chestnut Street ☐ Philadelphia, PA 19106-2702 ☐ USA
Telephone (215) 925-2222 ☐ Fax (215) 925-1954

Internet http://www.chemheritage.org

THE BECKMAN CENTER FOR HISTORY OF CHEMISTRY ☐ THE OTHMER LIBRARY OF CHEMICAL HISTORY ☐ PUBLIC EDUCATION

Arnold Thackray, *President*

TO: Dr. Alfred Bader
924 East Juneau, Suite 622
Milwaukee, WI 53202

Dr. Dudley Herschbach
Harvard University
Department of Chemistry and Chemical Biology
12 Oxford Street
Cambridge, MA 02138

FROM: Arnold Thackray AT

SUBJECT: Woodward papers

DATE: 17 February 2000

Raising funds to preserve papers that are not at CHF is a new venture for us, but one obviously in accord with our mission to preserve the chemical heritage. Numerous questions arise and, with your good aid, I am sure we shall answer them and succeed in this worthwhile endeavor.

I enclose for your mutual information
(1) Dudley's letter to me of 3 February 2000
(2) Robin McElheny's letter to me of 28 January 2000, and the Harvard preservation proposal
(3) An e-mail exchange between Alfred and Crystal Woodward, on 3 February
(4) My e-mail to Crystal of 17 February 2000

Herewith some comments for your further advice and input:
(a) I think it better not to give Crystal a "blow by blow" but keep her broadly informed.
(b) It may be that the Harvard Archives' proposal can be modified in certain aspects (including I would hope the deposit of copies of all copied items at CHF, where they will get greater use by interested scholars), and reduced in price to $100,000.
(c) An advisory committee—or co-chairs of the appeal—of 5 or 6 names along the lines Dudley indicates, is most desirable.

(d) As to funding, CHF will put in 'the final $25,000' if $75,000 can be raised. I would hope that $75,000 could come in two or three 'chunks'—possibilities might include the many Harvard tubs on their bottoms, foundations, the Woodward family, certain corporations and individuals. Alfred can vouch how laborious a "general appeal" is, and how low the yield.
(e) CHF is willing to donate the staff time for visits/proposals to not more than four prospects (each must be somewhere where we have a reasonable hope of $25,000-$50,000), and to oversee one general mailing. My Board expects us to raise a dollar for every 10 cents spent on development, so we are constrained as to what we can do.
(f) Can we utilize e-mail from here on? I can be found at: athackray@chemheritage.org.

Thank you both for your interest, patience, and good counsel.

Enclosures

FEB 07 REC'D

HARVARD UNIVERSITY
DEPARTMENT OF CHEMISTRY AND CHEMICAL BIOLOGY
12 Oxford Street, Cambridge, MA 02138, USA

Dudley R. Herschbach
Baird Professor of Science

Tel: 617-495-3218
Fax: 617-495-4723
E-mail: hbach@chemistry.harvard .edu

February 3, 2000

Dr. Arnold Thackery
Chemical Heritage Foundation
315 Chestnut Street
Philadelphia, PA 19106-2702

Dear Arnold:

I am glad indeed to accept your request to serve as honorary chair of the campaign to save the Woodward papers, however, since I am not an organic chemist, it is likely to seem a bit odd to many of the people receiving the letter. I wonder if it wouldn't be better to have several honorary chairs, including people who have worked closely with Woodward. Of course I'm thinking first of all of Roald Hoffmann (Cornell), but also Harry Wasserman (Yale), and Elkan Blout. Another good possibility would be Alfred Bader. It might be wise to have a number of names of distinguished foreign chemists as well , such as Albert Eschenmoser in Switzerland.

As I say, I would be glad to be among such a list but I would feel a bit strange being the only honorary chair, especially since among physical chemists, Roald Hoffmann would be the logical choice for the role in this campaign.

Long ago, after a conversation we had about the Woodward papers, I contacted Ms. Robin McEhlleny at the Harvard Archives. She promised to send an estimate of what the preservation of the papers should cost. I think I sent a message reminding her once or twice after that but never did receive an answer. Hope that you have better luck this time!

Best wishes,

Dudley

Dudley Herschbach

DH/mtp

FEB 04 REC'D

HARVARD UNIVERSITY ARCHIVES
CAMBRIDGE, MASSACHUSETTS 02138

PUSEY LIBRARY
(617) 495-2461
FAX (617) 495-8011

E-MAIL: archives-ref@hulmail.harvard.edu

January 28, 2000

Arnold Thackray
Chemical Heritage Foundation
315 Chestnut Street
Philadelphia, PA 19106-2702

Dear Mr. Thackray:

Thank you for your letter of January 14 announcing the initiation of the Foundation's fundraising effort on behalf of the papers of Robert Burns Woodward. Both Harley Holden and I are glad to know that there is the possibility of finding the resources to ensure the long-term preservation of this collection.

As you requested, I have enclosed a comprehensive preservation proposal that we sent to Crystal Woodward last March. Please let me know if you have any questions about this proposal and how it relates to the more specific proposal for deacidification of Woodward's chemical drawings that we prepared this fall.

Sincerely,

Robin McElheney

Robin McElheney

Cc: Harley Holden

Post-it® Fax Note 7671	Date 2/3/2000	# of pages ▶ 2
To Dr. A. Thackray	From Alfred Bader	
Co./Dept.	Co.	
Phone #	Phone # 414-277-0730	
Fax # 215-925-1954	Fax # 414-277-0709	

Please see e-mail exchanges

Subject: Re : Re: Re : Re: Re : [Fwd: [Fwd:
Date: Thu, 3 Feb 2000 05:29:58 EST
From: Woodcrystl@aol.com
To: baderfa@execpc.com

Dear Dr. Bader,

I am hoping to leave for London tomorrow a.m. early, getting there evening Feb. 4, and to be there into the beginning of next week. I mention this in case you may be in England. I won't have e-mail access there, though, so will check to see if there's a message from you by end of the (French time) day Thursday or early Friday.
Otherwise in London I hope to be at 171 351 4552, c/o Mrs. Gimpel.

I am conveying to Harvard that we are on the way to finding the needed $10,530 for the de-acidification of the RBW chemical drawings and papers. In addition to your matched contribution, there will be the note in their February CHF Newsmagazine about the fund-raising. Hopefully this will get a good response. My brother and I also are making significant contributions. I hope that this constitutes a basis on which Harvard can ask to schedule the de-acidification with the Northeast Document Conservation Center, in MA.*

I didn't get a response from Dr. Thackray about the further preservation work beyond the most urgent, of de-acidification, that which, as I wrote to Dr. Thackray in December**, involves color photography and microfilming, and for which Robin McElheny at Harvard had sent me an estimate of some $139,200. Have you communicated with Dr. Thackray about this aspect? One might wish, of course, that those costs could somehow be less, though I don't know whether this would be possible, - e.g. through improved technology? In any case, it seems to me that some mention of this further component should be included in the campaign considerations and letter CHF envisions for the near future, if not in the note going into the February 2000 issue of the Chemical Heritage Newsmagazine. I'd be interested in your thoughts on this.

I hope all is well with you. In London (and Paris) I hope to get to some good art exhibits. Have you any suggestions of what to see or galleries to visit? It is always a pleasure to hear from you about your artistic appreciation. Here in the Luberon the landscape is superb, yet I'm eager to view some good painting and drawing now too.

Best Wishes to you both,

Crystal

*A question I still have is whether with the renovations at the Pusey Library, due to start this Spring, there might be a new storage area on site - with the needed climate control- where the original R.B.Woodward papers, once de-acidified, could be placed. The plan is to have the originals, once treated, placed in an off-site storage, with climate control; I have some sense that it's unfortunate they'll be off-campus. Or does this not matter, the main point being that they be preserved? Have you an insight on this? Also to be considered are the logistics on the color photography of the drawings with color, i.e., when to do this if the drawings are going to go off-site?

**in fax of 21 Dec. '99 to Dr. Thackray, I summarized Harvard's estimate of $139,200. It includes:
- Preparation of material, by a person or persons working in the Archives at Harvard, some $36,000;
- Microfilming, some $79,200.
- Color Photography (of RBW chemical drawings with color), $24,000.

Dear Crystal,

In response to your e-mail of today, I do not believe that it is possible to raise $139,200 for all the work that would be desirable. I remember working immensely hard to raise some $80,000 for the exhibition. But I do believe that the $10,530 can be raised.

Of course it would be better to have the papers on view, but having them available to scholars is better than nothing.

My own experience with Harvard has not been good. I gave them $1 million for fellowships in Chemistry, specifically for Czech students, and Harvard has certainly not come up to my expectations in their efforts. A good friend of mine, Dr. Ira Kukin, told me just last week that he gave Harvard $5 million for a specific effort and he also was deeply disappointed.

I do feel that the Chemical Heritage Foundation is making a very real effort, but no matter how hard they try I don't think they will be able to raise such large sums of money.

Of course I much look forward to the book about your father. To me - and to many, many others - he was the greatest organic chemist of the 20th century.

With all good wishes I remain

Yours sincerely,
Alfred Bader

Perrin, Marthenia

From: Perrin, Marthenia on behalf of Thackray, Arnold
Sent: Thursday, February 17, 2000 5:15 PM
To: 'woodcrystl@aol.com'
Subject: Woodward papers

Dear Crystal,

Please rest assured of two things: (1) we are working with all due deliberation on your and my favorite project, preservation of the Woodward papers, and (2) while there will be no overnight miracles, we intend to stay the course. I am in touch with the Harvard Chemistry Department, and the Harvard Archives, among others. We will keep you posted.

Sincerely,

Arnold

A request for support for the

Preservation of and enhancement of access to the papers of Robert Burns Woodward

Harvard University Archives
Cambridge, Massachusetts
March 1999

Introduction

The Harvard University Archives seeks funding to preserve and enhance access to the papers of Robert Burns Woodward, professor of organic chemistry at Harvard from 1950 to 1979 and recipient of the Nobel Prize in 1965.

The goals of this project are twofold:

- To reformat the Woodward papers on preservation microfilm.
- To create a detailed inventory of the papers that will be available to researchers via the WorldWideWeb in Harvard's On-line Archives Search Information System (OASIS).

By reformatting the Woodward papers on silver gelatin microfilm, the University Archives will ensure long-term preservation of the information in the documents, even as the originals continue to grow brittle with age. In addition, the University Archives will be able to loan copies of the microfilm to researchers who are unable to make on-site use of the papers.

At the same time, on-line availability of an inventory will enable researchers to determine which parts of this large collection are pertinent to their research. The inventory will reflect the arrangement of the original documents as well as the organization of the microfilm version.

Significance of the Woodward papers

Robert Burns Woodward was born in 1917 in Quincy, Massachusetts. He received his elementary and high school education in Quincy public schools. He graduated from the Massachusetts Institute of Technology in 1937 with both B.S. and Ph.D. degrees. In 1938 Woodward came to Harvard as private assistant to Professor E.P. Kohler. From his appointment as an instructor in 1941, Woodward progressed to a full professorship in 1950. He was appointed Morris Loeb Professor of Chemistry in 1953 and held the Donner Professorship of Science from 1960 until his death in 1979.

The recipient of numerous honorary degrees and nearly every possible award in chemistry, Woodward dominated the field of mid-twentieth century organic chemistry. His work included completion of the synthesis of quinine (1944), cholesterol and cortisone (1951), strychnine and lysergic acid (1954), and chlorophyll (completed in 1960).[1]

The Woodward papers encompass professional correspondence, reports, manuscripts, research notes, data, and photographs, and teaching materials (examinations, course syllabi, lecture notes) and other papers relating to the Department of Chemistry at Harvard, as well as papers relating to the Woodward Research Institute in Basel, Switzerland. They also include personal and family papers. All in all, the collection consists of 70 cubic feet of documents, including 220,000 pages of text.

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[1] For more biographical information, see Woodward, Crystal, "Art and Elegance in the Synthesis of Organic Compounds: Robert Burns Woodward," in *Creative People at Work*, Oxford University Press, 1989.

The papers provide a nearly complete record of Woodward's career, from the preliminary stages of research through the formal presentation of results in lectures and publications. In addition to documenting key developments in the history of organic chemistry, this collection offers insight into the process of scientific research, both as the creative effort of an individual and as a collaborative activity.

Collection condition

Nearly all of the textual documents in the collection are now in perilously fragile condition, so that the University Archives may need to consider restricting further use of the originals. Most copies of outgoing correspondence, draft manuscripts, reports, research notes, and drawings are on highly acidic paper with little tensile strength. Over the years the acid in the paper has degraded the cellulose fibers so that the documents have yellowed and become extremely brittle. In many cases, pages show losses along the edges and corners have broken. As the collection continues to deteriorate, the University Archives will need to consider restricting use.

Project methodology

In selecting a methodology for preserving the Woodward papers, the University Archives has sought to address both the need to preserve the information that the collection holds and the need to provide long-term access to this information. Thus we have chosen a multi-faceted approach. While several preservation options are available, the size of the collection makes some options more practical than others. Deacidification, for example, can neutralize the acid in the paper and can arrest further deterioration. A costly procedure that requires item-by-item treatment in a conservation lab, deacidification cannot restore damaged paper to its original state so that physical handling of the documents must still be minimized or avoided.

Electronic reformatting could provide on-line remote access to the collection with the potential for enhanced searching and browsing through the use of electronic indexing tools. While the technology is available to scan the documents, the Harvard University Archives is not yet prepared to preserve and maintain access to the resulting electronic files over the long term.

After careful consideration of the various preservation options currently available, the Archives, in consultation with the Harvard University Library Preservation Center, has determined that microfilm offers the best long-term solution for the collection. If carefully prepared, processed, and stored, the microfilm can be printed to produce a positive copy for research use and it can eventually be scanned to provide electronic access to the documents.

In choosing preservation microfilm for this project, the Harvard University Archives is fortunate to have access to the services of the Harvard College Library Imaging Services Division. Established in the 1930s to microfilm published and unpublished materials, Imaging Services has consistently created microfilm of the highest quality and the staff has extensive experience in handling rare and fragile documents. Since 1989, the Division has prepared microfilm for Harvard's brittle books preservation projects funded

by the National Endowment for the Humanities. Imaging Services' microfilm adheres to current ANSI/AIIM[2] standards for microfilm production, quality control, and stability.

In addition to the black-and-white microfilm, we propose to copy nearly 3,000 chemical diagrams that Woodward drew in pencil and colored pencil onto 35mm. color transparency film. As with microfilm, if the transparency copies are carefully made and the film is properly processed and stored, the master copies can be duplicated for use by researchers and can later be scanned to provide electronic access to the images.

Throughout this project, the University Archives will follow guidelines and methods recommended in the *RLG Archives Microfilming Manual*,[3] which presents preferred practices for the preparation and handling of original documents, the arrangement of collections on microfilm, the filming process, the creation of targets and reel guides for the microfilm, and quality review procedures.

Project plan of work

The project will proceed in three phases, as funding becomes available.

Phase I: preparation for microfilming (12 months)

The University Archives will hire a project archivist to review the Woodward collection and prepare it for microfilming. The project archivist will ensure that all documents are in order, and he/she will prepare microfilm targets (labels) to indicate folder headings, document sequences, and a guide to the contents of each reel of film. The project archivist will also prepare instructions for the microfilmers when specific documents require special handling. During this phase, the project archivist will identify and list all color diagrams for reformatting on color transparency film in Phase III.

In addition to preparing the collection for microfilming, the project archivist will revise the existing collection inventory to reflect the microfilm version of the collection. The project archivist will mark up the electronic version of the inventory using Standard Generalized Mark-up Language and the Encoded Archival Description to create a fully searchable version that will be added to the Harvard University/Radcliffe College On-line Archives Information Search System.

Phase II: microfilming (6 months)

During this phase, the Woodward collection will be microfilmed at the Imaging Services Department of the Harvard College Library. In addition to filming and processing the film, Imaging Services will inspect the film to ensure that all documents and targets are included on the film, are legible, and have been filmed in the proper sequence.

Phase III: color photography (9 months)

After the Woodward collection has been microfilmed, color diagrams will be copied onto 35mm. transparency film by studio photographers in the Imaging Services Department. As with the microfilm, Imaging Services will provide full quality review of the color transparencies.

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[2] American National Standards Institute/Association for Information and Image Management

[3] Elkington, Nancy E., ed. Mountain View, CA: Research Libraries Group, 1994.

Budget

Phase I: preparation

220 boxes @ 7.5 hrs./box	1650 hours of preparation
1650 hours @ 35 hrs./week	48 weeks
Project archivist (Library Assistant IV)	$36,000 salary and fringe benefits for one year

Phase II: microfilm

220 boxes @ 1,000 documents/box	220000 documents
220,000 docs. @ 1 doc./microfilm frame	220000 frames of microfilm
220,000 microfilm frames @ $0.36/frame	$79,200 for microfilm master negative and use copy

Phase III: color photography

Color transparencies of 3,000 diagrams @ $8/transp.	$24,000

Project total

Preparation	**$36,000**
Microfilming	**$79,200**
Color photography	**$24,000**
Total project cost	**$139,200**

CHEMICAL HERITAGE FOUNDATION

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Arnold Thackray
PRESIDENT

October 26, 2001

Dr. Alfred Bader
924 East Juneau, Suite 622
Milwaukee, Wisconsin 53202

Dear Alfred:

Once again my best thanks for the splendid Reichstein gift, and for the appraisal information.

Enclosed with this letter is an agreeable reminder of our pleasant time together at Herstmonceux castle: I look forward to "many happy returns"!

Wishing all the best to you and Isabel in your travels.

As ever,

Arnold

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Arnold Thackray
PRESIDENT

1 May 2001

Dr. Alfred Bader
924 East Juneau, Suite 622
Milwaukee, Wisconsin 53202

Dear Alfred:

My thanks for your intelligence concerning Jane Russell Corbett and Professor Volker Manuth. We will be in touch with them.

We surely are serious about an exhibition of our chemical paintings. We will keep you posted and look forward to your good input as the idea gestates and develops.

Again, best thanks.

Sincerely,

CHEMICAL HERITAGE FOUNDATION

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May 3, 2001

Dr. Alfred Bader
Astor Hotel
924 East Juneau, Suite 622
Milwaukee, WI 53202

Dear Dr. Bader:

Dr. Thackray asked me to send you the enclosed photocopy of a print of the Bega painting that was formerly at a museum in Kassel, Germany.

Sincerely,

Marthenia Perrin

Marthenia Perrin

Enclosure

CHEMICAL HERITAGE FOUNDATION

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Arnold Thackray
PRESIDENT

13 April 2001

Dr. Alfred Bader
924 East Juneau Avenue
Astor Hotel – Suite 622
Milwaukee, WI 58202

Dear Alfred:

It was a great pleasure to visit with you and Isabel: your office has a stunning combination of well-deserved awards and wonderful paintings. And, your drawing room at home…!

The alchemical books from Professor Thaddeus Reichstein's collection had a comfortable journey to their permanent home. I am returning the travel bag that Isabel so kindly offered, and I will be in touch concerning an appraiser in just a little while. We were also greatly delighted to receive your wonderful, meticulous notes on R. B. Woodward's lectures: this is a wonderful treasure.

It was also a pleasure and a thrill for me to see the early documents and manuscripts concerning the origins and early years of Aldrich. CHF will be honored to become the home of the Aldrich archive at the proper time. Further, the Loschmidt, Couper and Crum Brown materials are all very great treasures. Again, we are delighted that their eventual home will be at the Chemical Heritage Foundation.

Alfred, you add value in everything you do, and it is wonderful that "historian of chemistry" is now one of your three "official" jobs (we won't even discuss the time you spend moonlighting!).

Lastly, let me simply note how pleased I was to see your alchemical paintings and to view the original of the marvelous Brande-Faraday. The fact that the heritage of chemistry in art is one more strand to bind us together, and to Roy Eddleman, makes me pinch myself, and wonder if I'm dreaming.

Again, my best thanks for all that you have done and continue to do for the field and for CHF, through your unstoppable gift for adding value.

Best to you and Isabel.

Sincerely,

Arnold Thackray
(Dictated but not signed)

12 April 2001 ✓

Dr. Alfred Bader
924 East Juneau Avenue
Astor Hotel – Suite 622
Milwaukee, WI 58202

Dear Alfred:

It was a great pleasure to visit with you and Isabel~~le~~: your office has a stunning combination of well-deserved awards and wonderful paintings. And, your drawing room at home…!

The alchemical books from Professor Thaddeus Reichstein's collection had a comfortable journey to their permanent home. I am returning the travel bag that Isabel~~le~~ so kindly offered, and I will be in touch concerning an appraiser in just a little while. We were also greatly delighted to receive your wonderful, meticulous notes on R. B. Woodward's lectures: this is a wonderful treasure.

this is OK
ignore tape

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Again, my best thanks for all that you have done and continue to do for the field and for CHF, through your unstoppable gift for adding value.

de

Best to you and Isabel~~le~~.

Sincerely,

FAX FROM:

Dr. Alfred Bader
924 East Juneau Avenue
Astor Hotel -Suite 622
Milwaukee, WI 53202
Ph: (414) 277-0730
Fax: (414) 277-0709
www.alfredbader.com
e-mail: baderfa@execpc.com

A Chemist Helping Chemists

March 28, 2001

TO: Dr. Arnold Thackray
Chemical Heritage Foundation

Page 1 of 2

FAX #: 215-925-9377

Dear Arnold,

In response to your fax of today, I look forward to showing you the alchemical books, which I acquired from Professor Thaddeus Reichstein, during your visit, and hope we have time to talk in San Diego.

You are of course most welcome to my notes of Woodward's lectures and you can take these with you when you visit in April.

I look forward to seeing you and Roy Eddleman in the afternoon of Wednesday, April 11th. I attach a map how to come to my office.

Will you and Roy be able to join Isabel and me for dinner?

Where will you be staying that evening? The Astor Hotel, where my gallery is, is comfortable and visitors to the gallery get special prices for hotel rooms.

Best wishes,

Alfred

A-11

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Arnold Thackray
PRESIDENT

5 March 2001

Dr. Alfred Bader
Astor Hotel-Suite 622
924 East Juneau
Milwaukee, WI 53202

Dear Alfred:

Just a line to confirm our meeting in Milwaukee. I believe I can arrive ahead of 5 p.m. on 11 April. Hopefully, we can look at Löschmidt and have dinner together. As Roy Eddleman has indicated an interest in being with us, I'm copying him on this note.

I am in the office only briefly—just long enough to glimpse the list of alchemical works: thank you! More anon.

Sincerely,

Arnold
(Dictated but not signed.)

cc: Roy Eddleman

CHF
CHEMICAL HERITAGE FOUNDATION

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Arnold Thackray
PRESIDENT

FAXED
3/28/01

March 28, 2001

Dr. Alfred Bader
924 East Juneau
Suite 622
Milwaukee, Wisconsin 53202

Dear Alfred:

Please forgive me for being such a bad correspondent!

Your most welcome, but unanswered, letter of 23 February is now joined on my desk by your letter of 23 March! To reply in order:

1. CHF will be delighted to receive the gift of what you modestly call "our chemical books."
2. We do not at this time possess any of the titles on your list and, as our checking indicates, they are all quite elusive in the holdings of other major research libraries. We shall be pleased to arrange an appraisal for you, when the books come to Philadelphia. As you know, IRS requires that this be at arms-length and "on your nickel."
3. I was pleased to see the photograph of the Munich Research Group of 1897. We are inquiring of Heriot-Watt University, concerning the status of the original.
4. We would love to have your notebook from R.B. Woodward's Chemistry 203A, from the 1948/9 academic year. We are still awaiting news on the Woodward proposal before the Dreyfus Foundation Board: black or white smoke should be seen sometime in April.
5. I am very much looking forward to my visit to Milwaukee, and to seeing your Loschmidt and Couper papers. As plans stand now, I will be meeting Roy Eddleman in Chicago and driving with him to Milwaukee on the afternoon of Wednesday, 11 April. I know that our time with you will fly, and the moment to leave will come all too soon on the following day.

Perhaps I may see you in the distance at ACS San Diego, also.

Sincerely,

Arnold

Subject: **Re: May 12th weekend**
Date: Wed, 03 May 2000 08:25:16 -0400
From: Mary Virginia Orna <mvorna@chemheritage.org>
Organization: Chemical Heritage Foundation
To: baderfa@execpc.com

Dear Alfred and Isabel,
Many thanks for your kind phone call. All is well. I am usually at New Rochelle on weekends with my community, so could not answer your call in person. I am sorry that you cannot come to the Othmer luncheon - Djerassi should be a very interesting lecturer, and part of the presentation will be a dual reading by D. and Roald Hoffmann from their play "Oxygen." It should be fascinating!
I hope that you will be able to attend the gala opening of CHF on June 22.
Do you need more details.
All the best, and looking forward to hearing from you soon!
Blessings.
Mary Virginia

Alfred Bader wrote:

> *Dear Mary Virginia,*
>
> *I haven't heard from you for a long time, except on your answering machine. Of course, we hope that you are well.*
>
> *Thank you for inviting us to the presentation of the Othmar gold medal. We wish that we could come, but unfortunately long ago planned to visit the widow of an old art historian friend at Oberlin that very weekend.*
>
> *With best wishes as always I remain*
>
> *Yours sincerely,*
> *Alfred Bader*

--
Mary Virginia Orna
Chemical Heritage Foundation
315 Chestnut Street
Philadelphia, PA 19106-2702
(215) 925-2178, ext. 242
(215) 925-1954 (FAX)

CHEMICAL HERITAGE FOUNDATION

315 Chestnut Street ☐ Philadelphia, PA 19106-2702 ☐ USA
Telephone (215) 925-2222 ☐ Fax (215) 925-1954

Internet http://www.chemheritage.org

THE BECKMAN CENTER FOR HISTORY OF CHEMISTRY ☐ THE OTHMER LIBRARY OF CHEMICAL HISTORY ☐ PUBLIC EDUCATION

Arnold Thackray, *President*

December 4, 1997

Dr. Alfred R. Bader
2961 North Shepard Avenue
Milwaukee, WI 53211

Dear Alfred:

Thanks to the leadership of our Advisory Board and Council of Friends, the Chemical Heritage Foundation is moving rapidly ahead. Serving the chemical and molecular sciences community and working to increase public understanding of the chemical sciences are our primary goals.

Highlights of the year include:

- "The Emergence of Biotechnology: from DNA to Genentech", which brought together major players in the biotechnology revolution, including Nobel laureates and leading entrepreneurs, to share reflections and assessments. The videotape of this event, which was attended by a capacity crowd, represents a significant contribution to the historical archive. An edited version will be available for use in the classroom.
- First annual Othmer Gold Medal Award (New York) and the successful launch of the Petrochemical Heritage Award (San Antonio, TX).
- A "standing room only" audience for the eighth annual Ullyot Public Affairs Lecture featuring P. Roy Vagelos, former Chairman and CEO of Merck & Co., Inc.
- A major exhibit, "Spinning the Elements – Wallace Carothers and the Nylon Legacy", showcasing an extensive and unique collection of photographs, documents, and artifacts given to the Foundation by Carothers' former laboratory assistant, Joe Labovsky. The exhibit is drawing in teachers, students, and individuals interested in our chemical heritage. Significant coverage of the exhibit appeared in *The News Journal*, and we're enclosing a copy for your information.

These are just a sampling of this year's activities. Much has been accomplished, but there is still a great deal to do in achieving our goals. With your guidance and support, we are confident that we will achieve those goals and realize our mission. As a token of our appreciation for your time and efforts on our behalf, I am enclosing copies of *Chemical Heritage* and *Chemical Achievers*, our latest educational guide for chemistry teachers.

Thank you, again.

Sincerely,

Arnold

All the best to you and Isabel for 98!

Nov. 3, 1997

The News Journal

Section D

BUSINESS MONDAY

▸ SMALL BUSINESS & THE WORKPLACE

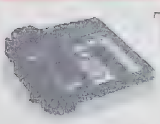
The yarn of nylon

A new exhibit in Philadelphia pays homage to one of man's greatest chemical achievements

Page 10

A portrait of nylon developer Wallace H. Carothers is on display at the Chemical Heritage Foundation in Philadelphia.

ASK THE EXPERTS



Today's phone-in:

■ Mutuals

Is it a good time to buy? Are you investing in the fund that's right for you?

▸ Call 324-2838
10:30-11:30 a.m. or
(800) 235-9100, Ext. 2838

Entrepreneur trends

Experienced business owners with little or no formal training are going back to school to get smarter.

D7

All fired up

Do-it-yourself pottery-glazing businesses are growing fast, fired by the passion of the ceramic hobbyist.

D3

[illegible] BY [illegible]

Stephanie Dukes, of Georgetown, works in the DuPont nylon plant, which opened in Seaford in 1939.

The yarn of nylon

The Chemical Heritage Foundation's exhibit may be the most authentic and the most complete on the birth and development of the fiber

By PHIL MILFORD
Special to The [illegible]

PHILADELPHIA — Tucked in one corner of [illegible] century-old bank building near the Delaware River waterfront is an assortment of old paint cans, hypodermic needles, faded photographs and yellowed women's underwear.

But this is no dumping ground. The items are being preserved in the name of history, part of an exhibit [illegible] post-World War II revolution in chemistry that has affected almost [illegible] development of nylon.

[illegible] DuPont Co. and [illegible] North Wilmington [illegible] which opened here on Thursday [illegible] Chemical Herit[illegible] Foundation [illegible] nce National [illegible]

Through May 1998, "Spinning the Ele[illegible] Wallace H. Carothers and the Nylon [illegible] will be open by appointment to [illegible] and public groups inter[illegible] history [illegible] chemist[illegible]

[illegible] of the photographs [illegible] laborat[illegible] [illegible] [illegible] [illegible] Joseph X. La[illegible], of Shellburne in [illegible] Hundred.

[illegible], now 8[illegible], [illegible] working as a [illegible] lab assistant for the team headed [illegible] [illegible] when they made their historic [illegible] through and discovered nylon in [illegible] 1930s.

[illegible] inspired us to do it," [illegible] Gapp, [illegible] curator for the foundation. [illegible] foundation [illegible] the collect[illegible] [illegible] ley Road, they knew an exhibit had potential.

"The [illegible] what he had was incredible … just astonishing," Gapp said.

Labovsky agrees. "It's the most complete and most [illegible] documented exhibit about nylon," said Labovsky. "They'll [illegible] this exhibit as a teaching tool to show what can be done not only on an individual level but for the nation," he said.

Opening the exhibit were Carothers' widow, Hel[illegible] S[illegible] of the Methodist Country House on K[illegible] Pike, Greenville, Del.; daughter Jane Carothers [illegible] of Orland[illegible], Fla.; Joseph A. Miller, DuPont [illegible] officer; and Labovsky.

[illegible] [illegible]thers, who suffered from [illegible] took his own life [illegible] [illegible] discovery came to fruition.

A personal perspective of Carothers

Carothers was born in Iowa in 1[illegible] [illegible] was so enamoured of chemistry that in his [illegible]hood he converted his bedroom into a [illegible] [illegible] according to historian Roger A. [illegible]

Carothers earned a doctorate in chem[illegible] [illegible] the University of Illinois in 192[illegible] [illegible] chemistry research at Harvard. By 19[illegible] [illegible] working for DuPont, but his bouts of depression deepened.

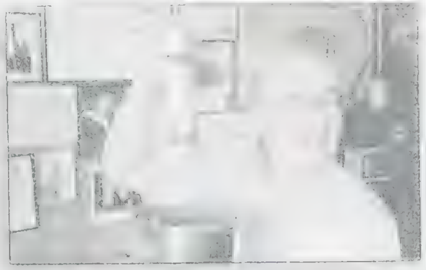
Research continued among Carothers' group at the DuPont Experimental Station to find the perfect synthetic silk. In 1937 nylon [illegible] ready for patenting and in 1938 [illegible] fiber was introduced to the public.

By then Carothers had died. During an [illegible] in April 1937, he [illegible] Philadelphia hotel and drank a [illegible] lemonade.

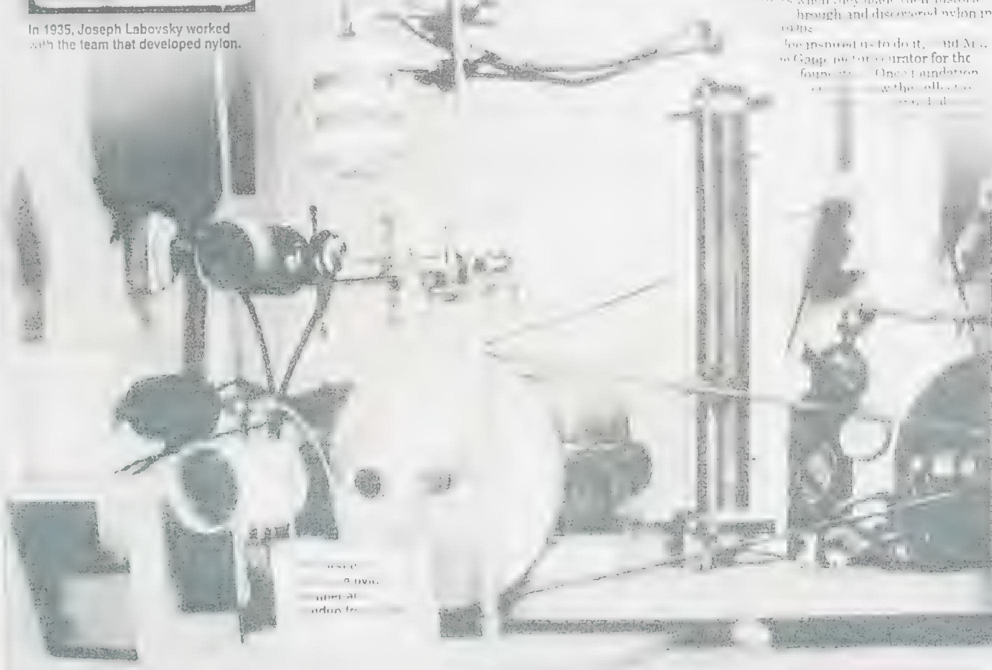
[illegible] depressive. In a group [illegible] he just listened, [illegible] But in the lab [illegible] experiment [illegible]

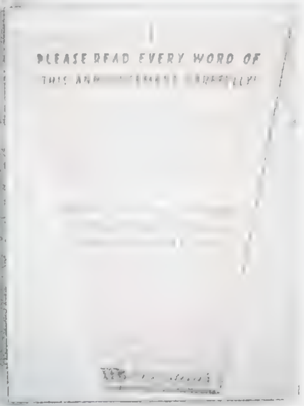
Continued on next page

In 1935, Joseph Labovsky worked with the team that developed nylon.



Joseph Labovsky's basement had [illegible]





PLEASE READ EVERY WORD OF
THIS ANNOUNCEMENT CAREFULLY!

[illegible]rize if you bought [illegible] war bond on Aug. 24, 1943.

[illegible]ph Labovsky (left) with Arnold Thackray, president of Chemical Heritage Foundation, at a reception marking the opening of the foundation's nylon exhibit.

[illegible] LON CHRONOLOGY

- **February 1935:** Wallace H. Carothers' DuPont team identifies "Polymer 66" from coal-derived benzene
- **April 1937:** DuPont applies for nylon patent
- **October 1938:** DuPont announces nylon to the public and decides to build a nylon plant in Seaford
- **October 1939:** First nylon [illegible] stockings go on sale in Wilmington stores
- **December 1939:** First nylon produced at Seaford
- **1941-1945:** Nylon is used for war materiel including parachutes, tires and [illegible]
- **August 1993:** DuPont announces plans for nylon plant in China
- **December 1993:** The Federal Trade Comm[illegible] approves swap that gains DuPont the Imperial Chemical Industries Ltd. nylon plants in Europ[illegible]
- **October 1995:** Seaford nylon plant designated National Historic Chemical [illegible]
- **Octo[illegible] [illegible]97:** Chemical Heritage Foundation launches major exhibit or [illegible] industry

[illegible]

What: Chemistry exhibit, "Spinning the Elements: Wallace Carothers and th[illegible] Nylon Legacy"

When: Through May 1998

Where: Chemical Heritage Foundation, 315 Chestnut St., Philadelph[illegible]

How: Tours arranged by appointment

information: Call Marie Stewart, director of external affairs for the foundation at (215) 925-2222, Ext. 239.

Nylon: It and women made the best chemistry

FROM PRECEDING PAGE

was most charming," Labovsky said.

"We would sit down and talk about music and literature. On a personal basis he was very talkative," said Labovsky.

To preserve his memories of Carothers and the DuPont nylon business, the chemical foundation conducted extensive interviews with Labovsky and compiled a 40-page oral history, which will become part of its archives.

Labovsky said one reason he donated the collection to the Philadelphia-based group was that other historical groups would just store the items, but the foundation will eventually put them on public display.

"They have quite a lot of traffic... visitors from all over the world," in the Independence Mall area, Labovsky said.

But he said the Historical Society of Delaware is also interested in a permanent exhibit, so he may help it put together some materials in Wilmington, too.

The Chemical Heritage Foundation was established in 1982 by the American Chemical Society and the American Institute of Chemical Engineers to highlight the historical role of chemistry.

Two years ago, to recognize the importance of nylon in modern chemistry, the American Chemical Society designated the original Seaford, Del., nylon plant as a National Historic Chemical Landmark.

Including the plant, which opened in 1939, DuPont spent $27 million to develop its nylon business. The fiber now brings in $5 billion a year for DuPont, which makes 20 percent of the world's nylon.

Illuminating nylon's birth

The nylon exhibit is part of a foundation's goal to teach the general public about chemistry and its history. It conducts educational activities, publishes books, magazines and brochures and is developing a museum of the chemical sciences. It also has a 50,000-volume library.

Much of the current nylon exhibit is technical:

A memo from Labovsky dated July 8, 1936, notes that "A series of experiments was performed to determine the practicability of electromagnetic titration...."

But also on display are the upside-down legs of store mannequins wearing the "latest" nylon stockings at the start of World War II; a paint can and hypodermic needle rigged by Labovsky to "draw" nylon and other test fibers from solution; and some early nylon underwear apparently pretested by DuPont Co. secretaries (one item is labeled, "Josephine Osborne") prior to marketing.

And the foundation is also displaying a letter to Mrs. Carothers from DuPont chemist Paul J. Flory, who devised the nylon formula and won a Nobel Prize in 1974. In the letter, Flory says Carothers himself deserved the prize.

Among the items on display are a lab notebook Carothers used in 1927 when he was at Harvard University, before DuPont lured him to Wilmington to head a polymers research group.

DuPont had begun funding basic research in the 1920s, and had no specific products in mind. The exhibit notes that Carothers felt polymers — large chains of molecules — could produce new kinds of fiber.

The team of scientists first synthesized nylon in 1936, but took several more years to perfect the process.

In the exhibit, an October 1938 copy of the New York Herald-Tribune announces the nylon breakthrough. Photographs show the first spinning apparatus at the DuPont Experimental Station; and the Seaford nylon plant under construction.

Other documents refer to the mysterious "Fiber 66," the experiment that showed successful nylon spinning was possible.

The fiber goes high-fashion

Nylon use took off during World War II - for parachutes, flak jackets, aircraft tires and other war materiel. Displays include actual parts or photos of nylon lab machinery, examples of nylon boat sails, and fiber spinoffs such as "honeycomb" aircraft structures and even a polymeric automobile engine intake manifold.

But nylon stockings were what the women of America (and the world) wanted.

A Wilmington Morning News from Aug. 24, 1943, encourages people to buy $500 war bonds — and offers a free pair of nylons for each bond purchased.

The Chemical Heritage Foundation is located in the remodeled 19th-century First National Bank Building at 315 Chestnut St. — next to the back entrance of Benjamin Franklin Court. It is still undergoing renovations and is not yet ready for regular walk-in public access.

It moved from near the University of Pennsylvania in west Philadelphia into the Chestnut Street building last year, "and this is the first time we've had an exhibit on this scale," said Marie Stewart, spokeswoman for the foundation.

"We'd like to get some school groups to come through," said Stewart.

Joseph Labovsky said he's glad his artifacts will be part of it.

"It's just a wonderful memorial for Carothers," said Labovsky after seeing the completed exhibit.

Dr. Alfred Bader
924 East Juneau, Suite 622
Milwaukee, Wisconsin 53202
Phone: 414/277-0730
Fax: 414/277-0709

A Chemist Helping Chemists

January 5, 1998

Mary Virginia Orna, OSU
Editor, *Chemical Heritage*
315 Chestnut Street
Philadelphia, PA 19106-2702

Dear Mary Virginia:

At last, after two-and-one-half years I have received the proceedings of the Loschmidt Symposium which was held in Vienna in June of 1995.

Copy is enclosed.

As you will see it contains a great variety of lectures, some of which are brilliant but irrelevant to Loschmidt.

Still it is a very interesting compilation and I am wondering whether Dr. Benfey might consider reviewing it.

With all good wishes, I remain,

Yours sincerely,

AB/nik

Enclosure

DR. ALFRED BADER
2A Holmesdale Road
Bexhill-on-Sea
East Sussex TN39 3QE
England
Phone/Fax: 44-1424-222223

A Chemist Helping Chemists

Nov 17 97.

Fax 001 215 925 1954

Ms Mary Virginia Orna, O.S.U.
Editor, Chemical Heritage

Dear Mary Virginia:

Thank you so much for your letter of Nov. 10, forwarded from Milwaukee – the first response to my article.

To answer your questions: (1) excise duties were paid at the time of purchase and (2) no useful records exist.(*) When I return to Milwaukee, on December 18, I will send you copies of my relevant correspondence with Cathy Proudlove in Norwich, and copies of her papers and of the actual canvas mark.

If you decide that you would like to reprint this, you have Chemistry in Britain's permission, and could include more photographs (e.g. of the canvas mark and of a younger Brandon).

Best regards, also to Arnold

(*) As far as I know.

Nov
44

CHEMICAL HERITAGE FOUNDATION

315 Chestnut Street ☐ Philadelphia, PA 19106-2702 ☐ USA
Telephone (215) 925-2222 ☐ Fax (215) 925-1954

Internet http://www.chemheritage.org

THE BECKMAN CENTER FOR HISTORY OF CHEMISTRY ☐ THE OTHMER LIBRARY OF CHEMICAL HISTORY ☐ PUBLIC EDUCATION

November 17, 1997

Dr. Alfred R. Bader
2961 North Shepard Avenue
Milwaukee, WI 53211

Dear Al:

Thanks to the continued support of friends like you, the Chemical Heritage Foundation is moving rapidly ahead--proud to serve the chemical and molecular community! CHF has truly emerged as a premier resource for education, history, and increased public understanding of the role of the chemical sciences in improving our lives.

The year's highlights include:

- Nearing the end of our capital campaign to finance our new home
- A "standing room only" attendance at the fall Ullyot Lecture on the role of chemistry in our lives, given by P. Roy Vagelos, former CEO of Merck, Inc.
- A spring event on "The Emergence of Biotechnology," attended by Nobel Laureates, leading entrepreneurs, and a capacity crowd at Philadelphia's WHYY studios
- *Chemistry is Electric!*, a new educational exhibit on the wonders of electrochemistry. Its accompanying book comes to you in appreciation of your support of CHF.

The enclosed brochure describes some other things CHF has done this year to preserve and promote our chemical heritage. Please take a moment to review and reflect upon the positive impact CHF is making in public awareness of the chemical sciences and industries.

As you know, this important community work requires resources. We are appreciative of your previous thoughtful gift of $1,800.00 to our Annual Fund. Your generous support is the lifeblood that sustains our educational programs. I invite you to continue your relationship with us by giving to our Annual Fund again this year. Please do renew your annual contribution. A reply card and envelope are enclosed.

Thank you for your thoughtful participation in CHF's activities on behalf of the chemical community.

Yours sincerely,

John C. Haas

John C. Haas, *Chair, Development Committee*

P.S. CHF will qualify for a matching gift from participating employers. Please alert your company that you have made a gift.

Dr. Alfred Bader
924 East Juneau, Suite 622
Milwaukee, Wisconsin 53202
Phone: 414/277-0730
Fax: 414/277-0709

A Chemist Helping Chemists

August 14, 1997

Dr. Arnold Thackray
President
Chemical Heritage Foundation
315 Chestnut Street
Philadelphia, PA 19106-2702

Dear Arnold:

Your kind letter of August 8th arrived today, and so also by "snail mail". Probably the Post Office is overworked because of the UPS strike.

I would love to help the ACS and also the California Section - and, of course, the Chemical Heritage Foundation - by giving that $5,000 to produce the tapes.

But somebody has to ascertain that the $5,000 will really do the intended job, and I cannot do that from here. Hopefully, somebody at the ACS in Washington, working with Dr. Nixon and the owners of the material, can do that. As soon as I have the ACS' assurance, I will send my check. When you see the material, you will easily understand what fun this material is to look at and how valuable it will be in the future.

Las Vegas is the last place in the world I would want to visit, as I gamble enough buying dirty, old paintings. But the American Institute of Chemists is presenting me with its Gold Medal on Friday, September 5th. However, Isabel and I are cutting our visit to Las Vegas to the minimum, arriving on Thursday evening, the 4th, and leaving at 7:00 am on Sunday, the 7th. This way I will miss all of the ACS meeting but suffer least being in Las Vegas. Hopefully, the next ACS meetings will be in more member-friendly places.

With best wishes, as always,

AB/cw

c: Ms. Jennifer D'Elia, Committee on Project SEED, ACS

CHEMICAL HERITAGE FOUNDATION

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THE BECKMAN CENTER FOR HISTORY OF CHEMISTRY ☐ THE OTHMER LIBRARY OF CHEMICAL HISTORY ☐ PUBLIC EDUCATION

Arnold Thackray, *President*

8 August 1997

Dr. Alfred Bader
924 East Juneau, Suite 622
Milwaukee, WI 53202

Dear Alfred:

Your welcome letter of 31 July arrived by what truly was **snail mail**, so I hasten to reply – especially as I shall be out of the office next week, but back on the 18th.

To take your points in order:

(1) we'd love to have an archival copy of the tapes in question, and to draw on them in various ways

(2) we'd be glad to cooperate with ACS

(3) we need a meeting of some kind… Las Vegas?

I'm copying Jennifer D'Elia on this note and will hope to hear from you or her, shortly.

Sincerely,

Arnold

P.S. Thanks for the news on your article: Mary Virginia Orna is out this week, but she and I will talk.

cc: Jennifer D'Elia
Mary Virginia Orna

CHEMICAL HERITAGE

VOLUME 12 ■ NUMBER 2 ■ SUMMER 1995

Oral Histories

In the Eye of the Beholder

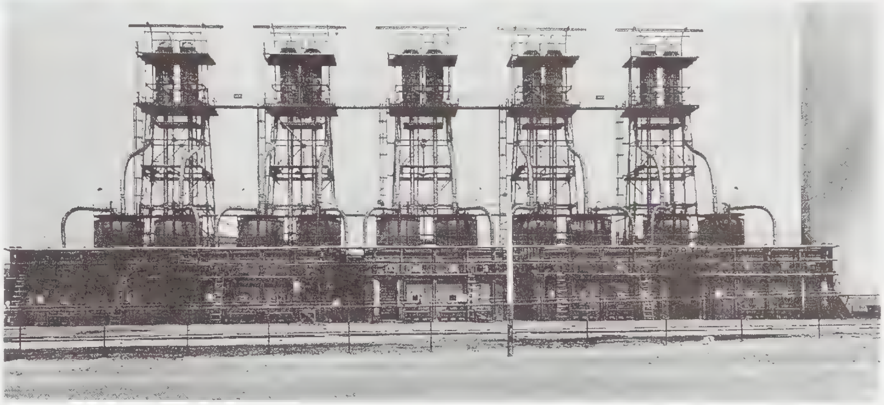
Interviewing Chemical Innovators to Define Chemical Innovation

More than fifty years ago the chemical industry was a shining star, an attractive discipline for students who saw long-term employment and financial security in a field that seemed destined for continued growth. A new chemical plant was a welcome sight in almost any community, a signal of jobs and prosperity. The industry was perceived as a savior: people were relieved when the automobile replaced the horse and thereby cleaned up an environmental hazard accumulating on the city streets —and relieved when Freon replaced the toxic gases ammonia and sulfur dioxide as refrigerants.

In the 1990s, however, people are relieved when they believe there are no "chemicals" in their lives. Yet this dilemma was foreseen. Over two hundred years ago, in his *Experiments and Observations on Different Kinds of Air*, Joseph Priestley warned that "in completing one discovery we never fail to get an imperfect knowledge of others of which we could have no idea before, so that we cannot solve one doubt without creating several new ones."

Hoping to solve problems accruing from chemists' earlier discoveries—and to anticipate any problems impending from their new discoveries—the chemical profession has quietly sought to rebuild its tarnished image. In his recent book *Designing the Molecular World*, Philip Ball avoids the dreaded "C" word by calling his introduction, "Engineering the Elements." And an ingenious

Continued on page 29



Dubbs petroleum cracking units at the Parco, Wyoming, refinery. Carbon Petroleum Dubbs developed the process, which was based on a patent by his father, Jesse Adams Dubbs. The father chose Carbon for his son's name; the son added Petroleum. Courtesy UOP.

UOP and PRF

How the Petroleum Research Fund Came To Be

THE PETROLEUM RESEARCH FUND was born of special circumstances. During PRF's first ten years it was transformed from an asset of questionable value to one that sold on the open market for about 70 million dollars. It was created in 1944, when the owners of the Universal Oil Products Company—seven major oil companies: Phillips Petroleum Company, Shell Oil Company, Standard Oil Company of California, Standard Oil Company (Indiana), Standard Oil Company (New Jersey), the Texas Company, and N.V. de Bataafsche Petroleum Maatschappij—donated UOP's capital assets to the fund. And the success of Universal contributed directly to the emergence of the Petroleum Research Fund as a granting organization.

Universal Oil Products controlled the early Dubbs patents for thermal cracking, giving it an important position as a supplier of technology to the nations' smaller refiners. The company pursued an aggressive policy of litigation in defense of its patent rights. In addition, the seven major oil companies that acquired Universal in 1931 took advantage of their joint ownership by engaging in a system of sharing patents known as "cross-licensing," a practice that raised serious questions of compliance with antitrust laws. By the early 1940s the company faced formidable legal challenges.

During World War II, however, the allied forces' demand for aviation fuel

Continued on page 5

FOUNDING SOCIETIES: AMERICAN CHEMICAL SOCIETY ■ AMERICAN INSTITUTE OF CHEMICAL ENGINEERS

AFFILIATED SOCIETIES: THE ELECTROCHEMICAL SOCIETY, INC ■ THE CHEMISTS' CLUB ■ AMERICAN SOCIETY FOR MASS SPECTROMETRY ■ SOCIÉTÉ DE CHIMIE INDUSTRIELLE ■ THE AMERICAN ASSOCIATION FOR CLINICAL CHEMISTRY, INC ■ AMERICAN OIL CHEMISTS' SOCIETY ■ AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS ■ THE AMERICAN INSTITUTE OF CHEMISTS INC ■ ALPHA CHI SIGMA ■ FEDERATION OF SOCIETIES FOR COATINGS TECHNOLOGY ■ CHEMICAL MANUFACTURERS ASSOCIATION

CHEMICAL HERITAGE FOUNDATION

THE CHEMICAL HERITAGE FOUNDATION (CHF) was established by joint action of the American Chemical Society and the American Institute of Chemical Engineers. Affiliated organizations include Alpha Chi Sigma, The American Association for Clinical Chemistry, Inc., the American Association of Textile Chemists and Colorists, the American Institute of Chemists, Inc., the American Oil Chemists' Society, the American Society for Mass Spectrometry, The Chemists' Club, The Electrochemical Society, Inc., the Federation of Societies for Coatings Technology, and the Société de Chimie Industrielle.

CHF seeks to advance the heritage of the chemical sciences by discovering and disseminating information about historical resources; encouraging research, scholarship, and popular writing; publishing resource guides and historical materials; conducting oral histories; creating traveling exhibits; and taking other appropriate steps to make known the achievements of chemical scientists and the chemical process industries.

CHF operates through the Arnold and Mabel Beckman Center for the History of Chemistry and the Donald F. and Mildred Topp Othmer Library of Chemical History.

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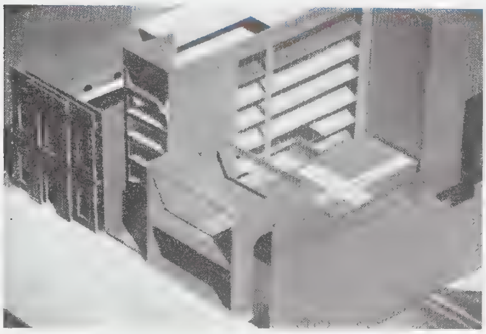

A New Home for CHF and the Othmer Library

The alchemist's garden is visible (middle right) in this cutaway view of the architect's model.

The Editor's Perspective

War—Its Heights and Its Depths

Chemical Heritage from time to time has described developments and achievements stimulated by the demands of war. As Leander Ricard reports in his piece on the Rensselaer dye works in this issue, World War I was a major stimulus in the creation of the American dye industry. It also helped establish the synthetic organic-chemicals industry in this country, as the 1992–93 Edelstein International Student Kathryn Steen is documenting in her doctoral studies.

World War II, which ended a half century ago, spurred much research in the chemical sciences. It confronted this country with a shortage of rubber, and thus led to the American Synthetic Rubber Research Program. Another shortage prompted a crash program to develop high-octane gasoline, which may well have been the deciding factor in the Battle of Britain. I was in Britain at the time, a grateful benefactor of that success. The war also spurred the mass production of penicillin and the development of modern antibiotics. And during the war Robert B. Woodward and William Von E. Doering announced the synthesis of the antimalarial quinine, hailed by the *New York Times* as the chemists' second answer to Japan—the first having been synthetic rubber. The threat of war led the United States government to organize the Manhattan Project, resulting in nuclear weapons and nuclear warfare—as well as an undreamed-of expansion of the periodic table with the far-off promise of nuclear energy. Even more darkly, it saw Nazi Germany create a technologically and bureaucratically efficient system for killing millions of Jews and others by using Zyklon B hydrogen cyanide gas.

In our Winter 1994–95 issue we sought to share with our readers our own horror at the lengths to which Nazi leaders went in distorting German history to pave the way for the ultimate horror of mass killing. We quoted in their German original the words of the Nazi leader Frick extolling racial purity. The words were used as the epigraph opening the novel *Anilin,* a distorted account of the German dye industry, by K. A. Schenzinger. Peter K. Baumgarten of Aiken, South Carolina, and Hans Schindler of New York wrote to protest such a prominent display of Nazi ideology. The latter rightly pointed out that we should at least have mentioned Frick's 1946 war crimes trial and execution. We should have realized that merely pointing to the discussion in Michael Keas's book was not enough.

Our comments so far might lead readers to conclude that I subscribe to the saying "necessity is the mother of invention," with necessity being particularly powerful in wartime. But war—and dire necessity—are not the only mothers of invention. The historian of metallurgy Cyril Stanley Smith, in his search for the source of metallurgy and many other discoveries, reached a dead end in museums of warfare and found the beginnings of many a technical achievement in artistic and religious activity, in the human response to the awareness of beauty and the divine. Metallurgy began as jewelry making; the Chinese bronzes at first were ritual vessels. Warfare until this century merely improved whatever had been invented and was available for use.

Theodor Benfey

CHF Move to Independence Park Draws Near

A flurry of planning is under way as this issue of *Chemical Heritage* goes to press. CHF expects to go to settlement on its purchase of the historic 315 Chestnut Street site on 31 July 1995. As previously reported (*Chemical Heritage* 11:2), the site includes the monumental First National Bank (1865), together with later additions and a parking lot, and abuts both Independence National Historical Park—home of Independence Hall and the Liberty Bell—and Franklin Court, the federal museum on the site of Benjamin Franklin's house.

Following settlement, modest renovations will be undertaken to allow CHF and its Othmer Library to move into 15,000 square feet. Move-in plans call for a reading room, stack space, and offices for the Othmer Library and Beckman Center, together with additional accommodations for a public museum and display area—a natural addition given CHF's prominent location at a favored destination for national and international tourists. An additional 15,000 square feet will be reserved for CHF's expansion over the next decade, and the remaining 30,000 square feet of usable space will be rented out long-term to a compatible tenant.

Architect Richard Conway Meyer continues to work closely with CHF staff on design issues and on construction drawings for the project. William E. Taylor, CHF's chief financial officer, has immediate oversight over the whole process of purchase, construction, and moving. We hope to be in our new, permanent quarters at Independence National Historical Park by 31 December 1995. Stay tuned for more details!

William E. Taylor, Chief Financial Officer

Because of the increase in the scale and complexity of CHF's financial operations, CHF Executive Director Arnold Thackray recommended and the Board of Directors agreed to the creation of the new position of Chief Financial Officer. We are pleased to announce the appointment to that position of William E. Taylor. Bill Taylor comes to CHF after a distinguished twenty-one-year career at DuPont, where he was most recently Assistant Treasurer.

Left: Sidney Edelstein took an extended trip to Mexico in 1965 to confirm that the indigenous Mexican peoples and the ancient Hebrews used the same kind of dyestuffs. Above: Mildred Epstein joined Sidney in Mexico City for a day visit. Both courtesy Dexter Chemical Corporation.

Below: Sidney Edelstein at twenty-three, at work on experimental mercerizing processes. From the Chattanooga Daily Times, *28 August 1935.*

Sidney M. Edelstein

22 January 1912–18 September 1994

For over fifty years Sidney M. Edelstein was one of the most colorful, talented, and multifaceted members of the history of science community. He left an indelible imprint on organizations as varied as the American Chemical Society, the Chemical Heritage Foundation, the Hebrew University in Jerusalem, the Shenkar College of Textile Technology and Fashion, and the Society for History of Technology. His death marks the end of an era, for with his passing we lose our last living witness to the truly amateur world of those who loved our field in the depth of the Depression, when openings toward paid careers in any academic discipline, let alone the history of science, were a rare commodity.

Sid Edelstein was educated at the Baylor School in Chattanooga and—from the age of sixteen—at MIT. Two themes from his MIT years—his discovery of history and his discovery of cellulose chemistry—were to define his life. The latter led to his creation of the Dexter Chemical Corporation in 1946, and to an entrepreneurial and business career noted for its creativity and success. The former led to a lifelong love affair with books and historical learning. Each theme is best caught in Sid's own words, excerpted on this page.

A full eloge of Sidney Edelstein, by Arnold Thackray, our Executive Director, will appear in a future issue of *Isis*, the official journal of the History of Science Society. An account of his early years was written by James J. Bohning in this journal, 6:1 (Winter 1989), 3–4.

CHF is in the early stages of planning an event that will pay tribute to Dr. Edelstein's influence on the field, as reflected in the work done by the Edelstein International Fellows and Students and by the recipients of the Dexter Award in the History of Chemistry.

Initiation into Chemical History and Chemical Research

Sidney Edelstein was interviewed in 1988 by Jeffrey L. Sturchio and Arnold Thackray for an oral history, now on file at CHF. In the following excerpts, he tells of his initiation into two of his passions—chemical history and chemical research.

History of Chemistry

You had to take one course as a senior [at MIT], no matter what else you took. It was a course in the history of chemistry, which was unusual. The professor was Tenney L. Davis. . . . This course was given on Saturday morning. Now here I am married, and I've got to get up and go in to take the class. When I first went in I thought, "Why the hell am I taking this?" The thing that got me is that this guy Davis used to bring in old books concerning the history of chemistry. I mean, it might have been a 1770 edition by Priestley, or something like that. Whatever it was, I used to go up and look at them. The very idea that these things existed got me completely interested in the goddamned field. It was a strange thing, which has remained with me until today. It came through taking this course with Tenney Davis. It wasn't because of what he said, but because of what he showed me I could feel. If I can feel and smell something, then I'm hooked. So that was a very special thing.

Chemical Research

MIT had a peculiar setup in their courses, but particularly in chemistry, which was Course V. At most schools you don't really do anything, although you might play around and do a few weeks' work on something for the B.S. degree. At MIT they used to let you do a month or two of research in most of the courses. But in Course V they allowed you (if you wanted) to do your whole last year as research, and take only a couple of courses.

So I got permission, with a lot of argument, to do research in a certain facet of cellulose chemistry. Now, when I went to the chemistry department, they thought it was organic chemistry and that I wanted to make a new compound. I said, "No, that isn't what I want. I want to study the colloidal behavior of cellulose under certain conditions." "Well," they said, "that's physical chemistry." So I talked to the department of physical chemistry, and they said, "We don't do anything like that. These are not definite compounds.

The only place that does this kind of foolishness is the department of chemical engineering!" That is very interesting. So I argued with the chemical engineering department and they said, "All right. You're not a student in this department, but we'll let you do it." So I was given a laboratory with an office and the whole works. I spent my last year doing research on the action of cellulose and its colloidal properties in the presence of strong alkalis. . . . It turned out to be very important later on because it led to a lot of patents.

From Our Far-Flung Correspondents

- Kenneth P. Magee of Blackley, Manchester, England, points out that the Hofmann-Perkin photograph obtained from him (see *Chemical Heritage* 12:1 [Winter 1994–95] 8) should have been credited, not to ICI, but rather to Zeneca Specialties, where Magee is the archivist. ICI has been restructured and Zeneca PLC created out of the former ICI Pharmaceuticals, ICI Agricultural, and ICI Specialties (once ICI's dyestuffs division). All three, as he points out, were set up at Blackley because of the chemical expertise of the color chemists there.
- A second company "restructuring-"prompted Hans Schindler of New York to write. The units constructed by Stone & Webster at the Abadan refinery in Iran (same issue, p. 4), he notes, were actually built for the Anglo-Iranian Oil Company (the former name of British Petroleum), which became the National Iranian Oil Company when nationalized in 1950.
- Joshua Brown of Richmond, Indiana, sought help from CHF in identifying a Japanese scientist referred to but not named by the philosopher and religious writer Thomas Kelly. Kelly merely mentioned that this person was so dedicated to investigating yellow fever that he went to West Africa in 1927, where he died of that disease the following year. Our editorial correspondent in Japan, Yasu Furukawa, immediately supplied the answer. Hideyo Noguchi (1876–1928), a student and for many years assistant of Simon Flexner at the Medical School of the University of Pennsylvania, moved to the Rockefeller Institute in New York before undertaking the African investigations that led to his death.

Italy's Natta stamp

Italy Honors Natta. Every year the countries of the European Postal Union issue stamps with a common theme to celebrate Europa, the European community. Henryk Eisenberg of the Weizmann Institute, Rehovoth, Israel, has sent us Italy's 1994 Europa stamp, which honors the chemist and Nobel laureate Giulio Natta. Natta, 1903–1979, shared the 1963 Nobel Prize with Karl Ziegler of Germany for the development of polymers that crystallized easily because of the regular spatial arrangement of their atoms. Natta's wife Rosita coined the word *isotactic,* derived from the Greek roots for "even" and "arrangement," for the phenomenon. Natta's isotactic polypropylene was created in 1954 and was in commercial production two years later.

Did other European countries honor chemists with stamps last year?

UOP and PRF—*continued from page 1*

escalated. That demand could only be satisfied if the new alkylation process under development by Universal was implemented extensively. Recognizing the vital role of the company, the Justice Department suspended its investigation of possible violations by its owners. But as the end of the war approached in the summer of 1944, it was clear that the investigations would resume. Universal's owners were unwilling to face the public relations effects of defending an antitrust action that inquired into their roles in Universal. In addition, in a patent infringement case heard in spring and summer of 1944, the Supreme Court handed down a verdict against Universal, and the company was indirectly implicated in a scandal involving the bribing of a federal judge.[1]

Universal's seven corporate owners wanted to dispose of it, but the company's marketability was doubtful at best. It was decided to donate UOP for charitable purposes, and on 6 September 1944 Frank A. Howard, vice president of Standard Development, approached Thomas Midgley, Jr., president and chairman of the board of the American Chemical Society, with the offer to donate UOP to the ACS. Under the terms of the proposed gift, the ACS would use income from the company to support fundamental research. The society's board of directors received the offer with enthusiasm and announced it at a banquet held at the 108th meeting of the ACS in New York (as described in *Chemical and Engineering News* 22 [1944], 1652, 1892). After the initial enthusiasm, growing doubts about the society's management of such a property forced it to decline the proposed donation. Besides access to the company's earnings for charitable purposes, the ACS needed shelter from the legal and financial risks accompanying ownership of Universal. A trust consisting of the capital stock of Universal, entitled the Petroleum Research Fund, was drafted, naming Guaranty Trust of New York as trustee and the ACS as qualified recipient of the income. The agreement was signed by all parties on 26 October 1944, just fifty days after the original idea of giving Universal to the society was proposed.

The Petroleum Research Fund Trust Agreement, unchanged, has guided the trustee and the American Chemical Society since its inception. It separated the function of Universal, a performer of applied research in the petroleum field and a supplier of technology for industry, from the charitable purposes of the trust, defined as support for "advanced scientific education and fundamental research in the 'petroleum field.' " It ensured that the results of research supported by PRF funds would be made

Continued on next page

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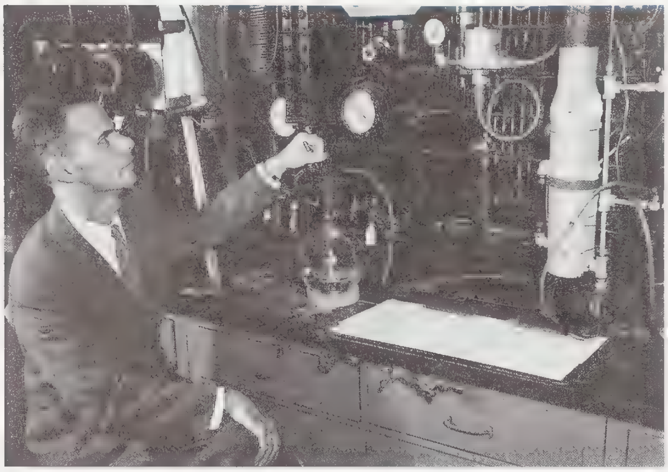
[1] Judge J. Warren Davis of the Third U.S. Circuit Court of Appeals was indicted in 1941, along with Morgan S. Kaufman, a lawyer from Scranton, Pennsylvania. Davis and Kaufman were tried twice on charges of conspiracy to defraud the United States and to obstruct justice. According to the *New York Times* of 20 June 1944, "both juries disagreed and the cases were dismissed." Universal's legal problem stemmed from its payment of $50,000 to Kaufman for "little or nothing" in its litigation in Judge Davis's court.



Above: In the 1930s and 1940s three giants of the petroleum field, Vladimir Haensel, Vladimir Ipatieff, and Herman Pines, worked at UOP. Left: Vladimir Haensel's "Platforming" petroleum catalyst process contributed markedly to the growth of the ACS Petroleum Research Fund. Both courtesy UOP.

UOP and PRF—*continued*

public, and it prevented advantage from accruing to any of the donors as a result of PRF-supported research. It restricted the trustee from selling Universal or permitting it to discontinue its business except under specific conditions. Finally, the provisions of the trust document gave the ACS extreme flexibility in using income from the trust for education and research in the "petroleum field."

David W. Harris (1892–1984), an executive of Arkansas Natural Gas Company, was induced to accept the presidency of Universal and undertake rebuilding the company under trusteeship. Harris found Universal beset by lawsuits, deteriorating morale, and acute financial problems. Understanding the importance of research and development personnel to the company, he enlisted support from among its technical leadership for his program of rebuilding. He settled lawsuits on the best possible terms, using as a negotiating tool the most recent technology available from Universal's laboratories. The most important technical achievement of the Harris era at Universal was the development and extensive licensing of "Platforming," the reforming of petroleum feedstocks in the presence of a platinum-containing catalyst. This feat, one of the major advances in the petroleum industry of the period, was spearheaded by Vladimir Haensel, a young engineer whose achievements in technology complemented Harris's in management. Catalytic reforming became the major source of aromatic hydrocarbons and a mainstay of the petrochemical industry. The financial success of the licensing of the Platforming process is reflected in the almost fourteen-fold increase in annual income from the trust paid to the American Chemical Society between 1955 and 1960.

In 1954 enough income had accumulated in the Petroleum Research Fund Trust for the ACS board of directors to authorize the first grant programs supported by the funds. ACS-PRF programs of grants-in-aid for "advanced scientific education and fundamental research in the petroleum field" were designed to provide flexible support for investigators and students. In 1957 the first unrestricted (and unsolicited) PRF grants were made to distinguished investigators in the petroleum field, highlighting the degree of innovation of the developing grants program.

At the end of 1955 Guaranty Trust decided to sell the Universal securities in the PRF Trust, a move that would permit Universal to use its income for its own business purposes and provide the trust with the diversified portfolio required to support a grants program. The ACS, under the leadership of Ralph Connor, then board chair, agreed to support legal efforts to permit the sale of Universal, but there was substantial opposition from the small refiners who depended on Universal, as well as from the State of New York. In lengthy court proceedings, terms were worked out to meet all of the objections. By March 1960 the final court orders were filed, and Guaranty Trust realized approximately $70 million from the sale.

David W. Harris retired from the company in 1960. Universal continued to grow and prosper as an independent company until it was merged with the Signal Corporation in 1978. In the thirty years of its existence as a diversified trust the value of the PRF Trust has grown from $70 million to over $230 million. In 1990 the ACS distributed over $14 million dollars in grants. The ACS-PRF grants program has achieved its respected position thanks in large part to the achievements of the scientists and engineers of the Universal Oil Products Company of the 1940s and 1950s.

JUSTIN W. COLLAT
American Chemical Society
Washington, D.C.

After this article was completed, UOP published Charles Remsberg and Hal Higdon, Ideas for Rent: The UOP Story *(Des Plaines, Ill.: UOP, 1994), a detailed and profusely illustrated account (455 pp.) of the company's history from the Dubbs process to our time, including of course the creation of the Petroleum Research Fund. For the article Vladimir Haensel, now a professor at the University of Massachusetts at Amherst, kindly furnished excerpts from an unpublished manuscript, Charles Remsberg, "Against Long Odds: The Story of UOP." The ACS files yielded two useful documents. The early history of the ACS-PRF grants program is covered in a report, "The Development and Significance of the Petroleum Research Fund Administered by the American Chemical Society," by Karl Dittmer (1979). A paper by the late ACS General Counsel Arthur B. Hanson, "The Petroleum Research Fund: Its Genesis—Its Present State" (1973), contains a legal opinion on the intent of the trust and the society's programs pursuant to the trust. I also acknowledge helpful conversations with the late Herman S. Bloch, a veteran UOP scientist and officer of the American Chemical Society.*

Coping with the Data Flood: The Federal Role in Chemical Registry

World War II spurred a boom in scientific and technological research. Sputnik, launched in 1957, signaled the need for still greater American effort. For chemistry alone Federal agencies were spending perhaps 200 million dollars a year by the early 1960s, simply to keep up with research results that might be relevant to a myriad of government missions. Dale B. Baker, director of the Chemical Abstracts Service (CAS), noted that the chemical literature was growing at the rate of 9 percent a year and doubling every twelve years. In 1960 Laurence Strong and Theodor Benfey (*Journal of Chemical Education* 37, 29–30) recorded the sobering thought that at the then-current rate of growth, the amount of chemical information published between 1960 and 1973 would equal all that had been published in the past, a prediction amply confirmed (see the graph).

Not only did the flood of information threaten to overwhelm established abstracting and publication processes, but traditional search methods used by readers were becoming inadequate. Alternate means of locating reports and journal articles containing desired data were being explored, among them sorting punched cards or searching computer tapes. But more was needed.

Many thought a giant step forward would be made if structural diagrams could be stored in and retrieved from a "mechanized" system. *How* to do it was the challenge. Several innovations were made in government circles—among them the chemical typewriter, developed by a team at Walter Reed Hospital, and keyword punch-card sorting, worked out at the army's Chemical Corps research labs at Edgewood, Maryland—but they failed to solve the problem. Many users favored alternate methods based on notations, or ciphers, primarily those developed by William J. Wiswesser and G. Malcolm Dyson. These made some progress, but none fully met expectations (see box).

A different idea—that of a chemical register—began to take shape during visits to the Chemical Corps by Fred A. Tate, assistant director at CAS. Tate was looking for an area where CAS could perform research for the government (a requirement under the American Chemical Society's charter) that would at the same time benefit its own developing computer-based system. CAS began issuing its *Chemical Titles* by computer in 1961; it then computerized its boron and fluorine files. These were the products of work headed by Dyson, the creator of the Dyson notation for identifying chemical compounds, whom CAS's Baker had brought from England in April 1959 to apply modern data-processing techniques to CAS operations.

Dyson's project had already produced an algorithm that would allow a computer to make a unique and unambiguous identification of any compound structure containing fewer than 150 atoms other than hydrogen. Henry L. Morgan of the CAS staff, building on work by Donald J. Gluck at DuPont, had worked out the algorithm. The plan was to translate each new compound into a connectivity table (q.v.) as the journal article that reported it was abstracted. This procedure could cover most new compounds. It seemed that a more efficient system for military use was in the making.

Wiswesser Notation

The Wiswesser line-formula chemical notation (1954) sought to convert structural formulas into line formulas with no subscripts, superscripts, or lowercase letters. Hence to distinguish Br and Cl from B and C, Br and Cl became E and G. Common groupings were abbreviated: thus the benzene ring was read as R, NH_2 as Z, and OH as Q. Bromochloroaniline then became ZRGE; $HOCH_2CH_2NH_2$ became Z2Q.

CAS agreed to develop a registry system with federal aid but wanted it to be capable of keeping up with the flow of new compounds being reported, then estimated at 100,000 a year (and now almost 600,000 a year), far above the needs of the Chemical Corps. Peppino Vlannes of the Army Research Office then joined in the negotiations, with wider defense establishment needs in mind, but higher government echelons preempted their taking action.

In May 1964 the National Science Board (NSB), in response to a proposal by Burt Atkinson of the Office of Science Information Services, authorized the expenditure of $14,000,000 by June 1968 on a new project. The National Science Foundation was to cooperate with other federal agencies in having CAS create a national computerized chemical information service that could meet federal agency needs and lead to a discipline-wide system under the aegis of the ACS.

The pervasive role of chemistry in American industry made it imperative to coordinate an approach to mechanized information handling in this

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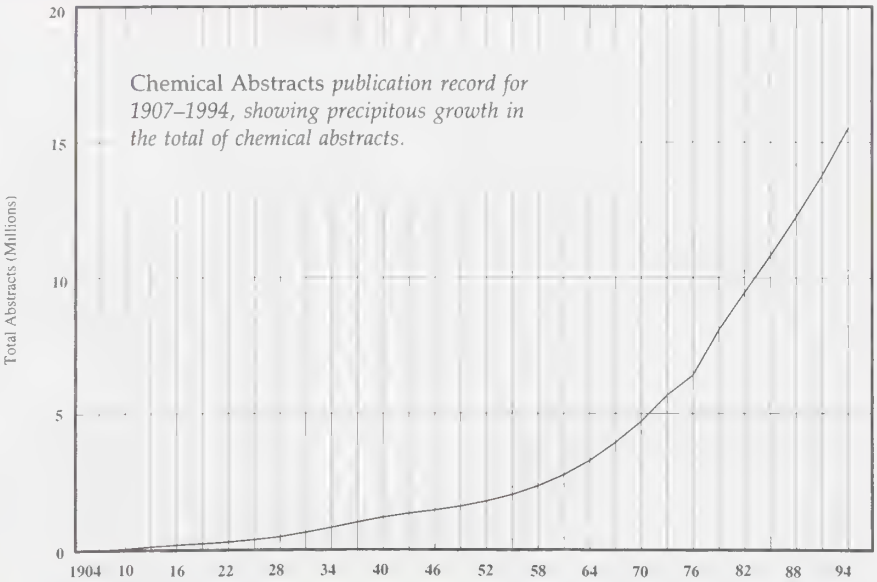
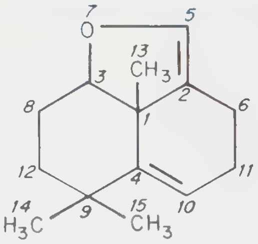


Chemical Abstracts *publication record for 1907–1994, showing precipitous growth in the total of chemical abstracts.*

Node no.	Atom	Connected to	Bond type
1	C	—	—
2	C	1	*1
3	C	1	*1
4	C	1	*1
5	C	2	*2
6	C	2	*1
7	O	3	*1
8	C	3	*1
9	C	4	*1
10	C	4	*2
11	C	6	*1
12	C	8	*1
13	C	1	–1
14	C	9	–1
15	C	9	–1
Ring closure	—	5-7, 9-12, 10-11	*1

1 = single bond　　* = cyclic bond
2 = double bond　　– = non-cyclic bond



Figures reprinted with permission from Chemical Abstracts Service. Copyright American Chemical Society.

Registration translates the two-dimensional diagram for a substance into a tabular form that can be searched by computer. The connectivity table (left) for the 10 millionth substance, CAS Registry Number 125417-03-0 (3-H-naphtho[1,8-bc]furan, 4,5,6,7,8,8a,8b-hexahydro-6,6,8b-trimethy1-, cis-(±)-)*, describes the bond attachment and elemental makeup of the substance.*

Benzoic acid
——, **2-acetyl-** *[577-56-0]*
condensation of, with formylthiazolylbenzamide, 254486y
cyclocondensation of, with ethanolamine, P 16296s
——, **4-acetyl-** *[586-89-0]*
Bordetella pertussis virulence gene transcription modulation by, structure in relation to, 229897a
2-(3-fluorophenyl)hydrazide *[145409-43-4]*, microencapsulated photog. emulsion contg., for rapid dry processing and good contrast images, P 70021m
——, **2-(acetylamino)-** *[89-52-1]*
electronic properties and acidity and conformation and UV spectrum and reaction of, with pertechnetate in presence of borohydride, 204066r
redn. of, by samarium diiodide, 80558f
technetium complex, formation and UV spectra of, 204066r
——, **3-(acetylamino)-** *[587-48-4]*
reaction of, in prepn. of (aminoacyl)piperazine analgesic, P 254960y
——, **4-(acetylamino)-** *[556-08-1]*
acetyltransferase inhibition by, acetylation phenotype identification in relation to, 246779f
esterification of, with hydroxyacetophenone, 124353s

Chemical Abstracts *now lists the chemical registry number after each name. The number itself is not a code; it serves, as do telephone numbers, to access information.*

DATA FLOOD—*continued*

science before attempting it in other sciences. At about this time the president's Committee on Scientific Information brought together representatives of federal agencies and the ACS to identify areas that needed research if a national network was to be implemented. The Science Information Council as well agreed that chemistry was the appropriate place to create a working model, or prototype, for all sciences, since CAS had already begun working on computer techniques for data storage. The National Academy of Science's Committee on Modern Methods of Handling Chemical Information, chaired by George Hager, recommended that CAS work on the "hard core of chemical information, centering on the structural formula, [which] is of vital concern to all users."

Leland J. Haworth, director of the NSF, began negotiations in September 1964 with Harold Brown, director of Defense Research and Engineering, and James A. Shannon, director of the National Institutes of Health, together with Donald F. Hornig, director of the Office of Science and Technology. On 23 December 1964 the three agencies agreed to provide $4,200,000 in fiscal years 1964 and 1965 to support research and development centered at CAS and aimed at testing a computer-based system that could meet agency needs and lead to a discipline-based system. A study group created to define the technical basis for such a contract proposed that a chemical compound registry like that discussed during Tate's visits to the Chemical Corps be created. In April 1965 the interagency Chemical Information Program (CIP) was established as executive agent for the cooperative effort, with headquarters at NSF. CIP's first weeks were spent in obtaining signed working agreements, transferring funds, negotiating the proposed contract, and resolving the vexing problems of data rights.

The two-year contract was signed with CAS on 2 June 1965. The next day Hornig announced that it was a "critical experiment in determining the future pattern of government–professional society relationships in the information service field." An estimated 200,000 compounds appearing in CAS volumes 62 through 65 were to be registered. Later additions raised the CAS support figure to $2,193,000 for the first year.

Thus began a cooperative venture between the federal government and the ACS to adapt the new computer-technology tools to processing chemical data—a venture that lasted into the mid 1970s. Today the concept of "single analysis–multiple use" operations made possible by computer technology is a common principle in the acquisition and distribution of all scientific information.

PAUL D. OLEJAR
Gaithersburg, Maryland

The author was the director of the Interagency Chemical Information Program.

CHF Goes On-line—and Beyond
Eugene Garfield Launches CHF Chemical Information Initiative

Eugene Garfield, founder of the Institute for Scientific Information and creator and publisher of *The Scientist*, has a long-standing interest in the history of chemical information. A steady supporter of CHF, he recently helped us begin to go on-line—to enter into World Wide Web the abstracts of close to a hundred oral histories created by the Foundation. These will serve as the first item of the CHF home page.

Garfield has now offered a challenge grant to help launch a major CHF initiative—documenting and publicizing the evolution of our present ways of storing and retrieving chemical information. More on this subject will appear in forthcoming issues of *Chemical Heritage*.

To reach the WWW server, first use http:/beckman1.sas.upenn.edu to reach the CHF home page, and then follow the "Resources Available at the Chemical Heritage Foundation" link to reach the oral history information.

NEWS from the Donald F. & Mildred Topp Othmer Library of Chemical History

Ralph Landau (second from left) welcomes Prince Bernhard of the Netherlands (right) to the Rotterdam plant of Oxirane, a joint venture of Scientific Design Company and ARCO Chemical Company. Courtesy Ralph Landau.

Ralph Landau Is Speaker at 1995 Othmer Luncheon

EVERY MAY, members and friends of the Othmer Library of the Chemical Heritage Foundation, the American Chemical Society, the American Institute of Chemical Engineers, The Chemists' Club, and the Société de Chimie Industrielle (American Section) gather at The Chemists' Club in New York City for what has become an eagerly awaited event. The Othmer Luncheon celebrates the birthday of an individual who has featured prominently in each of the five sponsoring groups, as member, director, or president. Donald F. Othmer, whose distinguished career as teacher, author, chemical engineer, and philanthropist has had impact worldwide, has long hoped that the five organizations he helped bring to their present eminence would find ways to cooperate in ventures of common interest.

One such venture is the annual Othmer Luncheon, inaugurated in 1989. Last year's luncheon, for Donald Othmer's ninetieth birthday, focused on Othmer's own achievements. This year the spotlight falls on Ralph Landau of Stanford University, Harvard's Kennedy School of Government, and the Scientific Design Company. Plans call for Harold A. Sorgenti, president of the American Section of the Society of Chemical Industry, to introduce Landau as the luncheon's featured speaker, and CHF Board chair Sheldon E. Isakoff, past president of the AIChE, to act as master of ceremonies.

Prominently on display for the occasion is a scale model of the new permanent home of the Othmer Library of Chemical History in the historical district of Philadelphia, soon to be occupied. The model not only shows the restoration planned for the exterior but can be opened to reveal the newly organized interior spaces. It makes a fitting ninety-first birthday present to Don Othmer, who has helped make possible this international resource for all who are interested in the heritage, achievements, and future directions of the ubiquitous chemical sciences.

113 Years of Dyes in Rensselaer

The BASF Corporation dye manufacturing plant in Rensselaer, New York, is now 113 years old. The plant started in 1882, as an outgrowth of a company founded in 1868. It is important, first, as the oldest continually operating dye manufacturing plant in the United States, if not in the world. Second, it has a proud heritage, having its origin in an era when William Henry Perkin manufactured mauve and August Kekulé announced the structure of benzene. Third, the winding path of mergers, reorganizations, intertwining management, and name changes of the twelve different companies and subsidiaries connected with this site is typical of how the dye manufacturing industry developed in the United States. Finally, the site now produces thirty-five million pounds of dyes annually, more than any other single plant in the United States.

The Beginning: 1868–1882

The present works had its origins in Albany in 1868, when A. Bott, a cardboard manufacturer, founded the Albany Aniline and Chemical Company after meeting the dye chemist August Wilhelm Hofmann while on a trip to Europe. In 1871 Bott resigned and returned to making cardboard, but the other stockholders—James Hendrick, Robert H. Pruyn, Paul Cushman, Chauncy P. Williams, and Carl Rumpf, the New York representative of Farbenfabriken of Elberfeld—carried on. Farbenfabriken apparently foresaw some potential in the Albany Aniline and Chemical Company, for in the early 1870s it sent one of its own plant foremen, Hermann Preiss, to Albany specifically to manufacture magenta. After a few years Rumpf sold out to local shareholders, and a number of new chemists shuttled across the Atlantic. Several were brought by Hendrick's son, Elwood, when he returned from studying

Continued on page 22

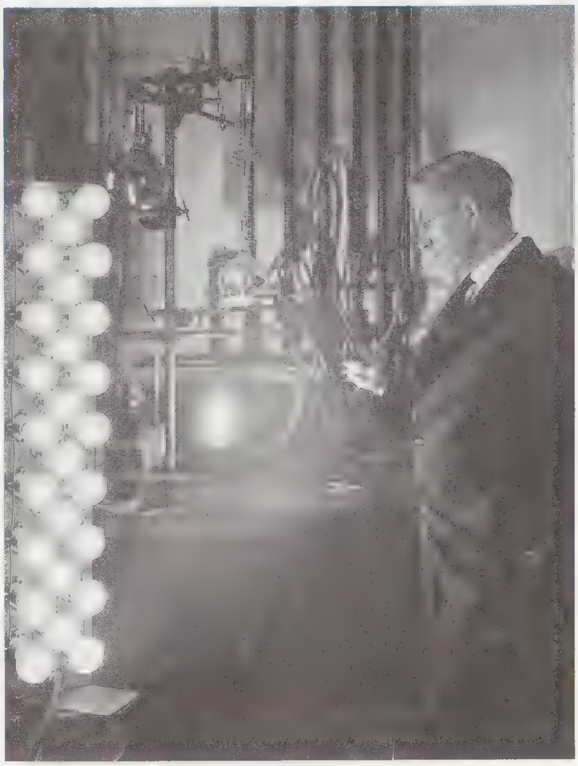
ARCHIVES

Electrochemical Society Archives Open

Let the research begin! In addition to resolutions, the new year brought glad tidings: the archives of the Electrochemical Society are completely processed. The project was initiated in April 1994, when Arnold Thackray, CHF Executive Director, and Tim Kernan, Project Archivist, first reviewed the collection at the society's headquarters. Once the society board of directors approved CHF's proposal for arranging and describing the materials to make them useful to researchers, the materials were transferred to CHF over the summer. In September Carmen Lee, a well-respected Philadelphia archival consultant and a former librarian in the Needham Research Institute's East Asian History of Science Library in Cambridge, England, began processing the collection with Kernan's guidance and the aid of a graduate assistant.

The collection spans the period from 1902 to the 1980s. Much of the material is administrative, such as membership dues records (including Thomas A. Edison's) and meeting minutes. A deeper mining, however, reveals hidden veins of gold. Among the treasures are the original by-laws and constitution, and letters supporting the establishment of an American Electrochemical Society (the original name) from such luminaries as Charles Hall, Wilder D. Bancroft (who reappears below), Edward G. Acheson, Charles Acker, Willis R. Whitney, and Charles H. Merz. There is also a letter of resignation from Charles F. Chandler, dated 1919. Other items of interest include Volume 1, Number 1 (September 1902) of *Electrochemical Industry*, published by the Philadelphia-based Electrochemical Publishing Company, and an amusing "advertisement" for a vaudeville skit allegedly to be performed during one of the society's meetings. The humor relies heavily on word play: for example, "Niagara Falls Amphitheatre, Illuminated by the Newly Discovered Baeke-Light," and "The Programme will open with a Lecture by that World-Renowned Scientist Dr. Bancroft, *Wilder than Ever*—Subject: The Theory of the Chemistry of the Electrometallurgy of the Electrochemistry of Metallurgy."

A new finding aid provides easy access to the collection. It is organized by archival series or group (e.g., Minutes and Reports, Administrative, Monographs and Symposia), and the document folders in each series are arranged chronologically where possible. For copies of this finding aid and further information about the collection contact Tim Kernan at (215) 898-2147.



The electrochemist at work: John W. Marden, a Westinghouse researcher, examines a mercury lamp in the company laboratory in Bloomfield, New Jersey. The mercury arc used 400 watts of electricity yet produced more light than the bank of twenty-six 50-watt tungsten-filament lamps on the left.

Paretchan Builds the G. N. Lewis Holdings

Harold Paretchan of Weymouth, Massachusetts, having discovered that Gilbert Newton Lewis was born in the same city, continues to gather and spread information about its distinguished citizen. (For his earlier efforts see this journal, 11:2 [Summer 1994], 11). Recently he succeeded in inserting a highlighted paragraph on Lewis in the Points of Interest section of the local telephone directory. He has also written to Nobel laureates for their memories of Lewis.

One laureate who replied, Herbert C. Brown of Purdue University, may owe his Nobel to Lewis's inspiration. When he discovered that his chances of gaining tenure at the University of Chicago were very small, he moved to Wayne University in Detroit, which offered only master's degrees and very little in research facilities. He could have become discouraged and ceased research, but he recalled Lewis's experience:

> In 1905 [Lewis] found himself in the Philippines, on the staff of the U.S. Bureau of Weights and Measurements. His official duties did not occupy all of his time. He decided to study the thermodynamics of the dissociation of silver oxide, Ag_2O, at elevated temperatures. This project would require accurate measurement of high pressures over several temperatures, but there was very little scientific equipment in the Philippines. He solved this problem in a remarkably simple way.
>
> He took a length of thick-wall glass capillary tubing. With a glassblower's torch, he bent it into a coil. He then sealed in a sample of Ag_2O. As this was heated and oxygen gas evolved, the coil straightened out. He measured the movement. Later he repeated the operation with a material of known vapor pressure in the coil. The article was published in the *Journal of the American Chemical Society* in 1906. . . .
>
> Accordingly, I decided to undertake a study of steric effect using highly branched tertiary alcohols made in the laboratories of the undergraduate organic class. . . . These studies led to an understanding of the F,B,I [front, back, and internal] strains in a molecule and to an invitation to Purdue University as professor in 1947, and ultimately to the Nobel in 1979.

More for the Julian Archives

Ray Fields Dawson of Winter Park, Florida—a former student of Percy L. Julian's at DePauw University, a business associate of his in Central America, and a long-time member of Columbia University—has made further additions to CHF's Julian archives, which contains correspondence from the 1960s regarding plant alkaloids and steroids (among them nicotine and diosgenin). Dawson sent two letters from 1934, when Julian was still teaching at DePauw, and the March 1965 issue of *The Chemist*, which had Julian on the cover and printed the address, "The Chemist as Scholar and Humanist," that Julian gave on receiving the Honor Scroll of the Chicago AIC chapter, together with tributes from Max Tishler and Ernest H. Volwiler. At CHF's request, Dawson also sent his reminiscences of Julian and his own Sigma Xi lecture on the biosynthesis of nicotine alkaloids. He also included originals of two letters from Robert Robinson, typical in their critical, acerbic tone.

In 1965 Dawson wrote Julian that he was thinking of resigning from Columbia to become an entrepreneur. Julian first wanted to discourage him but wrote instead:

> I then tore this letter up immediately, because it sounded indeed most hypocritical: All my life I have felt that the only happiness in life could be achieved by doing what one wanted to do. Accordingly, I gave up a $50,000 a year job at Glidden to establish my own research laboratories, with hardly a rational thought as to how I would actually make it go. Certainly I hadn't dreamed of developing it into a business enterprise, nor was I at all sure that I could get the necessary funds to make it go. Despite all this, I took the gamble at the ripe old age of 55.

In 1954 Julian created Julian Laboratories, located in Franklin Park, Illinois, and in Mexico City. He then sold them to Smith, Kline, and French in 1961 so that he could resume full-time research.

CHF recently sent copies of numerous items in its Julian archives for use in exhibits at the National Inventors Hall of Fame, into which Julian was inducted in 1990. Hand On! Inc., a museum planning and design firm, is preparing the exhibit areas for the new headquarters that the Hall of Fame will share with a projected educational arm, Inventure Place, in Akron, Ohio. The plan is to install prototypes of many exhibits in the new building; these can then be replicated for installation in other institutions or for use in traveling exhibits. The Hall of Fame's aim is to teach about and inspire inventing and help other centers do so also.

Percy L. Julian received the Honor Scroll of the Chicago chapter of the American Institute of Chemists. The cover of The Chemist, *March 1965, shows him with Maurice J. Kelley, Bernard E. Schaar, and Max Tishler.*

Other Gifts to the CHF Archives

CBA Archive Expands

James V. DeRose was one of the leading teachers writing and testing the Chemical Bond Approach materials for restructuring high school chemistry in the 1960s. He has contributed several missing volumes to the library's collection of CBA material. Thanks to Lawrence E. Strong's gifts and these additions, CHF now has a full set of trial editions prior to the publications of *Chemical Systems* and *Investigating Chemical Systems.* DeRose also donated his own writings on CBA, as well as the Japanese translation of Mary Elvira Weeks and Henry Leicester's *Discovery of the Elements.*

Penicillin at Eli Lilly

Joseph Corse of Lafayette, California, has contributed a copy of the Eli Lilly and Company research reports relating to the work he and others did there on the biosynthesis of penicillin during World War II. Corse also included Robert B. Woodward's second report to the United States Committee on Medical Research, some internal memos and reprints, and a copy of the group's main patent on the biosynthesis of penicillin. Corse's covering letter contains a detailed commentary that describes the project, some of his colleagues, and Eli Lilly himself, who took an active part in many of the decisions.

Slides of crystalline penicillin derivatives were part of the Eli Lilly donation from Joseph Corse.

Free Radical Offprints

Harry E. Reiff of Ambler, Pennsylvania, has sent original ACS offprints of two seminal articles by Moses Gomberg of the University of Michigan on triphenylmethyl and other stable free radicals: "On Triphenylchloromethane," and "On Trivalent Carbon," *Journal of the American Chemical Society* 23 (1901), 109–110 and 496–502.

NEWS FROM THE OTHMER LIBRARY

Union Carbide's History Project

The Carbide Retiree Corps, an organization of retired Union Carbide Corporation workers, has embarked on a project to document the corporation's history, especially its work in chemical and plastics. Union Carbide has sanctioned the project, which will lead to the assembly of two permanent archives, one at the Chemical Heritage Foundation in Philadelphia, and the other at Union Carbide's headquarters in Danbury, Connecticut. The CHF archive in the Othmer Library will be available for public inspection. In addition, a brochure about Union Carbide's history will be produced for Union Carbide employees and retirees and others.

Relying on technology developed in-house, Union Carbide pioneered the manufacture of most of the major petrochemicals, and its story has never been fully told. The project will emphasize products, technology, processes, and people rather than organizational history. Among the important chemicals that the company was first to produce synthetically and market in commercial quantities were acetylene, ethylene, propylene, butadiene, ethanol, acetone, acetic acid, acetic anhydride, butyl alcohol, ethylene oxide, ethylene glycol, ethyl ether, ethylene dichloride, isopropanol, and ethanolamines. Important firsts in plastics included vinyl resins, phenolic resins, and polyethylene. Union Carbide continues as a major producer in many of these areas.

Retired workers who were directly involved in these processes and thus have firsthand knowledge and experience of them are documenting Union Carbide's history on a volunteer basis. The work is expected to take about a year to complete.

ROBERT D. STIEF
Johns Island, South Carolina

Pauling Collection to Go On-line

In the spring of 1986 Linus Pauling, twice a Nobel laureate, presented his papers and those of his wife, the well-known peace activist Ava Helen Pauling, to Oregon State University. The collection, stored in over 800 archival boxes at the university library's Special Collections, contains more than 150,000 items of the Paulings' personal and scientific papers, notebooks, and correspondence. With the arrival of additional materials, the collection will be one of the largest of its kind, with over a quarter million items in all, benefiting scholars and researchers throughout the world. Prominent items in the collection include Pauling's Nobel medals; the original petition for nuclear disarmament presented to the United Nations, with the signatures of more than 11,000 prominent scientists and Nobel laureates from around the world; the original manuscripts of *General Chemistry* and *The Architecture of Molecules;* the original research notebooks used to record Pauling's scientific theories; the research books and notebooks for *The Nature of the Chemical Bond,* one of the most influential scientific books of the twentieth century; a series of papers on valence bond theory, which laid the foundation for the modern interpretation of the chemical bond; and letters from major twentieth-century scientists.

An archival find: a picture of Linus Pauling found in the Electrochemical Society's archives at CHF (see story, p. 10). Do any of our readers know the date or have other information about this picture?

Since Oregon first opened the Special Collections research area in April 1988, it has increasingly become a focal area for those researchers interested in the history of twentieth-century chemistry. Until now researchers have accessed Pauling papers by visiting the collection. With the implementation of a new imaging and text retrieval technology, researchers and scholars will be able to remotely access and view Pauling's papers via Internet. This revolutionary technique will allow easy search of and access to papers and save researcher's travel and search time. It will also preserve the papers by avoiding frequent handling.

The system consists of an IBM-compatible 486DX computer with 16 megabytes of random-access memory, a 21-inch high-resolution color monitor, and a Fujitsu scanner. The images are now stored on a 2-gigabyte hard drive; they are soon to be transferred to a 20-gigabyte optical tower. The system is also equipped with a high-speed fax modem capable of transmitting the images.

The process employs LaserFiche, an imaging and full-text retrieval software program, to create an image and text database. First the individual documents are scanned and stored using LaserFiche imaging software, then WordScan (optical character-recognition software) is used to extract the typewritten text of the scanned documents and create a searchable database.

Apart from permitting browsing through individual items, the system will also allow researchers to do keyword, easy Boolean, and fuzzy-word searches. For example, if a researcher wants to find all the correspondence between Pauling and Albert Einstein, the name "Einstein" is entered as a keyword. Then the computer will find every piece in the collection where Einstein's name is mentioned. This method lets researchers have a facsimile image of the original document and the extracted text side-by-side on a single screen. Researchers using this database may store the searched image, text, or both in digital form.

RAMESH KRISHNAMURTY
Oregon State University, Corvallis

A National Archives of Indian Pharmacy

A Report and a Plea

Some decades back, as a small hobby, I began collecting material on the history of pharmacy in India. The collection has now assumed formidable dimension. It covers roughly the last 150 years and includes originals or photocopies of reports from governmental committees, parliamentary debates, various legislative acts, and minutes of several statutory bodies; excerpts from relevant periodicals; biographical material; books, pharmacopoeias, and formularies; papers of pharmaceutical organizations; material on pharmaceutical education and research and on professional pharmacy; publications on indigenous drugs; and personal papers of luminaries of pharmacy.

The collected material has been bound and comprises about eight hundred volumes. The contents may be seen as the nucleus of the National Archives of Pharmacy in the making. After I published the first volume of *History of Pharmacy in India and Related Aspects* in 1994 (Delhi: Vallabh Prakashan), colleagues in the profession began to take the collection more seriously. In October 1994 the archival project was given official support for three years from the Indian National Commission for History of Science, Indian National Science Academy.

The archives will be made public after I have finished my writing or after my death, whichever happens first. The archives then will become the property of the profession and would appropriately be housed at some central place for reference.

I wish to continue building the collection; after me, others may expand and nurture it. I would appreciate any contributions of documents, correspondence, rare photographs, and any other archival material that we need to save for posterity, and I urge pharmaceutical scientists and educators, members of the pharmacy profession, pharmaceutical organizations, and private and government agencies and institutions to send them to me at 1135 Sector 43, Chandigarh 160022, India.

HARKISHAN SINGH
Chandigarh, India

Margaret Thatcher, Chemist

In addition to her other great achievements, Dorothy Crowfoot Hodgkin (1910–1994) was a tireless worker in the cause of peace. . . . One of her former chemistry students at Somerville College had been Margaret (now Lady) Thatcher, who had been somewhat hostile to Russia before receiving a letter from her former tutor, gently chiding her for criticizing a country before visiting it. As a result Prime Minister Margaret Thatcher did visit Russia, and to her pleasant surprise established close rapport with Mikhail Gorbachev and other Russian leaders.

—Keith Laidler
Chem 13 News, Dec. 1994, p. 5

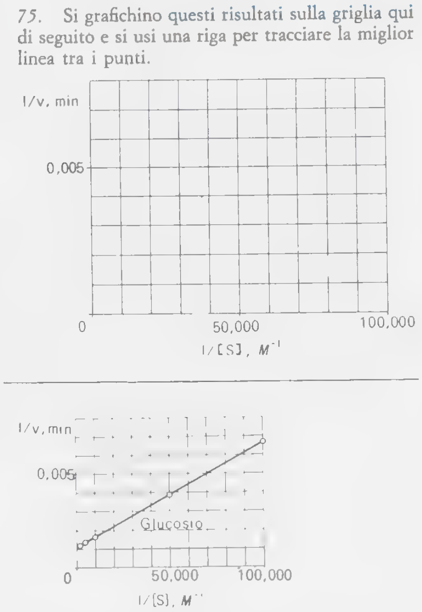
Gifts to the Othmer Library

When Skinner Invaded Biochemistry

In the early 1960s the Skinnerian revolution—inspired by Harvard psychology professor B. F. Skinner, author of *Walden Two*—swept through the chemical teaching profession. In brief the theory was that you don't learn much by sitting in class and listening, or because of threats or fear of failure: The way to learn is through bite-sized instructional items followed by problems, solvable but just hard enough to challenge, and from immediate feedback on whether the answer is correct. Carrots, not sticks, are the proper tools for instruction. Publishers of chemistry texts set up special editorial departments to develop Skinnerian programmed texts—instructional sequences with miniproblems followed immediately by answers.

The W. B. Saunders Company launched its offerings in 1963 with Halvor N. Christensen's *pH and Dissociation*. Christensen, professor of biological chemistry for many years at the University of Michigan, Ann Arbor, and now at the University of California, San Diego, has given the Othmer Library six of his "textual learning" programs, including his 506-page *Body Fluids and the Acid-Base Balance* (1964), composed of 124 instruction items with questions followed by answers.

Christensen suggests these could become part of an exhibit on the fate of programmed instruction, which after a meteoric rise, almost vanished from the publishing world because computers could do it better. Even the intricacies of Beilstein could once be mastered thanks to a programmed text. No doubt much that was learned from the early Skinnerian ventures in the 1960s was incorporated into the more successful computer instruction programs.


75. Si grafichino questi risultati sulla griglia qui di seguito e si usi una riga per tracciare la miglior linea tra i punti.

U.S. programmed instruction texts were often translated. In this page from an Italian translation of Halvor N. Christensen and Graham A. Palmer's Cinetica Enzimatica *(1971), an instructional section is followed by a question or blank to be filled in. The answer appears below the horizontal line. The next frame is then presented. The student covers the book's answer with a card while trying to solve the frame's question.*

Color Us Happy

■ Virginia Trimble of the University of Maryland's Astronomy Program donated about seventy books on photography assembled by her father Lyne S. Trimble, a former professor at the University of California at Los Angeles. The books range over such diverse topics as color theory and imaging systems, Kodak photographic papers for industrial use, color television engineering, photochemistry, and movie making; among them are copies of *Retouching Negatives and Prints from A to Z* and Lyne Trimble's *Color in Motion Pictures and Television* (Berkeley/Los Angeles: University of California Press, 1954, 1969).

The gift represents a major addition to the Othmer collections, and is particularly welcome as CHF develops its new traveling exhibit, "Colors, Culture, and the Chemical Sciences."

■ Just before a planning meeting on the CHF dye exhibit, Howard Turner, a friend of Charles C. Price (emeritus chair of the CHF Board), brought us the September 1926 issue of the *Journal of Chemical Education*, which had a lead article by E. R. Rose of DuPont on the growth of the dyestuffs industry. Most remarkable was the inclusion of forty-eight actual textile swatches dyed with the various dyes mentioned, and pasted into the article. The issue also contained

Continued on next page

GIFTS—*continued*

a novel three-dimensional periodic table. Turner also presented a copy of *SRI, The Founding Years: A Significant Step at the Golden Time,* by Weldon B. Gibson (Los Altos, Calif.: Publishing Services Center, 1980), which tells the story of the Stanford Research Center.

Years of Glory, Times of Change: Eastman Chemical 1920–1990

"Against All Odds, 1920–1945," "Coming of Age 1945–1975," and "Momentum to Change the World, 1975–1990" —these are the subtitles of three videotapes prepared by the Eastman Chemical Company of Kingsport, Tennessee, a Division of Eastman Kodak, to celebrate its first seventy years of existence. Michael O. O'Neill, public affairs director at Eastman, sent the tapes, together with a 69-page brochure, aptly titled "Eastman Chemical Company: Years of Glory, Times of Change." The tapes interweave scenes of war—and victory celebrations—when they fit the story, with photos and movie clips of various stages of Eastman's evolution and with interviews and commentaries by major Eastman figures.

The story begins with Eastman Kodak being lured to site the plant in Kingsport, to produce methanol, or wood alcohol, and other wood distillation products from sawn timbers. In 1930 the firm began manufacturing cellulose acetate from another of its products, acetic anhydride, to replace the flammable cellulose nitrate commonly used for photographic film. Donald Othmer played a major role in this development (see this journal 6:3 [Fall 1989], *Othmer Library News*, pp. 1, 4, 5). From film the company moved on to cellulose acetate fiber for the textile industry, and thereby eventually became a major player in the plastics industry. In between it built the huge electromagnet for the Manhattan Project in Oak Ridge and supplied hydroquinone for the synthetic rubber project—the best chemical to stop polymerization at precisely the right point. An impressive multimedia presentation of an impressive history.

George Eastman, founder of Eastman Chemical Company and its parent, Eastman Kodak, in a classic picture with Thomas Edison in 1928. Courtesy Eastman Kodak.

Other Gifts

- Alan J. Rocke of Case Western Reserve University sent us *Biographies of Morley Award Recipients, 1965 to the Present*, a 31-page brochure reprinting biographical information published at the time of each award. The brochure was prepared in 1994 by the Archives Committee of the Cleveland ACS Section, the sponsor of the award. The award recognizes contributions to chemistry through achievements in research, teaching, engineering, research administration, and public service, and outstanding service to humanity or to industrial progress. The recipient must be living within 250 miles of Cleveland, which many an eminent chemist did—or still does.

  The award is named for Edward Williams Morley (1838–1923), who taught chemistry at Western Reserve University and is best known for his part in the Michelson-Morley experiment of relativity fame. The first Morley award recipient was Ernest Eliel, at the time at Notre Dame University and later ACS president. Others so honored were Daryle H. Busch and Melvin S. Newman of Ohio State, Richard H. F. Manske of Dominion Rubber Company, Waldo L. Semon of B. F. Goodrich, and the 1994 Nobel prize winner George A. Olah, who in 1970 was teaching at Western Reserve.

- In exchange for a copy of CHF's Woodward booklet, the Smithsonian Institution Libraries donated *The Joys of Research*, edited by Walter Shropshire, Jr. (Washington, D.C.: Smithsonian Institution Press, 1981). Based on a symposium celebrating the centennial of Albert Einstein's birth, the ten papers it contains describe the joys of the authors' own research and link it to Einstein's "strain of decency and humanity," to which this book is dedicated. Representing the chemical sciences were Julius Axelrod, Howard M. Temin, Rosalyn S. Yalow, and Linus Pauling as speakers, and Anna J. Harrison as one of the moderators.

- Frederick Kurzer of London sent us a set of provisional trial numbers of the *Journal of Chemical Research*, vividly portraying the stages in the genesis of a new and important chemical journal that uses microform techniques to reduce its consumption of paper greatly while still serving the needs of its readers fully. The trial numbers were issued by the Chemical Society (now the Royal Society of Chemistry) before the new journal was finally launched in 1977. By 1977 the Gesellschaft Deutscher Chemiker and the Société Chimique de France had joined the Chemical Society as cosponsors. Full articles in French and German are welcomed for the microfiche and miniprint sections as long as synopses for the printed journal are supplied in English.

- Hans R. Jenemann of Hochheim am Main, Germany, an analytical chemist and collector of balances, has contributed two of his publications: *Die Waage des Chemikers*, a booklet with color illustrations written to accompany a DECHEMA exhibit (Frankfurt am Main: DECHEMA, 1979), and *Die Langarmigen Präzisionswagen im Liebig Museum in Giessen* (Giessen: Mettler Instrumente, 1988).

- Thanks to the good offices of E. N. (Ned) Brandt and the Dow Chemical Company, CHF now owns the British periodical *Chemical News*, Nos. 1–3781 (1859–1932). Included are the famous papers John Newlands published on the law of octaves (Nos. 12 [1895], 83, and 13 [1866] 130), which bracket the presentation he made to the Chemical Society at which George Carey Foster sarcastically asked him whether he had tried arranging the elements in alphabetical order.

PUBLICATIONS

NEW FROM CHF

American Chemical Enterprise

To commemorate the centennial of the Society of Chemical Industry (American Section)

Mary Ellen Bowden and John Kenly Smith

This lively and profusely illustrated history of major developments in the American chemical industries focuses on the contributions made by winners of the Perkin and Chemical Industry medals. An introductory section on the American Section of the Society of Chemical Industry is followed by chapters on electrochemicals; minerals and gases; synthetic organic materials; chemical education and industrial research; petrochemicals; nylon, rubber, and plastics; pharmaceuticals; communications and the environment; and the role of chemical industrialists. Appendices list chairmen of the American Section and winners of the Perkin and Chemical Industry medals


Bristol Myer Squibb

1994. 96 pp. 153 illus, apps, bibl. paper, 8 ½ x 9 ¼.
ISBN 0-941901-13-0 **$15.00**

Introducing the Chemical Sciences: A CHF Reading List

Edited by Theodor Benfey

An introductory guide to books in the history of the chemical sciences that is designed particularly for teachers of chemistry and their students, but is useful in many other contexts. The sections list reference works; histories of science and technology; histories of the chemical sciences, including company histories; autobiographies and biographies; edited classical texts; and journals

1994. 12pp. Paper, 8 ½ x 11, ISBN 0-941901-11-4
($2.50 each for 10 or more copies) **$4.00**

TO ORDER SEE PAGE 24

Too Difficult for Chemists?

Keith J. Laidler. *The World of Physical Chemistry*. Oxford/New York/Toronto: Oxford University Press, 1993. xii + 476 pp. $85.00.

Albert Einstein, Keith Laidler reminds us, once suggested that "the trouble with chemistry is that it is too difficult for chemists." Perhaps. But you could not prove the point by referring to this book. Laidler takes readers over some of the more difficult terrain in the history of science. Those who complete the tour will surely come away with an enhanced appreciation for the explanatory power and intricacy of modern physical chemistry and an enlarged respect for the chemists (and, to be fair, some physicists) who have made it what it is.

Readers will also develop a good deal of respect and affection for the teller of this tale. Laidler is enormously well informed about his science, as might be expected of a distinguished contributor to and teacher of physical chemistry. He has a shrewd insight into the interconnections between specialties, a fine sense of the physical meaning behind equations, and a clarity of exposition that reflects long experience in the classroom. He also has a wide acquaintanceship with other physical chemists, including some of signal importance in the twentieth century. No name-dropper, he brings his personal knowledge to bear in unobtrusive ways, seasoning his account with insights and humor that make the book valuable not just as a formal study of published work but also as a source on the personalities and working habits of such chemists as Henry Eyring and Ronald Norrish.

It is easy to like Keith Laidler, and one of his most likeable characteristics is his honesty. He knows he is not a philosopher, nor a sociologist, nor a "methodologically sophisticated" historian; he does not try to be such. Rather, his goal is the deceptively modest one of getting the story right, of piecing together, from a very large scientific literature, a connected account of how one important branch of physical science has developed. He offers some introductory remarks on the larger social and intellectual settings within which physical chemistry grew and occasional asides about dead ends and neglected figures, but his main focus is on the evolution of ideas about those phenomena which are today treated by physical chemists and the intruments and methods by which those ideas were developed. He organizes his treatment much like a textbook of physical chemistry, with chapters on thermodynamics, kinetic theory and statistical mechanics, spectroscopy, electrochemistry, kinetics, and so forth. This organization reflects his intention of writing for an audience of scientists rather than historians. Teachers of physical chemistry might well use this rich book in conjunction with a traditional textbook, either assigning chapters to students for historical context or mining it to add a historical dimension to lectures.

In his preface Laidler says that he hopes "that historians of science who are not also scientists may find the book useful, even though they may well want to skip over some of the early material with which they will be familiar and perhaps some of the more mathematical parts." Laidler succeeds here, too, although not perhaps quite in the way he intended. Readers acquainted with the history of the physical sciences are well advised to move quickly over the early chapters, not so much because the story is familiar as because Laidler is so clearly out of his element in the premodern era. Contrary to his assertion, Galileo did not state the law of falling bodies in 1590 or 1600 (p. 58), nor the

Continued on next page

GIFTS—*continued*

- Alan Warren, operations manager of the PQ Corporation, Conshohocken, Pennsylvania, has donated a complete bound set of *Ambix*, the British journal of history of alchemy and chemistry, to the Othmer Library.
- A 1981 survey of Romanian chemical activity from the fifteenth century on, "Open Roads in Chemistry," *Romanian Review* 35(6–7), 45–51, was recently sent us by D. Marchidan of the Center of Physical Chemistry in Bucharest.

PUBLICATIONS—*continued*

law of inertia in its modern form (p. 59). Aristotle, as even Francis Bacon acknowledged, did not practice a straightforwardly deductive method in the physical sciences (pp. 55–56). It is misleading to describe Bacon himself as an atomist or to trace Robert Boyle's enthusiasm for corpuscles to the influence of his countryman (p. 69). Historians will also be uneasy with such blunt assertions as "All of science has a mathematical superstructure" (p. 10); and "The distinction between sciences is, after all, no more than a matter of administrative convenience" (p. 5). The first statement seems to sweep much of the natural knowledge of earlier times and some of that of today into the category of "nonscience"; the second makes it difficult to understand why so many scientists in the past and present have become exercised about defining their fields.

These shortcomings are more than offset, however, by the strengths of later chapters, which treat physical chemistry's development during the past century or so. Here Laidler's advice to skip over the more mathematical parts is best ignored. In fact, the real value of this book for historians resides in the exceptionally clear and vivid discussion of the development of the theoretical superstructure of modern physical chemistry—a science that is decidedly mathematical. And it is precisely here where historians of science most need the scientist's help. Historians who write about the internal history of subjects as technically demanding as modern physical chemistry are prone to underestimate the complexity of the research enterprise, to smooth out, evade, or overlook details, and to miss links between one part of their subject and another. Insiders, especially those prepared by decades of immersion in the science, are often better able to appreciate such subtleties. Although the development of physical chemistry in the glory years of the 1880s and 1890s, when J. H. van't Hoff, Svante Arrhenius, and Wilhelm Ostwald were at the peak of their careers, has received attention from both insiders and outsiders, I know of no other work that carries the history of this specialty into and through the mid-twentieth century. Laidler does this with distinction.

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Ralph Landau, Engineer, Entrepreneur, Economist

Ralph Landau. *Uncaging Animal Spirits: Essays on Engineering, Entrepreneurship, and Economics.* Edited by Martha V. Gottron. Cambridge, Mass.: MIT Press, 1994. 423 pp. $42.50.

"In microcosm this book illustrates the opportunities, the obstacles, and the satisfaction of a career of a single individual in the field of chemical engineering. Multiply Ralph Landau's career a thousand times and you have the greatness of America," writes Robert White, president of the National Academy of Engineering, in his foreword to this book. Landau may say that "luck beats brains every time. And I've been a very lucky man." To which one can only counter with Louis Pasteur's observation that chance favors the prepared mind. Like Pasteur, Landau has the intelligence and persistence to use his luck in ways that maximize technological advantage and are of use to countless people throughout the world.

Landau was the cofounder and the animating spirit of Scientific Design Company, a pacesetting firm that brought the expertise of American chemical engineers to worldwide prominence in the 1960s and 1970s. He is now—uniquely for an engineer—a member of the economics faculty of Stanford University and a fellow at Harvard's Kennedy School of Government. *Uncaging Animal Spirits* presents twenty-seven of his papers, written from 1957 to 1993. Beginning with "Ethylene Oxide by Direct Oxidation," an early discovery, it contains sections on innovation and entrepreneurship; professional issues (e.g., "The Chemical Engineering Trilemma"); technology and trade in the global market; and technology, innovation, and the economy (e.g., "Innovation for Fun and Profit"). The books ends with three recent essays, grouped as "Lessons from Life," and with a bibliography of Landau's papers and patents.

Ralph Landau is speaking at the 1995 Othmer Luncheon. See page 9.

A Broad View of Chemistry

Seymour H. Mauskopf, editor. *Chemical Sciences in the Modern World.* Philadelphia, Pa.: University of Pennsylvania Press, 1993. 417 pp. $39.95.

The chapters in this book were first presented at a conference on the state of the history of the chemical sciences toward the end of the twentieth century. The meeting, held in 1990 at the Eagle Lodge outside Philadelphia, was organized by the Chemical Heritage Foundation; the more than sixty participants included twenty speakers and thirteen invited commentators, as well as CHF staff and invited academicians—among them nine secondary school chemistry teachers, suggesting that at least a few students are receiving a broad look at chemistry and its impact. As I can attest, most authors have incorporated relevant new materials or ideas that arose during discussion of the papers—including ideas introduced at meals, in the corridors of the lodge, or during walks on the premises.

Mary Jo Nye opens the volume with the question, "Is there a philosophy of chemistry? Physicists have a philosophy of their science, but chemists do not." She presents a valid position that chemists have generally avoided philosophy since chemistry appears to lack the precision of physics and astronomy, or even the biological sciences. She ends: "Whereas many twentieth-century physicists regard conventionalism, complementarity, and indeterminacy as concessions of failure in their philosophical enterprise, chemists were not surprised that electrons and atoms, like molecules, were hard to predict."

In the section on technical practice Yakob M. Rabkin looks at the significance of instruments in chemistry, with an impressive analysis of their impact on chemical knowledge as well as on the control of chemical processing. Robert E. Kohler explores how living organisms such as fruit flies and bread molds were reshaped as scientific tools in the study of biochemical problems, and helped shape the problems in turn. Alan J. Rocke points to a quiet revolution in nineteenth-century chemical theory, exploring the little-understood influence of the German chemist Hermann Kolbe. Frederick L. Holmes adds a perceptive study of Liebig's role in constructing organic chemistry.

In Part II, "Production," John Kenly Smith studies the evolution of the chemical industry, focusing on plastics, synthetic rubber, specialty glass, and the cracking of crude oil for aviation gasoline. John E. Lesch looks at how sulfa drugs were developed through a merger of chemistry and medicine in an industrial setting. In "Defining Chemistry: Origins of the Heroic Chemist," Robert Friedel opens with contrasting quotations from Mary Shelley's *Frankenstein* (1819) and John K. Mumford's *Story of Bakelite* (1924); argues that the modern chemist is bashful about success and predicts little, though achieving remarkable successes; and concludes with an appendix of twenty definitions of chemistry dating from 1914–1919.

Part III, "Challenge to Preserve," contains papers by two specialists on archives: Helen W. Samuels, "Documenting Modern Chemistry"; and Joan Warnow-Blewett, "Historical and Documentation Research."

Part IV concerns the "challenge to public outreach." William B. Jensen in "History of Chemistry and the Chemical Community: Bridging the Gap?" criticizes professional chemists for lack of interest in their history and professional science historians for not addressing the needs of chemical educators. (He found much agreement in the group!) Robert Bud, in "The Museum, Meaning and History: The Case of Chemistry," discusses the new demands made on science museums if they are to attract visitors.

The next section, "Challenges to Public Policy," introduces a variety of world problems of a chemical nature and the difficulties encountered in dealing with them. In "Themes in the History of Environmental Chemistry," Christopher Hamlin reports on his extensive research on the problems of public water supplies. Suzanne White develops an excellent study in "Chemogastric Revolution and the Regulation of Food Chemicals." Ellis N. Brandt concludes with "The Chemical Industries and Their Publics: How Can History Help?"

Part VI, "Prospects," concludes the volume. Erwin N. Hiebert opens with "The Prospect from Here"; John W. Servos follows with a bit of frustration titled "Bewitched, Bothered, and Bewildered"; and Pnina G. Abir-Am provides the thoughtful "Women in Research Schools: Approaching an Analytical Lacuna in the History of Chemistry and Allied Sciences."

For half a century I have been prejudiced for the significance of history of chemistry, and in 1990 I came away from the meeting with a good feeling about the future of the subject. The published book is an excellent contribution and opens the door to many aspects of the history of the chemical sciences that need further study.

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Books to Note

Michael Hunter, editor. *Robert Boyle Reconsidered*. Cambridge: Cambridge University Press, 1994. xviii + 231 pp. $49.95.

Historical research sometimes inverts our view of great scientists. Earlier it happened to Isaac Newton. Of him John Maynard Keynes remarked that he was not the first of the moderns but rather the last of the magicians. Michael Hunter's book puts Robert Boyle, the thirteenth child and seventh son of the

Continued on next page

New Editor Sought for CHF–ACS Series

The management board for the History of Modern Chemical Sciences series now seeks a new editor, from 1 January 1996. The series, copublished by the American Chemical Society and the Chemical Heritage Foundation, is aimed at a wide audience and offers reference works and popular books that complement the familiar offerings of academic presses. The first book in the series is *Nobel Laureates in Chemistry*, a compilation of short biographies. Volumes in press include the memoirs of a German nuclear chemist in Stalinist Russia, and an annotated collection of the classic papers of R. B. Woodward.

The new editor will build on the foundation established by the series' first editor, Jeffrey L. Sturchio of Merck & Co., Inc., and will actively encourage the publication of historical analyses of industries and segments of the chemical sciences; autobiographical memoirs, biographies, and reminiscences; edited collections of essays and documentary sources; classic reprints, pictorial volumes, and so forth. The aim of the series is to bring to life, within the context of their myriad social, political, and economic dimensions, the individuals, ideas, institutions, and innovations that have created the modern chemical sciences.

The ideal candidate will have professional experience and wide contacts in the world of chemistry and history, a record of personal accomplishment in scholarship or publishing, and a demonstrated commitment to improving public understanding of the contributions of science and technology to modern life.

If you are interested, or have candidates to suggest, please write immediately and in any case before 31 May 1995 to M. Joan Comstock, ACS Books, 1155 16th Street NW, Washington D.C., 20036, fax (202) 452-8913; or Arnold Thackray, CHF Executive Director, 3401 Walnut Street, Philadelphia, PA, 19104, fax (215) 898-3327.

PUBLICATIONS—*continued*

Earl of Cork, back on his own feet, and those feet are decidedly not those of a modern chemical investigator.

The usual image of Boyle is based on a limited acquaintance with available sources and on very wishful thinking. Perhaps wishful thinking plays a part in all biographical endeavors, while only the wishes change. Now that we are becoming open again to the role of religious belief and experience in motivating and molding scientific explorations, we are discovering the importance of such factors in many a man or woman active in the development of the sciences. The papers in the present volume discuss Boyle's political views, rhetoric, philosophy, alchemy, and theology, and the influences that shaped them—including the debt of Boyle's corpuscularianism to the *Summa perfectionis* of pseudo-Geber, described by William R. Newman.

Many of the essays use material from Boyle's manuscripts, which have only recently been catalogued. A new edition of Boyle's published works and correspondence is being readied by Hunter and two other authors in this book, Edward B. Davis and Antonio Clericuzi; it will finally supersede the Thomas Birch edition of 250 years ago. The four authors mentioned and the other essayists—Malcolm Oster, John T. Harwood, Rose-Mary Sargent, Lawrence M. Principe, John Henry, Jan W. Wojcik, Timothy Shanahan, and J. J. MacIntosh—have presented facets of Boyle and supporting evidence that will be the basis for every new Boyle biography.

Wendy B. Murphy. *Science and Serendipity: A Half-Century of Innovation at Syntex.* White Plains, N.Y.: The Benjamin Company, 1994. 143 pp.

This extraordinarily well written company history is far more than that. True, it is the story of a chemical manufacturer that broke into the prescription medicine market; the story of a small unknown Mexican company outside the so-called industrialized world taking on the giants—and succeeding; the story of innovation, improvisation, courage, and genius—and of a company designing its workplace to foster these qualities. It is also the story of the "Syntex Navy" of riverboats; the story of yams, hormones, and the "pill" and their meteoric entry into the commercial world; the story of an owner's investment of $100,000 netting him over $3 million in a dozen years—and of a stock offering that rose from $5.75 to $227.50 per share in ten months, when Syntex went public in 1963. It is a story of legendary names in chemistry and commerce—Carl Djerassi, Russell Marker (who died 3 March 1995), George Rosenkranz, Franz Sondheimer, Gilbert Stork, Alejandro Zaffaroni. Finally, it is the story of a company continually on the move: attached to the book is a marker announcing that Syntex, now headquartered in Palo Alto, California, is to be merged with Roche of Switzerland. (For stories on Syntex in earlier issues of our publication, see 3:2 [Fall 1985], 10–11; 4:2 [Summer 1987], 3–6; and 9:2 [Summer 1992], B6–B7.)

Kenne Fant. *Alfred Nobel: A Biography.* Translated from the Swedish edition (1991) by **Marianne Ruuth.** New York: Arcade Publishing, 1993. viii + 342 pp. + plates. $24.95.

Alfred Bernhard Nobel is known for his prizes, each now amounting to over $800,000, and for his invention of dynamite, which made explosive nitroglycerine remarkably safe by mixing it with diatomaceous earth. Kenne Fant's biography reveals other sides of Nobel. Excerpts from Nobel's play *Nemesis* appear frequently, and in the second half of the book many of his letters to Sophie Hess, hitherto unpublished, constitute chapters interspersed with the narrative of his life. Alfred Nobel was no Mr. Higgins, and Sophie, a former Viennese flower vendor, never became a real-life Eliza Doolittle. Bertha von Suttner, his earlier love and briefly his private secretary, later worked passionately for peace, for which she received the 1905 Nobel Peace Prize. When she and her husband visited Nobel in 1887, he stated his famous wish, "I should like to be able to create a substance or a machine with such horrific capacity for mass annihilation that wars would become impossible forever." On that search he invented blasting gelatin, smokeless gunpowder (ballistite), and the Nobel igniter.

In 1873 Alfred's brother Robert was sent to Baku—then part of Russia—among other places, to find good walnut for their brother Ludvig's rifle factory. Instead of walnut he found oil. The Nobel brothers thereupon entered the oil business, opening up and developing the deposits in Baku near the Caspian Sea, laying pipelines, constructing the first oil tankers, and inevitably coming into competition with the Rothschilds and the Rockefellers. The book is a remarkable mix of details on the industrial, personal, research, and literary involvements of a tormented, hugely successful entrepreneur.

Seventeen-year old Alfred with his older brother Ludvig. A younger brother, Emil, was killed in a nitroglycerine explosion. Courtesy Arcade Publishing.

Pamela H. Smith. *The Business of Alchemy: Science and Culture in the Holy Roman Empire.* Princeton: Princeton University Press, 1994. 178 pp. $45.00.

Johann Joachim Becher (1635–1682) is known among chemists as a precursor of Georg E. Stahl in the history of the phlogiston theory. Smith follows Becher's life and work along numerous directions in science, commerce, and economic thought to illuminate the rise of modern science and early capitalism in the sixteenth and seventeenth century. She explores the multifaceted aspects of alchemy and presents, in Betty J. T. Dobbs's words, a "thorough-going intellectual biography" of Becher.

Fathi Habashi, editor. *A History of Metallurgy.* Quebec: Librairie des Presses de l'Université Laval, 1994. 322 pp. $35.00.

Fathi Habashi of the Université Laval, trained in metallurgy in Cairo and Vienna, has published many detailed illustrated notes on historical metallurgy in the *Bulletin of the Canadian Institute of Mining, Metallurgy and Petroleum.* These include "Chemistry and Metallurgy in the American Indian Empire," 86:965 (1992) 103–107; "Metals in the Greek and Persian Empires," 86:969 (1993) 84–87; and "The Discovery and Industrialization of the Rare Earths," Part I, 87:976 (1994), 80–86, and Part II, 87:977 (1994), 71–76.

Habashi has now created a history of metallurgy by collating and editing sections on extractive metallurgy in the multivolume work *A History of Technology*, edited by C. Singer, E. J. Holmyard, A. R. Hall, and T. I. Williams (Oxford: Oxford University Press, 1954–58). R. J. Forbes and Cyril Stanley Smith wrote two of the metallurgy articles. Habashi wrote the introduction, with sections on Chemistry and Metallurgy Historians, Inspiration from History, the Role of Historians, and Men and Women of Science. He has also added a guide to the literature.

Roy Porter, consulting editor. *The Biographical Dictionary of Scientists.* Second edition. New York: Oxford University Press, 1994. 1024 pages. $85.00

This new edition of the *Biographical Dictionary* has expanded its coverage of scientists and engineers from 775 to over 1,200 men and women, and it includes structural formulas, explanatory diagrams, and figures of apparatus and machinery as needed. Helpful also are a 200-entry glossary and brief, but good, historical reviews of each science and of engineering and technology. The dictionary is organized alphabetically by names of scientists, but the editors are aware of the scholarly debates regarding individual versus social origins of scientific developments and seek to present lives in their historical and cultural context. The individuals' beliefs and their nonscientific interests and ventures are discussed. The work is a useful reference aid for high-school and university students, practicing scientists, libraries, and the general public.

RSC Posters and CHF Timelines

Recognizing the value of historical charts to teachers, students, and scientists trying to gain historical perspective on their current endeavors, the Chemical Heritage Foundation produced two timelines: *Electrochemistry: A Science at the Interface*, celebrating two hundred years of startling developments since Galvani, and *The First Century of Chemical Engineering*, created to commemorate the centennial of the first courses in that discipline. (Single copies of both timelines are available free from CHF).

The Royal Society of Chemistry recently launched a similar program—a series of wall charts, 64 × 90 centimeters, that map the growth of various segments of the chemical sciences. *Origins of Organic Chemistry*, by W. A. Campbell, *Chemical Atomic and Molecular Theory*, by N. G. Coley, and *Industrial Chemistry, 1800–1900*, by C. A. Russell, are already in print (Boca Raton, Fla.: CRC Press); an analytical chemistry poster will appear next. All were developed by the Graphic Design Group of Britain's Open University. The posters have a clean, uncluttered design and use color to separate and accentuate; they include photos of key actors and other pictures, diagrams, and charts. The industrial chemistry chart, neatly complementing the emphasis of CHF's timeline on the last century, puts William H. Perkin in its center column—along with the Queen Victoria penny postage stamp printed with his mauveine dye.

Other Recent Publications

Biography and Autobiography

David Cahan, editor. *Hermann von Helmholtz and the Foundations of Nineteenth-Century Science*. Berkeley: University of California, 1994.

Gotthardt Frühsorge; Gerhard F. Strasser, editors. *Johann Joachim Becher (1635–1682)*. Wiesbaden: Harassowitz Verlag, 1993.

James J. Bohning. "From Stereochemistry to Social Responsibility: The Eclectic Life of Otto Theodor Benfey." *Bulletin for the History of Chemistry* 13/14 (Winter/Spring 1992/93), 4–19.

Kenneth L. Caneva. "Robert Mayer and the Conservation of Matter." *Bulletin for the History of Chemistry* 13/14 (Winter/Spring 1992/93), 27–29.

Kozo Hirota. *The Chemist Kikunae Ikeda: Soseki, Umami, and Germany*. Tokyo, Tokyo Kagaku Dojin, 1994.

Mahlon Hoagland. *Toward the Habit of Truth: A Life in Science*. New York: Norton, 1994.

Pierre Laszlo. "Le Chatelier, 'Public Prosecutor' of Darzens." *Ambix* 41 (July 1994), 65–74.

David E. Newton. *Linus Pauling: Scientist and Advocate*. Makers of Modern Science Series, 136. New York: Facts on File, 1994.

Linus Pauling. "My First Five Years in Science." *Nature* 371:6492 (1 Sept. 1994), 10.

Jean-Pierre Poirier. "Madame Lavoisier." *L'Actualité Chimique* (March-April), 44–47.

Carole B. Shmurak. "Emma Perry Carr: The Spectrum of Life." *Ambix* 41 (July 1994), 75–86.

Hans-Werner Schütt. *Eilhard Mitscherlich: Baumeister am Fundament der Chemie*. Munich: Deutsches Museum, in Kommission bei Oldenbourg Verlag, 1992.

Chemical Industry; Chemical Engineering; Chemical Technology

Mary Ellen Bowden. "100 Years of Friendly Intercourse." *Chemistry & Industry* (3 Oct. 1994), 780–781. On SCI's American Section Centennial.

W. A. Campbell. *Industrial Chemistry, 1800–1900*. London: Royal Society of Chemistry, 1993. Distributed in North America by CRC Press, Boca Raton, Florida.

Colin Divall. "Education for Design and Production: Professional Organization, Employers, and the Study of Chemical Engineering in British Universities." *Technology & Culture* 35 (April 1994), 258–288.

Masanao Esaki. "Traditional Technology and Chemistry in Japan: History." *Kagakushi* 21 (1994), 258–277. In Japanese with English abstract.

Peter J. T. Morris; Anthony S. Travis. "The Chemical Society of London and the Dye Industry in the 1860s." *Ambix* 39 (Nov. 1992), 117–126.

Margaret Levenstein. *Price Wars and the Stability of Collusion: A Study of the Pre–World War I Bromine Industry*. Working Paper Series on Historical Factors in Long Run Growth, 50. Cambridge, Mass.: National Bureau of Economic Research, 1993.

Shizuyuki Ohta. "The History of Umami Seasonings in Japan (MSG, Guanylic Acid, and Others)." *Kagakushi* 21 (1994), 186–202. In Japanese with English abstract.

Jean-Pierre Poirier. "Lavoisier et l'industrie chimique en France." *L'Actualité Chimique* (March–April 1994), 40–43.

Leander Ricard. "A History of the Dye-Producing Industry in Rensselaer, New York." *Textile Chemist and Colorist* 26:8 (Aug. 1994), 23–26.

Anthony S. Travis. "Between Broken Root and Artificial Alizarin: Textile Arts and Manufacturers of Madder." *History & Technology* 12 (1994), 1–22.

________. "Erfinder des Regenbogens: Heinrich Caros Erbe für die Chemie synthetischer Farben." *Kultur & Technik* 2 (1994), 30–37.

________. "From Manchester to Massachusetts via Mulhouse: The Transatlantic Voyage of Aniline Black." *Technology & Culture* 35 (1994), 70–99..

Bayer's Seventy-Year Headache Ends

Bayer's aspirin cured the pains of millions, but for the German chemical giant that brought it to market it has been a seventy-year headache.

Bayer chemist Felix Hoffmann was seeking a variant of the antipyretic salicylic acid without the acid's frequent side effect of upset stomachs. He reached his goal with the acid's acetyl (CH_3CO) derivative, first synthesized by Frédéric Gerhardt in 1853 and marketed by Bayer AG in 1897. It was called *aspirin* after spiric acid, an alternate name for salicylic acid, the prefix *a* standing for *acetyl*. When the patent expired, competitors marketed the painkiller, and Bayer attempted in court to maintain that "Aspirin" was a company trademark, but lost. Nevertheless a devoted clientele continued to insist on aspirin from Bayer.

During World War I Bayer's assets in the United States were confiscated by the government, and after the war they were sold to Sterling Drug. The latter firm, as Sterling Winthrop, eventually became part of Eastman Kodak. Last August SmithKline Beecham purchased Sterling's worldwide over-the-counter (OTC) business from Eastman Kodak, and Bayer immediately sought to recapture its product lines, name, and logo. On 12 September it bought Sterling Winthrop's North American OTC assets from SmithKline for $1 billion.

Up to now Bayer has been operating in the United States through its Miles, Inc., subsidiary, based in Pittsburgh. Having reclaimed its name, its logo, and its aspirin, it will again operate under its own name. "This is a memorable event in our corporate history," proclaimed Manfred Schneider, Bayer's chairman. The long headache was over.

CONFERENCE REPORTS

ACS Meeting in Washington: On IUPAC and the News Service

Every five years the ACS manages to have a national meeting in Washington, simplifying enormously the task of moving its leaders and most of its operating staff from headquarters into a group of hotels. Last year the ACS staff already had to vacate their headquarters on 16th Street, just north of the White House, for an extended period. The venerable ACS building is being renovated to be ready for the next century.

At this meeting two organizations commemorated seventy-five years of existence: IUPAC—the International Union of Pure and Applied Chemistry—and the ACS News Service. IUPAC's celebration took the form of a symposium, at which CHF's James J. Bohning traced the Union's origins to the Karlsruhe Congress of 1860, when Cannizzaro successfully proposed a way to reach an internationally agreed-upon set of atomic weights and inspired Dmitri Mendeleev and Lothar Meyer to design their periodic tables. Bohning noted the recurring themes of the eight international chemical gatherings held before IUPAC was founded in 1919. Again and again the hope, the confidence, was expressed that chemistry transcends national boundaries and knows no frontiers, that chemical progress leads to peace and prosperity.

H. Steffen Peiser, formerly of the National Bureau of Standards and active for decades on the IUPAC Commission on Atomic Weights, described the ever-increasing precision of atomic weight determinations and their role in chemical practice. But he also noted that the mass spectrometer and similar tools can now document variations in atomic weights that depend on the geological or laboratory history of the elements studied. Our erroneous confidence in the constancy of atomic weights probably hastened early chemical progress, but ignoring their variability may be detrimental to research today. Peiser also described pivotal contributions to atomic weight determinations made by the Czech chemist Bohuslav Brauner (1855–1935), who was the first head of the subcommittee on atomic weights when IUPAC was established.

James G. Traynham, who helped organize the celebration in 1992 of the fiftieth anniversary of the Geneva system of organic nomenclature, spoke about IUPAC's seventy-five-year role in establishing acceptable names for chemical substances. The symposium was concluded by Warren A. Powell of the Chemical Abstracts Service, who explored the numerous interactions between CAS and IUPAC.

The festivities culminated in a reception, jointly hosted by IUPAC and ACS in the Great Hall of the National Academy of Sciences, to honor Glenn T. Seaborg, who has been associated with IUPAC for fifty years. At the ACS meeting in spring 1994 seaborgium (Sg) was officially proposed as the name for element 106. Seaborg was codiscoverer of ten transuranic elements, including americium (95), californium (98), and berkelium (97). Naming element 106 seaborgium seems a logical extension of that series of names. It creates a precedent, however, since no other element has been officially named for a living person. IUPAC makes the final decision. (IUPAC did not like the precedent, engendering a major controversy.)

Also commemorating IUPAC's anniversary is *History of IUPAC, 1919–1987,* by Roger Fennell (Blackwell Science, 1994). Its 354 pages discuss IUPAC's numerous sections, commissions, and activities and contain pictures of many of its presidents and officers. CHF is affiliated with IUPAC and is preserving some of its archives.

The ACS News Service held a luncheon to celebrate its seventy-fifth year. It was founded in 1919, after years of frustration at the inaccurate and hence misleading coverage of the chemical sciences in newspapers. The head of the News Service for twenty-five years (1923–1947), James Brady, honed the organization's operating principles: not to create publicity for ACS but to assist journalists with their difficult task of interpreting chemical developments and achievements to the public. Victor Cohn, the distinguished science writer of the *Washington Post,* who was born the year the News Service was founded, surveyed its work and the significant aid it has provided as science writers have tried to explain myriad chemical innovations from synthetic dyes and nylon to transuranic elements, tetracycline, silicon chips, and biotechnology.

Marston T. Bogert (ACS president 1907–1908) was the sixth president of IUPAC (and the first from the United States) during 1938–47—the longest tenure in IUPAC history. In January 1940 he appealed for continued international contact and cooperation among chemists despite the war.

Chemistry as Rubbish

In 1980 the more or less complete, if broken, equipment of a sixteenth-century metallurgical and pharmaceutical laboratory was discovered below a sunken floor in the former chapel of the Castle Oberstockstall in the village of Kirchberg am Wagram in Lower Austria. At a meeting on archaeology and the history of chemistry, the Society for the History of Alchemy and Chemistry heard a firsthand account of the excavation of this "alchemical laboratory" from R. Werner Soukup, an inorganic chemist and historian from the Technical University at Vienna. In a fascinating illustrated lecture Soukup showed how the excavated ceramic and glass alembics, aludels, cucurbits, distillation columns, crucibles, cupels, and metal utensils exactly matched the apparatus illustrated in the technological manuals of Georgius Agricola and Vannoccio Biringuccio, leading to the team's conclusion, also documented from local archives, that Oberstockstall had been an assay office and pharmacy. The reasons for its sudden closure and the burial of its contents remain unknown. Visitors to Austria can see an exhibition of the recovered apparatus in the Altes Rathaus, Kirchberg am Wagram, but should inquire ahead concerning the restricted opening times.

Continued on next page

CONFERENCES—*continued*

Another fruitful rubbish pit was described by Brian Moffat (University of Portsmouth), the director of the Soutra Hospital Research Project (SHARP). Soutra was a large and important Augustinian hospital (fl. 1190–1460) majestically situated a hundred feet above sea level on the main military road between England and Scotland, a few miles south of Edinburgh. Analyses of medical waste pits here have revealed large traces of blood (from bloodletting), enhanced levels of lead, and the remains of plants such as hemlock and henbane (used as anesthetics), ergots (for use in childbirth and abortion), and tormentil (used for deworming patients), as well as fragments of amputated bone and surgical instruments. The project is throwing considerable light on surgical and therapeutic practice in an early hospital, and drug companies have already shown interest in aspects of the herbal pharmacopoeia that is being revealed. For further information on SHARP's research reports and on site visits, write to Brian Moffat, 5 Fala Village, Pathead, Midlothian EH3T 5SY, Scotland.

A paper by A. M. Pollard (University of Bradford) examined the question of thermodynamic control in the early development of brassmaking, and Norman Redhead (Greater Manchester Archaeological Unit) spoke on the field evidence for medieval iron smelting in the Castleshaw Valley in Lancashire.

All four presentations demonstrated the value of applying archaeometric methods to gain detailed information about the processes used in early technical and pharmaceutical chemistry. The results suggest that there is still much to be learned about applied chemistry in the period before industrialization.

WILLIAM H. BROCK
University of Leicester

CHF Gillray Etchings at Priestley Commemoration

The exhibit "Joseph Priestley in America, 1794–1804" was held at Dickinson College in Carlisle, Pennsylvania, to celebrate the bicentennial of Priestley's arrival on this continent. CHF's collection of cartoon etchings of Priestley by James Gillray and others, donated to the foundation by Derek A. Davenport, was prominently displayed. An illustrated booklet of the same title accompanied the exhibit. Edited by Peter M. Lukehart, it contains articles on Priestley's religion, by Clarke Garrett; on his scientific virtuosity, by E. Robert Paul; on reconstructing the man through portraits and caricatures, by Valerie A. Livingston; on the Priestley House, by William N. Richardson; and on the college's Priestley collection, by Lukehart.

Founders of the Hudson River Aniline Color Works, about 1875. Front row, center: William Loesser. Back row, left: William Smith; center: Hermann Preiss. The others are unidentified.

RENSSELAER DYES—*from page 9*

chemistry in Germany in 1881. Another was William Loesser from England.

Albany Aniline prospered and manufactured such products as magenta, aniline oil, toluidine, dimethylaniline, methyl violet, fuchsine, rosaniline blue, malachite green, nigrosine, and the alkali and soluble blues. Loesser, however, was denied a promised partnership and therefore resigned. With financial support from an Albany stockholder, Louis Waldmann, and chemical support from Friedrich Bayer and Company of Germany, he and Preiss founded the Hudson River Aniline Color Works as an independent company in 1882, with Waldmann as president.

The Birth of the Rensselaer Plant

Plant construction for the Hudson River Works began on 10 February 1882 in the village of Greenbush—or Rensselaer, as it is now called. With ten employees the plant made its first batch of fuchsine on 1 July 1882 and its first of aniline blue two weeks later.

When the U.S. Tariff Act of 1883 lowered the very high tariff wall around the coal-tar dye industry, flooding the country with imports, many U.S. companies failed, but Hudson River Aniline Color Works survived, along with Albany Aniline. Other survivors were the Schoellkopf Aniline and Chemical Company in Buffalo, New York, and Heller and Merz Company, Newark, New Jersey. But because of poor sales, Albany Aniline soon faced financial problems. In 1884 the mortgage was foreclosed, and young Hendrick resigned. A bondholders committee took over the plant, reorganized it, and let most of its chemists go—thereby laying the groundwork for the ultimate closing of the Albany Aniline and Chemical Company in the early 1890s.

Growth Followed by Fire

From 1885 to 1895 Hudson River Aniline's product line was expanded and the poundage increased. In 1895 its Color Works burned to the ground. The directors immediately rebuilt on a large scale. In the meantime, dyes needed to continue sales were imported or supplied by the Schoellkopf Company in nearby Buffalo. The plant was soon operating again, this time with fifty men. Production increased from 40,000 pounds in 1897 to 440,000 pounds in 1903.

Apparently an agreement existed between Bayer and Hudson River Aniline which limited Hudson's production to dyes used mostly in the paper and leather trades. In return, Bayer put its distributing agency at the disposal of Hudson River Aniline. Accordingly, no textile dyes were produced at the Rensselaer plant. This agreement was not to the liking of some of the directors of the Rensselaer company, and in 1898 Waldmann organized a rival, the American Color and Chemical Company. The dissenters acquired land at Westerlo Island and built a plant there. The president of this new organization was again Waldmann, Loesser apparently not being interested. Other organizers were Martin Waldstein of New York and Friedrich E. Atteaux, a Boston importer and dealer in dyes. The dyes produced were mostly for the textile trade and sold through jobbers. Although the company prospered, a price war, increasing competition, and a small plant fire made dye manufacturing less and less attractive. Facing financial problems, the company was liquidated in 1903.

The Hudson River Aniline Works continued to make dyes, and productivity increased from 471,000 pounds in 1904 to 532,000 pounds in 1907. Moreover, since Bayer was already well established in the field of pharmaceuticals, facilities for making aspirin, phenacetin, and other pharmaceuticals were erected at Rensselaer in 1905.

The War Years

In 1910 the name "Hudson River Aniline Color Works" was abandoned and the name was changed to "Farbenfabriken of Elberfeld Company" which again gave way to "The Bayer Company" in 1913. When World War I broke out the following year, there were only seven plants in the United States for the manufacture of coal-tar dyes, and these made only a portion of what was used. Of these, the Bayer Company ranked third in production. When Great Britain blockaded Germany, the United States faced an acute shortage of dyes. Although occasional shipments were made via Holland or by spectacular voyages of the submarine *Deutschland*, these hardly fulfilled the demand. Consequently, existing plants were expanded, and new companies, large and small, were founded all over the country. In 1917 an ice plant and a filter plant were built at Rensselaer, mainly to manufacture wool green, the first of a line of triphenyl methane dyes. When war was declared with Germany, the U.S. government took over the Rensselaer plant and through its Alien Property Custodian sold it and all its rights and patents at public auction to Sterling Products in 1917. Sterling, interested only in the pharmaceutical business, resold the dye business to the Grasselli Chemical Company of Cleveland, Ohio. The Rensselaer plant now became the Grasselli Chemical Company, Dyestuff Division, and strengthened its position by producing many more intermediates.

Rensselaer-Albany Area Dye Companies

1868	Albany Aniline and Chemical Company
1882	Hudson River Aniline Color Works
1898	American Color and Chemical Company
1910	Farbenfabriken of Elberfeld Company
1913	The Bayer Company
1917	The Grasselli Chemical Company
1924	The Grasselli Dyestuff Corporation
1928	General Aniline Works
1929	American I.G. Chemical Corporation
1939	Rensselaer Division of General Aniline and Film Corporation
1968	Rensselaer Division of the GAF Corporation
1978	Rensselaer Works, BASF Corporation

A view of the Rensselaer plant about 1924, when the Bayer Company signed an agreement with the Grasselli Chemical Company. Courtesy Miles, Inc.

When dye prices dropped from their fantastic height in 1918, however, the Rensselaer plant became a burden to Grasselli. The depression of 1921 accentuated the situation. It soon became clear that the manufacture of dyes was a highly specialized art and that a closer contact with an experienced organization was necessary. Negotiations with Bayer took place in 1924, and the Grasselli Dyestuff Corporation was formed. In 1926 H. Grimmel was sent over to replace the earlier manager of the Rensselaer plant, E. von Salis. In 1927 the plant became the first in this country to manufacture solid diazo salts.

IG Farben, World War II, and the Present

Grasselli continued to operate under that name until 1928, when IG Farben assumed complete control and changed the name to General Aniline Works, Inc. In 1939 the company became General Aniline and Film Corporation, or GAF. During the period 1941–1965 GAF was controlled by the Alien Property Custodian. Swiss banking interests repeatedly attempted to secure control of the company, arguing that the company was never owned by IG Farben. They were unsuccessful in their attempts, and in 1965 GAF went public. In 1978 GAF divested itself of its photo, dyes, and felt divisions and therefore offered Rensselaer for sale. The plant was sold to BASF Wyandotte Corporation, which operates it today as the Rensselaer Works of BASF.

Dyes predate the dawn of civilization. Human beings have long produced color for garments, whether animal skins or homespuns, utilizing natural earth pigments, extracts of wood, bark, roots or leaves, vegetables or berry juices, and in some areas of the world, natural indigo. Perkin's discovery of mauve, the first synthetic dye, in 1856 resulted in an industry that now produces some 22,000 dyes. From this beginning, the world of synthetic organic chemistry evolved. The Rensselaer-Albany area industries were a vital part of this evolution from 1868 on.

LEANDER RICARD
East Greenbush, New York

A fuller description of Rensselaer's dye history can be found in the author's article in Textile Chemist and Colorist *26:8 (August 1994), 23–26.*

CHF PUBLICATIONS

A Guide to the Human Genome Project:

Technologies, People, and Information

Compiled by Susan L. Speaker & M. Susan Lindee, with Elizabeth Hansen

This simple, concise introduction to the HGP for the general reader explores the origins of the genome project and reactions in the scientific community; important technologies and techniques; institutions connected with the HGP, including designated genome centers, important suppliers of resources, and corporations; systems of communication; and ethical, legal, and social issues.A publication of the Beckman Center BIMOSI project.

1993. 40pp. Illus. apps; glossary, bibl, time-line.
Paper, 8 1/2 x 11, ISBN 0-941901-10-6. **$15.00**
($10.00 each for 10 or more copies)

From Vital Force to Structural Formulas

O. Theodor Benfey

"An in-depth treatment of the development of structural organic chemistry that features translated excerpts from the original literature." –*Journal of Chemical Education*

1964; rprt 1992. xii + 116 pp, figs; index, bibl.
Paper, 6 x 9, ISBN 0-941901-09-2. **$15.00**

Classics in the Theory of Chemical Combination

Edited by O. Theodor Benfey

Original papers by Wöhler, Liebig, Laurent, Williamson, Frankland, Kekulé, Couper, van't Hoff, and Le Bel. Intro, notes, epilogue. "More than a collection of classic masterpieces. Some will consider it to be a masterpiece itself." –*Journal of Chemical Education*

1981. xii + 192 pp, 9 illus, index.
Cloth, 6 x 9, ISBN 0-89874-368-0. **$20.00**

Polymer Pioneers:

A Popular History of the Science and Technology of Large Molecules

Peter J. T. Morris

An overview and biographical sketches of twelve pioneers.

1986. 88 pp, 80 illus, bibl. Paper, 7 x 9
ISBN 0-941901-03-3. **$10.00**
($8.00 each for 10 or more copies)

Guide to Archives

and Manuscript Collections in the History of Chemistry and Chemical Technology

Compiled by George Tselos & Colleen Wickey

An exhaustive inventory of resources in the United States.

1986. viii + 198 pp, 14 illus, indexes.
Paper, 8 1/2 x 11, ISBN 0-941901-05-X. **$10.00**

Corporate History and the Chemical Industries:

A Resource Guide

Edited by Jeffrey L. Sturchio

Essays and extensive annotated bibl.

1985. ii + 54 pp; 12 illus. Paper, 5 3/4 x 8 3/4
ISBN 0-941901-02-5. **$10.00**

Copublished with ACS

Nobel Laureates in Chemistry, 1901–1992

Edited by Laylin K. James
History of Modern Chemical Sciences Series; Jeffrey L. Sturchio, Series Editor.

An authoritative and informative volume that examines the scientific achievements in chemistry for which the Nobel Prize has been awarded.

1993. 650 pp. Cloth, ISBN 0-8412-2459-5 **$69.95**
Paper, ISBN 0-8412-2690-3 **$34.95**

Exhibit Booklets

Paper, profuse illus, bibl. $5.00 each
$4.00 apiece for ten or more.

Robert Burns Woodward

and the Art of Organic Synthesis

Mary Ellen Bowden & Theodor Benfey

"A multifaceted portrait of an extraordinary human being, teacher, and consummate organic chemist." –*Journal of Chemical Education*

1992. 48 pp, 8 1/2 x 9 1/2, ISBN 0-941901-08-4.

Structures of Life

Basil Achilladelis & Mary Ellen Bowden

How instrumentation has aided the merging of chemistry and biology in the new science of molecular biology.

1989. 36 pp, 8 1/2 x 7 1/2, ISBN 0-941901-07-6.

Polymers & People:

An Informal History

Eric Elliot

The people who developed plastics, rubbers, and resins; how these polymers are made; their increasing role in our future

1986. 32 pp, 8 1/2 x 7 3/4, ISBN 0-941901-04-1.

Scaling Up:

Science, Engineering, and the American Chemical Industry

John A. Heitmann & David J. Rhees

A tribute to the engineers who transformed laboratory reactions into large production facilities.

1984. 25 pp, 8 1/2 x 7 3/4 , ISBN 0-941901-01-7.

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NEWS from the Arnold and Mabel Beckman Center for the History of Chemistry

The Beckman Center is sponsored by the Chemical Heritage Foundation and the University of Pennsylvania. The Center is an academic unit of Penn, working closely with the Department of History and Sociology of Science and with the Departments of Chemistry, Chemical Engineering, and Biochemistry and the Laboratory for Research on the Structure of Matter. The Center's mission is to undertake scholarly research, publish materials on the history of the chemical sciences, support senior-level and graduate fellowships, and conduct a variety of scholarly events of interest to the academic community.

Conversazione

John H. Sinfelt Improves Catalysts

Catalysis has dominated the professional life of John H. Sinfelt, now Senior Scientific Adviser at Exxon Research and Engineering Company. At a CHF Conversazione he told of his early education in a two-room school house, his particular enjoyment of mathematics and Latin in high school, his university training at the University of Illinois, where Roger Adams still presided, and the job he found at Exxon (then Standard Oil of Ohio) when he graduated from college. He has stayed at Exxon ever since, focusing on improving catalysts.

A detailed study of catalyst structures led Sinfelt to explore bimetallic clusters. One of these, a platinum-iridium catalyst, rearranged petroleum molecules so successfully that the resulting high-octane gasoline could be used without lead additives. His work helped reduce urban air pollution significantly and increased fuel efficiency.

Sinfelt has been a guest lecturer at many universities, and in the second part of his CHF talk he gave his audience a historical overview of chemical catalysis, beginning with J. J. Berzelius, who first recognized the phenomenon and coined the term *catalysis*. He described the contributions of Wilhelm Ostwald and Paul Sabatier and showed how Irving Langmuir's detailed studies at General Electric of the chemical processes occurring at catalyst surfaces led Exxon to support Sinfelt's own investigations, which culminated in the discovery of the platinum-iridium catalyst.

A Milestone for the BIMOSI Project

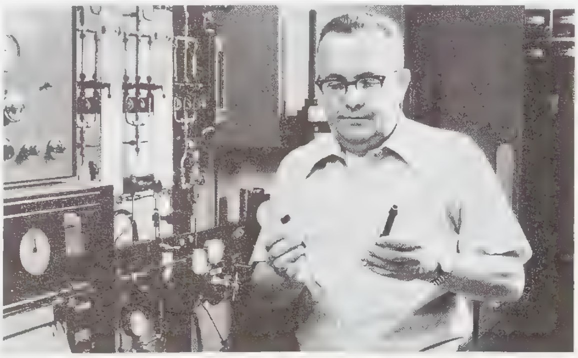
The Beckman Center's Biomolecular Sciences Initiative (BIMOSI) has reached a major milestone. BIMOSI's mission is to document what may constitute a revolution in the making: the contemporary history of the biomolecular sciences, including biochemistry, molecular biology, and biotechnology.

To properly record history in the making requires active intervention. *Chemical Heritage* reported in the last issue (12:1) that nearly 500 biomolecular science pioneers were being surveyed about the status of their personal, professional, and research papers. BIMOSI Project Archivist Tim Kernan reports that by the end of 1994 all follow-up activities were completed and the responses tallied. The responses were inspiring, in both quantity and quality. By press time, 284 (57%) surveys were returned, of which 108 (38%) requested CHF's assistance with placing papers in an appropriate repository. While the number of requests for assistance far exceeded expectations, even more significant are the scientific achievement and resulting notability of this group, which includes five Nobel Prize winners: in chemistry, Thomas Cech (1989); in physiology or medicine, Baruch Blumberg (1976), Michael Brown (1985), Jean Dausset (1980), and Phillip Sharp (1993).

This quality characterized those respondents also who have already made plans for their papers. These include the following Nobel laureates ("estate" denotes those whose estate responded): in chemistry, Linus Pauling (estate), Frederick Sanger, Melvin Calvin, Sir John Kendrew, Christian B. Anfinsen, Sidney Altman, and Elias J. Corey; in physiology or medicine, Joshua Lederberg, Severo Ochoa (estate), Arthur Kornberg, James D. Watson, Konrad Bloch, George Wald, Christian de Duve, David Baltimore, Renato Dulbecco, Howard Martin Temin (estate), Daniel Nathans, Hamilton O. Smith, Werner Arber, Baruj Benacerraf, and E. Donnall Thomas.

Several influential figures have written Kernan to encourage his efforts, among them John T. Edsall of Harvard, who supervised a survey of archived biochemistry and molecular biology collections in the mid 1970s; Leroy Hood, now at the University of Washington School of Medicine, whose lab at Caltech played a major role in DNA sequencing for the Human Genome Project; Britton Chance, a noted biophysical chemist at the University of Pennsylvania; and two more Nobel Prize winners: Christian de Duve of the Institute of Cellular and Molecular Pathology in Brussels; and Frederick Robbins of Case Western Reserve School of Medicine.

BIMOSI is now contacting those scientists who requested assistance to determine the size, scope, and content of their collections and to identify appropriate archival repositories. And as *Chemical Heritage* went to press, the National Historical Publications and Records Commission (the funding arm of the National Archives) notified CHF of a two-year grant to continue the project. One priority is to produce a guide to the collections we are able to place.



John Sinfelt studies catalysis at Exxon. Courtesy John H. Sinfelt.

CHF researchers from around the globe: Michael Chayut of Israel, Edelstein Student Pap NDiaye of Paris, and Edelstein Fellow Mi Gyung Kim of Seoul, Korea.

Brown-Bag Luncheons

CHF International

Many a day last fall three young researchers from very different parts of the world could be seen in CHF vigorously debating recent interpretations of events in chemistry and technology. They each shared their latest findings with the wider community during a brown-bag lunch presentation.

A theoretical chemist turned historian of science, Michael Chayut of Tel Aviv, Israel, raised the query "What can we do with Paul Flory?" He has concluded that a conventional biography of the Nobel laureate and former DuPont associate of Wallace Carothers would shortchange the man, not doing justice to the most intriguing issues his life raises—such as the value to scientists trained in one field of finding themselves in a quite different one, not clearly defined, at the periphery of knowledge. Flory is not the only example showing the powerful stimulus of such an environment.

Edelstein International Student Pap NDiaye spoke about his doctoral dissertation, which he will submit to the Ecole des Hautes Etudes en Sciences Sociales in Paris. His work concerns the change in "corporate culture" of chemical industry giants as they confronted the demands of World War II. He chose DuPont as a revealing example.

Before the war DuPont championed free enterprise. The Du Pont family opposed the New Deal, and several family members strongly supported such organizations as the American Liberty League to oppose Roosevelt's reforms. But the same company—and its chemical engineers, who converted the laboratory wonder of nylon into a commercial blockbuster—a few years later produced plutonium for the U.S. Government, creating plants in Hanford, Washington, and Savannah River, South Carolina.

Nylon was promoted as demonstrating that free enterprise can produce better things for better living without aid from New Dealers. Yet during World War II, executives at DuPont and in many other industries discovered not only that it was possible to work with the government but that it even had advantages. Government, rather than being merely a client and consumer, became a partner. The experience produced a new type of executive, comfortable both in government and in the private sphere. Crawford H. Greenewalt and Glenn T. Seaborg both came out of the Manhattan Project, the former ending his career as DuPont president, the latter, a Berkeley professor and Nobel Laureate, becoming chairman of the U.S. Atomic Energy Commission.

In her brown-bag presention, "Chemical Affinities: Measurements and Concepts," Mi Gyung Kim focused on a concept that raises a fundamental question about the status of chemistry. The CHF 1994–1995 Edelstein Fellow asked whether chemistry, a less-quantitative discipline than physics, is doomed to be absorbed by the latter? Or is chemistry perhaps the more profound, being closer to nature? After all, it was chemistry that established the laboratory—experimental manipulation and observation—in the sciences.

Classical physics knew of the universal attraction of everything for everything—gravity. Chemistry, on the other hand, sought to understand specific attractions—of copper for sulfur, of oxygen for iron but not for gold, and so on. What is the clue to "chemical affinity," substance-specific elective attractions between pairs of substances? It was a quest that absorbed nineteenth-century chemists, and "affinity" was redefined as the measuring process changed. Kim outlined the changing fate of the concept as methods changed from gravimetric—involving equivalent weight and valence—to thermometric—when heats of reaction were hoped to be a measure of chemical affinity—to electrochemical reactions—through which free energy values could be assigned to individual substances. In our century the concept of chemical affinity continues to remain elusive, awaiting perhaps another experimental metamorphosis.

AATCC: Of Wrinkled Cloth and Visionary Dyers

At a CHF brown-bag luncheon Mark Clark sketched the origins of the American Association of Textile Chemists and Colorists, whose history he is writing. The book, together with a collection of oral histories, is to be completed in time for AATCC's seventy-fifth birthday celebration in 1996.

AATCC was organized in 1921, following the explosive growth experienced by the American dye industry as German supplies were cut off in World War I. Its founding president was Louis A. Olney (see this journal, 9:1 [Spring 1992], B-7), and its historian and one of its guiding spirits for many years was Sidney Edelstein.

Clark emphasized that AATCC is a professional organization of practicing textile dyers, finishers, chemists, and executives, dedicated to fostering knowledge of the application of dyes and chemicals in the textile industry. A major function of the group is to develop reliable test methods for standardizing textile quality and dyeing performance. One method assays the wrinkledness of cloth.

AATCC developed in two directions. Its national meetings, planned by its national leaders and held in large cities, focused on scientific advances, and its journal *Textile Chemist and Colorist* published laboratory findings. Local and regional meetings by contrast were more often held in resort areas, encouraging socializing and relaxation. These meetings emphasized business concerns.

Fortunately for those interested in the dyer's heritage, one AATCC member was a scientist and executive with a profound historical sense. He sought the background of the dyer's art, recorded its development, and through his generosity encouraged others to develop a historical sense and share their findings. Sidney M. Edelstein, whose recent death we mourn, stands as a pillar of AATCC and of its historical awareness.

News from South Africa

Michael Laing—inorganic chemist, UCLA Ph.D., and professor at the University of Natal in Durban, South Africa—stopped by at CHF on his way home from western Pennsylvania, where he had attended the ACS Chemical Education conference and the Priestley celebrations held at Bucknell University and in Northumberland (see *Chemical Heritage* 12:1 [Winter 1994–1995], 27). At a brown-bag luncheon he spoke of the monumental task of integrating and modernizing educational systems currently run by three provincial ministries, black, Indian, and white, operating from different cities. Yet many a school in Durban has for years had white, black, and Indian students. Laing also discussed the challenges that face a center on his campus charged with upgrading black high-school science teachers for a post-apartheid society.

William Cole, Bibliophile and Scholar

William A. Cole of Issaquah, Washington, who came to examine some of our early editions in the Othmer Library, gave a brown-bag luncheon talk on how he became a collector. He began by gathering books generally, then narrowed his search to the physical sciences, then to chemistry, and finally to its eighteenth-century volumes. He found a rare Lavoisier item for which he paid $11, and a Guyton de Morveau first edition that included the author's inserted notes for the second edition.

Cole taught high school for twenty-seven years, started collecting in 1950, and has compiled a detailed bibliography of his holdings. He sold a third of his books to the University of Wisconsin to join the Denis Duveen Collection, sold another third to the Huntingdon Library—and still he collects.

Other Visitors

■ Andrew Miller, editor of the Society of Chemical Industry's London-based magazine *Chemistry and Industry*, dropped in to learn of CHF activities and to discuss common interests. After Mary Ellen Bowden told him of her work on *American Chemical Enterprise*, the volume celebrating the centennial of SCI's American Section, Miller asked her to write a story on the section. That article, "100 Years of Friendly Intercourse," appeared in *Chemistry and Industry* (3 Oct., pp. 780–781), coinciding with the centennial celebration.

■ For information on women and ethnic minorities in the chemical sciences two researchers from California, Patricia L. Perez of Mt. San Antonio College and Janan Hayes of Merced College, found help in the Othmer Library. They are compiling bibliographic information for a curriculum development project partially funded by the National Science Foundation. They will then create replacement units featuring the contributions of women and minorities, which teachers may use as alternative examples in their introductory chemistry courses.

O. A. Battista has found numerous uses for microcrystalline cellulose, including weight-arrest Expantabs™, before-meal expandable diet tablets that allow you to "eat what you enjoy, but less." In simulated gastric juice, left, the tablets expand to fifteen times their volume.

THE ULLYOT LECTURE

"Uphill All the Way" with O. A. Battista

"If we can learn to train the eye and the brain to harmonize, important new discoveries can sometimes be created that more complex attention will miss." Thus Orlando Aloysius Battista sums up his reflections on his life, which he presented in his Ullyot Public Affairs Lecture, "Uphill All the Way." That uphill path became possible through detours "involving 'mini-second connections' that my brain and eye saw but many others did not see."

The holder of numerous patents in the field of microcrystalline cellulose and other polymers that created countless jobs (e.g., man-made ivory, disposable protein contact lenses, protein wound and burn dressings), and author of over 1,000 published articles and 23 books, Battista has received five ACS gold medal awards (among them its award for creative invention) as well as the James T. Grady Award for interpreting chemistry for the public. In 1965–69 he wrote a series of articles on frontier chemistry developments for *Chemistry*, the ACS magazine for high school students and their teachers, with such tantalizing titles as "Titanium, the Cinderella of Metals." He also wrote *The Challenge of Chemistry* for high school students, a best-seller that went through eight printings.

Battista began his chemical education at McGill University. Associated for many years with FMC Corporation, he now heads the O. A. Battista Research Institute. Asserting that humans at best use only one percent of their brain power, he challenged his audience to start exercising the remaining 99 percent.

Glenn E. Ullyot, long associated with SmithKline Laboratories, established the lectureship to bring to public attention the impressive positive contributions of the chemical sciences, often overlooked in the media. The lecture is sponsored by the Philadelphia and Delaware sections of ACS, the University of Pennsylvania, the Philadelphia College of Pharmacy and Science, and CHF.

CHF Exhibits on the Road: 1995

Our traveling exhibits are becoming widely known, and reservations need to be made early. The only cost is that of return shipping. Write to Exhibits at the Chemical Heritage Foundation.

Exhibit itineraries for 1995 are as follows:

Structures of Life

1 October–31 October: University of Wisconsin, West Bend, Wisconsin.
7 November–15 December: Clemson University, Clemson, South Carolina.

Woodward and the Art of Organic Synthesis

1 May–15 June: Louisiana Arts and Science Center, Baton Rouge, Louisiana.
1–31 July: The Royal Society of Chemistry, London, England.
1 September–23 October, Auburn University, Auburn, Alabama.
1–30 November, Cameron University, Lawton, Oklahoma.

CHF's 1995 Chemical Dateline

As in the past, we ask our readers to send us important events (and their sources) in their areas of expertise which we overlooked in this dateline, for publication in our winter issue. Even more we need information for compiling our next dateline, for 1996, and eagerly await your help. Information on significant anniversaries in chemical engineering and the chemical process industries will be especially welcome. Our thanks to William H. Brock, Yasu Furukawa, Leopold May, and Christoph Meinel for information for the present dateline.

350 YEARS AGO

1645

11 November:
Nicolas Lémery, author of *Cours de Chymie,* is born.

300 YEARS AGO

1695

Nehemiah Grew finds Epsom salts in spring water.

8 June:
Christian Huygens, who developed the wave theory of light and studied light polarization, dies.

250 YEARS AGO

1745

18 February:
Alessandro Volta, inventor of the electrophorus and the voltaic pile, is born.

24 December:
Benjamin Rush, signer of the Declaration of Independence and author of an early American chemistry textbook, is born.

200 YEARS AGO

1795

3 January:
Josiah Wedgwood, pioneer potter and glazer, is born.

8 February:
Friedlieb F. Runge, discoverer (in 1834) of carbolic acid (phenol) and aniline in coal tar, is born.

7 April:
France institutes the metric decimal system and establishes its nomenclature.

20 July:
James Woodhouse is elected Professor of "Chymistry" at the University of Pennsylvania.

150 YEARS AGO

1845

The Royal College of Chemistry is founded in London.

Christian F. Schönbein discovers guncotton.

Hermann Kolbe publishes total synthesis of acetic acid.

Scientific American begins publication.

21 January:
Edward Mallinckrodt, founder of Mallinckrodt Chemical Works, is born.

13 March:
John Frederic Daniell, famous for his zinc-copper battery, dies.

27 March:
Wilhelm Konrad Röntgen, discoverer of X rays, is born.

28 October:
Zygmunt F. von Wròblewski, first person to liquefy air on a large scale, is born.

30 November:
Nils Gabriel Sefström, discoverer of vanadium, dies.

100 YEARS AGO

1895

William Crookes identifies a new gas (isolated from air by William Ramsay) as helium, discovered in the sun by Norman Lockyer in 1868.

Wilhelm Konrad Röntgen discovers X rays.

Karl von Linde constructs equipment by which air can be liquefied on a commercial scale.

11 April:
Julius Lothar Meyer, known for his periodic table and atomic volume curve, dies.

3 May:
Herman F. Mark, a pioneer in polymer chemistry, is born.

12 May:
William F. Giauque, a future Nobel laureate (for his studies in thermodynamics), is born.

8 July:
Johann Joseph Loschmidt, known for the Loschmidt number (the number of molecules in a cubic centimeter of gas) and for the graphic formulas he published in 1861 of several hundred organic compounds, dies.

10 August:
Felix Hoppe-Seyler, a leader in the study of blood and metabolism and founder of *Zeitschrift für Physiologische Chemie,* dies.
Morris S. Kharasch, known for synthetic applications of free radical chemistry, is born.

28 September:
Louis Pasteur, a pioneer of sterochemistry who also found a cure for rabies and saved the French silk industry from silkworm disease, dies.

30 October:
Gerhard Domagk, discoverer of prontosil (a precursor of sulfanilamide) but denied the 1939 Nobel Prize by order of the German government, is born.

75 YEARS AGO

1920

Tennessee Eastman Corporation is founded in Kingsport, Tennessee.

50 YEARS AGO

1945

J. A. Marinsky, L. E. Glendenin, and C. D. Coryell discover promethium (Pm, element 61).

The first National Plastics Exposition is held, in New York City.

Richard Angell, Jr., invents the structural-foam molding press.

Thermoplastic polyester is introduced commercially.

Penicillin becomes available commercially.

16 July:
The first atomic bomb explodes at Trinity Site, Alamogordo Air Force Base, New Mexico.

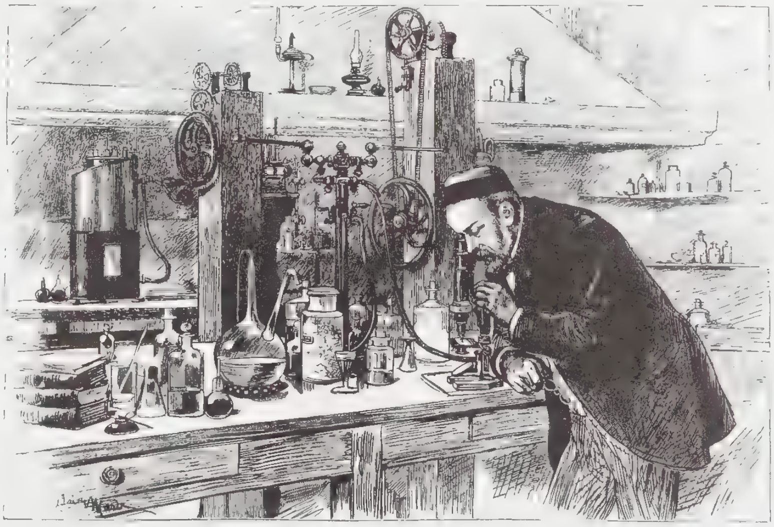
13 September:
B. B. Cunningham and **L. B. Werner** isolate the first microscopic amount of a compound of americium (Am, element 95) at the Wartime Metallurgical Laboratory, University of Chicago.

15 September:
Richard Friedrich Johannes Pfeiffer, who studied osmotic pressure across membranes, dies.

24 September:
Hans Geiger, Rutherford's collaborator and co-creator of the Geiger-Müller counter, dies.

11 November:
Glenn T. Seaborg announces the discovery of americium and curium (Cm, element 96) on the Quiz Kids radio program.

20 November:
Francis William Aston, who created the mass spectrograph and showed that neon was a mixture of Ne-20 and Ne-22, dies.



Louis Pasteur in his laboratory, as depicted in the London Graphic *in 1895. This year is again the "Year of Pasteur" (see facing page).*

BEHOLDER'S EYE—*from page 1*

French company has resorted to using the slogan "Masters of Matter."

Beyond side-stepping a crisis of public image, these phrases describe concisely and accurately how creative chemists use atomic attachments to manipulate molecules and so perfect their final products. Many such chemists received awards from the Society of Chemical Industry (American Section). Their collective accomplishments are celebrated in CHF's most recent publication, *American Chemical Enterprise*, by Mary Ellen Bowden and John Kenly Smith.

The Perkin Medal, first awarded in 1906, recognizes American chemists who have done valuable work in applied chemistry. To complement the Perkin Medal, the Society began issuing the Chemical Industry Medal in 1933, to honor those who have given "conspicuous service" to applied chemistry. It was this engaging juxtaposition of the masters and the managers of matter that led to the concept of interviewing the living recipients of both medals, to collect information about the nature of chemical invention, discovery, and creativity in an industrial setting. Would it be possible to define chemical innovation by listening to chemical innovators?

Thanks to the efforts of Harold A. (Hal) Sorgenti, chairman of SCI's American Section, and to the generous response of SCI's member companies, CHF has been able to launch an "oral history of innovation." An intensive round of interviews with more than twenty-five Perkin and Chemical Industry medalists has resulted in more than seventy-five hours of audio tape, now being transcribed and edited. The interviewees were always cordial and cooperative, sometimes candid or cautious, but never at a loss for words.

On the back cover of DuPont's 1993 annual report, a research scientist says proudly, "Good ideas, great ideas, happen at DuPont. What fascinates me are the possibilities." But good ideas and great possibilities are not enough. "You have to kiss a lot of frogs before you find a prince," according to the folklore at 3M. There aren't too many chemical princes among all those laboratory frogs; a nylon or a Teflon appears much less often on the market hit list than a product like Corfam, let alone those that languish and die on the laboratory floor.

The hockey player Wayne Gretsky ascribed his success to skating not to where the puck is, but to where it is going to be. Anticipation is but one segment of the innovation process, according to George H. Heilmeier, president of Bellcore and one of the inventors of LCD (liquid-crystal display) technology. He maintains that knowledge, skill, practice, experience, the courage to act, support, time, and luck were all involved in the innovative process in which he participated. Some of these ingredients—knowledge, skill, practice, and experience—seem obvious. Another, the courage to act, is a bold assertion that innovation does not belong to the timid. Support means the appropriate financial backing, but it also includes such intangibles as encouragement and guidance. Finally, we should not overlook the last element, never quantified, highly respected, and sometimes feared for its absence—luck.

Clearly, innovation as a concept cannot be defined in a simple fashion, though studies of it flourish in the business community. The hope is that if patterns of successful innovation were understood, they could be applied to new circumstances to generate new achievements. Some such hope no doubt lay behind a management directive to one Perkin medalist, who was not allowed to follow up his major discovery by participating in its development and commercialization, but was instead directed to return to the laboratory and create another major discovery. Yet such singular and spectacular events occur once in a lifetime at best, and then for only a minority of the research establishment.

Crawford Greenewalt, president of DuPont, when he won the Chemical Industry Medal of the American Section of the Society of Chemical Industry in 1952.

The SCI oral history interviews have focused on chemical innovation as experienced and interpreted by these medalists. How many frogs did they kiss before they found a prince? What factors contributed to their success and how did they relate to management objectives? The long careers of most of these individuals furnish a unique vista for the retrospective analysis of changes in research support, management attitudes, and success and failure factors. These varying agendas have been explored in some detail.

The first person interviewed was Vladimir Haensel, professor of chemical engineering at the University of Massachusetts. Haensel has written extensively on creativity and innovation. In the September 1994 issue of *Chem Tech*

Continued on next page

The Year of Louis Pasteur

The centennial of Louis Pasteur's death on 28 September 1895 is being commemorated throughout this year. In the United States the inaugural ceremony was held 30 January at the University of Pennsylvania. The exposition "Louis Pasteur: His Life and Work" was on display at Penn in February and has been shown in many other cities since. Several films and lectures on Pasteur form part of the festivities. Highlights of the exhibit's appearances are as follows:

1–31 May: Rose Medical Center, Denver
1–28 September: Dittrick Museum of Medical History, Cleveland
October: Cleveland Health Science Museum
18 October–30 November: Maison Française, French Embassy, Washington
24 October–30 December: National Atomic Museum, Albuquerque
1–30 November: St. Louis Science Center, St. Louis

Another high point is an international symposium honoring Pasteur "Stereospecificity and Molecular Recognition," at the Rockefeller University in New York City, 12–15 September. For information on these and other programs contact the Pasteur Foundation, 555 Madison Avenue, New York, NY 10022, (212) 752-2050.

GRANTS

Edelstein International Fellowship and Studentship

Applications are invited from established scholars for the 1996–97 Edelstein International Fellowship in the History of the Chemical Sciences and Technologies. The Edelstein Fellow will be expected to divide his or her residency between the Chemical Heritage Foundation (CHF) in Philadelphia and the Edelstein Center for History and Philosophy of Science, Technology, and Medicine in Jerusalem. The resources of the Edelstein Library (especially strong in all aspects of chemical history) are available in Jerusalem. Philadelphia resources include the Othmer Library of Chemical History and the Edgar Fahs Smith Collection (University of Pennsylvania). The major portion of the fellow's time will be devoted to research, but the fellow will also contribute to the work of each institution in an appropriate manner. The period for the Fellowship, which may be held in conjunction with other research or sabbatical support, is 1 September 1996 to 30 June 1997. A travel allowance is also available.

Letters of application should indicate how CHF and Edelstein Collection resources in the chemical sciences are relevant to the applicant's research; applicants should also enclose a financial statement, a curriculum vitae, and the names of three references. Applications should be received by 15 November 1995 and should be sent to Professor Seymour Mauskopf, Coordinator, Edelstein International Awards, Department of History, Duke University, Durham, NC 27708; phone (919) 684-2581.

The 1994–1995 Edelstein Fellow is Mi Gyung Kim of Seoul National University in Korea. Earlier Edelstein Fellows were Seymour Mauskopf of Duke University, William H. Brock of the University of Leicester, Peter J. T. Morris of the Science Museum, London, and Kostas Gavroglu of the National Technical University in Athens.

The Edelstein International Studentship is available to support dissertation research and writing in the history of the chemical sciences and technologies. Candidates should have fulfilled all requirements for the Ph.D. except the dissertation. The Studentship provides a stipend and travel and dissertation fee support for a five- to six-month residency in Philadelphia and a three- to four-month stay at the Hebrew University of Jerusalem in the course of the academic year. Resources in Jerusalem and Philadelphia are as noted for the Edelstein Fellowship. Candidates for the 1996–97 Studentship should send applications to Professor Seymour Mauskopf at the address given in the Fellowship announcement, by 15 November 1995. Applications should include a dissertation prospectus, a brief statement of research and writing plans for the year of the Studentship, a curriculum vitae, and the names and telephone numbers of two references.

The 1994–95 Edelstein Student, Pap NDiaye of the Ecole des Hautes Etudes en Sciences Sociales (now in Jerusalem) will return in September to teach in the Department of History and Sociology of Science at Penn. Earlier Edelstein Students were Kathleen Steen of the University of Delaware and James Altena of the University of Chicago.

BEHOLDER'S EYE—*continued*

("The Magazine of Chemical Science, Technology, and Innovation"), Haensel proposes some tantalizing criteria for creativity. He maintains that encyclopedic knowledge is not as important as the ability to use knowledge for "further intellectual growth and constructive performance," that "a good sense of reasoning may be deadly, because reasoning carried to an extreme may inhibit free thought." The same can be true of curiosity, because the "person who is curious about everything never finished a project."

In emphasizing that creativity cannot be forced, Haensel points to Dimitri Shostakovich, a genius who wrote horrible music when it was demanded by the Russian government. "Creativity is like love," Haensel insists; "if you have to ask for it, it is not much good." Virtually all of the SCI oral history project interviews have reinforced Haensel's penetrating insight that "creativity is highly individualized and therefore a personal trait. It cannot be bought or forced or ordered, nor can it be measured or evaluated or organized. Once ignited, it will result in a continuous thought process that attempts to exclude all interferences until it culminates in either success or failure."

JAMES J. BOHNING

A Message to Our Friends

The growth and success of CHF's educational outreach depends on the generous support of friends like you. Over the past five years our annual giving appeals have yielded a steady increase in both the number of gifts and the total amount contributed.

In the first half of 1995 alone, we have witnessed an encouraging 37 percent increase in annual contributions, averaging $17.00 more per gift than in 1994. The geographic range has also expanded, with gifts coming in from 47 states (including 40 gifts from California, 23 from Illinois, and 27 from Florida) and 18 foreign countries—reflecting the national and global popularity our programs and services are enjoying.

You still have time (through 30 June) to participate and to help make our 1994–95 campaign the most successful and productive ever. If you have not sent your donation, we hope that you will do so soon. All *new* and *increased* gifts are currently being matched one-to-one through the generosity of a Haas family trust, thus doubling your gift and markedly increasing our ability to advance the heritage of chemical achievement.

Thank you most warmly for your support!

Travel Grants

The Chemical Heritage Foundation offers small travel grants to enable interested individuals to make use of the research resources of the Beckman Center for the History of Chemistry, the Othmer Library of Chemical History, and associated facilities.

Grants, which may be used for travel, subsistence, and copying costs, will not normally exceed $500. Applications should include a vita, a one-paragraph statement on the research proposed, a budget, and the addresses and telephone numbers of two references. Deadlines are 1 February for grants to be used April–June; 1 May for July–September; 1 August for October–December; and 1 November for January–March. Applications should be sent to Laurel Adelman, Travel Grants, Chemical Heritage Foundation, 3401 Walnut Street, Suite 460B, Philadelphia, PA 19104-6228.

Frederick L. Holmes, 1994 Dexter Award winner, had numerous interviews with Hans Krebs, discoverer of the citric acid cycle, in preparation for writing his two-volume biography. Courtesy F. L. Holmes.

Larry Holmes on Lavoisier: The Dexter Address

The 1994 Dexter Award for distinguished achievement, given by the ACS Division of History of Chemistry, was presented to Frederic L. Holmes, chair of the history of medicine section of Yale University School of Medicine. He entered the field via a bachelor's degree from MIT and a Ph.D. in history of science at Harvard, then taught at MIT, Yale, Western Ontario, and since 1979 again at Yale. His major work has been in the "fine structure of scientific investigation," an approach he has applied to the study of Claude Bernard, Lavoisier, and Hans Krebs.

Chemical Heritage *here presents an excerpt from Holmes's award address, "What Was the Chemical Revolution About?" The* Bulletin for the History of Chemistry *will publish the complete paper.*

To reaffirm that the chemical revolution was about the overthrow of the phlogiston theory is not to imply that the changes Lavoisier introduced into chemistry were limited to that domain. The list of his achievements that had major impacts on the future development of the various subfields of chemistry that emerged during the nineteenth century is astonishingly long. They range from his thoroughgoing quantitative style of experimentation and his introduction of a whole new level of complexity of instruments and apparatus—through calorimetry, the elementary analysis of organic substances, and a theory of fermentation which provided the first description of a chemical process as a balanced equation—to the list of pragmatically defined elements from which all subsequent tables of the elements have evolved, and the reformed nomenclature.

Some of these achievements changed the theory and practice of chemistry rapidly; others took many years to exert their full effects. The more dramatic effects might be called "revolutionary," if we follow the popular tendency to describe highly visible, rapid changes of any kind as revolutions. To do so as historians, however, only blunts our use of the language and diminishes the precision of our interpretations. It is useful to distinguish scientific revolutions that require ruptures involving radical change and the overthrow of something essential to the prerevolutionary state, from other kinds of major scientific transformations. Lavoisier caused a revolution focused on the phlogiston theory. He produced or laid the groundwork for many additional transformations in chemistry. But some well-established parts of chemistry, in which there was rapid progress contemporary with Lavoisier, but to which he contributed little, continued to develop in the same directions in which they had been heading when he arrived on the scene. They too played their parts in the founding of modern chemistry.

Nominations are now being sought for the 1995 Dexter Award. They should be sent by 1 February 1996 to Alan J. Rocke, Program for History of Science and Technology, Case Western Reserve University, Cleveland, OH 44106.

The American Philosophical Society offers a doctoral dissertation fellowship of $12,000 in the history of the physical sciences in the twentieth century. The **John Clarke Slater Fellowship** is open to candidates for the doctorate in the United States and abroad who plan to spend the fellowship year in association with an American university or research institution, and who have passed their preliminary examinations. The deadline is 1 December of each year. Write to Slater Fellowship, American Philosophical Society, 104 South 5th Street, Philadelphia, PA 19106-3387.

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If you have changed your address, or if you are not now on our mailing list, please detach and return this form.

Our list, compiled from diverse sources, inevitably shows duplication. If you receive more than one copy of *Chemical Heritage*, please pass the extra along to an interested friend or colleague.

DOUBLE YOUR DOLLARS: Through the generosity of a Haas family trust and other friends, new and increased gifts will be matched one-to-one during our annual giving campaign. For more details on our annual and planned giving programs, please contact Irene I. Lukoff at (215) 898-3675.

I enclose a gift of $________ in support of the work of the Chemical Heritage Foundation.

☐ My company has a matching-funds gift program.

MAIL TO
Chemical Heritage Foundation
Department 12-2
3401 Walnut Street
Philadelphia, PA 19104-6228 USA

MEETINGS

ASBMB National Meeting, San Francisco, California, 21–25 May 1995.

ASMS Annual Meeting, Atlanta, Georgia, 21–26 May, 1995.

Electrochemical Society Spring National Meeting, Reno, Nevada, 21–26 May 1995.

Josef Loschmidt Centennial Symposium, Vienna, Austria, 25–27 June 1995.

Lectures by A. Bader, P. Becker, Carl Djerassi, Ernest L. Eliel, Albert Eschenmoser, Max Perutz, H. Spohn, and others. Address inquiries to Committee for the Loschmidt Memorial Year 1995, c/o Natural Science Faculty of Vienna University, Dr. Karl-Lueger-Ring 1, A-1010 Vienna, Austria.

AACC Annual Meeting, Anaheim, California, 16–20 July, 1995.

AIChE Summer National Meeting, Boston, Massachusetts, 30 July–2 August 1995.

Second International Conference on the History of Chemistry and Chemical Industry, Eger, Hungary, 15–19 August 1995.

Registration fee to be paid by 1 June 1995. Contact Dr. György Gálosi, Hungarian Chemical Society, H-1027 Budapest, Fö u. 68, Hungary; phone 36-1-201-6883; fax 36-1-201-8056.

210th ACS National Meeting, Chicago, Illinois, 20–25 August 1995.

HIST Program chair: Richard E. Rice, Department of Chemistry, University of Montana, Missoula, MT 59812, (406) 243-4022 or 2302. The symposium "75th Anniversary of the ACS Division of the History of Chemistry," includes a session paying tribute to Sidney Edelstein.

"Imperial Chemistry," Meeting of the Royal Society of Chemistry, London, 21–23 September 1995.

To celebrate the 150th anniversary of the founding of the Royal College of Chemistry, the founding college of Imperial College. Lecturers will include Colin A. Russell, Sir Derek Barton, and Sir Geoffrey Wilkinson. An all-day historical symposium organized by Gerrylynn Roberts will feature William H. Brock, Frank A. J. L. James, and others. For more information write to John F. Gibson, "Imperial Chemistry" Meeting, The Royal Society of Chemistry, Burlington House, London W1V OBN, UK.

AATCC International Conference and Exhibition, Atlanta, Georgia, 8–11 October 1995.

Electrochemical Society Fall National Meeting, Chicago, Illinois, 8–13 October 1995.

HSS Annual Meeting, Minneapolis, Minnesota, 26–29 October 1995.

Society for Literature and Science Annual Meeting, Los Angeles, California, 2–5 November 1995.

AIChE Annual Meeting, Miami Beach, Florida, 12–17 November 1995.

211th ACS National Meeting, New Orleans, Louisiana, 24–28 March 1996.

For general papers session, send paper title by 15 September and 3 copies of abstract by 15 October to Richard Rice (see address above).

Electron '97.

Contact Samuel Devons, Nevis Laboratory, Columbia University, P.O. Box 137, Irvington, NY 10533, phone (914) 591-8100, ext. 251; fax (914) 591-8120.

CONTENTS 12:2

Chemical Heritage (ISSN 0736-4555), published twice a year by the Chemical Heritage Foundation, reports on CHF's activities and on other news of the history of chemistry, chemical engineering, and the chemical process industries. Address inquiries and information to the Editor, *Chemical Heritage*, 3401 Walnut Street, Philadelphia, PA 19104-6228 USA; tel. (215) 898-4896; fax (215) 898-3327.

Dr. Alfred R. Bader
2961 North Shepard Avenue
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CHEMICAL HERITAGE FOUNDATION
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THE BECKMAN CENTER FOR HISTORY OF CHEMISTRY ☐ THE OTHMER LIBRARY OF CHEMICAL HISTORY ☐ PUBLIC EDUCATION

Arnold Thackray, *President*

10 September 1997

Dr. Alfred Bader
924 East Juneau, Suite 622
Milwaukee, WI 53202

Dear Alfred:

Congratulations again, on your receiving the AIC Gold Medal. Your name adds further luster to a lustrous list of recipients. It was a pleasure to be with you and Isabel for the occasion.

As we briefly discussed, chemical archives are central to CHF's reasons for existing, so we'd love to have an archival copy – and permission to make appropriate use of – the tape to which you refer. However, to speak frankly, ACS is so sensitive about CHF at this time that I think all financial and operational details in regards to the tapes are best handled directly by you, Alan Nixon, and ACS.

When someone gives CHF the tape, we'll be pleased to archive it.

Sincerely,

Arnold

AT/c
Cc: Elizabeth Swan, Director of Library Services, CHF

Dr. Alfred Bader
924 East Juneau, Suite 622
Milwaukee, Wisconsin 53202
Phone: 414/277-0730
Fax: 414/277-0709

A Chemist Helping Chemists

July 31, 1997

Dr. Arnold Thackray, President
Chemical Heritage Foundation
315 Chestnut Street
Philadelphia, PA 19106-2702

Dear Arnold:

May I ask you for your advice and help in an interesting matter, though I must caution you that it might involve you in some work.

Some months ago, Alan Nixon wrote to me about some wonderful videotapes produced in the 1950's. In these, Dr. Soello gave some really enthusiastic lecture demonstrations, but of course, at the time, he wasn't wearing any safety equipment.

At the last ACS meeting, in San Francisco, the meeting on Project SEED was regaled with some of these videotapes, and Dr. Soello was there, talking about what he did over 40 years ago. He still has the same enthusiasm, and all that seems to have changed was that his full head of hair is now white.

As you will see, Dr. Nixon estimated that to produce the tapes and distribute them would cost $5,000. Of course, like most chemists, I admire and respect Alan's enthusiasm and service to the ACS, and so I replied that I would gladly supply the $5,000 provided that the ACS would handle the tapes and Dr. Nixon would make certain that there would be no cost overrun. Like most of us involved in such productions, I have heard of cost estimates which later were greatly exceeded.

More seriously, Dr. Brennan wrote to Dr. Nixon on June 16th and her letter (copy enclosed) will be self-explanatory.

I understand that these tapes should not be shown to students because of the legal hazards involved. As I have said many times and you have heard many more times, all it takes these days to file a lawsuit is $30 and an unemployed lawyer.

Clearly the ACS - and I also - have rather deep pockets, and my attorney has pointed out to me that even I might be blamed just for supplying the funds.

But the simple fact remains: The production was really inspiring, and it is also historically important because it shows so clearly what could be done in 1950 by a man like Soello with great enthusiasm.

What I would like to suggest is that I give the $5,000 either to the Chemical Heritage Foundation or to the ACS with the understanding that they be put into your archives, and if it can be done safely, that the availability also be made known to local Sections. If you saw them, you would understand quickly how much many old-timers in local Sections would enjoy seeing them.

Alan has suggested that I should just give the funds to the California Section, but for obvious reasons, I am reluctant to do that. If you and/or the ACS agreed to ascertain that the $5,000 would suffice and then take care of the distribution of the tapes, please just decide between yourself and Jennifer D'Elia whether I should send my check to the Chemical Heritage Foundation or the ACS. If the latter, then I would still want to be certain that one set of the tapes still comes to you.

To turn now to a much easier matter: You will recall that we corresponded about the possibility of publishing my paper on *Prussian Blue* in your fine magazine. *Chemistry in Britain* has accepted this, and I enclose a part of the galleys showing specifically my indebtedness to you.

There is very little overlap between your readership and that of *Chemistry in Britain*, and the latter has no objection to your publishing another version. That in *Chemistry in Britain* must necessarily be rather short, and I am allow at most 6 illustrations. I am just tying up some loose ends and hope to have the corrected galleys back to *Chemistry in Britain* by the end of August, with publication later this year.

If you would then still be interested, I would happily send you a somewhat enlarged version which could easily refer to the shortened version in *Chemistry in Britain*.

With all good wishes and best personal regards, I remain,

Yours sincerely,

AB/cw

c: Dr. Alan Nixon, California Section, ACS
Dr. Christine Brennan, Committee on Project SEED, ACS
Ms. Jennifer D'Elia, Committee on Project SEED, ACS

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[illegible]

Dr. Alfred Bader
[illegible] East Juneau, Suite [illegible]
[illegible]
Fax 414 [illegible]

Dear Dr. Bader:

[illegible] is not in today but I left a me[illegible] will be here. His secretary told me that [illegible] and I [illegible] Chestnut S[illegible]

[illegible]

To David Bader

Please pick us up that Friday at ca. 5 pm.

Love

21 I 97

To Dr. Ute Deichmann
Chemical Heritage Foundation

DR. ALFRED BADER
WHITE GABLES
2A HOLMESDALE ROAD
BEXHILL-ON-SEA
EAST SUSSEX TN39 3QE
TEL: 01424 222223

← hier bis am 6 I,
dann Milwaukee

001 215 925 1954

Dear Dr. Deichmann

Thanks for your letter of Dec. 20, forwarded to here

For Loschmidt's support of Jews, see footnote 9, of my paper.

Other chemists for your consideration

Roald Hoffmann, Nobel Laureate, hidden by Poles.

Ernest Eliel – see his autobiography From Cologne to Chapel Hill, Priestley Award, ACS president

Ernest Wenkert, left Vienna ca. 1939, PhD Woodward, professor U Cal San Diego

Ernest Buncel, concentration camp survivor, Ph.D U.C. London, professor, Queen's University, Kingston Ont

Carl Amberg (fellow internee), Dean of Science, Carleton University, Ottawa, Canada

Among industrial chemists of note: John Biel, Arno Cahn

My travel schedule: Milwaukee January 6 – 28
New York City January 28 – 31
Visiting my son David & his family in Pa near Frenchtown, NJ Feb 1 – 3
Milwaukee Feb 3 – 9
ACS lecture tour, Florida Feb 10 – 16

I hope to meet you & answer other questions

Alles Gute für 1997

Alfred Bader

31. XII. 96

[illegible] REQUIREMENTS FOR DEGREE [illegible]

[illegible]

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See footnote ⇒

Ernest Eliel Ernie Wenkert

Roald Hoffmann John Biel

Dr. Alfred Bader
924 East Juneau, Suite 622
Milwaukee, Wisconsin 53202
Phone: 414/277-0730
Fax: 414/277-0709

A Chemist Helping Chemists

April 9, 1997

Dr. Arnold Thackray, President
Chemical Heritage Foundation
315 Chestnut Street
Philadelphia, PA 19106-2702

Dear Arnold:

I am sorry that a visit to Purdue to Herbert Brown's 85th birthday has delayed my thanking you for your letter of April 2.

Unfortunately I cannot possibly have the finished manuscript to you by June the 1st because I have to put some finishing touches on the manuscript at the Royal Institution - which I plan to visit for a day or two in July.

The earliest I could have it to you would be in August or September, that is for your Spring issue.

Of course I would understand if that is too late for you to print it.

Please let me know at your convenience.

Isabel and I are travelling most of the time between now and August but sometime this Autumn we hope to have a chance to visit you in Philadelphia.

Best wishes, as always,

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Arnold Thackray, *President*

April 2, 1997

Dr. Alfred Bader
924 East Juneau, Suite 622
Milwaukee, Wisconsin 53202

Dear Alfred,

Thank you for your various recent, thoughtful communications. In no particular order:

(1) *Chemical Heritage* will not, in the nature of the case, publish simultaneously with *Chemistry in Britain* (we're a twice-yearly, they are monthly). But publication should be *close,* which means our *fall* issue; which means a clear understanding of everything by 1 June. The number of photos we can accommodate is limited, as is the length of the text. So we need to be in full dialog, soon!

(2) *Wisdom, Knowledge & Magic* is wonderful!

(3) You remarks on philanthropy are carefully noted. Obviously, it's territory we should spend time in, together. Events here at CHF are moving at such speed now, that I hope the conversation may take place soon. May I call you, to review where and when we might meet?

All best wishes to you and Isabel.

Sincerely,

Arnold

cc: Mary Virginia Orna

AT/deb

Dr. Alfred Bader
924 East Juneau, Suite 622
Milwaukee, Wisconsin 53202
Phone: 414/277-0730
Fax: 414/277-0709

A Chemist Helping Chemists

March 31, 1997

Dr. Sheldon Isakoff
Chairman, Board of Trustees
Chemical Heritage Foundation
315 Chestnut Street
Philadelphia, PA 19106-2702

Dear Dr. Isakoff:

Thank you for your kind invitation to join you for a reception and dinner on April 23rd.

I would love to be able to come but this is on Passover and so we cannot attend.

With best wishes, I remain,

Yours sincerely,

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THE BECKMAN CENTER FOR HISTORY OF CHEMISTRY ☐ THE OTHMER LIBRARY OF CHEMICAL HISTORY ☐ PUBLIC EDUCATION

Sheldon E. Isakoff, *Chairman, Board of Trustees*

March 24, 1997

Dr. Alfred R. Bader
2961 North Shepard Avenue
Milwaukee, WI 53211

Dear Dr. Bader:

This note brings you spring greetings along with a special invitation to a lecture, reception and dinner on Wednesday, April 23.

For several years now it has been our tradition to precede our Board Meetings with an informal afternoon and evening offering for some of our closest friends, sponsors, and key leaders of the chemical community. It is an opportunity for you to visit with old friends and colleagues or to meet new ones, and to learn more about the latest developments at CHF. For us, it is a warm and friendly occasion to express how much we value your continued friendship and support.

We hope that you will join us in celebrating the beginning of a second year at our new home in "America's most historic square mile." Kindly return the enclosed form, as indicated, by April 20. Thank you, and we look forward to seeing you on April 23!

Yours sincerely,

Sheldon Isakoff

Enclosure

CHF BOARD RECEPTION/DINNER
315 Chestnut Street

Wednesday, April 23, 1997

5:00 - 6:00 p.m.	Early Bird Program "Doing Chemistry at the Art/Archaeology Interface" Sister Mary Virginia Orna, CHF Director of Educational Services
6:00 - 7:00 p.m.	Open House and Reception
7:00 - 8:15 p.m.	Dinner Welcome and Introductions Arnold Thackray, CHF President
8:15 - 8:45 p.m.	"Order Out of Chaos: The Historical Library in the Electronic Age" Elizabeth Swan, CHF Director of Library Services
8:45 - 9:00 p.m.	Discussion
9:00 p.m.	Adjourn

****

I [ ] will attend the Early Bird Program, on Wednesday, April 23, 1997.

I [ ] will attend the reception/dinner on Wednesday, April 23, 1997.

NAME:____

PHONE:____

Please note that all activities will be held at CHF, 315 Chestnut Street, Philadelphia, PA.

Please return this form to Paula Williams (CHF) by April 20, by mail or by fax (215) 925-1954. **Limited parking is available at the Chemical Heritage Foundation on a first-come first serve basis.**

Please note: If you plan to stay in Philadelphia overnight, we recommend the following two nearby hotels: Best Western Independence Park Inn (215 922-4443) at 235 Chestnut Street, and the Sheraton Society Hill (215 238 6000) at One Dock Street. A special rate is available at the more upscale Sheraton Society Hill, if you call them by April 2 and mention CHF.

Arnold Thackray

TABLE OF CONTENTS

(NOTE: This book will be organized with figures, full-size as originally published or close, accompanied by essays. In this way, it is similar in organization to the book *Chemistry Imagined* by Hoffmann and Torrance; the book is anticipated to be about 2/3 pictures and 1/3 text in page layout)

Preface

Fig. 1. (1738 allegorical *Physica Subterranae* frontis: *Prima Materia*) "What Fresh Hell Is This?"

. Practical Chemistry: Mining, Assaying, Metallurgical Chemistry

Fig. 2. Ercker frontis- "Seeding The Earth With Metals"
Fig. 3. Charras Book (1678)- "Chymicall Characters" (includes discussion of ancient chemical symbols, Lead as Saturn, Iron as Mars, allegory from Primo Levi's book *The Periodic Table*, 1976 Viking Mission and 1996 Mars meteorite
Figs. 4-14 (Ercker)- "Practical Chemistry: Mining, Assaying and Refining" (figs depict: 16th centuery assaying lab, washing alluvial gold, molding cupels, assay balance, gold separation by amalgamation, distillation of *aqua regia*, parting acid, cementation of gold leaf, smelting of bismuth in open air, leaching saltpeter from sheep pens, crystallization of saltpeter

Spiritual and Allegorical Alchemy

Figs. 15-27. (Valentine 1678 Book) Twelve Keys of Basil Valentine & Summary Emblem (with brief explanations)
Fig. 28-30. Nazari (1599 book) 3 allegorical plates- one of which depicts sophic mercury, sophic sulfur and salt
Fig. 31. frontis portrait from Porta, *Distillatione*, 1608 ed
Figs. 32-38. depictions of early 17th century glassware with animal, human and monster allegories
Fig. 39. ca 1580 copperplate "Distillatio" engraved by Galle after painting by Stradanus (Van Der Straat)
Figs. 40-45 6 figures from *Mutus Liber* (1914 Paris folio reprint)

Iatrochemistry and Spagyricall Preparations

Fig. 46 frontis of *Basilica Chymica* (1611, Croll)
"Paracelsus" (includes quotes from Evan S. Connell book and medical remedies culled from Paracelsus)
"The Dream Team of Alchemy" (re Croll's frontis)
Figs. 47-51 Plates from Gesner's 1599 on Elizabethan Medicine
Figs. 52-57 Plates from French's 1653 ed *Art of Distillation*
NOTE: Figs 47-57 will have brief discussions of Elizabethan and later medicinal preparations

Chemistry Begins To Emerge As A Science

Fig. 58. Title page, 1606 Libavius *Alchimia*
Figs. 59 & 60. Building and Floor Plan Libavius Lab Building
Figs. 61 & 62. Libavius allegorical figs- Philosopher's Stone
Fig. 63. Helmont, *Ortus Medicine* frontis
"Van Helmont and the 'Tree Experiment'"
"Curing Wounds By Treating The Sword With Powder of Sympathy"
"Do Anonymous Passersby Defecate At Your Doorstep? A Solution"
Fig. 64. Glauber 1689, Complete Works, *Philosophical Furnaces*,
"A Bath Tub And A Still In Every Home"
Fig. 65. Glauber, 1689, more stills
Fig. 66. Boyle frontis *Chymist Scepticus*, 1668
"Boyle Versus Aristotle and Paracelsus"
Fig. 67. Boyle's Law J-Tube Plate (1662) "Boyle's Law"
Fig. 68. tp from 1739 Boyle's *Degradation of Gold/Anti-Elixir*
"Who Would *Want* An Anti-Elixir"
Fig. 69. figure of chemist calcining antimony using sunlight from LeFebvre (1670)
"The Triumphal Chariot of Antimony"
Fig. 70. tp from *Secrets Revealed* (Philalethes aka John Starkey)
"A Harvard-Trained Alchymist"
Fig. 71. frontis Becher's *Chemical Oedipus* (1664)
"Phlogiston: Chemistry's First Comprehensive Scientific Theory"
Fig. 72. Mayow's expt on "nitro-aerial spirit"
"Gun Powder, Lightning and Thunder, and Nitro-Aerial Spirit"
Fig. 73. tp from Stahl's 1723 text
"The 'Modern' Phlogiston Concept"
Fig. 74. tp from Boyle's 1673 *Effluviums* book
"What Are Effluviums?"

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chemistry texts of mid-seventeenth - early-eighteenth centuries

Fig. 75. Beguin 1659 frontis
Fig. 76. tp and frontis Glaser (1684 German)
Fig. 77. Glassware from Charras 1678 book
Fig. 78. Glassware from Lemery 1686
Fig. 79. Chemist in Laboratory (Barchusen, 1698)
Figs. 80-83. allegorical figs from Cohausen's book on Phosphorus (1717)
Fig. 84. fig. (thermometers) from Boerhaave's *Elements of Chemistry* (1735).

Fig. 85. Geoffroy's Table of Affinities (from De Machy 1781 book)
"Chemical Affinity"
Figs. 86-88. figs from Hales' *Vegetable Staticks*
Fig. 89. Joseph Black portrait
"Cavendish Weighed The Earth But Thought He Had Captured Phlogiston In A Bottle"
Fig. 90. tp from Priestley's 1772 pamphlet on Pyrmont Water
"Making Soda Pop"
Fig. 91. tp from Franklin's Electricity Book

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Fig. 92. fig from Scheele's discovery of oxygen
Fig. 93. pneumatic trough from Priestley
"Where Is The Invective Of Yesteryear?"
Figs. 94-97. figs from Lavoisier's 1776 *Essays Physical and Chemical* and 1790 *Elements of Chemistry* (1st English)
Figs. 98-100. from Bergman's *Elective Attractions* (1785)
2 mini essays on the use of Bergman's tables
Figs. 101-103. 3 tables from 1787 *Nomenclature Chimiques*
Figs. 104-105. 2 tables from Lavoisier's Treatise showing his caloric postulate
Fig. 106. cannon-boring fig. from Rumford's essay (1798)
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Figs. 107-108. Davy's Nitrous Oxide book
"Laughing Gas For Everybody!"
Fig. 109. tp Berthollet's *Essais Statique Chimique*, 1803
"Some Last-Minute Glitsches Before The Dawn of the Atomic Theory"
Figs. 110-112. figs showing atoms, molecules, crystals from Dalton's *Chemical Philosophy*, 1808. Essays on Gas Laws including Avogadro, Gay-Lussac, etc. here.
Figs. 113-114. Tp and page depicting "gravitational attraction" between atoms from John Friend's 1712 (English) text
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Fig. 118. Frontis from Davy's 1818 book *Safety Lamp for Coal Miners*
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Fig. 127. Chemical formulas from Butlerov book
Fig. 128. FULL-COLOR FOLIO PLATE from Youmans' text (1865) depicting homologous series (increase by C_2H_2, sic)
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Figs. 131-132. Tables from Cannizzaro detailing atomic masses
Fig. 133. text (in Russian) from 1863 Organic Chemistry by

Mendeleev showing germ of Periodic Table idea
Fig. 134. Periodic Table by Mendeleev (1891 St. Petersburg)
Fig. 135. tp "600 Receipts Worth Their Weight In Gold"- American folk medicine around the Civil War.

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Figs. 136-138, tp and 2 figs from Faraday's *Chemical History of a Candle*
(I will also use excerpts from Jane Marcet's book)
Fig. 139. FULL-COLOR FOLIO PLATE from Youmans' text (1865) a rather "Dada-ist" depiction of a candle flame- connect to Faraday and also Berzelius' blow-pipe
Figs. 140-143. Figs from 1823 book by the magician Henri Decremps *Diagrammes Chimiques*- novel use of folio flow diagrams to explain chemical principles
Figs. 144-149. charming figures from 1888 text *Fairyland of Chemistry* depicting chlorine, hydrogen, hydrochloric acid, salt and water fairies and fairies of the air- a delight!
Fig. 150. tp *Chemistianity* (a psalm book *ca* 1880 to teach chemistry to young children and older people by reciting chemistry psalms in unison- some samples will be included)
Fig. 151. tp of Bayma's 1866 book titled *Molecular Mechanics;* this is not a scoop of Prof. Allinger's work- rather a scientific-sounding, rather mathematical, but ultimately a book soundly based on religion- what the Brits call "A Nutter"

THE APPROACH TO MODERN VIEWS OF CHEMICAL BONDING

Fig. 152. Depictions of 3-D chemistry from Van't Hoff's *Chemistry In Space* (1891- first English ed)
Figs. 153-155. 3 figs from 1896 Smithsonian essay by Rayleigh and Ramsay on Argon
Fig. 156. Periodic Table by Mendeleev to Explain the new superlight inert gas apparently comprising the celestial ether (1904) "Atoms of the Celestial Ether"
Fig. 157. mid-nineteenth century depictions of dinosaurs illustrating human limits in theorizing based on existing models (relevant to Mendeleev/ether concept)
Fig. 158. X-ray lattice/X-ray camera from Max Born 1923 book
Figs. 159-160. Bragg's Law; X-ray camera (Bragg's book)
Fig. 161. Diffraction pattern (Born book)
Fig. 162. "Octet-Rule" graph ca 1896 (Born book)
Fig. 163. Atomic Numbers vs X-ray Fluorescence (Born book)
Figs. 164-165. Lewis structures from 1916 JACS G.N. Lewis article
Figs. 166-168. Lewis-type structures a la Langmuir JACS 1919
Fig. 169. Formation of H_2 molecule ca 1920 (Born book)
Fig. 170. Cycloalkanes, tetrahedra, Lewis structures (Smith, 1924)
Fig. 171. Depiction of atomic orbits ca 1924 (Smith book)
Fig. 172. Electron skating in spiral track on surface of 4s orbital
Figs. 173-174. from book by Kramers and Holst - 2 COLOR depictions of atomic orbits ca 1924
Figs. 175-177. tp from JACS article *Nature of The Chemical Bond*, with subsequent figs of sp^3 orbital and bonding in ethane

Fig. 178. Periodic Table (1940 ed *Nature of The Chemical Bond*)
Fig. 179. Periodic Table *ca* 1949 includes elements through 96 depicting modern transmutation
Fig. 180. Periodic Table *ca* 1997 including element 112 (or whatever), the "island of stability" and also estimate of how expensive transmutation is: cost per ounce of element 112 and compared to gold;
"The Chemistry of Gold is Noble But Not Simple"
Figs. 181-184. DNA: base pairs, A-DNA, B-DNA and Z-DNA (courtesy C. Murphy, U. of S. Carolina)
Fig. 185. FULL COLOR Huckel MOs of C_{60} (courtesy of R. Haddon, AT&T)
Fig. 186. FULL COLOR Doped C_{60}- superconductor
Fig. 187. Atomic Corral- STM, AFM manual manipulation of atoms (from 1995 *Accounts of Chemical Research*)

Postscript- **ENDING IN IMAGERY**
(poetry on matter by 1995 Nobelist Seamus Heany)

FIG. 1

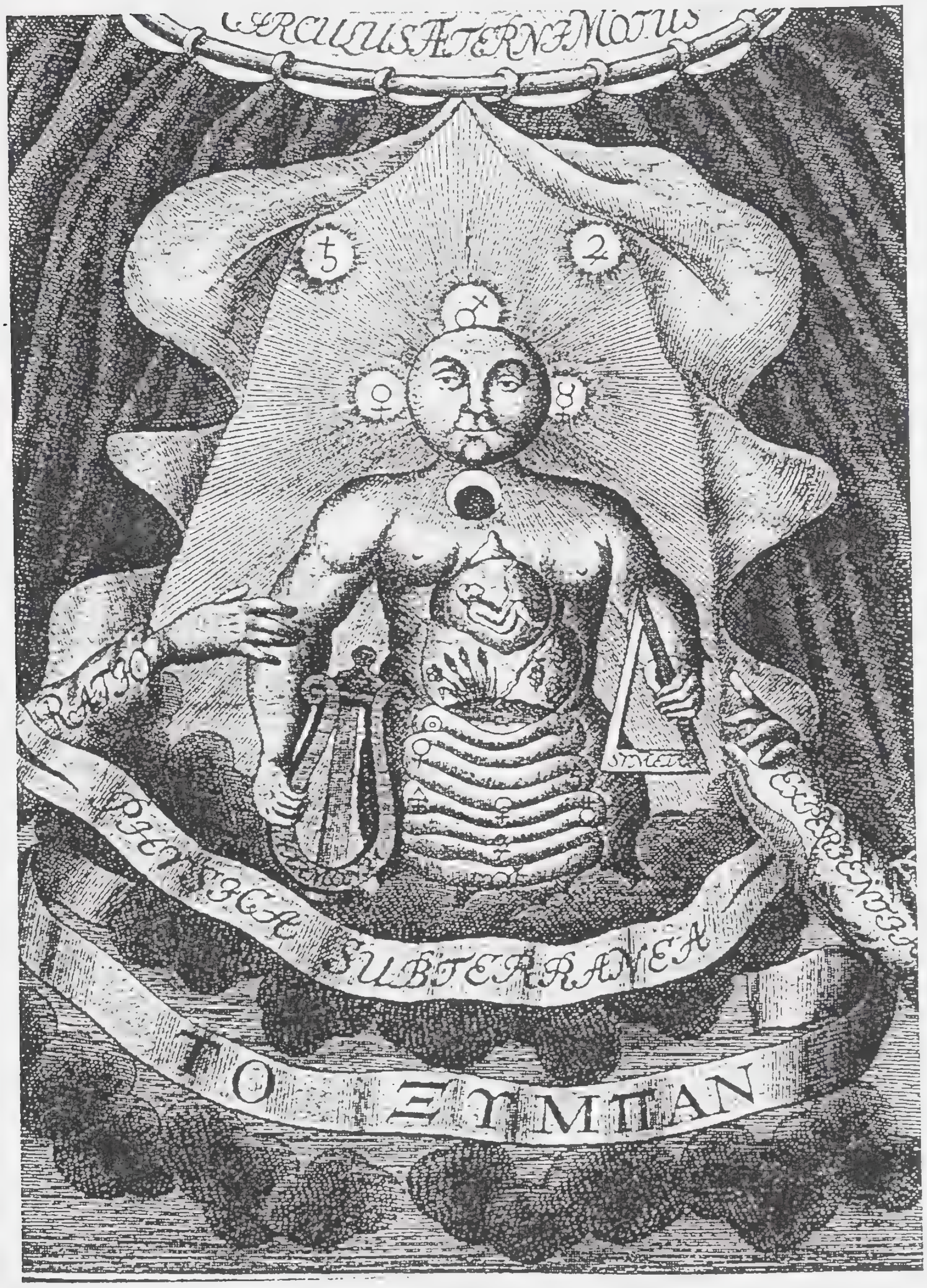

CIRCULUS ÆTERNI MOTUS
RATIO
EXPERIENTIA
PHYSICA SUBTERRANEA
TO ΞΥΜΠΑΝ

Fig. 2

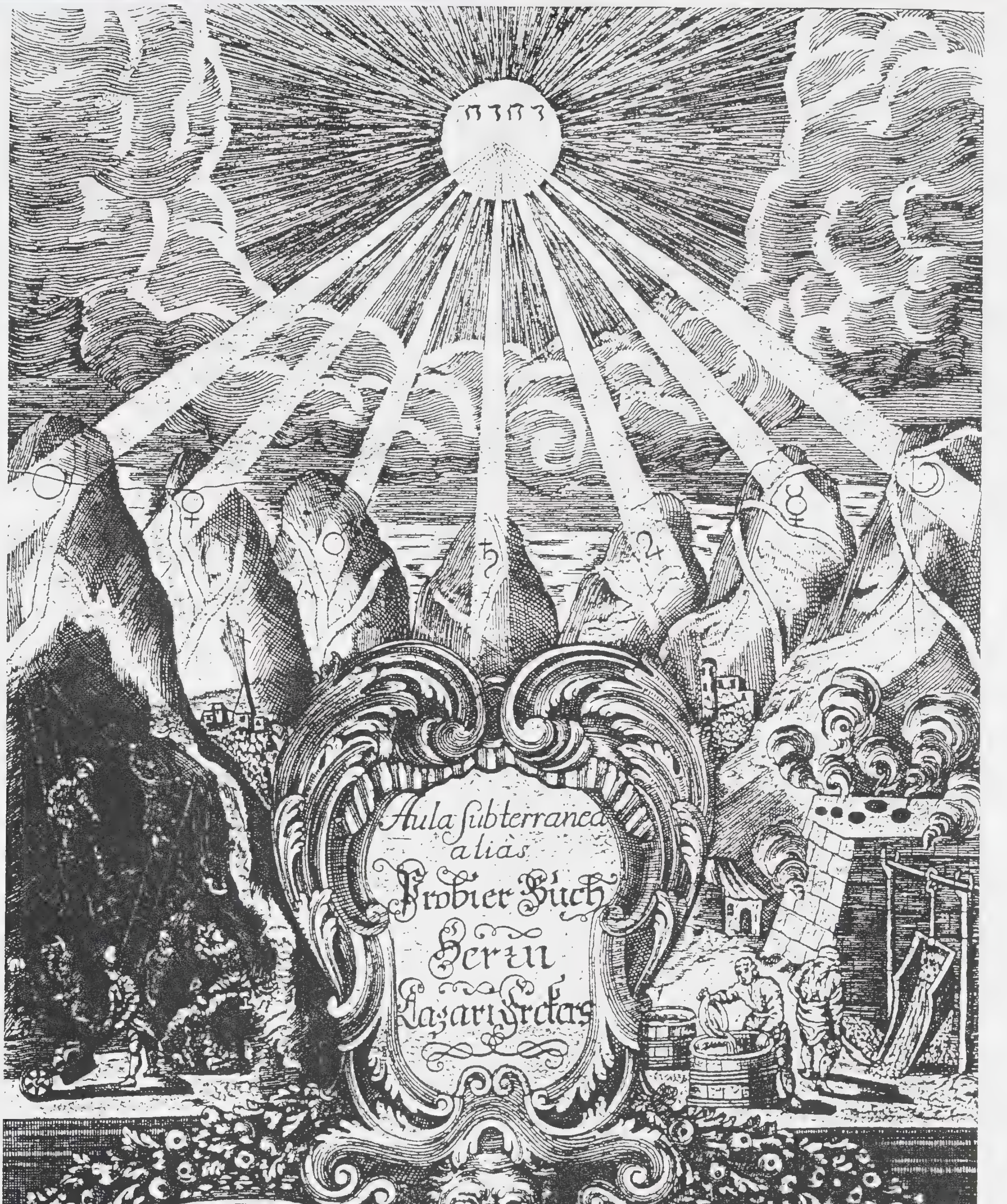

יהוה
Aula subterranea
alias
Probier Buch
Herrn
Lazari Erckers

Fig. 9

FIG. 15

Fig. 28

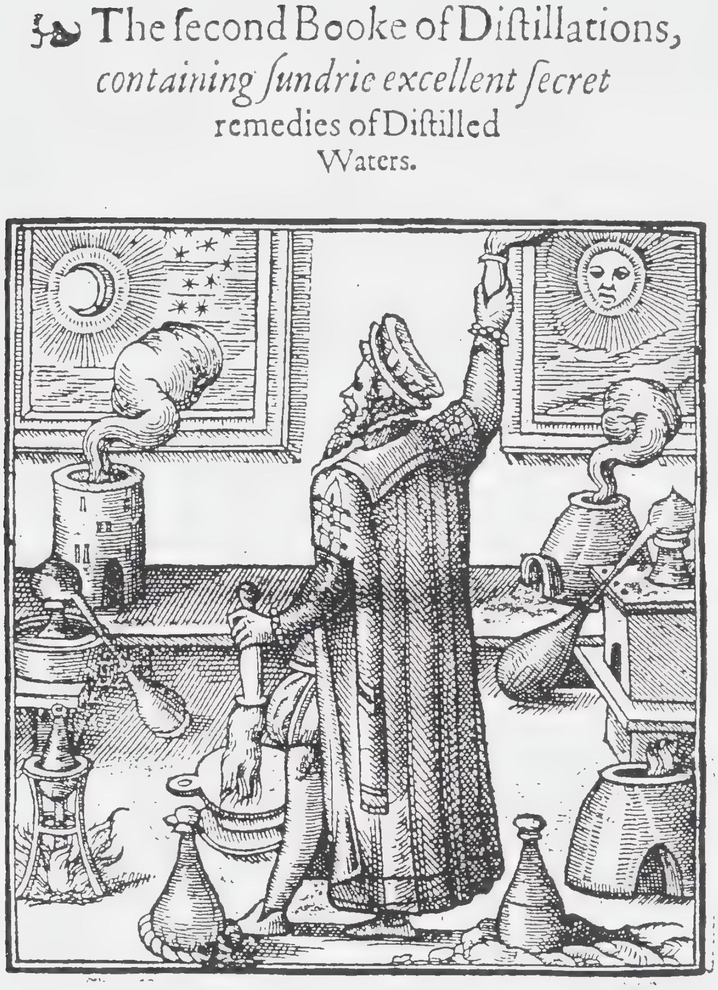
FIG. 31


IOANNES BAPTISTA PORTA NEAPOLITANVS ANNO AETATIS SVAE LXIIII
I. Lauri f.

FIG. 39

FIG. 41

Fig. 50



The ſecond Booke of Diſtillations,
containing ſundrie excellent ſecret
remedies of Diſtilled
Waters.

FIG. 59

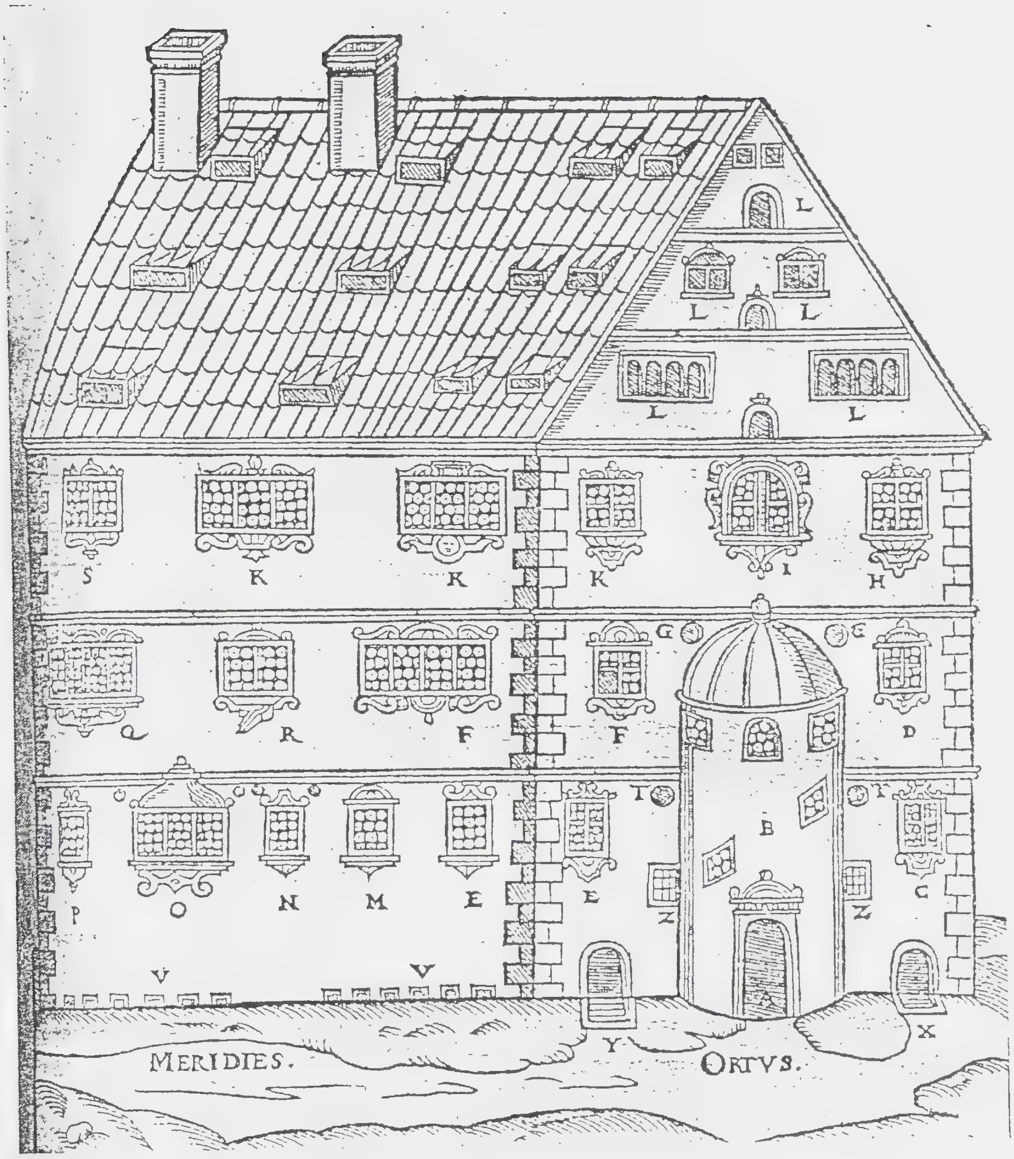
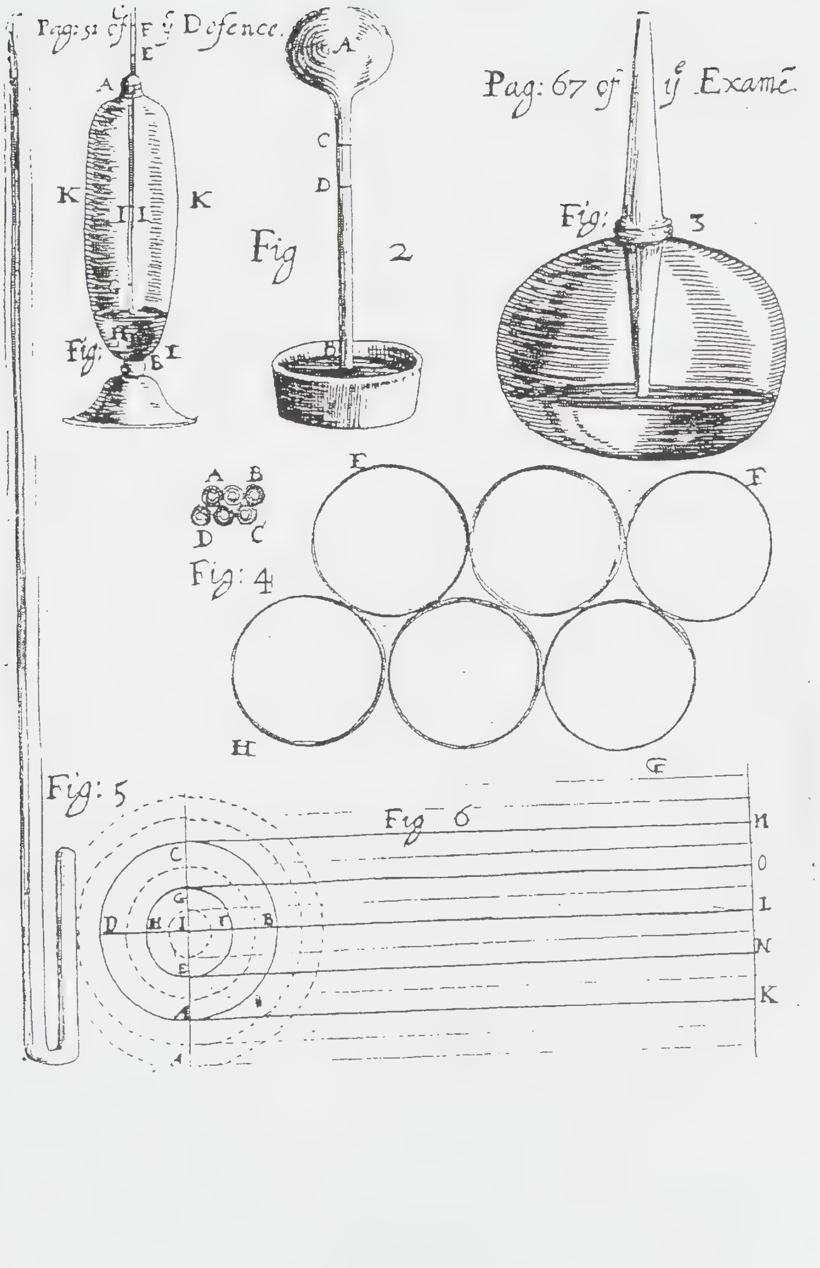


FIG. 67


Pag: 51 of ye Defence.
Pag: 67 of ye Examẽ.
A
E
F
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K
K
I
I
H
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Fig:
A
C
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Fig 2
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Fig: 3
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D C
Fig: 4
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F
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G
Fig: 5
Fig 6
C
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D
H
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K

FIG. 126 (Youmans' text - 4 COLOR)

PLANTS, ANIMALS, AND THE AIR.

hanges impressed by the Vegetable World upon the Atmosphere. Changes impressed by the Animal World upon the Atmosphere.

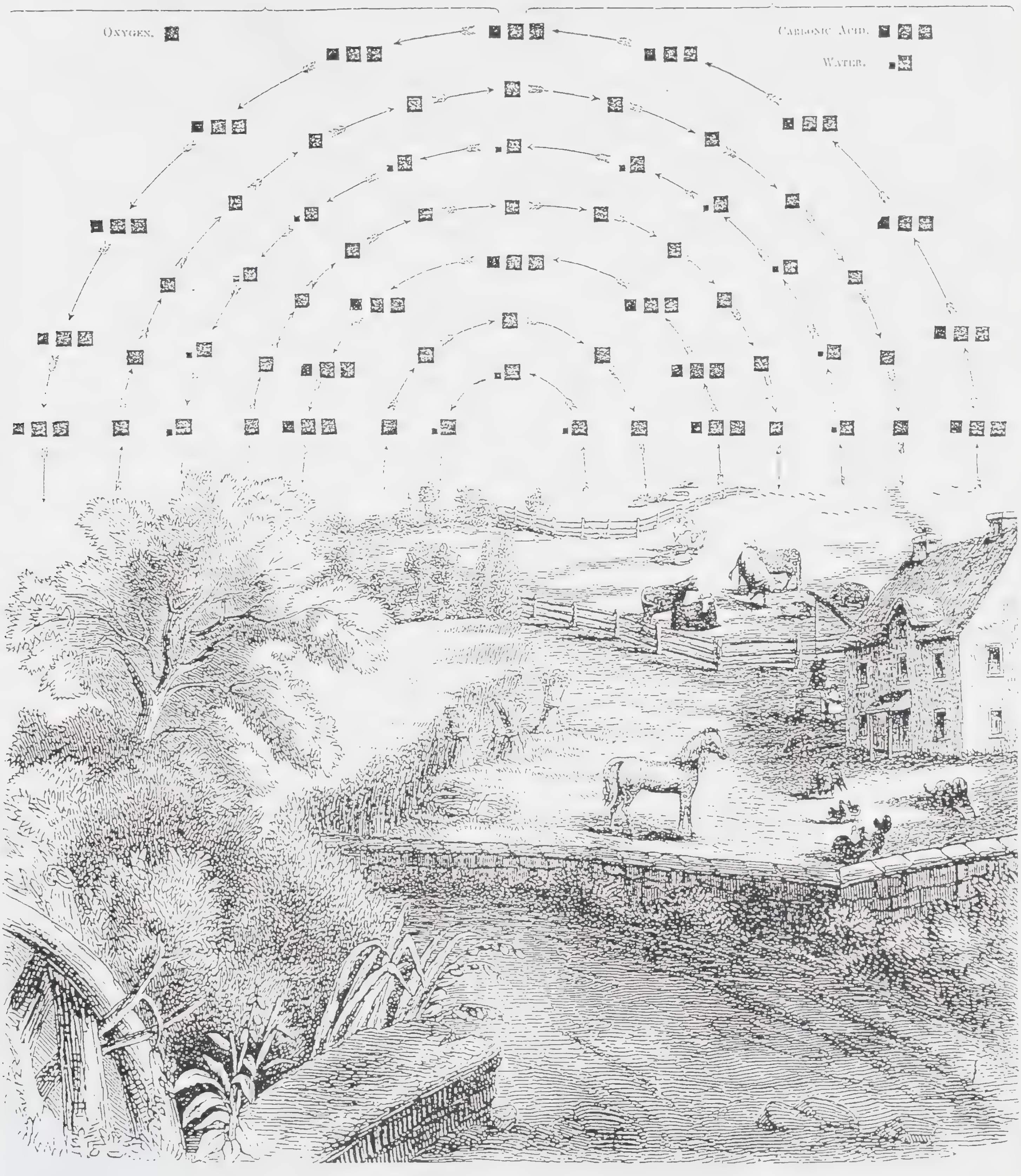
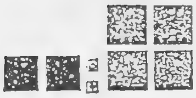


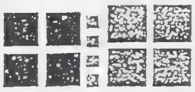
FIG. 128 (YOUMANS' 4 COLOR)

HOMOLOGOUS SERIES OF COMPOUNDS.

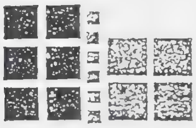
C_2H_2 is the common difference, that is, each member of the series differs from the one preceding it and the one following it by two equivalents of Carbon and two of Hydrogen.



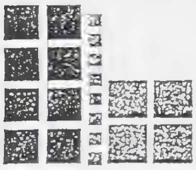
FORMIC ACID, $C_2H_2O_4$



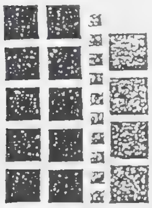
ACETIC ACID, $C_4H_4O_4$



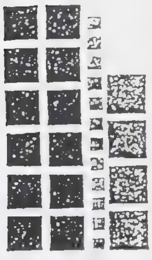
PROPYLIC ACID, $C_6H_6O_4$



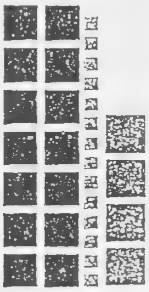
BUTYRIC ACID, $C_8H_8O_4$



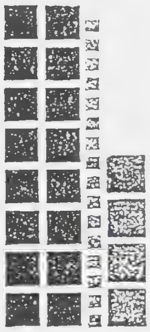
VALERIANIC ACID, $C_{10}H_{10}O_4$



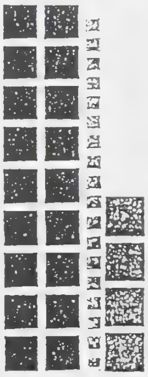
CAPROIC ACID, $C_{12}H_{12}O_4$



ÆNANTHYLIC ACID, $C_{14}H_{14}O_4$

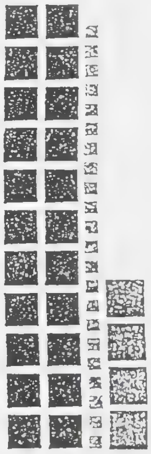


CAPRYLIC ACID, $C_{16}H_{16}O_4$



PELARGONIC ACID, $C_{18}H_{18}O_4$

CAPRIC ACID, $C_{20}H_{20}O_4$



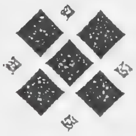
MARGARITIC ACID, $C_{22}H_{22}O_4$

LAUROSTEARIC ACID,	$C_{24}H_{24}O_4$
COCINIC ACID, - -	$C_{26}H_{26}O_4$
MYRISTIC ACID, -	$C_{28}H_{28}O_4$
BENIC ACID, - - -	$C_{30}H_{30}O_4$
ETHALIC ACID, - -	$C_{32}H_{32}O_4$
MARGARIC ACID, -	$C_{34}H_{34}O_4$
BASSIC ACID, - -	$C_{36}H_{36}O_4$
BALENIC ACID, - -	$C_{38}H_{38}O_4$
* * *	* * * *
BEHENIC ACID, - -	$C_{42}H_{42}O_4$
* * *	* * * *
CEROTIC ACID, - -	$C_{54}H_{54}O_4$
* * *	* * * *
MELISSIC ACID, - -	$C_{60}H_{60}O_4$

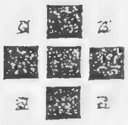
Fig. 129 (Youmans) 4 COLOR

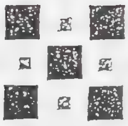
EXAMPLES OF ISOMERISM.

Metamerism.


Oil of Lemons.

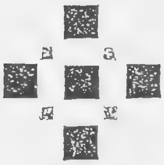

Oil of Turpentine.
(Spirits of Turpentine.)

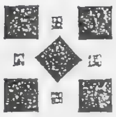

Oil of Juniper.


Oil of Copaiba.

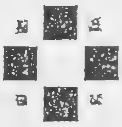

Oil of Limes.


Oil of Bergamot.

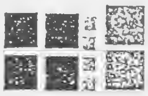

Oil of Black Pepper.

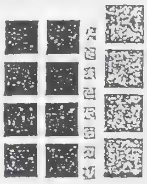

Oil of Oranges.

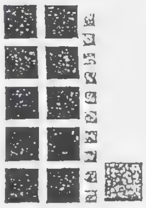

Oil of Roses.


Olefiant Gas.

Polymerism.


Aldehyde.


Acetic Ether.


Oil of Peppermint.

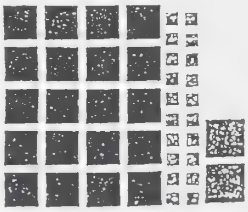
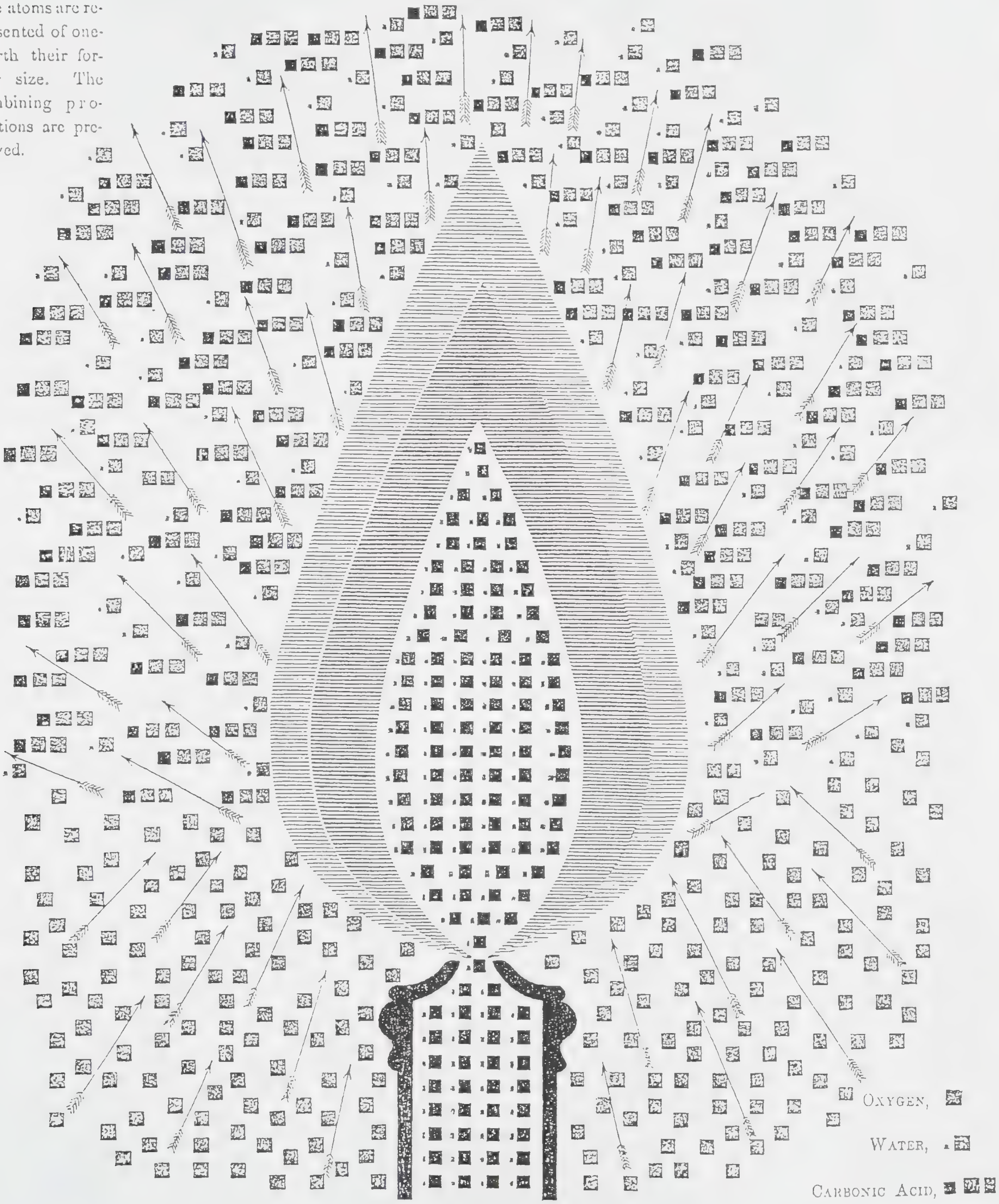

Oil of Lavender.

Fig. 139 (Youmans) 4-COLOR

CHEMISTRY OF COMBUSTION AND ILLUMINATION;

STRUCTURE OF FLAME.

The atoms are represented of one-fourth their former size. The combining proportions are preserved.



PREFACE

This book is perhaps the inevitable result of a twenty-five year university chemistry teaching career, a twenty-year book collecting fever and a rapidly accelerating interest in artwork. My first university chemistry teaching assignment included a "Chemistry for Non-Science Majors" course which sparked a lifelong interest in communicating chemistry to the public. In this type of endeavor, the question of "how did we come to believe or know this?" arises almost naturally and we take tentative steps to explore the historical development and context. It immediately becomes clear how little *we* practicing scientists understand about the histories of our own fields and, in any case, why *should* we understand more? In chemistry, most of the early beliefs and theories are now known to be incorrect, the symbols are outdated and the language arcane- often deliberately so. It is challenging enough to assimilate the canons of chemical knowledge as a student and then to battle (really, only slow down) obsolescence as a practicing chemist that it does not seem wise or practical to learn this superfluous, out-dated stuff.

I believe, however, that I can convincingly argue that part of being a cultured professional or an effective teacher is knowing the history of one's field and, thus, gaining historical perspective. I remember some twenty years ago attending an evening talk to a local American Chemical Society section by an organic chemistry professor whose work achieved considerable distinction during the 1950s and early 1960s. He began his talk by solemnly announcing that "Chemistry is a dead science." He indicated that each family meal began with a two-word prayer: "Be Useful" and that he was applying this philosophy to his professional work- no more theory. As a thirty-year-old chemist beginning his career, I was somewhat depressed to hear this from one of the beacons of the academic world and raised some questions concerning recent results in gas-phase organic chemistry that he cavalierly dismissed as artifacts. It is now clear that "reports of chemistry's demise were premature". Restriction enzymes for custom-tailoring DNA were being explored as our speaker finished his dessert; gas-phase chemistry experiments coupled with computation were changing our concepts of chemical behavior; the large-scale synthesis of C_{60} ("buckyball"), spectroscopic observation of transition states, and the ability to pick up and move individual atoms and write corporate logos in atomic script were only 15-20 years into the future. I would argue that our distinguished speaker lacked the historical perspective to realize that periods of consolidation are usually followed by bursts of discovery.

But perhaps of even greater importance is our need to reach out to the public and to capture the interest of students still in high school. First, most people feel that the sciences are purely objective and that facts and theories merely await discovery. When a fact is misinterpreted or a theory disproven, the feeling is that somebody was naive, made mistakes or worse. A feeling for the context and nature of discoveries ("How did we come to know this?" "Why could we not have known that back then?") would allow lay people to understand the human creativity involved in scientific

discovery and to better understand the scientific process.

Chemistry *is* in trouble. Visit any of the chain megabookstores and you will find large sections on astronomy and physics (Carl Sagan, Stephen Hawking, Roger Penrose and Richard Feynman are in vogue), computers, biology (Stephen J. Gould and Edward O. Wilson might not always agree but they both sell well), medicine and ecology. Even if the chemistry section is marked, it is small despite two recent wonderful books by Roald Hoffmann and renewed interest in Linus Pauling. In fact some of our books are found in the New Age section. And this is ironic. For among the sciences, chemistry has most clearly emerged from its practical and mystical beginnings to assume its place as the explainer of matter, deftly postulating groups of atoms too small to see with the best optical microscopes, which move at the speed of sound and are "alive" as briefly as a femtosecond. Molecular biology and biotechnology are both applied chemistry. Like the ancient Greeks, our culture has become the fabric of the society so that we are now almost forgotten except when a tank truck containing solvent overturns.

The purpose of this book is to provide a light-hearted tour through selected aspects of chemical history. It is meant to provide an entertaining and attractive, but informative resource for high school and college chemistry teachers as well as practicing professionals in chemistry and related fields, including medicine, and the lay public interested in science and appreciative of illustration. We are increasingly an image-oriented culture and I have, thus, provided a picture book with sufficient text to explain details and context. There are a number of truly wonderful books on aspects of chemical history. The most authoritative is the four-volume reference work *A History of Chemistry* by Partington- it is rigorous, amply referenced, engagingly written, nicely illustrated and read by very few chemists let alone non-scientists. (Partington also published a one-volume abbridgement). The book by Aaron J. Ihde, *The Development of Modern Chemistry*, is an excellent, and reasonably accessible, yet fairly comprehensive text, sharing most of the best aspects of the Partington tomes, but is also too scholarly to be widely read. Two books by John Read, published almost fifty years ago, *A Prelude to Chemistry* and *Wit and Humour in Chemistry* start to answer the need, but the first, for example, while nicely illustrated goes into depth in alchemy only. A number of other handsomely illustrated books on alchemy, Roberts, *The Mirror of Alchemy*, Burland, *The Arts of the Alchemists*, and *Alchemy, The Secret Art*, by De Rola, and the Time-Life book *Secrets of the Alchemists*, for example, are interesting and beautiful but do not speak to modern chemistry nor address the transition from alchemy to modern chemistry in a useful way. The venerable classic *Crucibles*, by Bernard Jaffe, is well aimed at a general readership and its "fly on the wall", novelistic approach, is amply justified by the number of readers, especially young readers, it has inspired over its continuing 65-year history. It has a nice balance showing the transition from alchemy to early twentieth-century chemistry, but it is sparcely illustrated and, thus, much less suited to a late twentieth century audience who might also find its writing style a bit quaint.

An excellent book is that by Ferchl and Sussenguth, *A*

Pictorial History of Chemistry, English translation of the original German book, published in 1939. It contains 185 plates compressed into 213 pages of informative and straightforward text and begins with the earliest stirrings of the chemical art and moves to the early nineteenth century, stopping at Liebig (*ca* 1840). Again, it is a bit much for an introductory student or a non-scientist. For practical reasons, numerous illustrations have been reduced in size to make room for text. When a folio-size illustration is reduced to a 2-inch-by-3-inch picture, the details must suffer and the illustration is devalued. This is not a criticism. The Ferchl and Sussenguth book is excellent but would not be widely read today even were it still in print. It is also worthwhile mentioning the enjoyable book by Edgar Fahs Smith, *Old Chemistries*, published in 1927 for chemical bibliophiles. It is a relaxed, idiosyncratic tour with over 30 plates, about half of these portraits of famous chemists, with a fireside writing style and a very nice coverage of early American chemistry. The 1949 book by Henry M. Smith, *Torchbearers of Chemistry*, is actually close to the philosophy of the present book in that pictures comprise about three quarters of the book. These pictures are, overwhelmingly, portraits of famous chemists and the text is mostly biographical and relatively brief in illustrating principles. The American Chemical Society fairly recently published a fine resource book titled *From Caveman to Chemist*. It has enjoyed considerable success despite lacking the enhancements of illustrations.

The present book, *A Chemical History Tour*, is almost as much an art book as a chemical history book. It has no pretension of thoroughness and reflects the idiosyncracies of the author-collector. It is meant to be skimmed as well as read. This book begins with the practical, medical and occult philosophical roots of chemistry and witnesses in pictures and some words its evolution into a modern science. It starts with the metaphorical frontispiece in the 1738 edition of *Physica Subterranea*, the last edition of the text by Becher that introduced the phlogiston concept and ends with images in two short works of the modern poet Seamus Heany. We trace the evolution of alchemical concepts into phlogiston and examine critical steps in the development of modern chemistry. Our coverage starts to thin out in the nineteenth century and is, deliberately, very sparce through the twentieth century. The modern literature continues to grow exponentially and, thus, "weighted" coverage would overwhelm the pre-twentieth century material and cause the reader to lose sight of the centuries-long evolution of our field. For these reasons, we highlight the atomic theory, development of organic chemistry (and specialization), the concept of valence, the structure provided by the Periodic Table, and the beginnings of stereochemistry in the nineteenth century. In the twentieth century, we highlight crystallography, Lewis theory, resonance (valence bond) and molecular orbital theories of bonding, artificial elements and the manipulation of single atoms on a surface. Thus, with the realization of transmutation (much more expensive than anticipated) and the manual manipulation of individual "corpuscles" we have come full circle.

I anticipate justified criticism of this idiosyncratic tour due to the numerous sites not visited and admit that there are

countless other paths through chemical history and apologize in advance for discoveries omitted or given short shrift. However, I want this book to be useful and to fulfill this mission it must be read and enjoyed by non-specialists. A more thorough or encyclopedic approach will not help to achieve this goal.

Although our Tour is meant to be both light-hearted and light reading it tackles some of the important issues that are often too lightly or confusingly broached in introductory courses and are difficult to teach:

-Was alchemy mere "puffery" or did it have a more profound role? What was its relationship to chemistry?
-Why did Boyle not understand how iron gained weight upon rusting?
-Did phlogiston theory really stall chemistry for almost 100 years or was it a truly great unifying theory that focused chemists on the right questions?
-What is meant by chemical affinity? Is it constant?
-If Dalton's Atomic Theory could not explain non-stoichiometric compounds or Berthollet's observations of the mass law effect, why was it retained in the early 1800s?
-How could a brilliant man like Van Helmont believe that a powder sprinkled on a bloody sword would cure the wound inflicted by the sword? (Were the early scholars idiots?)

Our Tour will occasionally add some humor and even some of the earthiness so evident in the Renaissance works of Chaucer and Rabelais. How else can one illustrate Van Helmont's suggestion for rapid and 100 % efficient punishment of anonymous "slovens" who leave excrement at one's doorstep? The ancients equated the metal iron to the planet mars- the planet was clearly red, blood is red-weapons are made of iron or steel; rust is red, and, by gum, we now feel that the surface of mars is covered by red oxides of iron-exciting to us, perhaps self-evident to them. It will examine such all-too-human foibles as Mendeleev's postulation of a new ultrasuper light inert gas to explain the Universal Ether in terms of his Periodic Table or Wilson's pyrrhic victory over Ben Franklin in the design of the lightning rod. We even furnish two nineteenth century pictures of dinosaurs to bring home the point that theorizing is a human endeavor and that we sometimes force data to incorrectly fit models in harmony with the paradigms of the day.

I hope to reengage chemists and other scientists in the history of our field, its advances, stumbles, its culture and its manner of expressing and illustrating itself and to provide teachers in introductory chemistry courses with some guidance through difficult teaching areas and a few anecdotes to lighten the occasional slow lecture. And if a few students are caught snickering over a page of Rabelaisian chemical lore or some bad puns, would that be such a bad thing?

I am grateful to Roald Hoffmann for having written the book *Chemistry Imagined*, in collaboration with artist Vivian Torrence, and to long-time friend Jeffrey Sturchio for pointing out the similarity in the style of the present book to that earlier one, which I so enjoyed reading and, sometimes, merely skimming.

(w/ Fig. 1)

WHAT FRESH HELL IS *THIS*?[1]

What does this allegorical figure represent? This bald, muscular figure has the symbols of seven original metals arrayed around and (possibly including) the head. Figure 2 defines these and other ancient symbols of the earliest known chemical elements. The all-to-perfect roundness of the head appears to correspond to the perfect circle that represents gold.

The elements, also including antimony and sulfur, are also buried in the intestines of the figure- literally its bowels and now we have a hint of its nature. Any attempts at further interpretation are in the realm of psychology rather than science and, indeed, the famous psychologist C.G. Jung owned a valuable collection of alchemical books and manuscripts and wrote extensively on the subject.[2]

At its heart, alchemy postulated a fundamental matter or state, the *Prima Materia*, the basis for formation of all substances. The definitions[2] of the *Prima Materia* are broad, partly chemical, partly mythological: quicksilver, iron, gold, lead, salt, sulfur, water, air, fire, earth, mother, moon, dragon, dew. At a more philosophical level, it has been defined as Hades as well as Earth.[2] Another figure from a seventeenth-century book on alchemy was identified by Jung as the *Prima Materia*- a similar muscular Earth shown suckling the "son of the philosophers".[2] Our figure also has the breasts of a woman and this hermaphroditic being is reminiscent of the derivation of Eve from Adam and the subsequent seeding of the human species.

Let us cling to the Earth analogy because it seems to help in understanding the presence of the elements in its bowels. The small figure in the upper abdomen may be considered to be a type of Earth Spirit nurturing the growth of living things (see vegetation below it) and "multiplication" of the metals. The unique positions of gold (the head as well as the highest level in the intestines) implies *transmutation*- the conversion of base metals into noble metals. The figure holds a harp, representing harmony, and an isosceles triangle representing symmetry. It is a metaphor for the unity the true alchemists perceived between their art and nature.

This plate is the frontispiece from the book *Physica Subterranea* published by the German chemist and physician Georg Ernst Stahl in 1738. It is the last edition of the famous book published by Johann Joachim Becher in 1669. Becher evolved chemistry's first unifying theory, the Phlogiston Theory, from alchemical concepts and it was subsequently made useful by Stahl. So in this plate are themes of alchemical transmutation, spiritual beliefs and early chemical science that will begin our Tour.

1. With apologies to the writer Dorothy Parker.
2. N. Schwartz-Salant, *Jung on Alchemy*, Princeton University Press, Princeton, New Jersey, 1995, pp 25-30; 44-49.

(w/ Fig. 2)

SEEDING THE EARTH WITH METALS

Chemistry began to emerge as a science in the early seventeenth century. Its roots included practical chemistry- the mining and purification of metals, the creation of jewelry, pottery and weaponry, medicinal chemistry- the use of herbs and various preparations made from them, and mystical beliefs- the search for the Philosopher's Stone or the Universal Elixir.

The figure shown here is the frontispiece from the final German edition (1736) of Lazarus Ercker's book *Aula Subterranea...* which was first published in Prague in 1574. Unlike so many books of the sixteenth century, this important treatise on ores, assaying and mineral chemistry was clearly and simply written by a person personally experienced in the mining arts. For this reason (and for its beauty) the book was reprinted in numerous editions over a period of 160 years. The plates in this 1736 edition are made from the original blocks used in the 1574 edition and the gradual, but slight but cumulative deteriorations in the blocks are evident in the various editions.[1] Image the value ascribed to this work to motivate printers to carefully preserve the blocks for centuries.

This handsome plate depicts the seeding by God of the metals into the earth (where they were thought to multiply) and the laborious human work in mining, purifying and assaying them. Although we recognize the seven metals (gold, silver, mercury, copper, lead, tin, and iron) as well as arsenic and sulfur as the 9 elements known to the Ancients, they were certainly not recognized then as elements in the modern sense. Instead they were considered to be rather mystical combinations of, for example, salt, sophic mercury and sophic sulfur.

1. A.G. Sisco and C.S. Smith, *Lazarus Ercker's Treatise On Ores And Assaying (translated from the German Edition of 1580)*, The University of Chicago Press, Chicago, 1951.

(w/ Fig. 3)

CHYMICALL CHARACTERS

This table of chemical symbols (Figure 3,E/plate54.w) is found in the book titled *The Royal Pharmacopoea, Galenical and Chymical, According to the Practice of the Most Eminent and Learned Physitians of France, and Publish'd with their Several Approbations*, the English edition published in 1678. The author, Moses Charras, fled religious persecution in France to join the enlightened intellectual environment in the England of Charles II, who chartered the Royal Society. Its membership included Robert Boyle, Robert Hooke and Isaac Newton.

The elements listed in the Table include the 9 ancient elements described previously and a few others readily separable. Gold, of course, being "inert" is commonly found in an uncombined state and its high density (about 9 times denser than sand) allows it to be panned. Actually, we now also know that inert gases such as helium, neon and argon are also found uncombined in nature, but they are colorless and odorless and, in any case, we are suddenly over 200 years ahead of ourselves and apologize to the reader for getting carried away by our enthusiasm.

The association of elements with planets and their symbols, evident in Figure 3, appears to have been adopted from the ideas of Arab cultures during the Middle Ages. Association of gold with the sun is too obvious. The others are more subtle. For example, of the planets, mercury appeared to the Ancients to move most rapidly in the sky and was most suited as a messenger. Mercury's wings nicely represent the metal's volatility. In contrast, Saturn was the most distant of planets observed by the Ancients (Uranus, Neptune and Pluto were discovered in the eighteenth, nineteenth and twentieth centuries). Its apparent slow movement through the skies was likened to Saturn, the god of seed or agriculture, who is sometimes depicted with a wooden leg. Lead was dense, slow...leaden. A person who is "saturnine" is sluggish or gloomy (not to be confused with a person who is "saturnalian"- riotously merry or orgiastic after the Roman holiday Saturnalia).

But let's return to a modern use of metaphor, based upon lead, and visit the book *The Periodic Table*, by Primo Levi,[1] who used 21 elements as metaphors in 21 stories. For example:

> *My father and all of us Rodmunds in the paternal line have always plied this trade, which consists in knowing a certain heavy rock, finding it in distant countries, heating it in a certain way that we know, and extracting black lead from it. Near my village there was a large bed; it is said that it had been discovered by one of my ancestors whom they called Rodmund Blue Teeth. It is a village of lead-smiths; everyone there knows how to smelt and work it, but only we Rodmunds know how to find the rock and make sure it is the real lead rock, and not one of the many heavy rocks that the gods have strewn over the mountain so as to deceive man. It is the gods who make the veins of metals grow under the ground, but they keep them secret, hidden; he who finds them is almost their equal, and so the gods do not love him and try to bewilder him. They do not love us Rodmunds: but we don't care.*

> *All the men have resumed their former trades, but not I: just as the lead, without us, does not see the light, so we cannot live without lead. Ours is an art that makes us rich, but it also makes us die young. Some say that this happens because the metal enters our blood and slowly impoverishes it; others think instead that it is a revenge of the gods, but in any case it matters little to us Rodmunds that our lives are short, because we are rich, respected and see the world.*
>
> *So, after six generations in one place, I began traveling again, in search of rock to smelt or to be smelted by other people, teaching them the art in exchange for gold. We Rodmunds are wizards, that's what we are: we change lead into gold.*

With his naked eye, ancient man could discern that the planet Mars is red, just as is the calx of iron ("rust"). Associating Mars- the god of war, with iron- the stuff of weapons, as well as with blood, is intuitively reasonable. Late twentieth century business executives still wear red "power ties" to meetings. But in an almost too wonderful confirmation of ancient intuition, the findings of the NASA Viking Mission, which landed two spacecraft on Mars in 1976, indicated a red surface composed of oxides of iron: eyeball chemical analysis by the Ancients at over 30 million miles- not bad!

But let us take irony one or two steps further. As of this writing, it appears that Mars sent its own messenger to Antartica 13,000 years ago in the form of Meteorite ALH84001.[2] Comparison of the carbon isotope content in the carbonate globules of the meteorite with Viking data indicated its Martian origin. Among the fragments of chemical evidence, the finding of iron(II) sulfide coexisting with iron oxides, suggests a biogenic origin since these two are essentially incompatible under abiotic conditions. The electrifying conclusion of the scientists[2]:

> *Although there are alternative explanations for each of these phenomena taken individually, when they are considered collectively, particularly in view of their spatial association, we conclude that they are evidence for primitive life on early Mars.*

1. P. Levi, *The Periodic Table* (English translation of the Italian text), Schocken Books, Inc., New York, 1984 (see pp 80-81 for the three quotations employed here).
2. D.S. McKay, E.K. Gibson, Jr., K.L. Thomas-Keprta, H. Vali, C.S. Romanek, S.J. Clemett, X. D., F. Chillier, C.R. Maechling and R.N. Zare, *Science*, Volume 273, Number 5277, 1996, pp 924-930.

(w/Figs 4-14)

PRACTICAL CHEMISTRY: MINING, ASSAYING AND REFINING[1]

Figure 4 (D/plate60.w) depicts the inside view of an assay laboratory of the late 16th century. Figures 4-14, like Figure 2, are from the 1736 edition of Ercker's *Aula Subterranae*... and were printed using plates from the 1574 edition. Figure 5 (F/erk.2.w) depicts a machine washing alluvial gold ores. The great density of gold (19.3 g/cm^3; water, 1.0 g/cm^3; mercury "only" 13.6 g/cm^3) allows its ready separation from sand and other minerals). Figure 6 (F/plate61.w) depicts the operations in making cupels. Cupellation was a technique for purifying gold or silver in ores. Cupels were cup-like objects made of ground bones in which ground ores were placed. The ores were principally sulfides and heating in air roasted the sulfides and formed oxides of the less noble (more reactive) metals while melting gold or silver. The oxides were absorbed into the cupel while a droplet of gold or silver remained on its surface.

To make cupels, calf or sheep bones are calcined (heated in open air), crushed and ground to the texture of flour and the "ash" moistened with strong beer. The ash is then placed in cupel molds (see A and C, Figure 6) and coated with facing ashes, best obtained according to Ercker, from the foreheads of calves' skulls. The molded ash is then pounded and shaped (see H, man pounding cupels), removed from the molds (see B and D and the stack of cupels E) and allowed to dry. In Figure 6, G depicts a man washing ashes and F is a ball of washed ashes.

Figure 7 (F/erk.4.w) depicts an assayer's balance including: A, Forged Balance Beam, B) Shackle, C) Half of Shackle, D) Filed Assay Beam with half of Shackle, E) Two little Beads- upper end of Shackle and Pointer, F) Ends, G) How the Beam is suspended, H) Sleeves of Shackle, K) knots by which Strings are hung, L) Pans of the balance, M) Assay Head Forceps.

Figure 8 (F/erk.5.w) depicts the amalgamation of gold concentrates and recovery of mercury by distillation of the amalgam. One of the earliest precepts of chemistry is "like dissolves like", which explains why oil floats on water while alcohol freely mixes with water. Mercury, being a liquid metal, dissolves other pure metals and forms alloys called amalgams. Relatively mild heating of the amalgam frees the volatile mercury from the metal of interest. However, mercury does not dissolve salts (calxes or oxides, sulfides) of metals. Thus, crushed ore was treated by Ercker with vinegar for 2 or 3 days, then washed and rubbed into mercury by hand and then with a wooden pestle by the amalgamator depicted in Figure 8.F. (*Note: Elemental mercury is very toxic- it caused nerve damage in workers who made hats in England during the 19th century- this was Mad Hatters' Disease- the source of the madness of the tea party in Alice in Wonderland. There has been some concern late in the twentieth century that amalgams used to make tooth fillings give off a steady stream of mercury vapor*). The mercury itself was purified by squeezing through a leather bag (see L and G in Figure 8). Distillation of mercury from the amalgam employed a large furnace called an Athanor (A) which supplied uniform and constant heat, side chambers (B), earthenware receiver (C) and still head (D), a blind head through

which water can be poured for cooling purposes (E), and an iron pot (lower part H; upper part K) to contain the amalgam to be heated. Also depicted (M) is a man who remelts gold using bellows.

Aqua regia (3 parts hydrochloric acid/1 part nitric acid) had the valuable property of dissolving gold and allowing its ready recovery (see our later discussion of this subtle chemistry). Figure 9 (F/erk.6.w) shows the distillation of *aqua regia* involving the Athanor (A) and a chamber B for the flask, situated as in C. D is the glass distillation head and E the receiver.

Figure 10 (G/erk.6.w) depicts the use of parting acid to separate gold and silver. Parting acid (essentially nitric acid) "dissolves" silver but not gold and is obtained by melting pure saltpeter (potassium nitrate, KNO_3) with vitriol, $FeSO_4$, adding a small amount of water and distilling.

Figure 11 (G/erk.7.w) shows a self-stoking furnace for cementation- a process having some similarities to cupellation for purifying gold. The "cement" is made by taking 4 parts of brick dust, 2 parts of salt and 1 part of white vitriol (zinc sulfate, $ZnSO_4$), grinding the mixed solid and moistening the powder with urine or sharp wine vinegar. One finger thickness of the cement is used to cover the bottom of the pot and upon this layer are placed thinly-hammered strips of less pure gold, moistened with urine, for further purification. Then follows alternating layers of cement and gold strips finishing with a top layer, one-half finger thick, of cement. The furnace is applied for 24 hours at a temperature lower than gold's melting point. At the conclusion, the powder is cleaned off and the resulting gold is said to be 23 carat.

Figure 12 (G/erk.8.w) depicts the smelting of bismuth in open air with the aid of a very stylized wind. Walnut-size pieces of ore are placed in pans such that windblown fire will smelt the ore and cause liquid bismuth to flow in the pans.

Although saltpeter was used to make nitric acid (for research?) on a small scale, its largest demand was for its use in manufacturing gunpowder. Figure 13 (G/erk.9.w) depicts steps in the leaching and concentration, by boiling, of saltpeter. First, the best "earth" for obtaining saltpeter was said by Ercker to come from old sheep pens (which contain the remains of excrement and rotted building matter). Part A depicts the "earth" to be leached and B shows pipes containing water to run into the vats. The vats are continuously drained into gutters (C) which run the leachate into a sump D. Part E depicts a little vat from which the leachate runs into a boiler and F-L depict parts of the furnace. The boilers distill off considerable water to move a concentrated "liquor".

Figure 14 (G/erk.10.w) shows pans (F) and tubs (G) for crystallizing concentrated leachate. One hundred pounds of this concentrate yield about 70 pounds of crystalline saltpeter upon standing.

1. The translations and interpretations used here were obtained from A.G. Sisco and C.S. Smith, *Lazarus Ercker's Treatise on Ores and Assaying (translated from the German Edition of 1580)*, The University of Chicago Press, Chicago, 1951.

(w/Figs 40-45)

THE WORDLESS BOOK

One of the most beautiful books of the seventeenth century was titled *Mutus Liber* (wordless book), published in France in 1677 and authored by "Altus" a pseudonym representing the "Classic Elder" of alchemy. It consists of 15 folio-sized figures with only slight text in the title figure which depict The Great Work. The figures are totally allegorical and there is no firm interpretation of them. It is interesting that the pictures depict a man and a woman (possibly husband and wife) apparently working as co-equals. This was a rather novel aspect of the book since women played virtually no significant role in chemistry for a long period. There was, however, apparently an ancient Alexandrian women called Maria the Jewess or Maria Prophetissa,[1-3] sometimes equated to Miriam the sister of Moses, who developed an early still called a *kerotakis* as well as the water bath, used for gentle heating. The water bath has survived into modern times and is termed the *bain-marie*. Moreover, Maria the Jewess is said to have originated the process of fusing lead-copper alloy with sulfur to make a blackish material.[3] Such black materials were often the starting points for transmutation and represent allegorical death preceding resurrection. This is one of the origins of the term "Black Arts" for alchemical practices.

The six figures shown here are selected from a 1914 Paris reissue of the *Mutus Liber*.[4] The title page (Figure 40) shows a picture believed to depict Jacob and the Ladder to Heaven. His head rests on a rock some say represents the Philosopher's Stone. The translation is as follows:[3]

> *The Wordless Book, in which nevertheless the whole of Hermetic Philosophy is set forth in heiroglyphic figures, sacred to God the merciful, thrice best and greatest, and dedicated to the sons of art only, the name of the author being Altus.*

Figure 41 is the second plate in the *Mutus Liber* and depicts the sun above two angels holding a vessel containing Sol and Luna at the sides of Neptune who is considered to represent a watery or liquid substance needed in the great work as the two alchemists kneel at their furnace. (Any chemist who has tried a new reaction would appreciate this picture). Figure 42 is the fourth picture in *Mutus Liber* and shows the collection of dew in sheets spread in the pasture under the influence of the sun in Aries and the moon in Taurus (Springtime). Dew is considered to be a type of *Prima Materia* and the two alchemists wring it into a large collection plate.

In the book's next figure (Figure 43), the man and woman prepare the dew for distillation. The man subsequently takes the distillate pours it into four vessels which are heated- apparently for 40 days. The woman removes the residue from the distillation vessel, spoons it into a bottle which she gives to an old man, holding a child and bearing the mark of Luna. Some interpret the man as Saturn.

In Figure 44 the original distillate, following 40 days of heating, is again distilled. Now the residue (left middle panel) takes on the aspect of a flower- possibly representing a color

change. The woman spoons this into a flask (wherein it now looks almost like our modern structure of benzene) and presents it to a figure possibly representing the sun-god Apollo and residue (from Figure 43?) is placed into a crucible. Subsequent mysterious operations include Saturn seemingly biting the infant, possibly to mingle the young child's blood into the operation. In Figure 45, the last picture in *Mutus Liber*, the Ladder is no longer needed, the body of Hermes lies at the bottom under the influence of Sol and Luna, the old man is being transported to heaven by angels and the two alchemists exclaim in unison:

> *Given eyes To see, thou seest.*[1]

The Great Work Is Finished.

1. C.A. Burland *The Art of The Alchemists*, MacMillan, New York, 1967, pp. 188-198. This book shows all 15 figures in a reasonably-large format.
2. *Secrets of the Alchemists*, Time-Life Books, Alexandria (VA), 1990, pp. 70-77. This book depicts all 15 figures (in gold tint no less!), significantly reduced in size, but with nice textual discussion.
3. Read, pp 155-159.
4. *Mutus Liber- Le Livre d'Images sans Paroles, ou toutes les operations de la Philosophie hermetique sont decribes et representes. Reedite d'apres l'original et precede d'une Hypotypose explicative par MAGOPHUN.*, Librairie Critique, Emile Nourry, 1914.

(w/ Fig. 46)

PARACELSUS

Theophrastus Bombastus Von Hohenheim (1493-1541), who called himself Paracelsus, applied chemistry to affect medical cures and fathered a field called *iatrochemistry*. His break with the ancient medical doctrines of Galen was total and his tone intolerant and bombastic. He is recognized as having introduced experiment and observation into medical treatment.

Rather than search for Paracelsan quotes, we borrow from the novel by Evan S. Connell, *The Alchymist's Journal* (North Point Press, 1991), in order to gain insight into his mind and style:

> *"I have said that all metals labor with disease, except gold which enjoys perfect health by the grace of elixir vitae. I have taught Oporinus how this metal is sweet and exhibits such goodly luster that multitudes would look toward gold instead of the generous sun overhead. In fixity or permanence this substance cannot be exceeded and therefore it must gleam incorruptibly, being derived from an imperial correspondence of primary constituents which makes it capable of magnifying every subject, of vivifying lepers, of augmenting the heart. Conceived by our gracious Lord, it is a powerful medicament. False gold, which is a simulacrum boasting no remedial virtue, assaults internal organs and therefore it should be abjured, since the alchymic physician repudiates meretricious matter. We must not keep true gold beyond its measure but distribute what we hold, allegorically reminding each man of an earthly choice he is obliged to make between damnation and bliss."*
>
> *"Pseudo-Alchymists that labor against quicksilver, sea salt and sulfur dream of hermetic gold through transformation, yet they fail to grasp the natural course of development since what they employ are literal readings of receipts. Accordingly they bring baskets of gilded pebbles to sell, or drops of silver in cloudy alembics- futile panaceas meant for a charnel house. This is false magistry."*
>
> *"Should it be God's will to instruct an alchymist at his art He will dispense understanding at the appropriate season. But if by this wisdom he concludes that anyman was unfit or should He decide that irrevocable mischief would ensue, then that sanction is withheld."*

The first novelized quotation indicates the imperfections in baser metals which are converted to gold (perfection) using the elixir vitae (or the Philosopher's Stone). True gold can be used as a medication. The second quotation indicates the hopeless quest of false alchemists, sometimes called "puffers" after their furnace bellows, whose goal is solely gold making without an eye toward the unity of alchemy with nature. The last is perhaps most interesting: failure to duplicate an alchemical recipe is due to God's denial of the secret to the unworthy seeker rather than shortcomings in the original formula or method. It is, by the way, never clear how the Stone or the Elixir brings about its transformations.

We may obtain some feeling for the medicine of the period by visiting some of the cures attributed to Paracelsus in a book published in London in 1652 titled *THREE EXACT PIECES of LEONARD PHIORAVANT, Knight and Doctor in PHYSICK, viz. His RATIONAL SECRETS, and CHIRURGERY, Reviewed and Revived, Together with a Book of Excellent EXPERIMENTS and SECRETS, Collected out of the Practices of Severall Expert Men in both Faculties, Whereunto is Annexed PARACELSUS his One hundred and fourteen EXPERIMENTS: With certain Excellent Works of B.G. a Portu Aquitano, Also Isaac Hollandus his SECRETS concerning his Vegetall and Animal Work, With Quercetanus his Spagyrick Antidotary for GUN-SHOT.* (Nice to know what's in a book before you buy it):

- A certain woman was long sick of the Passion of the heart, which she called *Cardiaca*, who was cured by taking twice our *Mercuriall* vomit, which caused her to cast out a worm, commonly called *Theniam*, that was four cubits long.

- A boy of fifteen years old, falling down a stone staires, had his arme and leg benummed and voide of moving, whose neck with the hinder part of the head, and all the back bone I annointed with this unguent:
    a) Of the fat of a Fox; b) Oyle of the earth-wormes; c) *Oleum Philosophorum*. I mixed them together, and annointed therewith, and in short space no wound nor swelling appeared in him so hurt.

- One that spit bloud, I cured by giving him one scruple of *Laudanum Precipitatum*[1], in the water of Plantaine, and outwardly I applied a linnen cloth to his brest, dipped in the decoction of the bark of the roots of Henbane.

- One had two Pushes, as it were warts upon the yard, which he got by dealing with an unclean woman, so that for six moneths he was forsaken of all Physitians as uncureable, the which I cured by giving him *Essentia Mercurialis*, and then mixed the oyle of Vitriol with *Aqua Sophia*, and laid it on warm with a suppository four daies.

- A boy of eighteen years old had a tooth drawn, and three months after a certain black bladder appeared in the place of the tooth, the which I daily annointed with the oyle of Vitriol, and so the bladder was taken away, and the new tooth appeared.

- A fat drunken Taverner was in danger of his life by a surfet, who was restored to his health by letting of bloud.

- One who was troubled with paines in the stomackthrough weaknesse, who took *Oleum salis* in his drink, and caused him to have many seeges or stooles, and so was restored to his health, as we have written on our book called *Parastenasticon*.

- A man that was troubled with the head-ach, I purged by the nostrills, casting in the juice of *Ciclaminus* with a siringe.

- A woman being almost dead of the Collick, I cured with the red oyle of Vitriol, drunk in Anniseed water, and a while after that potion, she voided a worm and was cured.

- To cause nurses to have abundance of milk, I have taken the fresh branches or tops of fennell, and boyled them in water or wine, and given it to drinke at dinner or supper, and at all times, for it greatly augmenteth the milk.

- A man being vehemently troubled a years space with pains in the head, I cured onely by opening of the skull, and in the same manner I cured the trembling of the brain, taking therewithall, *Oleum salis* in water of Basil.

- A Prince in *Germany* that was troubled with the Frenzie, by reason of a Sharp Fever, whom I cured by giving him five grains of *Laudanum nostrum*[1], which expelled the Fever, and caused him to sleep six houres afterward.

---

[1] Partington, Vol. 2, p. 150, notes that opium had been employed by the Arabs in their medicine well before Paracelsus. But he also raises doubts over whether Paracelsus' laudanum ever had any opium. If not, then the above cures suggest effective placebos.

THE DREAM TEAM OF ALCHEMY

The *Basilica Chymica*, by Oswald Croll, was published in 1611 and printed in subsequent editions for 100 years. It is credited for passing the knowledge of Paracelsus and his followers into the seventeenth century.

The book's beautiful frontispiece depicts the **Alchemical Dream Team:**

Hermes Trismegistus, Egyptian
Geber, Arabs
Morienes, Romans
Roger Bacon, English
Ramon Lull, Spanish
Paracelsus, Germans

It's a Dream Team in another sense as well. There is no evidence that a Hermes Trismegistus ever existed. The name of the reputed father of alchemy, Hermes-The-Thrice-Great, is a bit suspicious. In any case alchemy came to be called the "hermetic art". When we hermetically seal something, we protect it from air much as some alchemical experiments were sealed in glass and buried literally for years.

(w/Fig. 63)

VAN HELMONT AND THE "TREE EXPERIMENT"

How ironic that Johann Baptist Van Helmont (1577-1644) refers to "Dame Nature" as "the Proto-Chymist"[1], for if ever there was a human proto-chemist it was he. His writings navigate the borders between science, pseudo-science and superstition. The picture of Van Helmont (left) is from the *Ortus Medicinae*, compiled by his son the alchemist and polymath Franz Mercurious (also shown) and first published in 1648.

At a time when measurement and experiment were just beginning to define science, Van Helmont performed his famous "tree experiment". He believed that there were only two true fundamental elements, water and air, and that trees were composed of the element water. To test this hypothesis, he added 200 pounds of dried earth, moistened it with water and added the stem of a willow tree weighing 5 pounds. After 5 years of judicious watering he determined that the tree weighed 169 pounds, the soil, when separated and dried, still weighed 200 pounds and, thus, the extra 164 pounds could only come from addition of the element water.[2]

These conclusions were, of course, totally erroneous. We now know that the mass of the tree is comprised of cellulose and water. Cellulose is derived from photosynthesis (only discovered some 140 years later) involving carbon dioxide and water. And again, how ironic that the person who coined the term "gas" (from "chaos") and effectively *discovered* carbon dioxide did not understand its role in his "tree experiment".

1. J.B. Van Helmont, *A Ternary of Paradoxes* (translated by Walter Charleton), London, 1650, p. 7.
2. Leicester and Klickstein, pp 23-27.

(w/Fig. 63)

CURING WOUNDS BY TREATING THE SWORD WITH POWDER OF SYMPATHY

Let us explore Van Helmont's beliefs a bit further. He was a fervent believer in the Powder of Sympathy. Rather than defining it, let us let Van Helmont describe it's application[3]:

> *"...Mr. James Howel...interceding betwixt two Brothers of the sword, received a dangerous wound through the Arm: By the violent pain whereof, and other grievous accidents concommitant, he was suddenly dejected into extreem Debility and Danger. That in this forlorn plight, despairing to finde ease or benefit, by the fruitless continuance of Chirurgery, and fearing the speedy invasion of Gangraen, he consulted Sir K.D.*[4]*, who having procured a Garter cruentate, wherewith the hurt was first bound up, inspersed thereon, without the privacy of Master Howel, a convenient quantity of Roman Vitriol. That the powder no sooner touched upon the blood, in the Garter, then the patient cryed out, that he felt an intolerable shooting, and penetrative torment, in his Arm: which soon vanished upon the remove of all Emplasters and other Topical Applications, enjoyned by Sir K.D. That thenceforward, for three days, all former symptoms departed, the part recovered its pristine lively Colour, and manifest incarnation and consolidation ensued: but then Sir K.D. to compleat his experiment, dipt the garter in a fawcet of Vinegar, and placed it upon glowing coals; soon whereupon the Patient relapsed into an extream Agony, and all former evils instantly recurred. And finally, that having obtained this plenary satisfaction, of the Sympathy maintained between blood extravenated, and that conserved in the veins...he took again the Garter out from the Vinegar, gently dryedit, and freshly dressed it with the Powder, whereupon the Sanation proceeded with such admirable success, that within few days, there remained only a handsom Cicatrice, to witness there was once a wound.*

In other words, treat the dressings which once covered the wound and are covered with blood with the Powder of Sympathy and the cure will be communicated to the blood still in the body. This could be, incidentally, regarded as a conceptual advance beyond Paracelsus' earlier doctrine wherein sprinkling Powder on the sword which caused the wound would heal the wound. Van Helmont argued that it is not the sword, but the blood on the sword, that communicates with the wound.

3. Van Helmont, *op. cit.*, Prologue.
4. Sir K.D. was Sir Kenelm Digby, scientist, physician, privateer and gifted scoundrel whose Powder of Sympathy (a copper sulfate) was considered the best. He certainly was not faint of heart or capable of much sympathy himself.

(w/ Fig. 63)

DO ANONYMOUS PASSERSBY DEFECATE AT YOUR DOORSTEP? A SOLUTION.

Here is another practical use of the Sympathy concept[5]:

> *"Hath any one with his excrements defiled the threshold of thy door, and thou intendest to prohibit that nastiness for the future, do but lay a red-hot iron upon the excrement, and the immodest sloven shall, in a very short space, grow scabby on his buttocks, the fire torrifying the excrement, and by dorsal magnetism driving the acrimony of the burning, into his impudent anus."*

Think about this. First, it is not *only* blood that can "communicate" over long distances. Second, if only the blood of the wounded or the anus of the perpetrator is affected, then the cure and the punishment are "DNA-fingerprinted"- a major advance over late twentieth century medical care and forensic science.

[5] Van Helmont, *op. cit.*, p. 13.

(w/ Fig. 64)

A BATH TUB AND A STILL IN EVERY HOME

Johann Rudolph Glauber (1604-1670) is widely considered the father of industrial chemistry and chemical engineering. Although he certainly believed in transmutation, Glauber made numerous important contributions to chemistry. He was the first to describe crystalline sodium sulfate (Na_2SO_4), commonly termed Glauber's salt, and its seemingly amazing medicinal properties[1]:

> *"Externally adhibited, it cleanseth all fresh wounds, and open Ulcers and healeth them; neither doth it corrode, or excite pain, as other salts are wont to do. Within the body it exerciseth admirable virtues, especially being associated with such things whose virtues it increaseth, and which it conductith to those places to which it is necessary they should arrive..."*

He called sodium sulfate *Sal Mirabile* (Wonder Salt).

The three figures shown are from *The Philosophical Furnaces*, a work reprinted in the beautiful 1689 folio *The Works of The Highly Experienced and Famous Chemist*.... Stills (used for making wine, beer and medicines) and bath tubs of the period were usually made of copper, thus were extremely expensive and required special furnaces for each application. While not a problem for the wealthy, ownership of these household appliances was often out of reach for the less well off.

Glauber designed a copper globe, about the size of a human head along with its own furnace which could be moved and plumbed into inexpensive wooden stills and baths. (Plumbing seals were made with Oxe-bladders or with starch and paper.) Figure 1 shows the furnace (**A**) and copper globe (**B**) and their attachment to distilling vessel **C**, itself attached to refrigeratory **D** (with "worm"- twisted copper tubing for condensation) which feeds to receiver **E**. Figure 2 depicts a balneum (bath apparatus) with a cover having holes for glasses containing samples for gentle, controlled heating. The third figure shows a wood bath tub as well as a wooden box for a dry bath (to provoke sweat with volatile spirits). The same furnace (**A**) and copper globe (**B**) could be used with each appliance.

Although Glauber notes that heat is supplied more slowly than would be the case for a copper appliance with its own customized furnace, the savings are worthwhile (except for the wealthy for whom time is *always* money). As for those foolish enough not to avail themselves of this innovation, Glauber says:

> *"Let him therefore keep to his copper vessels, who cannot understand me, for it concernes not me"*.

---

1. Leicester and Klickstein, pp 30-33.

(w/Fig. 66)

BOYLE *VERSUS* ARISTOTLE AND PARACELSUS

Robert Boyle (1627-1691), born to an aristocratic English family, is considered by many to be the true father of chemistry. His most famous book, *The Sceptical Chymist* (1661), put an end to the Aristotlean concept of the Four Elements (air, earth, fire, water) and started the descent of the Paracelsian concept of the Three Principles (mercury, sulfur, salt). He demonstrated that air is necessary to support life and to transmit sound. His studies of air as a gas (pneumatic studies) were vital to the discoveries in the late eighteenth and early nineteenth century by Lavoisier, Dalton, Avogadro and others that led to the atomic theory- the fundamental paradigm of chemistry. The engraved title page shown here is from an early continental edition, published in Amsterdam in 1668 of *The Sceptical Chymist*.

(w/Fig. 67)

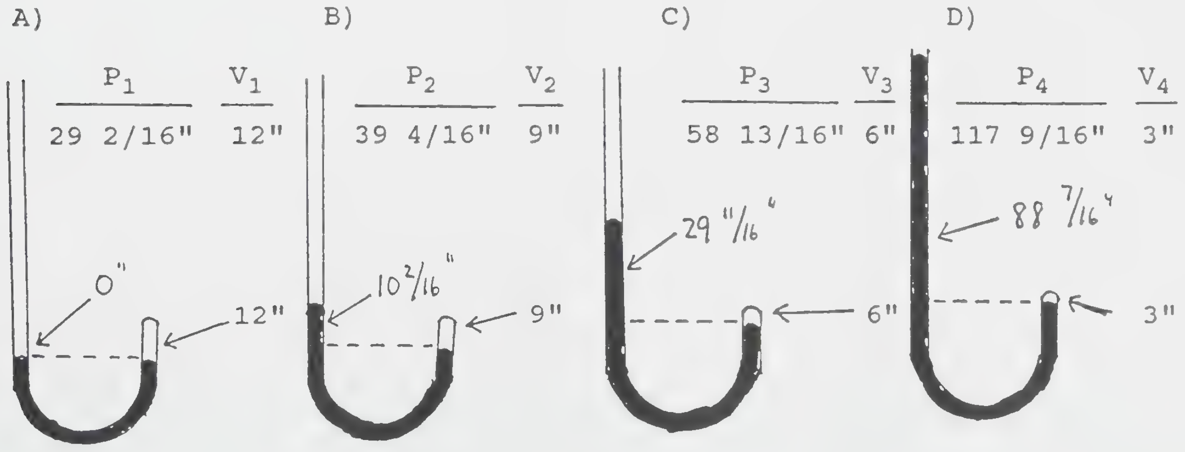
BOYLE'S LAW

The second edition of Boyle's first book, *New Experiments Physico-Mechanical Touching The Air*, was published in 1662 and contained a section titled *A Defense of Mr. Boyle's Explications of his Physico-mechanical Experiments, against Franciscus Linus.* In this section, he disclosed the relationship between the pressure and the volume of a gas which we now call Boyle's Law- the first Ideal Gas Law. Why must all high school chemistry students learn this simple relationship? In part, because Boyle's Law and the other gas laws helped to establish the reality of atoms and molecules over 150 years later.

In the plate shown here, Figure 5 depicts the J-tube Boyle designed to test the pressure/volume relationship of the only gas he knew- air. The experimental data pictured below are taken directly from Boyle's book. On the day he performed the experiments, the air pressure measured with a barometer, was 29 and 2/16 inches of mercury (the pressure of atmospheric air supports a column of 29 2/16 inches against a vacuum). Boyle poured mercury into the open end of the J-tube so as to trap a parcel of air and he carefully adjusted the amount of mercury so as to have equal heights of mercury in both arms (see Figure A). This means that the pressure on the trapped air sample is 29 2/16 inches. (Since the two arms of the tube have the same cross-sectional area, the volume is directly related to height, in inches, which Boyle used as his measure of relative volume). If enough mercury is added to compress the air "volume" to 9 inches (3/4 of the original volume), the total pressure is 39 4/16 inches (29 2/16 + 10 2/16) or 4/3 of the original pressure (Figure B). If sufficient additional mercury is added to compress the height of the trapped air to 6 inches from its original 12, inches, this air packet is supporting 29 11/16 inches of mercury in addition to the atmospheric 29 2/16 inches for a total of 58 13/16 inches: double the pressure- halve the volume (Figure C). In Figure D enough mercury has been added to compress the air to 3 inches (one fourth of original volume) and the total pressure on the trapped air packet is 88 7/16 + 29 2/16 or 117 9/16 inches or four times the original pressure.

Thus, the form of Boyle's Law is:

$$PV = \text{Constant} \quad \text{or} \quad P_1V_1 = P_2V_2 = P_3V_3 = P_4V_4 = \text{etc}$$



(w/Fig. 68)

WHO WOULD WANT AN ANTI-ELIXIR ?

A strange narrative indeed! Although *The Sceptical Chymist* rid chemistry of the Aristotlean Elements, Boyle was a believer in the possibility of transmutation (as was fellow member of the Royal Society Isaac Newton).

This pamphlet is considered to be the rarest of Boyle's works. Of the first [anonymous] edition published in 1678 and this second, attributed edition of 1739, Duveen[1] accounted for only four known copies combined although Ihde[2] suggests possibly four copies of each edition. In it Boyle narrates a series of one-time only reverse transmutation experiments he witnessed in which the transmuting agent was a miniscule amount of solid substance. The claim tested was that the substance could transform gold into a baser metal. Why would anybody be interested in such an "anti-elixir"? Using very modern chemical logic, Boyle reasoned that if one learns how to transmute gold into a baser metal, then one would also gain the knowledge to perform the reverse operation.

The experiments narrated in this pamphlet gave tantalizing but inconclusive evidence for the chemical degradation of gold into a lesser metal, perhaps even a salt, but the world's known supply of Anti-Elixir was consumed- apparently never to be rediscovered. Ihde[2] speculated over whether the experiment was ever done at all, done incompetently or was possibly a joke by Boyle. His firmer conclusions were that the experiment was, in all likelihood, actually carried out at Boyle's customarily high level of competence and that Boyle had no sense of humor, especially in regard to experimentation. Ihde's tentative conclusion: some sleight of hand by one of Boyle's laboratory assistants to give the chief his desired conclusion and help him recover from an earlier embarrassment at the hands of that young upstart Isaac Newton.[2]

1. D. Duveen, *Bibliotheca Alchemica Et Chemica*, HES Publishers, Dordrecht, 1986, p. 97.
2. A, Ihde, *Chymia*, No. 9, 47-57 (1964).

(w/Fig. 69)

THE TRIUMPHAL CHARIOT OF ANTIMONY

The plate shown here is from Nicholas Le Fevre's *A Compleat Body of Chymistry* (second English edition, 1670), one of the important texts of the seventeenth century. It depicts a chemist calcining (forming the calx or oxide) of metallic antimony using sunlight.

Antimony was one of the nine elements known to the ancients.[1] It was found as the ore stibnite (Sb_2S_3) and this black sulfide was used by women as an eye cosmetic in biblical times. An early means for obtaining the metal was to roast the ore on charcoal heated to incandescence. Later methods involved heating stibnite with tartar and nitre or with iron. The resulting "lead" was used to fashion a Chaldean vase of pure antimony around 4000 B.C.[1]

Early chemical books show an amazing fascination with antimony far beyond our modern interest. Why? One reason was its preferred use for releasing gold from metallic impurities. Antimony has a fairly low affinity for sulfur (higher than gold, lower than silver- see Geoffroy's Table of Affinities later- pure antimony or Regulus of Antimony is represented by a 3-pointed crown). Thus, its common ore will release sulfur to baser metals forming "scum" easily scooped from molten gold. It can separate silver from gold since silver captures sulfur from stibnite and the resulting liquid slag of silver sulfide and antimony sulfide is separable from gold antimonide. This last is burned to free the volatile antimony oxide leaving pure gold.[2]

The wolf depicted in the First Key of Basil Valentine, see earlier, represents antimony (sometimes called *lupus metallorum* or wolf of the metals by the alchemists). Another famous seventeenth century picture depicts the wolf devouring a dead human (impure gold) with subsequent burning of the wolf (loss of volatile antimony oxide) to release the king (gold).[3]

Now if metals could so effectively be purged of their impurities by antimony, should it not also be an effective human medicine- a purge (or emetic) to remove illness? Paracelsus first described antimony as a purge and set off a violent philosophical debate among physicians. The classical Galenical view was the use of a medicine with properties *contrary* to the disease. The Paracelsans argued for cure by *similitude* (*i.e.* fight poison with poison). The question of whether antimony was a medicine or a poison raged over centuries but was apparently settled by the cure of Louis XIV with vin emetique (emetic wine- yum) in 1658.[4] Le Fevre was much taken with medicinal antimony and particularly with its purification and fixation (as the calx) by the sun.[4] He too noted the increase in weight upon calcination. The book *Triumphal Chariot of Antimony*, first published in 1604 and attributed to the legendary Benedictine Monk, Basil Valentine, used this flashy, hollywood-like title to strike a blow for antimony in this long and passionate debate. For a modern encore, we eagerly await the movie version starring Kirk Douglas as the chariot-driver.

It is worthwhile recognizing that modern anti-cancer agents "poison" normal cells, but are greater poisons to cancerous cells which multiply much more rapidly. Thus, the Paracelsian view is vindicated in this case but not in neutralizing stomach acid.

1. N.N. Greenwood and A. Earnshaw, *Chemistry of the Elements*, Pergamon Press, Oxford, 1984, p. 637.
2. F. Ferchl and A. Sussenguth, *A Pictorial History of Chemistry*, William Heinemann Ltd., London, 1939, p. 61.
3. Read, *op. cit.*, pp 200-202; 240-241 (see Plate 47 in this book which is taken from the book by Michael Maier (1687) titled *Secretioris Naturae Scrutinium Chymicum*.
4. A.G. Debus, *The French Paracelsans*, Cambridge University Press, Cambridge, 1991, pp 21-30; 95-99

(w/Fig. 70)

A HARVARD-TRAINED ALCHYMIST

Renaissance alchemy conjures up back alleys in Prague and other Old World images. Harvard University is, of course, strictly New World in our minds- a cradle for progressive thought and the home of Nobel Laureates. How delightful that John Starkey (born in Bermuda in 1628, died in the London plague of 1665) provides us with a surprising conjunction of the Old and New Worlds.[1,2] Eirenaeus Philalethes ("A Peaceful Lover of Truth") was the pseudonym provided for his posthumous writings and *Secrets Revealed* (see Figure) is the english translation of his most influential book.

Starkey graduated from Harvard in 1646, one of a class of four[3] who received their lectures from President Dunster.[2] He shared a dorm room (measuring no more than 7 feet 9 inches by 5 feet 6 inches) with a John Allin.[2] Courses included "Logick", "Physicks", "Ethicks and Politicks" and "Arithmetick and Geometry".[2] The natural philosophy curriculum at Harvard reflected some of the finer points of the great debate between the Aristotleans (matter is continuous; there are no vacant spaces; "nature abhors a vacuum") and Cartesians such as Boyle (followers of Descartes who believed matter to be composed of finite particles or corpuscles which collide with our sensory organs). According to Newman,[2] this division was not so clearcut at Harvard where a late Aristotlean view, which allowed for finite particles, was in currency. In any case, following graduation Starkey rated the natural philosophy curriculum at Harvard as "totally rotten".[2]

On the basis of his examination of Harvard theses from the mid-seventeenth to late-eighteenth centuries, Newman[2] notes the following successfully-defended positions:

1687-Is there a stone that makes gold? Yes.
1698,1761-Is there a universal remedy? Yes in 1698, No in 1761
1703-Can metals be changed into one another alternately? Yes.
1703,1708,1710-Is their a sympathetic powder? Yes.
1771-Can real gold be made by the art of chemistry? Yes.

As Newman notes,[2] "Obviously, Harvard was far from being an uncongenial place for the budding alchemist; as late as 1771, Harvard undergraduates were defending the powers of the philosopher's stone".

Moving to England in 1650, Starkey became an important exponent of Van Helmont's approach and worldview. Van Helmont did not support the Galenical view of medication ("contraries") or the Paracelsian view ("similitude"). Instead he believed in cures that produced "healing ideas in the *Archeus*"- the inner architect or life spirit located in a region between the stomach and spleen.[4] Van Helmont and Starkey shared a belief in the importance of pyrotechny (arts, such as distillation, involving fire) and the utility of practical, experimental work. Starkey had little use for the abstractions of mathematics. He referred to himself, as a Philosopher By Fire, in sneering contrast to the safe academicians who eruditely cited published facts. Such firey rhetoric made him few academic friends. However, he had important correspondence with Robert Boyle and Newman establishes that Isaac Newton, who seriously studied alchemy, cited Starkey's works far more often

than any other alchemist of the period.[2] "Heady stuff" for a young man of modest means from the Colonies.

1. C.C. Gillespie (Editor-In-Chief), *Dictionary of Scientific Biography*, Vol. XII, Charles Scribner's Sons, New York, 1975, pp. 616-617.
2. W.R. Newman, *Gehennical Fire: The Lives of George Starkey, an American Alchemist in the Scientific Revolution*, Harvard University Press, Cambridge, Massachusetts, 1994.
3. The historical evidence is, thus, unambiguous: there was no varsity basketball team when Starkey attended Harvard.
4. J.R. Partington, *A History of Chemistry*, Vol. 2, MacMillan and Co. Ltd., London, 1961, pp 209-241.

(w/Fig. 71)

PHLOGISTON: CHEMISTRY'S FIRST COMPREHENSIVE SCIENTIFIC THEORY

The initial concept of phlogiston was due to Johann Joachim Becher (1635-1682) and has clear alchemical roots.[1] For Becher, the important elements were Water and three Earthy Principles. (He regarded air and fire to be agents of chemical change rather than elements in the chemical sense). His three Earthy Principles corresponded very roughly to the Paracelsian "salt", "mercury" and "sulfur". This last "sulfur-like" Earthy Principle was termed *Terra Pinguis* ("fatty earth") by Becher and was said to be present in combustible matter and released upon combustion. It was this principle that Georg Ernst Stahl (1660-1734) later equated to his phlogiston (O).

Becher *was* aware, as was Boyle (see effluviums discussion earlier), that calxes were heavier than the corresponding metals. He too attributed these observations to igneous ("firey") particles small enough to move through glass and join the metal inside.

Becher was an argumentative man who described himself as[2]:

> *"...one to whom neither a gorgeous home, nor security of occupation, nor Fame nor health appeal, for me rather my chemicals amid the smoke, soot and flame of coals blown by the bellows. Stronger than Hercules, I work forever in an Augean stable, blind almost from the furnace glare, my breathing affected by the vapour of mercury. I am another Mithridates, saturated with poison. Deprived of the esteem and company of others, a beggar in things material, in things of the mind I am a Croesus. Yet among all these evils I seem to live so happily that I would die rather than change places with a Persian King."*

Clearly, Becher was a truly "hard-core", "gung-ho" chemist. Happily, we modern-day chemists do not have to recite this pledge as our professional oath.

The figure shown here is from the book *Oedipus Chymicus*[3] (1664) and it depicts Oedipus solving the riddle posed by the Sphinx. It is thought to represent the chemist solving the alchemical riddle and is consistent with Becher's firm belief in transmutation. Of course, once Oedipus relieved Thebes of the dreaded Sphinx he was made King but other disasters followed.

Perhaps personal disaster would have also afflicted the discoverer of the Philosopher's Stone or the Elixir: King Midas comes to mind.

1. Leicester and Klickstein, pp 55-58.
2, Partington, Vol. 2, pp 637-652 (quotation on p. 639).
3. This figure, from the book *Oedipus Chymicus* is from *Science and Technology: Catalog 5* (San Francisco: Jeremy Norman & Co., Inc., 1978),p. 13. Courtesy of Jeremy Norman & Company, Inc.

(w/ Fig. 72)

GUN POWDER, LIGHTNING AND THUNDER, AND NITRO-AERIAL SPIRIT

Gunpowder is a mixture of saltpeter (KNO_3) or nitre ($NaNO_3$), sulfur and carbon developed possibly as early as 1150 AD by the Chinese.[1] Its explosive power is due to the reaction below in which a large volume of gas (carbon dioxide and nitrogen) is generated suddenly and violently along with a great deal of heat. Gunpowder burns under water or in a vacuum. In modern terms, we see saltpeter as the oxidizer (in place of gaseous oxygen) which converts charcoal to carbon dioxide. Thus, saltpeter and nitre are capable

$$2\ KNO_3 + 3\ C + S \longrightarrow N_2 + 3\ CO_2 + K_2S$$

of supporting combustion. Calcination of antimony in air, under a magnifying glass and sunlight (see earlier figure) formed the same calx (Sb_2O_3 in modern terms) as obtained by dissolving antimony in nitric acid (HNO_3) and heating. Apparently, "nitro-aerial spirit" present in saltpeter and nitric acid is also present in air.

These observations led two of Boyle's assistants, Robert Hooke (1635-1703) and John Mayow (1641-1679), to form theories that appear, at least superficially, to anticipate Lavoisier.[2] Hooke, a physicist, discovered diffraction, the law of elasticity, invented the compound microscope, coined the term "cell" for the microscopic chambers in cork, and made a number of important observations and discoveries in astronomy. Hooke explained lightning and thunder by the violent clash between sulfurous matter in air and nitro-aerial spirit similar to saltpeter. "Sulfurous matter" has a bit of the "smell" of Becher's *terra pinguis* to it.

Mayow took this view a number of steps further.[2-4] In his 1674 book *Tractatus quinque Medico-Physici* he reported a brilliantly-designed experiment in which a candle is burned in a glass bulb inverted over water. In this apparatus there is also a stage with camphor or sulfur on it. When the burning ceased, Mayow cleverly demonstrated a loss in air volume. He then used a magnifying glass and tried unsuccessfully to ignite the flammable camphor or sulfur in this depleted atmosphere. His experiments further indicated that nitro-aerial spirit was needed for calcination and respiration as well as combustion. Mayow also noted, along with other contemporaries, that metal calxes were heavier than the metals.

The idea that addition of a component of air was required for combustion, calcination and respiration seems to have anticipated Lavoisier by 100 years. Had Mayow heated nitre strongly in his investigations, he might have discovered oxygen[3] and, some might argue, allowed chemists to skip Stahl's phlogiston theory. However, like Van Helmont who coined the term "gas" 30 years earlier for his *spiritus sylvester* which escaped from burning charcoal, Mayow did not really have the expertise to collect gases and the pneumatic chemistry introduced by Hales was still 50 years in the future.

1. J.R. Partington, *A Short History of Chemistry*, Third Ed., Dover Publications, Inc., New York, 1989, p 33.
2. Partington, *op cit*, pp 80-84.
3. Brock, pp 72-74.
4. Hudson, pp 44-46.

(w/ Fig. 73)

THE "MODERN" PHLOGISTON CONCEPT

The Phlogiston concept was chemistry's first truly unifying theory and was developed in its useful form early in the eighteenth century by Georg Ernst Stahl (1660-1734), an irrascible, egotistical and rather unpleasant chemist and physician. It was said of him that: "Stahl seems to have regarded his ideas at least in part due to divine inspiration and the common herd could have no inkling of them".[1] "...his lectures were dry and intentionally difficult; few of his students understood them".[1] Stahl attacked adversaries vehemently and while he clearly acknowledged his debt to Becher (Stahl reissued Becher's *Physicae Subterranae*, see the first plate in the present book), he also found much to criticize.

The plate shown is the title page of Stahl's famous 1723 textbook. It summarizes Stahl's views as early as 1684. Over a half-century later this book was ceremoniously burned by Madame Lavoisier dressed in the outfit of a Priestess.

Phlogiston (0) was postulated to be present in substances that could burn as well as in metals, which were known to form calxes. The concept works like this:

$$\text{Charcoal (contains } \phi\text{)} \longrightarrow \text{Residue} + \phi$$

$$\text{Metal (contains } \phi\text{)} \longrightarrow \text{Calx} + \phi$$

Aside from relating these two seemingly very different kinds of chemistry, it explained the well-known ability to convert calxes into metals by heating with charcoal:

$$\text{Calx} + \text{Charcoal (contains } \phi\text{)} \longrightarrow \text{Metal (contains } \phi\text{)} + \text{Residue}$$

Similarly, combustion of phosphorus in air formed phosphoric acid, of sulfur, sulfuric acid. Heating of these acids with charcoal produced elemental phosphorus and sulfur respectively.

This powerful and conceptually useful theory held sway for about a century. When Priestley discovered oxygen in 1774, he called it "dephlogisticated air" since it supported combustion which allowed it to vigorously attract phlogiston from substances such as charcoal or to iron. Nitrogen was initially called "phlogisticated air" because it did not support combustion and was obviously saturated with phlogiston. When Cavendish discovered hydrogen gas in 1766 and found that its density was less than one-tenth that of air, he thought this flammable gas was phlogiston itself.

Although we sometimes are told in chemistry texts that the phlogiston concept delayed modern chemistry by 100 years, this theory was a powerful unifying concept and raised the right questions for later experiments. One of these was the well known problem of the gain in weight of metals upon forming calxes despite their *loss* of phlogiston during calcination. Attempts to retain the theory by postulating negative weight (levity) for phlogiston ultimately failed to convince the scientific community.

1. Partington, p 655.

(w/ Fig. 74)

WHAT *ARE* EFFLUVIUMS ?

"Effluvium": now there's a rare word! *Websters's New World Dictionary of the American Language* (College Edition) defines it as: 1. a real or supposed outflow of a vapor or stream of invisible particles; aura. 2. a disagreeable or noxious vapor or odor (plural: effluvia).

Boyle believed in a corpuscular theory of matter- something of a forebearer to atomic theory. In this pretty little "Effluviums" book he conducts *gedanken* (thinking) experiments to calculate the upper limits to the measurable masses of effluvia. But before we illustrate some of these, let Boyle define the contemporary debate:

> *"Whether we suppose with the Ancient and Modern ATOMISTS, that all sensible Bodies are made up of Corpuscles, not only insensible, but indivisible, or whether we think with the CARTESIANS, and (as many of that Party teach us) with ARISTOTLE, that Matter, like Quantity, is indefinitely, if not infinitely divisible: It will be consonant enough to either Doctrine, that the EFFLUVIA of Bodies may consist of Particles EXTREMELY SMALL. For if we embrace the OPINION OF ARISTOTLE or DES-CARTES, there is no stop to be put to the subdivision of Matter, into Fragments, still lesser and lesser. And though the EPICUREAN Hypothesis admit not of such an INTERMINATE division of Matter, but will have it stop at certain solid Corpuscles, which for their not being further divisible are called ATOMS ("atomos") yet the Assertors of these do justly think themselves injured, when they are charged with taking the MOTES or small Dust, that fly up and down in the Sun-Beams, for their Atoms, since, according to these Philosophers, one of those little grains of Dust, that is visible only when it plays in the Sun-Beams, may be composed of a multitude of Atoms, and may exceed many thousands of them in bulk."*

(MODERN) ENGLISH TRANSLATION: Do not think, for a moment, that I am so foolish, as to assume that the effluvia whose masses I will estimate are the same things as my version of atoms. I am estimating an upper limit for the masses of effluvia each of which are composed of many thousands of atoms. In any case, stay tuned and see how effluvia explain my observations of metals and their calxes.

Here are some thought experiments by Boyle:

1. One grain (0.0648 grams) of silver has been drawn by a master silversmith into a wire 27 feet long. Boyle had a special ruler subdivided into 200 divisions per inch. Therefore, the wire can be subdivided into 27 X 12 X 200 = 64,800 silver "cylinders" each weighing 0.0000010 gram (1.0×10^{-6} g).

2. If it were possible to gild this silver wire, the mass of the gold sheath would be even much less per "cylinder of sheath".

3. "An Ingenious Gentlewoman of my Acquaintance, Wife to a Learned Physician" drew 300 yards of silk gently from the mouth of a silkworm. The silk strand weighed 2.5 grains. The division of the silk gave 300 X 3 X 12 X 200 = 2,160,000 silk "cylinders" each of mass 0.000000075 grams (7.5 X 10^{-8} g).

4. Six minute pieces of gold were each beaten into squares with 3 1/4 inch sides. The total mass of the six square leaves of gold was 1 1/4 grains. Therefore the six square leaves could be subdivided into a total of 6 X $(3.25 \times 200)^2$ = 2,535,000 squares of gold each weighing 0.000000032 grams (3.3 X 10^{-8} g).

Now, if we go "Back To The Future", we know that 1 mole of gold has a mass of 197.0 grams and is comprised of 6.02 X 10^{23} atoms (Avogadro's number). Therefore, an individual gold atom weighs 3.27 X 10^{-22} grams- about 100 trillion times less than the minute square gold effluvium above. However, Boyle never claimed to be weighing individual atoms.

And why this interest in effluviums? Toward the end of the book Boyle describes his accurate measurement of the *increase* in weight upon heating a metal, such as iron, in air to form a calx such as rust. In 1673 this was an extremely important observation (also noted by Ray, Becher, Stahl, Mayow and Le Fevre among others). Boyle's explanation: minute effluviums in the flame (Becher's igneous particles) penetrate the pores of the sealed glass vessel containing metal and air and "adhere" to the metal thus forming a calx weighing more than the metal. This was a near avoidance of the Phlogiston Theory that was already in its embryonic stage.

It is also worth noting that Van Helmont explained the "sympathy" concept as well as magnetic phenomena as arising from contact between effluvia (for example, between the blood on a sword and the blood in the wounded person's body).

Toward the end of the "Effluviums" book Boyle explicitly raised the possible health issue of the effect of effluviums from fire landing on cooked meat and being consumed. We now know that when the fats from meat drip onto hot coals during charbroiling, they pyrolyze to form carcinogenic polycyclic aromatic hydrocarbons which rise up from the grill and deposit on the surface of the meat. Thus, in this regard, Boyle anticipated the human exposure health specialists by 300 years.

(w/ Fig. 85)

CHEMICAL AFFINITY

Pictured is one of the first logically organized tables of the properties of chemical substances. It was composed by Etienne-Francois Geoffroy (1672-1731) in 1718.[1] The top horizontal row depicts 16 substances (elements and compounds), classes of substances and even mixtures in a fairly arbitrary order from left to right. Each column rank orders substances according to "affinity". Those substances closest to the top have the highest affinities for the substance at the top (the "header"), while those toward the bottom have the lowest affinities.

Let's examine some brief illustrative examples. In Column 16, we see water as the "header" with alcohol above salt. This means that alcohol has a greater affinity for water than salt. Thus, if you added "alcohol" (say, ethanol or 200 proof vodka) to salt water (saline) the liquids would mix and the salt would precipitate forming a filterable solid. Alcohol has displaced salt from water. In contrast, if you took 50:50 alcohol/water (100 proof vodka), you could not dissolve salt in it since water has greater affinity for alcohol.

Column 1 shows the chemical affinities of substances for acids. Most metals react chemically with acids and release hydrogen gas- they appear to "dissolve" and release "air". However, if we first mix an alkali (base) such as potassium carbonate (K_2CO_3) with the acid and neutralize it, the solution will no longer "dissolve" metals. If a metal is "dissolved" in acid and alkali is added, a solid will precipitate (actually the insoluble metal carbonate or hydroxide). Thus, the alkalis have higher "affinity" for acids than do metallic substances.

But wait a minute dear readers. Those of you who have had some high school chemistry realize that solubilities of alcohol and salt in water are physical properties while "solubilities" of metals in acids are chemical properties. *You* would not have received a good grade for confusing the two. Clearly, the differences were not yet fully clear to early eighteenth century scientists.

Human history is writ large in Column 9! Let us look at the affinities of sulfur. Of the metals shown, iron has the highest affinity, with tin and copper (which form the alloy bronze) having lower affinities. Tin and copper ores (commonly sulfides) could be smelted relatively easily and the Bronze Age thus began around 3000 B.C. Higher temperatures, and therefore more modern furnace technology, were required to win iron from its sulfides and the Iron Age only began around 1200 B.C.

Notice gold at the bottom of Column 9. This noble metal has little affinity for sulfur and can often be found in nature as shiny nuggets or granules in an uncombined state.

Geoffroy's table, a somewhat arbitrary conglomeration of chemical and physical properties, elements, compounds, classes of substances and mixtures, is, nevertheless, a distant relative of the Periodic Table, formulated some 150 years later.

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1. This version of Geoffroy's table is from M. De Machy, Recueil de Dissertationes Physico-Chimiques, Paris, 1781 (Plate 1). Also, see discussion in Leicester and Klickstein, pp 67-75.

(w/ Fig. 89)

CAVENDISH WEIGHED THE EARTH BUT THOUGHT HE HAD CAPTURED PHLOGISTON IN A BOTTLE

Although we modern chemists go to some lengths to let the public know that we play tennis, like fast cars and stylish clothes and are down-to-earth social-mixer types, we must admit that our passion for smelly, smokey mixtures will likely get us booted from most respectable country clubs. Henry Cavendish (1731-1810) was definitely an unwordly type. He lived with his father until the latter died in 1783, did not marry, communicated with his housekeeper using daily notes and dressed in shabby, out-dated clothing despite inheriting a fortune when he was 40.[1] The French physicist Jean-Baptiste Biot described him as "the richest of all learned men, and very likely also the most learned of all the rich."[1]

In our modern era when university tenure decisions are sometimes based upon the sheer poundage of publications, it is interesting to note that Cavendish published 18 papers in the *Philosophical Transactions of the Royal Society* (and no books).[2] He left many unpublished works and unstylishly referred to them in his published works.

But what works they were! In his first paper, published in 1766, Cavendish employed the pneumatic studies of Stephen Hales and Joseph Black to isolate hydrogen gas by pouring acids on metals such as zinc, copper and tin. Indeed, the well known affinities of these baser (more active) metals (see Geoffroy's Table of Affinities) for acids were long known to produce calxes. In so doing, the metals were believed to lose phlogiston to the air. The ignitable gas collected, which appeared to escape from the metal, was named by Cavendish "inflammable air". It was less than one tenth the density of atmospheric air and for a period it was felt that phlogiston itself had been isolated.

In 1784 Cavendish published his work on the composition of water based upon his experiments igniting hydrogen in air. (Primacy for the discovery that, once and for all, water is a compound and not an element was later given to James Watt). At this time he also noted that absorption of all of the oxygen (dephlogisticated air) and nitrogen (phlogisticated air) by chemical reaction left a tiny, but reproducible trace of unreactive gas. Cavendish had earlier trapped atmospheric nitrogen in a salt and accurately determined the composition of the atmosphere both at sea level and at balloon height. In this, he anticipated the discovery by Lord Raleigh of the inert gases (*e.g.* argon) 110 years later.

In 1798, Cavendish applied Newton's gravitation law to an experiment involving two lead balls and two smaller spheres. In so doing, he accurately determined the mass of the earth.

Let's examine his file: Eighteen published papers, no books, discovery of hydrogen, vital contributor to understanding the composition of water, discoverer of nitrogen and composition of the atmosphere, separated the inert gases from atmospheric air and weighed the planet: probably a good bet for tenure even today.

1. *Encyclopedia Brittanica* Fifteenth Edition, 1986.
2. Partington, Vol. 3, pp 302-362.

(w/Fig. 90)

MAKING SODA POP

Joseph Priestley's 1772 pamphlet was addressed to the Right Honourable John Earl of Sandwich, First Lord Commissioner of the Admiralty. Any modern grantsman will recognize a final report for a Department of Defense contract in it. By pouring oil of vitriol (sulfuric acid) on chalk (calcium carbonate) Priestley generated "fixed air" (carbon dioxide) and impregnated water with it. This articial soda was more readily available and cheaper than the carbonated waters from spas so many of which were, unfortunately, located in the borders of the hated enemy France.

Carbonated water had long been reputed to prevent "the sea-scurvy" on long voyages, and to slow the putrefaction of water. In addition, it settled upset stomachs and acted as something of a substitute for the fresh vegetables that help digestion. Priestley thus helped Brittania to "Rule the Waves". Nothing like soda to help a sailor down a ship's store of salt pork. Whether or not the meat was pressed between slices of bread is not clear from this slim pamphlet.

(w/Fig. 93)

WHERE IS THE INVECTIVE OF YESTERYEAR?

Invective was employed as an art form in scientific discourse centuries ago. A wonderful example is from the Preface to the 1776 edition of a book called *Phosphori*,[1] written by Benjamin Wilson (1721-1788). Like Priestley, he believed in phlogiston and held that the glow of phosphorescence was visible evidence of phlogiston, the fire trapped in many types of matter.

Wilson[2] endured his family's poverty while not yet twenty, worked in poor circumstances and commenced artistic studies in these circumstances and started to enjoy some success in his forties, being appointed by the Duke of York to succeed William Hogarth as Sergeant-Painter in 1764. He speculated in stocks and was declared a defaulter on the Stock Exchange in 1766. During the 1740s he also developed an interest in electricity and later engaged in a highly-charged public debate with Benjamin Franklin on the shape of lightning rods. Franklin argued for a sharp point, and Wilson correctly argued for a rounded point which would not actually attract lightning. He won the debate but his arguments were so excessive that he received the following criticism in the *Philosophical Transactions*:[2]

> *"But he has been chiefly distinguished as the ostensible person whose perverse conduct in the affair of the conductors of lightning produced such shameful discord and dissensions in in the Royal Society, as continued for many years after, to the great detriment of science".*

The scorn so evident in the Preface of *Phosphori* is generally missing in scientific discourse. After all, Dr. X may eventually review Dr. Y's research grant proposal. In reading this excerpt one should note that Doctor Priestley was a rather stiff-necked English clergyman and a friend of Franklin (and sympathetic to the American Colonies fight for independence) who had immense standing in the scientific community and had criticized Wilson's experiments:

> *"Now why may not such a plain philosopher (with the good Doctor's gracious leave) be supposed capable of, at least stumbling upon discoveries, which had escaped the observation of preceding philosophers, even of the highest and most respectable characters? For it is well known, that it is not always men of 'vast and comprehensive understandings', that have been favoured by Providence with making discoveries sometimes the greatest, and most useful to the world: but on the contrary, (to allude to the words of an eminent writer with whom Dr. Priestley is intimately acquainted) the Great Author of Nature hath frequently chosen "weak things", in the philosophical, as well as the spiritual world, 'to confound the mighty, and things that are not, to bring nought the things that are."*

1. B. Wilson, *Phosphori*, 2nd Ed., London, 1776.
2. *Dictionary of Scientific Biography*, Vol. XIV, Charles Scribner and Sons, New York, 1976, pp 418-419.

(FW/Figs 99,100)

A SINGLE ELECTIVE ATTRACTION
(SINGLE DISPLACEMENT)

Calcium sulfide (CaS or **1**) will be decomposed by sulfuric acid (H_2SO_4 or **2**) in water (**3**) to produce elemental sulfur (**4**) which precipitates (downward half bracket) and calcium sulfate (gypsum, $CaSO_4$ or **5**) which also precipitates (downward bracket). Thus, sulfuric acid (**2**) has a higher affinity for pure calcareous lime (**6**)-really the source of calcium in **1**- than does sulfur (**4**).

A DOUBLE ELECTIVE ATTRACTION
(DOUBLE DISPLACEMENT)

Silver nitrate (**1**) and sodium chloride (**2**, table salt) decompose each other in water (**3**) to produce silver chloride (**4**) which precipitates (downward bracket) and sodium nitrate (**5**) which remains in solution (upward bracket).

w/Fig. 106

A BORING EXPERIMENT

Even as Lavoisier demolished phlogiston, he postulated a new gaseous "simple substance" or "element" called *caloric*- the element of heat (see Lavoisier's Table of Elements). Caloric could be transferred from a warmer body to a cooler body without chemical change. However, Lavoisier also posited that oxygen gas contained caloric, released as heat and light when a substance burned (see the accompanying table). The similarity between the caloric concept and the phlogiston concept is almost obvious.

The figure shown is from Volume 2 of *Essays, Political, Economical and Philosophical* (third edition, 1798) by Benjamin Thompson (Count Rumford) (1753-1814). He demonstrated that the mechanical work involved in boring a brass cannon was sufficient to boil water and that the heat capacity of the chips produced by boring was the same as when these chips were part of the cannon.[1] One would have expected a loss in caloric to be manifested in a loss of mass and/or heating capacity. In effect, Rumford showed that there was no limit to the amount of caloric that could be released as the result of mechanical friction. He also carefully established that there is no change in mass upon freezing water. At the time, Rumford's work had little impact: explanations offered were that the quantity of caloric present in the cannon was incredibly large and hardly any had been released in Rumford's experiments and that caloric was exceedingly light.

This study was a first quantitative step toward establishing the *First Law of Thermodynamics* in terms of the mechanical equivalent of heat:

$$\text{Energy}_{\text{System}} = (\text{Heat Added})_{\text{System}} - (\text{Work on Surroundings})_{\text{System}}$$

In the boring experiment, work is done by the surroundings on the system (the brass cannon), the energy of the system rises and heat is also released to the surroundings (water bath).

Benjamin Thompson was born to a modest farming family in the Colony of Massachusetts in 1753. He received little formal education, was largely self-taught, moved to Concord, New Hampshire to teach school and married a wealthy widow fourteen years his senior when he was 19. They separated permanently in 1775 as the American Revolution began and Thompson worked as a spy for the English eventually fleeing to England. He retired from the British Army and was Knighted by George III in 1784 and moved to Germany, became head of the Bavarian Army and was appointed Count Rumford of the Holy Roman Empire in 1793. The early thermodynamics studies grew out of this military experience in Germany. Count Rumford returned to England in 1798, helped found the Royal Institution in 1799 and appointed Humphrey Davy Lecturer in Chemistry in 1801 following publication of his work on laughing gas.

1. W. Kauzmann, *Thermal Properties of Matter, Volume II: Thermodynamics and Statistics: With Applications To Gases*, W.A. Benjamin, New York, 1967, pp 34-35.
2. *Dictionary of Scientific Biography*, Charles Scribner's Sons, New York, 1970, Vol. 13.

w/ Figs 107, 108

LAUGHING GAS FOR EVERYBODY!

Priestley's work on different kinds of air in 1772 produced impure nitrous oxide (N_2O). In 1799 Humphrey Davy (1778-1829) heated ammonium nitrate and obtained the pure gas. His experimental and physiological studies were published in *Researches, Chemical and Philosophical, Chiefly Concerning Nitrous Oxide, Or Dephlogisticated Nitrous Air And Its Respiration* (1800). The plate shown is the frontispiece from the 1839 reprint of this exceedingly rare book and depicts a gas-holder and breathing apparatus. His reckless breathing of the various newly discovered gases of the period were, for once, rewarded with nitrous oxide (laughing gas):

> *"On April 16th, Dr. Kinglake being accidentally present, I breathed three quarts of nitrous oxide from and into a silk bag for more than half a minute, without previously closing my nose or exhausting my lungs. The first inspirations occasioned a slight degree of giddiness. This was succeeded by an uncommon sense of fulness of the head, accompanied loss of distinct sensation and voluntary power, a feeling analogous to that produced in the first stage of intoxication; but unattended by pleasurable sensation. Dr. Kinglake, who felt my pulse, informed that it was rendered quicker and fuller."*

Davy, who wrote poetry and was an avid fisherman, had a wide variety of friends and correspondents who sampled nitrous oxide: These include Dr. Peter Mark Roget, future physician and author of the Thesaurus, but only 20 years old at the time, and Samuel Taylor Coleridge, one year after composing *The Rime of the Ancient Mariner*. Coleridge's description is the more poetic:

> *"The first time I inspired the nitrous oxide, I felt a highly pleasurable sensation of warmth over my whole frame, resembling that which I remember once to have experienced after returning from a walk in the snow into a warm room. The only motion which I felt inclined to make, was that of laughing at those who were looking at me. My eyes felt distended, and towards the last, my heart beat as if it were leaping up and down. On removing the mouth-piece, the whole sensation went off almost instantly."*

Nitrous oxide was first used as an anesthetic in 1846 but not before it had caused a stir in college dorms of the period.

w/Fig. 109

SOME LAST-MINUTE GLITSCHES BEFORE THE DAWN OF THE ATOMIC THEORY

Introductory chemistry books paint a fairly neat picture of the orderly march toward Dalton's atomic theory: Discovery of the Laws of Conservation of Matter, Definite Composition and Multiple Proportions and thence Atomic Theory. It was never quite so neat.

Chemists who preceded Lavoisier for decades if not centuries implicitly assumed that matter could not be created or destroyed.[1] Why else would they postulate the addition of effluviums of fire (see Becher, Boyle, Freind) to explain the increase in mass when metals form Calxes or the need to postulate buoyancy (or negative mass) for phlogiston to explain the same phenomena? However, Lavoisier's careful work with chemical balances and pneumatic chemistry established the Law of Conservation of Matter on firm scientific ground.[1] Similarly, the Law of Definite Composition had long been assumed- that the back oxide of copper, for example, would always be 80% by weight copper and 20% by weight oxygen no matter the country, chemist or method of origin. The studies of Joseph Louis Proust (1754-1826) established this and helped to solidify the principles of chemical composition (*stoichiometry*).

However, Claude Louis Berthollet (1748-1822), one of the great collaborators with Lavoisier on the *Nomenclature Chimiques*, raised some difficult questions in his book *Essai de Statique-Chimique* published in 1803.[2] Although there was some confusion about mixtures and compounds, he noted that there were some crystalline compounds having indefinite and varying compositions. He was correct. For example, the iron ore wustite is typically given the formula FeO although it really ranges from $Fe_{0.95}O$ (76.8% iron) to $Fe_{0.85}O$ (74.8% iron) depending, as we know today, on the balance between Fe^{2+} and Fe^{3+} ions to balance the O^{2-} ions in the ionic salt.[3] Since 2 Fe^{3+} will be equivalent to 3 Fe^{2+} ions in neutralizing 3 O^{2-} ions, replacement of Fe^{2+} by Fe^{3+} ions will produce gaps in the crystalline lattice and cause the Fe/O ratio to be less than 1:1 and slightly variable. Wustite is an example of a *nonstoichiometric compound* and such compounds are sometimes called *berthollides*.

Even more serious, was Berthollet's finding that in some cases the products obtained in a chemical reaction depended upon reaction conditions. For example, a well-known laboratory chemical reaction is:

$$\underset{\text{(muriate of lime)}}{CaCl_2} \quad + \quad \underset{\text{(soda)}}{Na_2CO_3} \longrightarrow \underset{\text{(limestone)}}{CaCO_3} \quad + \quad \underset{\text{(salt)}}{2NaCl}$$

The precipitation of solid limestone drives this "double elective attraction". However, accompanying Napolean on a trip to Egypt in 1798, Berthollet was surprised to discover deposits of soda on the shores of the salt lakes.[4] He reseasoned that high concentrations of salt in the lakes could reverse the normal "affinities" and, thus, the products of the reaction depended upon conditions. In fact, he had discovered the reversibility of chemical reactions and the Law of Mass Action, but this was only understood later.

$$CaCl_2 + Na_2CO_3 \rightleftharpoons CaCO_3 + 2NaCl$$

There is something here for us to learn about the Scientific Method. To borrow the oft-cited example given by the philosopher Karl Popper: If one observes only white swans for decades, then the hypothesis "All swans are white" appears reasonable and as it continues to be verified over decades it assumes the status of a theory and possibly even a law. It can never be proven *true* since all possible future cases cannot be tested. However, the confirmed scientific observation of a black swan will overturn the theory. Now Berthollet's scientific observations might have been taken as invalidating the Law of Definite Composition and seriously undermining the Atomic Theory. However, rather than tossing them out due to the observation of a few "black swans", chemists retained these explanations, correctly anticipating that the inconsistencies would be explained in the future.

1. F.L. Holmes, *Chemical and Engineering News*, Vol. 72, No. 37 (September 12, 1994), pp 38-45.
2. Leicester and Klickstein, pp 192-201.
3. D.W. Oxtoby and N.H. Nachtreib, *Principles of Modern Chemistry*, Third Ed., Saunders College Publishing, Fort Worth, 1996, p. 9.
4. Brock, p. 144.

W/ Figs 113, 114

CHEMISTRY IS *NOT* APPLIED PHYSICS

Dalton's atoms were derived from chemical experiments and explained chemical laws. Atoms were "adopted" by physicists only after many decades passed.

Indeed, attempts 100 years earlier to apply the physics of the age- Newton's great work- to chemistry failed. Among the first to attempt these applications were mathematician John Keill (1671-1721) and physician John Freind (1675-1728).[1] Newton had expressed the force arising from gravitational attraction between two bodies with the formula:

$$F = \frac{Gm_1m_2}{d^2}$$

The distance (d) was calculated from the centers of mass (center of the earth, mass m_1; center of the apple, mass m_2) and the weakening of the force with the square of the distance ($1/d^2$) meant that if the distance doubled the force was only one quarter of the original.

Keill and Freind both recognized gravity as a weak force unless a planet was involved. In this very rare book by Freind, he describes another similar attractive force, extremely strong at exceedingly minute distances and present on the surfaces of particles (points c and d) and having a higher-order relationship with distance ($1/d^{10}$, $1/d^{100}$,...?) and thus vanishing when the distance between c and d remains tiny.

Freind too recognized that a metal was lighter than its calx. He explained this observation by postulating the incorporation of igneous particles (particles of fire, see Boyle's "effluviums") further separating the particles of metal, therefore weakening the forces between them. Thus, it is understandable that the melting point of silver metal is 962 °C while its calx (Ag_2O) decomposes at only 230 °C. Metal calxes, though not terribly water soluble, were more soluble than the metals themselves. However, lead melts at 327 °C, while the white pigment litharge (PbO) melts at 886 °C; mercury is a liquid while HgO is a solid albeit very slightly more water soluble than the metal. Adding to the confusion were calxes that were actually mixtures having components that readily decomposed.

During the twentieth century we have come to recognize that Newtonian physics explains the behavior of large, slow-moving objects like Nolan Ryan's fastball. The electrons which we know are responsible for holding atoms together need quantum mechanics to explain their behavior. They simply do not obey Newton's laws. Ironically, the forces which hold together salts, composed of ions such as Fe^{3+} and O^{2-} (ions were established by Arrhenius in the late 19th century), are almost entirely explained by the classical physics of Coulomb's law.

[1] Partington, Vol. 2, pp 478-482.

w/Fig. 118

DAVY RESCUES THE INDUSTRIAL REVOLUTION

"Two great events amazed Britain in 1815: the victory of Wellington over Napolean and the victory of Davy over mine gases."[1] The Industrial Revolution was in danger of stalling in the early nineteenth century due to the dangers in mining with contemporary lamps which used flame and ignited explosions. A disaster near Newcastle in 1812 killed 101 miners and more than two-thirds of the coal mines in England were considered too dangerous to work because of their levels of coal gas (primarily methane).[1]

In 1815, Humphrey Davy was invited by the Chairman of a "Society for Preventing Accidents in Coal Mines" to invent a solution.[2] His elegant and simple invention is shown in the frontispiece of his 1818 book *On The Safety Lamp For Coal Miners; With Some Researches On Flame*. Davy had earlier studied flames and their propagation and noted that flames could not propagate through small holes. Thus, his solution was to merely surround the lamp with a cylinder of wire mesh which still left the flame open to the atmosphere. The mesh conducted away the heat of the flame, thus cooling it so that the temperature methane would encounter at the lamp would be lower than its flash point. The flame itself could not penetrate the mesh.[2]

While on the topic of coal gas, we note that chemist Friedrich Accum (1769-1838) played an important role in support of the introduction of coal-gas lighting in England. It is hard to imagine the change in London night life upon its widespread use. Accum wrote a number of interesting books on chemical amusements and adulteration of food among others in addition to his *Practical Treatise on Gas Light*. Unfortunately, he was caught tearing pages from books in the library of the Royal Institution and the trial (possibly initiated by those he accused of adulterating food) and flight to Germany in 1822 ruined his reputation.[3] His excellent 1824 work, *An Explanatory Dictionary of the Apparatus and Instruments Employed in the various Operations of Philosophical and Experimental Chemistry*, was published anonymously.

1. J. Stradins, *Chymia*, No. 9, 125-145 (1964).
2. J.R. Partington, *A Short History of Chemistry*, 3rd Ed., Dover Publications, New York, 1989, pp 189-190.
3. C.A. Browne, *Chymia*, No. 1, 1-9 (1948).

(w/Fig. 150)

AND NOW TURN TO PAGE 3 OF OUR CHEMICAL PSALM BOOK

The illuminated title page of the gentle 1873 English Christian psalm book *Chemistianity* is depicted in Figure 150.

This work may prove a memory burnisher.
To teen-youth or octagenarian,
And act as match or chemistian torch
For needed light to order Ignorance.

Its clarion call to study chemistry is a bit "forced":

Chemistry lore should be
Well known on land and sea
To sow the seed of Chemistry, so heigh, so ho, so hee

Our Service begins on page 3 (ALL RISE):

MATTER, is the body of the universe,
That, by the aid of Chemical Science,
With the best of all known appliances,
Has been resolved into Sixty-three bodies
(Or conditions of free, real essence)
Term'd ELEMENTS, or Simple Substances;
These, we have been unable to split up.
Or subdivide, into more Primal being.
Named in order of their combining weights,
And forty-three known, proved, real Metals,
Arranged under Chemist Roscoe's system,
By classing in ten families or Klans;
The bodies appertaining to each Klan
Are writ in order of their combining weight
Or type of their Chemical energy.

Please turn now to page 61:

OXYGEN, the Queen of Body Affection;
The supporter of man's Earthual life;
The needed Air-puff for all common forms
Of combustion in term'd live Animals,
In ordinary burning Wood or Coal;
And the prime mover in most heat-felt goceptions,
Is a colorless gaseous metalloid,
Tasteless and devoid of odour.

(PLEASE BE SEATED)

(The author has coined the term "goception" for chemical action and God is called The Great Goceptor).

Sellars writes that: "In reading the names of chemical compounds, many persons are disappointed at their length and unmeaningness to them." (This remains a common complaint among students in Freshman Chemistry courses.) He, thus, develops a

simpler alphabetical nomenclature which will be very briefly illustrated. For the five lightest elements known to the author we have:

Alphabetical Name	Composition Name in Brief	Pronounced	Present Name
ABGEN	Ab	Abb	Hydrogen
AMYAN	Am	Amm	Boron
ATYAN	At	Att	Carbon
BAGEN	Ba	Bay	Nitrogen
BEGEN	Be	Bee	Oxygen

Using this nomenclature, water (H_2O, which we *could* call today dihydrogen oxide but don't) would be pronounced "die-abb-bee". Common glass (silicon dioxide) would have the pleasing sound "die-bee-day" and P_2O_3 the jolly "try-bee-die-dee". However, nitrous oxide or laughing gas (N_2O) is "die-bay-bee", not likely to encourage a dental patient, but fortunately it is not N_3O, pronounced "try-bay-bee".

It appears that this gentle and heartfelt effort, doomed by its doggerel and nomenclature, is a compelling argument for separation of Church and Oxidation State.

w/Figs 156,157

ATOMS OF THE CELESTIAL ETHER

Early hints of the wave nature of light included the seventeenth century discovery of diffraction by Hooke and other manifestations of interference. It was obvious that dropping a rock into a pond created waves and Boyle showed that air was necessary for the transmission of sound waves. Thus, it appeared that there had to be a medium for transmitting light waves and it was thought to be a kind of "universal ether"- present everywhere, yet imperceptable. During the 1880s, the physicists Michaelson and Morley disproved, experimentally, the existence of the ether. Nevertheless, the concept continued to influence many outstanding scientists for perhaps two more decades. In a book published in 1895 titled *Cod-Liver Oil and Chemistry*, the author Friedrich Moller explains the rotation of plane-polarized light, clockwise or counterclockwise, by invoking clockwise or counterclockwise rotation of a bond in the molecule producing clockwise or counterclockwise "wakes" in the ether.

Mendeleev was clearly a believer in the ether. His explanation was straightforwardly chemical and constructed from his Periodic Table and the newly-discovered inert gases.[1] The 1904 English edition of Mendeleev's book *An Attempt Toward a Chemical Conception of the Ether* appeared when the Russian master was 70. He postulates that the ether is composed of atoms of an as-yet-unknown super-light inert gas. Clearly, the gas must be inert in order to penetrate all matter without being reacted or absorbed and clearly it must be superlight not to be perceived.

He fits the "ether element" into his Periodic Table in the manner shown in the accompanying figure. Mendeleev placed the inert gases in a Group 0, to the left of hydrogen and the alkali metals. This places helium in Period 2 and leaves a gap to the left of hydrogen in Period 1. Our modern Periodic Tables place the inert gases in Group 8 and thus helium now sits in Period 1 for reasons theoretical as well as practical. Mendeleev postulated a new Group 0-Period 1 element, element "y" in the accompanying figure, which he calculated to have a relative atomic weight of 0.4 (hydrogen = 1.0) and notes that while this is clearly far too massive for atoms of the ether, it may correspond to unassigned lines in the solar spectrum (remember, helium was already known). He then postulates another new element "x" (see figure) in Group 0-Period 0, which he reasons has a relative mass in the range 0.00000096-0.000000000055, the atom comprising the celestial ether.

This all-too-human attempt by Mendeleev cram the ether concept into his Periodic Table illustrates our very human limitations in trying to fit our own world views to facts. The next two pictures illustrate mid-nineteenth century illustrations of dinosaurs. The bones were "crammed" into the shapes of bear-like or ox-like creatures depicted because these were the large land carnivores and herbivores known. Indeed, the planetary model of the atom, developed by Bohr in 1913 and later completely eclipsed, was probably based upon his desire for a unity in the universe and an analogy with the solar system.

1. A. Greenberg, *The Chemical Intelligencer*, April, 1995, pp 31-36.

(w/Fig. 180)

THE CHEMISTRY OF GOLD IS NOBLE BUT NOT SIMPLE

Now here is an interesting point: it was obvious to the ancients that gold was "noble" in the same sense that we think of the Group 8A gases (helium, neon, *etc*) as "noble"- namely, unreactive. It did not tarnish like its valuable cousin silver- silver tarnish is due to atmospheric hydrogen sulfide which forms a coating of black silver sulfide (Ag_2S) and it could be heated repeatedly with no change. It did not dissolve in hydrochloric acid or nitric acid. It did "dissolve" in *aqua regia*, a mixture of 3:1 HCl/HNO_3, but evaporation of the solution and intense heating recovered the gold unchanged, unlike the baser metals where a calx remained.

We know that gold does exhibit reactivity (but so does xenon).[1,2] For example, the "dissolution" in *aqua regia* is really a chemical reaction in which HNO_3 and HCl act synergistically (as a team)- the oxidation of elemental gold to Au(III) can only happen because of the stability of the $AuCl_4^-$ ion:

$$\begin{tikzcd} Au + HCl + HNO_3 \arrow[r] & AuCl_4^- + NO_2 + H_3O^+ \arrow[d, "evaporate"] \\ Au + HCl + Cl_2 + H_2O & H_3O^+[AuCl_4^-](H_2O)_3 \arrow[l] \end{tikzcd}$$

chloroauric acid

Similarly, in the presence of dilute cyanide solutions, it will oxidize in air at room temperature to form stable $Au(CN)_2^-$ ions and this reaction is used to purify gold.

The explanation of gold's nobility is *not* obvious.[1] In modern terms, we note that the outermost electrons in the atoms of the coinage metals copper, silver and gold are $4s^1$, $5s^1$ and $6s^1$. Thus, they appear at first to be close cousins of the decidely *ignoble* alkali metals potassium, rubidium and cesium (also $4s^1$, $5s^1$ and $6s^1$ repectively)- cesium would "date" almost anybody. The alkali metals described "underly" their outermost electrons with a completed subshell structure- the octets of the preceding noble gas. These octets shield the outermost electrons (ns^1) from nuclear attraction and make them easy to ionize (lose) and, thus, render the alkali metals reactive. Cesium has its outermost electron furthest from the nucleus and is most reactive. In contrast, the coinage metals "underly" their ns^1 electrons with a completed 18-electron shell which would also imply great stability. However, the d-electrons are not particularly effective in shielding the ns^1 electrons which are thus strongly attracted to the nucleus and hard to ionize.[1] In further contrast to the alkali metals, the order of reactivity is smallest to largest, copper most reactive- gold least reactive. Apparently, relativistic physics is required to explain the behavior of the $6s^1$ electron in gold.[2] So it appears that, in this instance at least, chemistry has been rescued by "the triumphal chariot of physics".

1. B.E. Douglas, D.H. McDaniel and J.J. Alexander, *Concepts and*

Models of Inorganic Chemistry, 3rd ed., Wiley, New York, 1994, pp 724-725.

2. F.A. Cotton and G. Wilkinson, *Advanced Inorganic Chemistry*, 5th ed., Wiley, New York, 1988, pp 937-939.

Post-Script

ENDING IN IMAGERY

We end this book as it was started- with metaphors that suggest a unity between matter, nature and the human spirit and conclude with one short poem, *The Poplar*, and excerpts from two longer poems by Seamus Heaney,[1] the Irish poet who was awarded the 1995 Nobel Prize in Literature.

The Poplar

Wind shakes the big poplar,
  quicksilvering
The whole tree in a single sweep.
What bright scale fell off and left this
  needle quivering?
What loaded balances have come to
  grief?

The shimmering of quicksilver (mercury) and the suggestion of the balance provide an image that "records a moment of beauty- and questions what natural balance might have been upset to produce it."[2]

The Spirit Level (an excerpt)

Hoard and praise the verity of
  gravel.
Gems for the undeluded. Milt of
  earth.
Its plain, champing song against
  the shovel
Soundtests and soundblasts words
  like "honest worth".

The sound and feeling of gravel is likened to noble human values.

To A Dutch Potter in Ireland (an excerpt)

And if glazes, as you say, bring down the sun,
Your potter's wheel is bringing up the earth.
Hosannah ex infernis. Burning wells.

Hosannah in clean sand and kaolin
And, 'now that the rye crop waves beside the ruins',
In ash-pits, oxides, shards and chlorophylls.

---

1. S. Heaney, *The Spirit Level*, Farrar, Straus and Giroux, New York, 1996.
2. R. Tillinghast, *New York Times Book Review*, July 21, 1996, p. 6.

Dr. Alfred Bader
924 East Juneau, Suite 622
Milwaukee, Wisconsin 53202
Phone: 414/277-0730
Fax: 414/277-0709

A Chemist Helping Chemists

March 17, 1997

Dr. John C. Haas
Rohm and Haas Building
100 Independence Mall, West
Philadelphia, PA 19106-2399

Dear John:

Isabel and I very much appreciated your thoughtful and thought-provoking letter of March 7th.

I consider the Chemical Heritage Foundation and the Royal Institution in London the two most helpful centers for research in the history of chemistry and we would like to consider carefully how we might help.

I am certain that most thinking, well-to-do people are torn between helping the ablest and the neediest and as you will see from the enclosed we have tried to help both.

You know how interested I am in history - and particularly in the history of chemistry - and when next I am in Philadelphia I would like to spend some time with Arnold to see how we might help.

Of course I know how very well the Othmer bequest has helped the Chemical Heritage Foundation which must be the best endowed such institution in the world. Could we make a difference? John, this is not a matter to be discussed by letter. But I have known and respected Arnold for a good many years and Isabel and I plan to listen to him very carefully.

With all good wishes, I remain,

Yours sincerely,

AB/nik

Enclosure

c: Dr. Arnold Thackray

John C. Haas
Rohm and Haas Building
100 Independence Mall, West
Philadelphia PA 19106-2399

March 7, 1997

Dr. Alfred R. Bader
2961 North Shepard Avenue
Milwaukee, WI 53211

Dear Alfred:

It was a great pleasure to see you and Isabel on your all-too-brief visit to the Chemical Heritage Foundation at its new Independence Park home back in January. It's a privilege and pleasure to see you devoting a part of your prodigious talents and energies to chemical history. The field stands in great need of your insights and inputs, as we all seek to explore the true heritage of the chemical sciences, and to battle the pervasive chemophobia of our age.

CHF is now in a position to take on the leadership. Donald Othmer's benefaction will assure the creation of a great scholarly library, open to researchers from around the globe. What we now need are the resources to support visiting scholars: fellowships, studentships and travel grants. A good start has already been made with our Edelstein Fellowship (faculty, sabbatical support) and Studentship (graduate student, dissertation research), our Garfield Fellowship (postdoc), and our Cain Studentship (dissertation research).

May I invite you to consider underwriting, initially on an annual basis, one or more of the following means to increase the usefulness of CHF to the community of scholars:

1. An Alfred Bader Faculty Fellowship, to allow a European faculty member (chemist or historian of science), to spend a year based at CHF, and to travel for historical research to other American universities, conferences and meetings (Cost $70 - $75,000);

2. An Alfred Bader Postdoctoral Fellowship (European postdoc) to spend a year based at CHF, and to travel for historical research to other American universities, conferences and meetings (Cost $40-$50,000);

3. An Alfred Bader Travel Fund, to provide small grants to allow European scholars (faculty, postdocs, or graduate students) to travel to North American sites, including CHF; and to allow North American scholars to make brief visits to European archives and meetings (Cost $20-$20,000);

4. An Alfred Bader Studentship, to allow a European graduate student to spend a North American year, based at CHF (Cost $15-$20,000).

Please be in touch with me, or with Arnold Thackray, if we can provide further information on these or other ways of advancing the heritage of chemical achievement, which may be of particular interest to you or Isabel.

With all best wishes.

Sincerely,

John

John C. Haas

cc: Dr. Arnold Thackray

Dr. Alfred Bader
924 East Juneau, Suite 622
Milwaukee, Wisconsin 53202
Phone: 414/277-0730
Fax: 414/277-0709

A Chemist Helping Chemists

March 18, 1997

Dr. Arnold Thackray
President, Chemical Heritage Foundation
315 Chestnut Street
Philadelphia, PA 19106-2702

Dear Arnold:

I so enjoyed your proposal for an artist's tour of chemical history.

During the last few years you have spent so much of your energy on fundraising and I am so happy to see that you are returning to scholarship.

I look forward to seeing the finished work. It is the sort of book of which I would like to buy quite a few copies to send to my best chemist friends around the world though I fear that the average "chemist-on-the-street" may not appreciate what a great work it really is.

Enclosed please find a recent exhibition catalogue from Queen's University that deals with a number of our chemical paintings that may be of interest to you.

Also you might like to consider to include what, to me, is one of the finest chemical paintings, that of Joseph Wright of Derby depicting phosphorus.

Also please do not forget Loschmidt. Avogadro predicted in 1811 that somebody would some day be able to calculate the number which you call Avogadro's number. Loschmidt actually calculated that number in 1865.

If you really wonder where the invective of yesteryear is, please do consider some of Liebig's worst examples, such as for instance what he said about chemistry in Austria and Meissner.

Also, as you will see from the enclosed, invective is not completely dead - even today - and I am just sorry that *Chemistry in Britain* did not publish this letter.

You will have seen John Haas' interesting letter of March the 7th and I enclose a copy of my reply which will be self explanatory.

With all good wishes, I remain,

Yours sincerely,

AB/nik

Enclosures

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Arnold Thackray, *President*

4 March 1997

Dr. Alfred Bader
924 East Juneau, Suite 622
Milwaukee, WI 53202

Dear Alfred:

I'm taking the liberty of sending you the enclosed "proposal" for an artist's tour of chemical history since

a) I thought you'd enjoy browsing through it

b) I would greatly value your opinion as to whether this has the makings of a really interesting "coffee table" type volume that would capture something of chemical art and imagery ("culture") in a rewarding way

c) If the answer to (b) is affirmative, your thoughts on how the texts and illustrations might be extended, modified, and/or trimmed would be most helpful.

Again, my apologies for troubling you, and in hope of your good counsel,

Sincerely,

AT/c
Enclosure

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Alfred Bader
924 East Juneau, Suite 622
Milwaukee, Wisconsin 53202

21 February 1997

Dear Dr. Bader,

A review of my files seems to indicate that I have yet to thank you for your donation of additional copies of Professor Reichsteins's "The Meaning of Alchemy" to the Othmer Library. Please forgive this oversight.

Once gain, on behalf of the Chemical Heritage Foundation and the Othmer Library, I thank you for your generous support.

Sincerely,

Paul Giblin
Assistant Librarian
215-925-2222 ext. 246
giblin@chemheritage.org

Dr. Alfred Bader
924 East Juneau, Suite 622
Milwaukee, Wisconsin 53202
Phone: 414/277-0730
Fax: 414/277-0709

A Chemist Helping Chemists

February 27, 1997

Dr. Ute Deichmann
c/o Chemical Heritage Foundation
315 Chestnut Street
Philadelphia, PA 19106-2702

Dear Dr. Deichmann:

In response to your letter of February 25th, Dr. Wilhelm Matthes was neither the owner of Raschig, nor on its board of directors. I believe that his title was Director of Research and more important, he was the inventor of the process of oxidizing picolines to all the possible pyridinecarboxaldehydes. That process is still in use, and Raschig sells many tons of the various isomers.

Dr. Paul Löw-Beer's address is Zwerngaße 17, A1170 Vienna, Austria, and his new telephone is 43-1-486-2397.

You will be able to get Dr. Robert Tauber's address and telephone number from Dr. Löw-Beer.

You might also like to talk to Dr. Robert Rosner, whose address is Paul Heysegasse 32, A1110 Vienna, Austria, and whose new telephone number is 43-1-769-86-07.

Both Dr. Löw-Beer and Dr. Rosner are in constant touch with Dr. Robert Tauber and visit him often.

Would a transcript of the interview of my uncle, Count Serenyi Miklos, with the U.S. Immigration Service be interesting to you? My uncle just re-hashed much of the garbage spoken more intelligently by George Scheüneren and Karl Lueger 50 years earlier.

With all good wishes, I remain,

Yours sincerely,

AB/cw

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25 February 1997

Dr. Alfred Bader
924 East Juneau, Suite 622
Milwaukee, Wisconsin 53202

Dear Dr. Bader,

Thank you very much for your kind letter. I apologize for writing only now, but I was out of town for more than two weeks and returned only today. I shall have you sent a copy of Lise Meitner's letter in German as soon as possible. I don't have a copy here, but I shall ask people from my institute in Cologne to send you one.

I also enjoyed our conversation very much, and I found particularly remarkable your accounts about Wilhelm Matthes and about the brother of you mother. I forgot: Had W. Mathes been owner or Aufsichtsratsvorsitzender of Raschig?
I would appreciate if you sent me the addresses of Paul Loew-Beer and Robert Tauber.

With my best wishes and many regards, also to your wife

Yours sincerely

FOUNDING MEMBERS: AMERICAN CHEMICAL SOCIETY ☐ AMERICAN INSTITUTE OF CHEMICAL ENGINEERS

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Arnold Thackray, *President*

23 October 1996

Dr. Alfred Bader
924 East Juneau, Suite 622
Milwaukee, WI 53202

Dear Alfred:

This hasty note is penned on the eve of our Board meeting.

Glad to have the Reichstein essay: thank you.

Your own essay on anti-Semitism obviously has considerable potential. One question is how much more time you want to put into the subject--Ute Deichmann, our Edelstein Fellow (who is already in touch with you, I believe) could help supply the answer.

We do look to your good advice in developing our programs, and especially our links with Britain/Europe. So please come visit, and bring Isabel to cheer us up and on!

Sincerely,

Arnold

AT/c

Dr. Alfred Bader
924 East Juneau, Suite 622
Milwaukee, Wisconsin 53202
Phone: 414/277-0730
Fax: 414/277-0709

January 22, 1997

A Chemist Helping Chemists

Dr. Paul Giblin
Assistant Librarian
Chemical Heritage Foundation
315 Chestnut Street
Philadelphia, PA 19106-2702

Dear Dr. Giblin:

I am sorry that a long trip to Britain has delayed my thanking you for your letter of November 11th regarding Professor Reichstein's "The Meaning of Alchemy".

Isabel and I look forward to being at the Chemical Heritage Foundation on Friday afternoon January the 31st and I will then bring another dozen copies with me to leave for you.

Keep in mind that Aldrich printed hundreds of copies but as Isabel's and my name was attached to the translation, they would have been thrown out and were saved by my good friends at Aldrich. Hence, if at any point, you wanted another twenty or fifty or even one hundred, just let me know and they will be yours.

Tadeus Reichstein was our very good friend and we were saddened to know that he died, at age 99, just a little while ago. When we visited him in Basel last June he recognized us but could hardly speak.

With all good wishes, I remain,

Yours sincerely,

AB/nik

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Alfred Bader
924 East Juneau, Suite 622
Milwaukee, Wisconsin 53202

11 November 1996

Dear Dr. Bader,

Again, thank you for your generous donation of Professor Reichsteins's "The Meaning of Alchemy" to the Othmer Library.

I have enclosed a completed copy of our Instrument of Donation form for your records.

In response to your offer of additional copies of "The Meaning of Alchemy," we would be delighted to receive from you any copies you could spare. Our goal in acquiring more copies would be to make them available to the Foundation's visiting researchers. We plan to hold two copies in the Library's permanent collection; anything in addition to these would be made available for "patron consumption" by displaying them in our reading room and/or reception area.

If you have any questions regarding this arrangement, please do not hesitate to call me. I am in the office Monday through Wednesday. Should you wish to ship us additional copies, please send them to my attention at the above address.

Thank you for your support of the Othmer Library and the Chemical Heritage Foundation.

Sincerely,

Paul Giblin
Assistant Librarian
215-925-2222 ext. 246
giblin@chemheritage.org

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"The Meaning of Alchemy" Reprint of Lecture given Zurich 1931 by Tadeus Reichstein (5 copies)
Translated by Isabel and Alfred Bader.

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November, 1996

Dr. Alfred R. Bader
2961 North Shepard Avenue
Milwaukee, WI 53211

Dear Alfred:

Our lives are enhanced through scientific and technological progress, and progress occurs because of individuals like you! Thanks to your generous support, the Chemical Heritage Foundation has been chronicling the remarkable story of innovation and entrepreneurship in the chemical and molecular sciences for over a decade. As a token of our appreciation for your continued partnership, I am pleased to enclose ***Milestones in Chemistry***, the calendar prepared in conjunction with National Chemistry Week.

Simply preserving and making known our heritage of scientific achievement is not enough. We need to celebrate that heritage and actively deploy it to inspire and cultivate new genius--so that we will be ready to face the challenges of the new millennium and ensure the health and prosperity of future generations. I am delighted that CHF now has the means to accomplish these ends.

CHF has established a Gold Medal to commemorate Donald F. Othmer (1904-1995), renaissance man and citizen of the world chemical community "extraordinaire". Don exemplified that lifetime achievement in the chemical sciences which enriches our daily lives and material culture. To extend his creative legacy, the first Othmer Medal will be awarded at the 1997 Othmer Luncheon in New York, to an individual who has contributed broadly to our common chemical heritage. It is our hope that this Medal will become one of the scientific community's most prestigious awards.

There is, of course, much more to the CHF story. I am pleased to share with you some highlights (attached) of our 1995-1996 program achievements, which were made possible thanks to your participation. As the enclosed ***Chemical Week*** article proclaims, "we walk tall," and we greatly appreciate your making this journey with us!

In order to meet our goals for 1996-1997, we are asking our friends to consider increasing their support. Any increase will be greatly appreciated, and it will once again be matched dollar for dollar through an annual challenge grant. As a **CHF Benefactor** you contributed **$1,200.00** to our 1995-1996 annual fund drive. I invite you to raise the level of your support in FY '97, and join us in extending CHF's educational outreach. A donor statement and return envelope are enclosed for your convenience. Together we will promote scientific achievement and help ensure the future of our civilization! Thank you.

Sincerely,

John Haas
John C. Haas
Chairman, Development Committee

Enclosures

FOUNDING MEMBERS: AMERICAN CHEMICAL SOCIETY □ AMERICAN INSTITUTE OF CHEMICAL ENGINEERS

AFFILIATED SOCIETIES: ALPHA CHI SIGMA FRATERNITY □ THE AMERICAN ASSOCIATION FOR CLINICAL CHEMISTRY, INC. □ AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS □ AMERICAN INSTITUTE OF CHEMISTS, INC. □ AMERICAN OIL CHEMISTS' SOCIETY □ AMERICAN SOCIETY FOR MASS SPECTROMETRY □ CHEMICAL MANUFACTURERS ASSOCIATION □ THE CHEMISTS' CLUB □ THE ELECTROCHEMICAL SOCIETY, INC. □ FEDERATION OF SOCIETIES FOR COATINGS TECHNOLOGY □ INTERNATIONAL SOCIETY FOR PHARMACEUTICAL ENGINEERING □ THE NORTH AMERICAN CATALYSIS SOCIETY □ SOCIETY FOR APPLIED SPECTROSCOPY □ SOCIÉTÉ DE CHIMIE INDUSTRIELLE

Chemical Heritage Foundation

Putting Chemicals on the Map

THE CHEMICAL HERITAGE FOUNDATION (CHF; Philadelphia) wants to establish a center for the chemical industry appropriate to its significance in modern life. When CHF took over new premises last February in Philadelphia's historic district, part of the objective was realized.

The former bank building provides handsome premises to house the Othmer Library, which is CHF's authoritative collection of texts covering the history of the chemical industry, for which $2.5 million/year in operating funds has been made available by a bequest from the late Donald Othmer. CHF is two-thirds of the way to raising $6 million from industry to match a $6-million gift from Othmer to purchase and renovate the building.

Thackray: 'Bedrock' of achievement.

The location, next to Benjamin Franklin's house, in an area visited by 1.5 million people each year, has opened new possibilities. The objective is to create a science center with a public display that would draw in this flow of tourists.

"Ultimately I would hope we'd have a museum that chronicles the benefits to mankind of chemistry over the past 100 years," says Harold Sorgenti, partner in the Freedom group and former Arco Chemical boss, who is leading CHF's fundraising effort. Attracting people to such a display "would help enormously with the industry's public image," says Sorgenti, who is also a former chairman of CMA and the Society of Chemical Industry (SCI).

CHF was established in the early 1980s by the American Chemical Society and the American Institute of Chemical Engineers as a "partnership of the chemical community," CHF director Arnold Thackray says. It organizes traveling exhibits, information for school teachers, publications, corporate histories, lectures, and public events. An oral history project assisted by SCI is under way to interview key figures in the industry—whether on the business side like Gordon Cain, or the research side, like Daniel Fox, who invented polycarbonate at GE Plastics. Sorgenti underlines that CHF's roots leading out from the professional side of the chemicals community—rather than being a corporate-type venture—are a great strength. "It's nice that the professional scientists thought it important to create a monument to chronicle industry's contributions," he says.

The library will be central to the new building, with a spacious reading room, Thackray says. With the Othmer funding, this "cornerstone of CHF's new establishment is assured," he says. "Where we need funding is to do the publicly visible activity with more immediate impact, such as teacher workshops and traveling exhibits."

CHF: Proud new home.

Twenty chemical firms have pledged contributions. Dow Chemical, DuPont, Eastman, Hoechst Celanese, and OxyChem have pledged $200,000 each. Bayer has promised $150,000. Air Products, Arco Chemical, BFGoodrich, Elf Atochem, Monsanto, and Rohm and Haas have pledged $100,000 each, and smaller donations will come from Henkel, Huntsman, Lyondell, Morton International, Nalco, PPG Industries, Solvay, and Witco. "We're gradually working our way through the list," Sorgenti says. There have also been large contributions from the Crystal Trust, the Dow and Gerstacker Foundations, and John Haas.

"Understanding molecular structure and manipulating molecules are what makes the modern world so different," says Thackray. "That is not well understood [by the public]. It's amazing that the industry's mode is so defensive, when its achievement is so huge."

Public perception of the industry has varied, Thackray says. The promise of science and technology and the chemical industry was viewed positively during the Depression, through its contribution to the World War II effort, and on into the 1950s and 1960s. "From the industry's perspective, there was super delivery on its promise, from nylon to other polymers, and all the drugs that were developed, with the result that the chemicals and scientific communities were lulled to sleep by their success," Thackray says.

But the shifting public mood in the 1960s, when the industry again thought it was "the good guy" helping the Vietnam War effort—and the rise of environmentalism in the '70s—made clear the width of the perception gap. "The whole chemical community was on the wrong foot and staggering to regain its balance, to get from saying 'we're the good guys' to saying 'we've got to do Responsible Care,'" he says.

What is important now is that "the agonizing reappraisal is over," Thackray says. "If we go back to the trendline scenarios, whatever we can say about the intellectual promise and performance of chemistry in the past, we can say it infinitely more strongly now. We have got to pull the conversation back toward that bedrock," he adds.

"Manipulating molecules is the big game, and the chemical industry is absolutely at the center of it. The public doesn't have awareness of how big this game is, and how central we are to that game," Thackray says. "The fundamental message is that we walk tall." CHF offers "a key to public understanding" of the chemical industry, he says. "It's not the key, but a key. We need a lot of keys." —DAVID HUNTER *in Philadelphia*

CHF ON THE MOVE ...

...TO **THE WORLD WIDE WEB!**
OUR MESSAGES AND PROGRAMS DON'T STOP
AT INDEPENDENCE NATIONAL HISTORICAL PARK

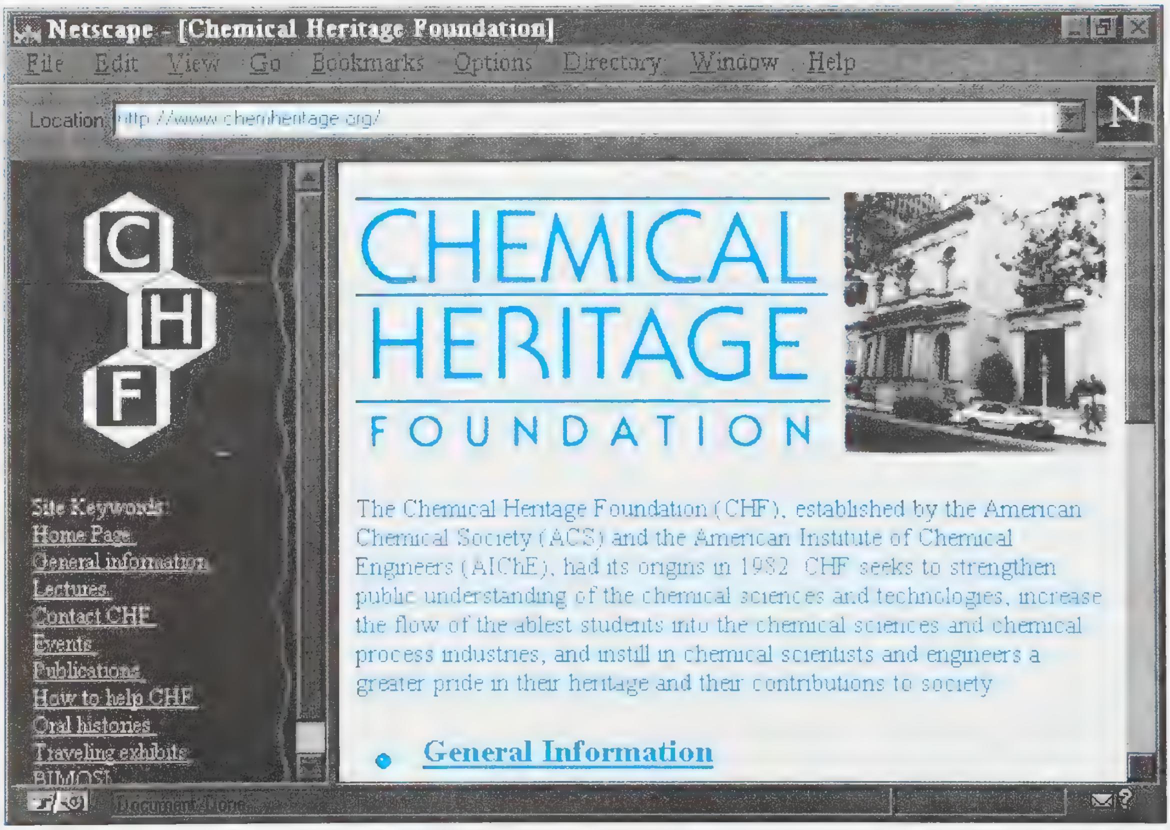
CHF HAS GONE GLOBAL

DIRECTIONS TO OUR SECOND HOME —
ON THE INTERNET:
FROM OUR PERMANENT HOME
AT 315 CHESTNUT STREET
(IN "AMERICA'S MOST HISTORIC SQUARE MILE")

TAKE THE INFORMATION SUPERHIGHWAY AND
AIM YOUR NET BROWSER AT:

HTTP://WWW.CHEMHERITAGE.ORG

AND YOU HAVE ARRIVED!



Location: http://www.chemheritage.org/

CHEMICAL
HERITAGE
FOUNDATION

The Chemical Heritage Foundation (CHF), established by the American Chemical Society (ACS) and the American Institute of Chemical Engineers (AIChE), had its origins in 1982. CHF seeks to strengthen public understanding of the chemical sciences and technologies, increase the flow of the ablest students into the chemical sciences and chemical process industries, and instill in chemical scientists and engineers a greater pride in their heritage and their contributions to society.

- General Information

CHEMICAL HERITAGE FOUNDATION
1995-1996 PROGRAM HIGHLIGHTS

- CHF has taken to the information superhighway to promote quality science education and increased public understanding. Come visit us on the World Wide Web at: **http://www. chemheritage.org.** Whether from our permanent home at Independence National Historical Park or from our newest site, in cyberspace, we are striving to advance scientific literacy and channel fresh talent into the chemical and molecular sciences and industries.

- Our publication program is expanding rapidly. We are poised to launch a new series on **Innovation and Entrepreneurship** with the release of Gordon Cain's autobiography ***Everybody Wins! A Life in Free Enterprise.*** You will find more on this event, including a related symposium to be held on March 23, 1997, in San Antonio, Texas, in the fall issue of ***Chemical Heritage***.

- Our educational activity is also in high gear. Our exhibit on electrochemistry will usher in the centennial of the Dow Chemical Company (May 1997) in Midland, and it will travel throughout the U.S. and abroad before returning to Philadelphia to mark the centennial of The Electrochemical Society (June 2002). These and future educational initiatives will greatly benefit from the contributions of Sister Mary Virginia Orna, distinguished chemical educator and recipient of the 1996 ACS Norris Award, who joined our staff recently.

- Our affiliated societies continue to benefit from the expertise of our archival and public programs staff. Efforts under way include: processing the archives of the ECS; working with the ACS national historic chemical landmarks program; and planning for anniversary celebrations with the AACC (50th), AIC (75th), AATCC (75th), and AIChE (90th).

- On our **BIMOSI** front we are writing the script for a conference on "Biotechnology: The First Quarter Century." The conference will lead to a video of discussions with and among key players in the biotechnology revolution, including Paul Berg, Ronald Cape, Arthur Kornberg, and Maxine Singer. On June 13, 1997, in Philadelphia, participants will review "The Emergence of Biotechnology." It is hoped that subsequent sessions will deal with the Human Genome Project and related social, ethical, and legal implications.

- Our scholarly activity is greatly enriched by the work of the 1996-1997 **Edelstein International Fellow,** Ute Deichmann (University of Cologne), who is investigating the forced emigration of Jewish chemists and biochemists from Nazi Germany; and of the **Edelstein International Student,** Jonathan Simon (University of Pittsburgh), whose dissertation focuses on chemistry and pharmacy in the eighteenth and nineteenth centuries.

- We have embarked on the next phase of **Othmer Library** development and are delighted that after an extensive national search, we have appointed Elizabeth Swan as our first Director of Library Services. Other scholars who will use our library and archival resources include Mark Hamel (University of Pennsylvania), the **Cain Fellow in Innovation and Entrepreneurship**; Robert V. Williams (University of South Carolina), the **Garfield Postdoctoral Fellow in the History of Scientific Information**; and Leo Slater (Princeton), the **Ullyot Scholar in the Public Understanding of Science.**

CHEMICAL
HERITAGE
FOUNDATION

315 Chestnut Street ☐ Philadelphia, PA 19106-2702 ☐ USA
Telephone (215) 925-2222 ☐ Fax (215) 925-1954

THE BECKMAN CENTER FOR HISTORY OF CHEMISTRY ☐ THE OTHMER LIBRARY OF CHEMICAL HISTORY ☐ PUBLIC EDUCATION

Arnold Thackray, *Executive Director and Librarian*

May 24, 1995

Dr. Alfred Bader
2961 North Shepard Avenue
Milwaukee, WI 53211

Dear Alfred:

My thanks for your good letter of 2 May.

I'm pleased to hear that you will be at the Royal Institution (a wonderful place, and one of my old stomping grounds) in July, at work on Brande, Faraday and Prussian blue. I have two questions/requests for you to consider.

(1) As you'll see when the Summer 1996 **Chemical Heritage** magazine reaches you in a couple of weeks time, we are moving to full color for the covers. Would your painting be a good candidate for a future cover?

(2) At all events, we'd love to publish a brief report by you, on both the p~~rin~~ainting itself and your historical sleuthing.

Please let me have your thoughts on these suggestions.

On a different front, I've taken the liberty of seeking an anonymous referee's response on the manuscript by George Kauffman. I enjoyed reading George's pentrating portraits but, as you'll see from the enclosed, the referee was under-whelmed.

It was a pleasure to have a copy of your Parsons' address (wish we'd thought to ask to publish it!), and your additional materials on the Smithsonian follies. Perhaps CHF can one day do a good exhibit on Chemistry in American Life.

With best regards to you and Isabel. Come visit, soon!

Sincerely,

Arnold

FOUNDING MEMBERS: AMERICAN CHEMICAL SOCIETY ☐ AMERICAN INSTITUTE OF CHEMICAL ENGINEERS

AFFILIATED SOCIETIES: ALPHA CHI SIGMA FRATERNITY ☐ THE AMERICAN ASSOCIATION FOR CLINICAL CHEMISTRY, INC. ☐ AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS ☐ AMERICAN INSTITUTE OF CHEMISTS, INC. ☐ AMERICAN OIL CHEMISTS' SOCIETY ☐ AMERICAN SOCIETY FOR MASS SPECTROMETRY ☐ CHEMICAL MANUFACTURERS ASSOCIATION ☐ THE CHEMISTS' CLUB ☐ THE ELECTROCHEMICAL SOCIETY, INC. ☐ FEDERATION OF SOCIETIES FOR COATINGS TECHNOLOGY ☐ INTERNATIONAL SOCIETY FOR PHARMACEUTICAL ENGINEERING ☐ THE NORTH AMERICAN CATALYSIS SOCIETY ☐ SOCIETY FOR APPLIED SPECTROSCOPY ☐ SOCIÉTÉ DE CHIMIE INDUSTRIELLE

Consider, for example, the entry for William McPherson (p. 17). Kauffman's Ref. 72 first cites Wyndam Miles "*American Chemists and Chemical Engineers*", p. 328-329. All other citations in Kauffman's Ref. 72 are taken directly from the Miles entry, which was written by Lawrence P. Eblin. Kauffman's Ref. 65 (p. 7) is supposed to be for E. C. Franklin. But the citation in Ref. 65 for the Miles entry is incorrect. It is for J. B. F. Herreschoff, which Kauffman mentions on p. 4, also with Ref. 65. But here again, Kauffman's citations in Ref. 65 are all taken from the Miles entry. There are no new citations added by Kauffman. Actually, the correct Reference number for Franklin is Kauffman's No. 66. In this case, the citations for Franklin given by Kauffman are not as complete as those found in the Miles entry, written by Henry Leicester. These are not isolated examples, as further scrutiny would reveal.

Of greater concern, however, are the parallels between Kauffman's writing and the entries from Miles. For example, regarding the entries for McPherson, consider the following quotes:

> Eblin: "McPherson's own researches were on the formation of carbohydrates in the vegetable kingdom, reactions between substituted hydrazines and quinones, and the bearing of asymmetric syntheses on the doctrine of vitalism."
>
> Kauffman: "His laboratory research involved the formation of carbohydrates, reactions between substituted hydrazines and quinones, and the effect of asymmetric syntheses on the doctrine of vitalism."

By eliminating the phrase "in the vegetable kingdom," Kauffman is omitting an important detail which makes the Eblin writing more valuable than Kauffman's.

This is not an isolated example. Consider the Miles entry for Irving Langmuir, written by Egbert K. Bacon.

> Bacon: "Langmuir served the government in both World Wars."
>
> Kauffman: "Langmuir served the U.S. government during both world wars."
>
> Bacon: "Langmuir was much in demand as a semi-popular lecturer. He enjoyed expressing his views on the philosophy of science and the interrelationship of science and social and political problems."
>
> Kauffman: "In great demand as a semipopular lecturer, he spoke and wrote on the philosophy of science and the relationship between science and social and political problems."
>
> (The term 'semipopular' is not common and would most likely not be used in 1996.)

Time does not permit me any more analysis between the Kauffman entries and the Miles entries, but if any publication is considered, a very careful comparison should be made.

I submit that there is very little new information in the Kauffman manuscript. The manuscript is merely a series of unconnected brief bios of ACS presidents. There is no common thread or theme except that the individuals were all ACS presidents. Basically, there is almost nothing in the Kauffman manuscript that isn't readily available in the Miles and Miles/Gould books on American chemists and chemical engineers, or in Browne and Weeks 75th anniversary ACS history, published in 1952.

Dr. Alfred Bader
924 East Juneau, Suite 622
Milwaukee, Wisconsin 53202
Phone: 414/277-0730
Fax: 414/277-0709

A Chemist Helping Chemists

August 19, 1996

Dr. Arnold Thackray
Executive Director & Librarian
Chemical Heritage Foundation
Suite 460B
3401 Walnut Street
Philadelphia, PA 19104-3327

Dear Arnold:

I am sorry that a very long trip to Europe has delayed my responding to your important letter of May 24th.

I really enjoyed your Summer '96 *Chemical Heritage* magazine and have read it from cover to cover. My painting on Prussian blue would certainly make a good cover some time in the future, and I enclose a good photograph.

There is no question in my mind that the painting depicts the making of Prussian blue, and you will recall that the suggestion that the teacher is Brande came from you. Since then, I have compared images of Brande at the Royal Institution with that of the man here, and I think that you are right. Of course, when I publish this, I will thank you for making that suggestion.

Chemistry in Britain has asked me to write an article on this painting. There is a fair amount to write about because both Brande and Faraday published a good deal on Prussian blue and Faraday recorded references to Prussian blue in handwriting in his copy of Brande's textbook.

It seems hard to believe that no one published at least something - hopefully, a line drawing - about this painting when it was completed. The enclosed correspondence will be self-explanatory.

I was thinking of mentioning in my article in *Chemistry in Britain* that I would pay £1,000 to anyone who identifies a description of the painting in Victorian literature.

Last month, I had lunch with the chief curator of the National Gallery, and when I mentioned this to him, he said, "Why don't you give art historians the first chance?" Hence, I gave him a photograph and again a copy of my letter to Christopher Brown will be self-explanatory.

Of course, hope springs eternal, and nothing would give me greater pleasure than if you could locate that reference. Only then, we should publish that paper together!

To turn now to George Kauffman's manuscript: I am greatly bothered by this and would like to share my involvement with you.

The Kauffmans wrote a very complimentary review of my autobiography for *Angewandte Chemie*, both in English and in German. When Isabel saw that, she said that it is a fine review, but sadly, whoever reads it will not have to purchase the book: It's all in the review. When I thanked George Kauffman, he suggested that I could help him to get his biography of presidents of the ACS published.

There had been a promise for publication that was cancelled. But of course, it has occurred to me that it was cancelled for the very reason given in your referee's comments.

As you will see from a copy of Kauffman's letter to me, he has been suffering from a curious illness for some years now, and perhaps that illness is the cause for the state of the biography.

Do you think that we would do him a favor if either you or I shared the referee's comments with him? Naturally, I would not do this without your explicit permission, and it might actually be better if it came from you. Please do let me know what you think.

You may have noted that Tadeus Reichstein died two weeks ago. When Isabel and I visited him in Basel in June, he was very sick and could barely speak to us. But then we must remember that he was 99 and had a wonderful life.

Some years ago, Aldrich published an essay, *The Meaning of Alchemy*, written by Reichstein in 1931 but never published. My friends at Aldrich told me that they had been ordered to throw out the remaining copies because the essay was translated by Isabel and me, and of course, I gladly accepted the offer to keep them here. Would you perchance like to have a few copies, one of which I enclose?

I am so happy to see how well the Chemical Heritage Foundation is doing. Most of that, I am sure, is due to you, and I just hope that you will continue to do your great work.

Best wishes, as always,

AB/cw

Enclosures

Dr. Alfred Bader
924 East Juneau, Suite 622
Milwaukee, Wisconsin 53202
Phone: 414/277-0730
Fax: 414/277-0709

A Chemist Helping Chemists

October 9, 1996

Sr. Mary Virginia Orna, OSU
Chemical Heritage Foundation
315 Chestnut Street
Philadelphia, PA 19106-2702

Dear Sr. Orna,

Thank you for your thoughtful letter of September 20th.

You know the old saying: "Do not sell the skin until you have the bear". I hope to work on the Prussian blue paper in the Royal Institution in London, in December and will then know better whether I have an acceptable paper. I will then get in touch with you.

With all good wishes, I remain yours,

Sincerely,

AB/lh

CHEMICAL
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MEMORANDUM

DATE: September 11, 1996

TO: Advisory Committee and Council of Friends

FROM: Arnold Thackray AT

RE: Update on CHF

Fall is upon us, and with it comes the promise of another exciting and productive program season.

Nominations for the first recipient Othmer Medal are now being sought. This Gold Medal, which commemorates the life and achievements of Donald F. Othmer, will be awarded annually at the Othmer Luncheon in New York, to an individual who has contributed broadly to our common chemical heritage (through such areas as innovation, entrepreneurship, research, education, public understanding, legislation, or philanthropy.)

Our architects are hard at work developing the schematic designs for the next phase of renovation at 315 Chestnut Street, with the Othmer Library reading room as the central element.

Following an extensive national search, we are delighted that Elizabeth Swan has been appointed as our first Director of Library Services. Under her direction, the Othmer Library will become a resource commensurate with the remarkable achievements of the chemical and molecular sciences and industries.

Our Finance Committee has identified managers and set policy for the investment/management of CHF's capital funds. At the same time, the Development Committee continues in high gear, with the Unique Partnership Campaign (matching the $5 million balance of Don Othmer's initial challenge grant) as our central fundraising priority.

News of our expanded facility/activities is spreading rapidly (see attached ***Chemical Week*** article: **"Putting Chemicals on the Map"**). Not surprisingly, increased public attention brings with it increased media scrutiny. Hence, a CHF policy for dealing with the media is now in place.

CHF's many program activities include a reception and dinner on October 23 (from 6:15 - 9:00 p.m.) proceeding the October 24 Board Meeting--here at our new location (315 Chestnut Street). Should you be in the area and, time permitting, we would love to have you join us at this social.

Please stay tuned for a fuller articulation of our accomplishments over the past year and a glimpse of what is in store for the coming year (e.g., our new site on the Internet, etc.).

Chemical Heritage Foundation

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“Manipulating molecules is the big game, and the chemical industry is absolutely at the center of it. The public doesn't have awareness of how big this game is, and how central we are to that game,” Thackray says. “The fundamental message is that we walk tall.” CHF offers “a key to public understanding” of the chemical industry, he says. “It's not the key, but a key. We need a lot of keys.” —DAVID HUNTER *in Philadelphia*

Dr. Alfred Bader
924 East Juneau, Suite 622
Milwaukee, Wisconsin 53202
Phone: 414/277-0730
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A Chemist Helping Chemists

September 20, 1996

Dr. Arnold Thackray
Executive Director & Librarian
Chemical Heritage Foundation
Suite 460B
3401 Walnut Street
Philadelphia, PA 19104-3327

Dear Arnold:

Thank you so much for your memo of September 11th.

I wish I could be at your reception and dinner on October 23rd but must be in Canada for the opening of an art exhibition then.

It is wonderful to see what the CHF is doing, and it wouldn't be possible without you.

Chemistry has become such a dirty word in these last 50 years, and I think that your efforts are among the very best to turn the tide.

As I told you, I will be working on the Prussian Blue paper and hope to have a reasonable draft ready by the end of the year. Naturally, I will pass it by you, and of course, thank you for the important suggestion that the teacher is Brande.

May I ask you for your advice in a different matter? A good friend of mine in Vienna, Dr. Robert Rosner, and I have written a paper on anti-Semitism among chemists in Vienna in the 19th century. A rather rough draft is enclosed.

CHEMICAL HERITAGE FOUNDATION

315 Chestnut Street ☐ Philadelphia, PA 19106-2702 ☐ USA
Telephone (215) 925-2222 ☐ Fax (215) 925-1954
Internet http://chemheritage.org

THE BECKMAN CENTER FOR HISTORY OF CHEMISTRY ☐ THE OTHMER LIBRARY OF CHEMICAL HISTORY ☐ PUBLIC EDUCATION

Alfred Bader
924 East Juneau, Suite 622
Milwaukee, Wisconsin 53202

21 October 1996

Dear Dr. Bader,

Thank you for your generous donation of Professor Reichsteins's "The Meaning of Alchemy" to the Othmer Library. This is a welcome addition to our collection as such materials are often very hard to come by.

I have enclosed a copy of our Instrument of Donation form. Would you please complete parts 1-3 of this form, sign it and return it to my attention in the enclosed envelope? We will return a copy of the processed form to you for your records.

Thank you for your support of the Othmer Library and the Chemical Heritage Foundation.

Sincerely,

Paul Giblin
Assistant Librarian
215-925-2222 ext. 246
giblin@chemheritage.org

Mary Virginia Orna
Editor

315 Chestnut Street
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315 Chestnut Street ☐ Philadelphia, PA 19106-2702 ☐ USA
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Internet http://chemheritage.org

THE BECKMAN CENTER FOR HISTORY OF CHEMISTRY ☐ THE OTHMER LIBRARY OF CHEMICAL HISTORY ☐ PUBLIC EDUCATION

September 20, 1996

Alfred Bader
924 East Juneau Street, Suite 622
Milwaukee, WI 53202

Dear Alfred:

I would like to follow up on the letter you sent to Arnold Thackray on August 19, 1996. In that letter, you mention a painting that depicts the making of Prussian blue and the fact that you will be writing an article on that painting for *Chemistry in Britain.*

You also suggest that the painting would make a good cover for a future issue of *Chemical Heritage*. On this point, I agree with you wholeheartedly and would like to ask you to follow up on this suggestion by providing us with an article either excerpted or reprinted from your *Chemistry in Britain* article (we will take care of obtaining the necessary permissions).

I wish you success in finding a reference to the painting in Victorian literature and hope that some art historian can track down the source.

I look forward to hearing from you.

With every good wish to you and Isabel, I am

Sincerely,

Mary Virginia Orna

Mary Virginia Orna, OSU
Editor, *Chemical Heritage*

Sister M— V— Orna

FOUNDING MEMBERS: AMERICAN CHEMICAL SOCIETY ☐ AMERICAN INSTITUTE OF CHEMICAL ENGINEERS

AFFILIATED SOCIETIES: ALPHA CHI SIGMA FRATERNITY ☐ THE AMERICAN ASSOCIATION FOR CLINICAL CHEMISTRY, INC. ☐
AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS ☐ AMERICAN INSTITUTE OF CHEMISTS, INC. ☐ AMERICAN OIL CHEMISTS' SOCIETY ☐
AMERICAN SOCIETY FOR MASS SPECTROMETRY ☐ CHEMICAL MANUFACTURERS ASSOCIATION ☐ THE CHEMISTS' CLUB ☐ THE ELECTROCHEMICAL SOCIETY, INC. ☐
FEDERATION OF SOCIETIES FOR COATINGS TECHNOLOGY ☐ INTERNATIONAL SOCIETY FOR PHARMACEUTICAL ENGINEERING ☐
THE NORTH AMERICAN CATALYSIS SOCIETY ☐ SOCIETY FOR APPLIED SPECTROSCOPY ☐ SOCIÉTÉ DE CHIMIE INDUSTRIELLE

Cheryl
Note new
address.

CHEMICAL
HERITAGE
FOUNDATION

Benfey
909 Woodbrook Drive
Greensboro NC 27410

9/23/96

Dear Clifford,

Lovely article in *Chemistry in Britain*. Thank you for sending it to me.

I am back in Greensboro at the address above but still do some work for CHF.

Best wishes,

Ted Benfey

THE OTHMER LIBRARY OF CHEMICAL HISTORY ☐ PUBLIC OUTREACH ☐
THE BECKMAN CENTER FOR HISTORY OF CHEMISTRY

CHF
CHEMICAL
HERITAGE
FOUNDATION

315 Chestnut Street ☐ Philadelphia, PA 19106-2702 ☐ USA
Telephone (215) 925-2222 ☐ Fax (215) 925-1954

THE BECKMAN CENTER FOR HISTORY OF CHEMISTRY ☐ THE OTHMER LIBRARY OF CHEMICAL HISTORY ☐ PUBLIC EDUCATION

Arnold Thackray, *President*

3 October 1996

Dr. Alfred Bader
924 East Juneau, Suite 622
Milwaukee, WI 53202

Dear Alfred:

It's always good to hear from you. Now it's my turn to ask your indulgence of my delay in replying to yours of 19 August. In the interim, I know you've heard from Sister Mary Virginia (another treasure we have discovered) about **Chemical Heritage** and Prussian blue.

As to George Kauffman, I think we do him a kindness if we simply encourage him in his irresistible urge to write (he has no time for true, scholarly historical research which--as you well know--is a slow and torturous business). As to the Reichstein **Meaning of Alchemy**, of course we'd love to have some copies!

We are very busy, full of plans and optimism--and with the unique privilege of telling the story of chemical achievement which, as you know, is enormous, rapidly expanding, and too little known. Our Edelstein Fellow, is now being joined by Othmer, Ullyot, Cain and Garfield Fellows. Is this the time to revive the idea of a Bader Fellowship, to allow young European scholars to profit from some of the energy, professionalism and excitement that characterizes American academic activity in the history of science? Let me know what you think or, better still, come visit and bring Isabel with you.

As ever,

Arnold

AT/c

Your letter on my desk as I sign this: will read and respond to your article, with pleasure

CHF
CHEMICAL HERITAGE FOUNDATION

315 Chestnut Street ☐ Philadelphia, PA 19106-2702 ☐ USA
Telephone (215) 925-2222 ☐ Fax (215) 925-1954

THE BECKMAN CENTER FOR HISTORY OF CHEMISTRY ☐ THE OTHMER LIBRARY OF CHEMICAL HISTORY ☐ PUBLIC EDUCATION

Arnold Thackray, *President*

Private and Confidential

June 11, 1996

Dr. Alfred R. Bader
2961 North Shepard Avenue
Milwaukee, WI 53211

Dear Alfred:

As you may know, CHF is beginning the search for the first Librarian for its Othmer Library of Chemical History. May we ask for your assistance in identifying outstanding individuals able to meet the leadership needs of CHF.

The opportunities and challenges our first Librarian will enjoy are described in the enclosed "Position Specification".

The formal screening process will start in early July, and we would, therefore, appreciate your response to this inquiry as soon as possible. We are being assisted in this search by Shelly Weiss Storbeck, Managing Director, and Susan VanGilder, Senior Associate, of the A.T. Kearney Education Practice. Nominations and inquiries should be submitted to them at:

A.T. Kearney, Inc.
Education Practice
222 West Adams Street
Chicago, IL 60606
312/223-6029 (phone)
312/223-6369 (fax)
susanvang1@aol.com (email)

Nominations and inquiries will be held in the strictest confidence.

Thank you in advance for your thoughtful consideration. We are excited by the opportunities ahead, and we look forward to your counsel.

Sincerely,

Arnold Thackray

CHEMICAL HERITAGE FOUNDATION

POSITION SPECIFICATION

Position:	Librarian, Donald F. and Mildred Topp Othmer Library of Chemical History
Institution:	Chemical Heritage Foundation
Location:	Philadelphia. PA

Description: The Chemical Heritage Foundation (CHF) is a young, growing organization on the brink of national recognition. A bequest from a major donor has allowed the Foundation to acquire and launch the renovation of its permanent home, an historic building at Independence National Historical Park, and to strengthen the services it provides in support of its mission. Founded in 1982, CHF seeks to advance the heritage of the chemical sciences by discovering and disseminating information about historical resources; encouraging research, scholarship, and popular writing; publishing resource guides and historical materials; conducting oral histories; creating traveling exhibits; and taking other appropriate steps to make known the achievements of chemical scientists and the chemical process industries. CHF operates through the Arnold and Mabel Beckman Center for the History of Chemistry and the Donald F. and Mildred Topp Othmer Library of Chemical History.

Successful projects of CHF include: recording over 100 oral histories of chemical scientists and industrialists; organizing symposia that bring together industrial and academic leaders; and funding research at and travel to the Othmer Library by both academic historians and chemical scientists. In support of its public education mission, CHF conducts popular summer workshops for high school chemistry teachers and develops traveling exhibits that feature the contributions of chemical scientists and industries to society. In addition to its magazine, *Chemical Heritage*, the Foundation publishes a growing range of books, booklets and reports.

The Othmer Library houses more than 60,000 volumes--the core collections having been donated by the Chemists' Club--as well as personal papers, visual materials, electronic media, artifacts, and other archives. Home to the archives of the American Institute of Chemists, the Electrochemical Society, and the International Union of Pure and Applied Chemistry, and other professional organizations, the library maintains a broad selection of reference and secondary literature on the history of the chemical sciences and technologies. Its collection features the personal papers of the Nobel laureate Paul J. Flory, "Lexan" inventor Daniel W. Fox, and polymer chemist Carl S. ("Speed") Marvel.

CHF was established by joint action of the American Chemical Society and the American Institute of Chemical Engineers. Affiliated organizations include Alpha Chi Sigma, The American Association of Textile Chemists and Colorists, the American Institute of Chemists, Inc., the American Oil Chemists' Society, the American Society for Mass Spectrometry, the Chemical Manufacturers Association, The Chemists' Club, The Electrochemical Society, Inc., the Federation of Societies for Coatings Technology, the International Society for Pharmaceutical Engineering, The North American Catalysis Society, the Society for Applied Spectroscopy, and the Société de Chimie Industrielle.

CHF's policies and programs are developed by a Board of Trustees composed of Nobel Laureates, noted industrial scientists, and representatives of the major chemical associations. CHF has an Advisory Board composed of distinguished academics and industry leaders. The Foundation is further sustained by its Council of Friends, a larger body on which it draws for technical expertise, financial support, and greater access to the varied segments of the chemical community.

Future Goals and Directions: CHF is renovating the historic First National Bank building at Independence National Historic Park in downtown Philadelphia to provide its new home. To deepen the scholarly presence of the Foundation, this five-story, 60,000 square-feet building will have as its central feature a modern library to house the growing collections and provide research space for scholars. Plans for the Othmer Library include seminar rooms, studies, carrels for researchers, a spacious reading room, and computer capabilities that will eventually allow on-line access to the resources of the Library.

Many of the Library's holdings are now stored in boxes in temporary locations. The new Librarian will work with the Library staff to sort, classify, and catalogue the inventory. Because the Library's procedures and systems are as yet minimal, the Librarian will also have the opportunity to develop all catalogue, collection, and circulation policies, as well as develop a culture and long-term direction for the Library's growth.

Budget: With cash reserves in excess of $4 million and a successful multi-year capital campaign in progress, CHF enjoys strong financial health. Started in 1996, the capital campaign has received commitments of more than $3 million to date, with a total goal of $5 million by the year 2000.

A generous bequest from the late Dr. Donald F. Othmer will endow the basic operations of the Library. In addition, annual gifts in support of CHF come from individuals, corporations, federal and private foundations an the professional societies of the chemical community. This annual support totaled over half a million dollars in 1996.

1997 operating expenses are budgeted as follows:

Staff	1,100,000
Fellowships	104,000
General Operations	506,000
Facilities	251,000
Total Operating Expense	1,961,000

The Othmer Library is at the center of the Foundation's plans for growth, and the Librarian will have a major role in helping shape budgets for staffing, acquisitions, information technology, public service, etc.

Reporting Relationships: The Librarian will report to Professor Arnold Thackray, CHF's President and a nationally recognized scholar of the history of science. Working directly with other senior staff in defining and developing the Foundation's programs, the Librarian will be responsible for proposing the structure and additional staffing requirements of the Library.

The Librarian's specific responsibilities include, but are not limited to, the following:

- assessing the current space requirements of the Library and developing recommendations to be considered by the renovation team;
- developing a plan to evaluate and catalogue the existing collection;
- identifying a plan to meet the technological needs of the Library;
- assessing the needs of Library users;
- developing collection and circulation policies;
- managing budget and staff of the Library;
- articulating the aspirations and needs of the Library internally and within the philanthropic community;
- promoting the use of the Library and its resources; and
- working with internal and external constituencies to support the mission of the Foundation and activities of the Library.

Professional Qualifications: Candidates should have significant experience in a historical research library similar in complexity to the Othmer Library. A doctorate in a historical field and experience or education equivalent to an M.L.S. is preferred. A knowledge of the sciences is highly desirable.

Personal Characteristics: In addition to the professional qualifications that are required for this position, the Librarian should be:

- flexible in working within a growing and dynamic organization;
- able to prioritize and balance multiple demands;
- a creative problem-solver;
- able to articulate the goals and needs of a library both internally and externally;
- committed to the academic and public education mission of a library; and
- comfortable within a non-hierarchical, collegial organization.

Compensation: Open and competitive

Starting Date: Open

Deadline: The search will remain open until the position is filled.

Contacts:

Shelly Weiss Storbeck
Vice President & Managing Director
A.T. Kearney Education Practice
222 West Adams Street
Chicago, IL 60606
Phone: 312/223-6029
Fax: 312/223-6369

or

Susan VanGilder
Senior Associate
A.T. Kearney Education Practice
222 West Adams Street
Chicago, IL 60606
Phone: 703/548-2441
Fax: 703/548-2268
Email: susanvang1@aol.com

All inquiries, nominations and applications will be held in the strictest confidence.

CHEMICAL HERITAGE FOUNDATION

LIBRARIAN

The Chemical Heritage Foundation invites nominations and expressions of interest for the position of Librarian of the Othmer Library of Chemical History. Through scholarly research and public programs, CHF seeks to strengthen understanding of the chemical sciences and technologies and their contributions to society. The Foundation is in a period of growth and is currently renovating an historic building at Independence National Historical Park, in Philadelphia, PA, as its permanent home. The Othmer Library undergirds the work of the Foundation, serving all who are interested in the development of the chemical sciences, technologies and businesses.

The successful candidate will have a unique opportunity to create the culture, collection policies, structure, and staffing for a rapidly expanding collection of 60,000 volumes together with personal papers, visual materials, electronic media, artifacts, and other archives relating to the history of the chemical sciences. The Librarian will work directly with other senior staff in defining and developing the Foundation's programs.

Candidates should have significant experience in an historical research library or comparable environment with a commitment to an academic and public education mission. A doctorate in an historical field and experience or education equivalent to an M.L.S. is preferred.

Although the search will remain open until the position is filled, the review of applications will begin on June 28. We are being assisted in this search by the A.T. Kearney Education Practice. All correspondence and inquiries should be directed to:

Shelly Weiss Storbeck and Susan VanGilder
A.T. Kearney, Inc., Education Practice
222 West Adams Street
Chicago, IL 60606
312/223-6029 (phone)
312/223-6369 (fax)
susanvang1@aol.com (email)

Dr. Alfred Bader
924 East Juneau, Suite 622
Milwaukee, Wisconsin 53202
Phone: 414/277-0730
Fax: 414/277-0709

A Chemist Helping Chemists

May 2, 1996

Dr. Arnold Thackray
Executive Director & Librarian
Chemical Heritage Foundation
Suite 460B
3401 Walnut Street
Philadelphia, PA 19104-3327

Dear Arnold:

I am sorry that lecture tours to Purdue, Southern Illinois University, and San Diego have delayed my thanking you for your letter of April 15th.

I think that George Kauffman's manuscript is totally different from Skolnik's and Reese's *A Century of Chemistry*. But rather than talk in generalities, enclosed please find Chapter 3, the middle chapter, of Kauffman's work. There you will see what an enormous amount of research went into just the 21 pages of this manuscript.

The first two chapters were published in *The Hexagon* of Alpha Chi Sigma, and I just don't know why they stopped the publication.

As you know, I pride myself in being just a catalyst, and I would like to suggest that you talk to George Kauffman directly.

Kauffman's book clearly should be published, either by you or the ACS or jointly. I just wrote to you first because I know you so well.

I just read Ernest Eliel's really moving Priestley Award address published in *C&E News*. I am writing to Ernest also to inquire what he might suggest about Professor Kauffman's work.

Regarding the painting showing Brande teaching Faraday how to make Prussian blue, I hope to write a paper describing this work. But first I would like to find out just why this painting was produced. I am a life member of the Royal Institution and hope to spend quite a bit of time there in July trying to trace the history. I presume that the painting was commissioned by Brande, but surely must have been described somewhere.

Enclosed is also a copy of my Parsons Award address, which was published by *the Chemical Intelligencer*. I have expanded that somewhat to incorporate my disgust about the way that the Smithsonian has treated the ACS, and I enclose that expanded manuscript also.

With all good wishes, I remain,

Yours sincerely,

AB/cw

Enclosures

CHEMICAL
HERITAGE
FOUNDATION

315 Chestnut Street ☐ Philadelphia PA 19106-2702 ☐ USA
Telephone (215) 925-2222 ☐ Fax (215) 925-1954

THE BECKMAN CENTER FOR HISTORY OF CHEMISTRY ☐ THE OTHMER LIBRARY OF CHEMICAL HISTORY ☐ PUBLIC EDUCATION

Sent by FAX to 414 277 0709

15 April '96

Dear Alfred,

So nice to hear from you

To respond to your [illegible] thoughts:

(1) CHF is developing its own series of books

(2) CHF is co-publisher of a series with [illegible]

Hence ACS history is of interest to us

How does George Kauffman's MS differ from Herman Skolnik & K M Reese, *A Century of Chemistry* (ACS 1976)

Please call me (ext 265) so we ~~ch~~ can chat, when you have a minute

Fascinated in the continuing Brande - Faraday saga ... as you know *Chemical Heritage* is going to *color* printing are there possibilities here for reproduction of the painting, plus an art by you. Our new editor, Mary Virginia Orna, may be [illegible]

[illegible] we'n [illegible]

Arnold

cc F. Kohler; M V Orna

FOUNDING MEMBERS: AMERICAN CHEMICAL SOCIETY ☐ AMERICAN INSTITUTE OF CHEMICAL ENGINEERS

AFFILIATED SOCIETIES: ALPHA CHI SIGMA FRATERNITY ☐ THE AMERICAN ASSOCIATION FOR CLINICAL CHEMISTRY, INC. ☐ AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS ☐ AMERICAN INSTITUTE OF CHEMISTS, INC ☐ AMERICAN OIL CHEMISTS' SOCIETY ☐ AMERICAN SOCIETY FOR MASS SPECTROMETRY ☐ CHEMICAL MANUFACTURERS ASSOCIATION ☐ THE CHEMISTS' CLUB ☐ THE ELECTROCHEMICAL SOCIETY, INC FEDERATION OF SOCIETIES FOR COATINGS TECHNOLOGY ☐ INTERNATIONAL SOCIETY FOR PHARMACEUTICAL ENGINEERING ☐ THE NORTH AMERICAN CATALYSIS SOCIETY ☐ SOCIETY FOR APPLIED SPECTROSCOPY ☐ SOCIETE DE CHIMIE INDUSTRIELLE

FAX FROM:

DR. ALFRED BADER'S OFFICE
Suite 622
924 East Juneau Avenue
Milwaukee, Wisconsin 53202
Telephone: 414/277-0730
Fax: 414/277-0709

April 16, 1996

To: Dr. Arnold Thackray
Fax: 215/925-1954

Dear Dr. Thackray:

Thank you for your fax of yesterday to Dr. Bader. He is on speaking tour in Southern Illinois this week and in San Diego next week. He will respond personally upon his return.

Best wishes,

Cheryl

Cheryl Weiss
Office Manager

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                    TRANSACTION REPORT

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79 106 25×2

158 212 50

FAX FROM:

Dr. Alfred Bader
924 East Juneau, Suite 622
Milwaukee, Wisconsin 53202
Phone: 414/277-0730
Fax: 414/277-0709

A Chemist Helping Chemists

November 7, 1995

TO: Dr. O. Theodor Benfey
Chemical Heritage Foundation
FAX: 215/898-3327

Dear Ted:

If you plan to use the photograph of Isabel and me at Herstmonceux, which I sent you recently, please credit the photographer, Alex Mayboom.

Best wishes,

AB/cw

Alfred, we'd love to use it but it was folded across the middle for ~~[illegible]~~ mailing. Could you send us a glossy print, this or another showing you and Isabel and possibly showing even more of the castle? Thanks Ted

It is my understanding that ACS is charging $25.95.

[illegible]

FAX FROM:

Dr. Alfred Bader
924 East Juneau, Suite 622
Milwaukee, Wisconsin 53202
Phone: 414/277-0730
Fax: 414/277-0709

A Chemist Helping Chemists

November 7, 1995

TO: Dr. O. Theodor Benfey
Chemical Heritage Foundation
FAX: 215/898-3327

Dear Dr. Benfey:

Thank you for your hand-written note to Dr. Bader regarding the photograph. He is in England through the end of December, but we will attempt to locate a good copy of the photo for you and hope to have it in the mail sometime next week.

Please let me know if I can be of further assistance.

Best wishes,

Cheryl Weiss

Cheryl Weiss
Office Manager

[illegible]

[illegible]

[illegible]

[illegible] [illegible] [illegible]

[illegible] [illegible] [illegible]

Dr. Alfred Bader
924 East Juneau, Suite 622
Milwaukee, Wisconsin 53202
Phone: 414/277-0730
Fax: 414/277-0709

A Chemist Helping Chemists

November 27, 1995

Dr. Theodor Benfey
Editor
Chemical Heritage Foundation
Suite 460B
3401 Walnut Street
Philadelphia, PA 19104-3327

Dear Dr. Benfey:

I have received the duplicate photos and transparencies from Queen's University, and I enclose one of each for your use. May I impose on you to return the transparency when you are finished with it?

As Dr. Bader has indicated, the photographer would like to be credited as follows:

Copyright 1995 Alex Meyboom Photography

(I believe this spelling may be different than previously provided, but this is per a letter from ConnAd, Mr. Meyboom's agency.)

Again, if I can be of further assistance, please don't hesitate to call or fax. I am in the office fulltime during Dr. Bader's trip to England.

Best wishes,

Cheryl Weiss
Office Manager

Enclosures

C H F
CHEMICAL
HERITAGE
FOUNDATION

3401 Walnut Street ☐ Suite 460B
Philadelphia, PA 19104-6228 ☐ USA
Telephone (215) 898-4896 ☐ Fax (215) 898-3327

THE BECKMAN CENTER FOR HISTORY OF CHEMISTRY ☐ THE OTHMER LIBRARY OF CHEMICAL HISTORY ☐ PUBLIC EDUCATION

November 14, 1995

Dr. Alfred R. Bader
2961 North Shepard Avenue
Milwaukee, WI 53211

Dear Alfred:

As a champion of our chemical heritage, you are crucial to the success of the **Chemical Heritage Foundation's** programs. Your enthusiasm and generous support in 1994-1995 were central to our expanding efforts to identify, preserve, and **communicate** that heritage. To convey our appreciation, I am pleased to enclose ***Milestones in Chemistry***, the 1996 calendar prepared in conjunction with National Chemistry Week, along with the newly released ***Chemical Heritage Foundation*** brochure.

One of our primary concerns at CHF is the state of science education nationwide. Weak educational standards threaten America's lead in the chemical sciences and related industries. Unimaginative educational programs strip children of their natural curiosity and excitement, leading to scientific illiteracy, a less qualified work force and - more widely - negative perceptions of the chemical sciences and industries. These problems must be addressed, and the process must begin in the schools.

Over the past two years we have been designing history-based curricular materials to supplement introductory chemistry courses at high school, two-year college, and four-year college and university levels. Our first product, Introducing the Chemical Sciences: A CHF Reading List, was distributed to high school teachers nationwide, at regional and national professional society meetings (including our affiliates), as well as to our Friends and the general public.

Encouraged by the positive reactions to the reading list, CHF is now producing a second curricular package, titled Chemical Achievers, to address a specific need that many teachers mentioned. The package contains images -- portraits, scientific drawings, factories and laboratories -- representing over 70 notable achievers in the chemical sciences and industries. The accompanying text weaves biographical information into a cogent historical narrative, grouping the scientists under appropriate chemical topics. This tool complements the curricula of the chemical sciences by humanizing them -- bringing students face to face, as it were, with the brilliant scientists who created the chemistry now being taught.

Your staunch support of CHF and our growing array of educational projects and programs is highly prized. As you may know, CHF faces many challenges, not the least of which is financial, in its mission to identify, preserve, and communicate our chemical heritage and its integral role in society's progress. We are seeking an increase of 10% from our Friends in 1995-1996. As a CHF Benefactor, you contributed $1,200.00 to our 1994-1995 annual campaign. I ask you now to consider increasing your level of support to help us transcend our challenges and fulfill our mission: the **preservation**, **study** and **communication** of the story of chemical achievement.

Yours sincerely,

John

John C. Haas
Chairman, CHF Development Committee

Enclosures

Dr. Alfred Bader
924 East Juneau, Suite 622
Milwaukee, Wisconsin 53202
Phone: 414/277-0730
Fax: 414/277-0709

A Chemist Helping Chemists

November 27, 1995

Dr. John Haas
Chairman, CHF Development Committee
Chemical Heritage Foundation
Suite 460B
3401 Walnut Street
Philadelphia, PA 19104-3327

Dear Dr. Haas:

Thank you for your letter of November 14th to Dr. Bader and the enclosures.

Dr. Bader is in England through the end of December and will reply personally upon his return to Milwaukee.

Best wishes,

Cheryl Weiss
Office Manager

Dr. Alfred Bader
924 East Juneau, Suite 622
Milwaukee, Wisconsin 53202
Phone: 414/277-0730
Fax: 414/277-0709

A Chemist Helping Chemists

January 2, 1996

Dr. Arnold Thackray
Executive Director & Librarian
Chemical Heritage Foundation
Suite 460B
3401 Walnut Street
Philadelphia, PA 19104-3327

Dear Arnold:

It was nice chatting with you last week.

Isabel and I will certainly try to visit you in Philadelphia later this year.

Enclosed please find my annual contribution to your Foundation.

With all good wishes for 1996, I remain,

Yours sincerely,

AB/cw

Enclosure

Dr. Alfred Bader
924 East Juneau, Suite 622
Milwaukee, Wisconsin 53202
Phone: 414/277-0730
Fax: 414/277-0709

A Chemist Helping Chemists

April 5, 1996

Dr. Sheldon Isakoff
Chairman, CHF Board
Chemical Heritage Foundation
315 Chestnut Street
Philadelphia, PA 19106-2702

Dear Dr. Isakoff:

Thank you for your kind invitation to join you for a reception and dinner on April 24th.

Unfortunately, I have prior engagements to give several lectures in San Diego during that week. Thank you for your thoughtfulness.

With best wishes, I remain,

Sincerely yours,

AB/cw

CHF
CHEMICAL HERITAGE FOUNDATION

315 Chestnut Street ☐ Philadelphia, PA 19106-2702 ☐ USA
Telephone (215) 925-2222 ☐ Fax (215) 925-1954

Internet http://chemheritage.org

THE BECKMAN CENTER FOR HISTORY OF CHEMISTRY ☐ THE OTHMER LIBRARY OF CHEMICAL HISTORY ☐ PUBLIC EDUCATION

March 25, 1996

Dr. Alfred R. Bader
2961 North Shepard Avenue
Milwaukee, WI 53211

Dear Dr. Bader:

This note brings you greetings and a special invitation to a reception and dinner on Wednesday, 24 April.

For several years now it has been our tradition to precede our Board Meetings with an informal evening for some of our closest friends, sponsors, and key leaders of the chemical community. It is an opportunity for you to visit with old friends and colleagues or to meet new ones, and to learn about the latest happenings at CHF. For us it is a warm and friendly occasion to express how much we value your continued friendship and support.

In celebration of our move to **Independence National Historical Park** earlier this year, we will be hosting an open house with informal tours of the facility and cocktails beginning at 5:30 p.m. Directions are enclosed. We shall then adjourn to the Sheraton Society Hill, Hamilton Room, just a short walk away at Second and Walnut Streets, for dinner at shortly after 7:00 p.m..

We very much hope that you will join us. Please return the enclosed form to Terri Hubbard by 15 April. Thank you.

Yours sincerely,

Sheldon

Sheldon E. Isakoff
Chairman, CHF Board

CHF BOARD RECEPTION/DINNER

24 April 1996

5:30 - 7:00 p.m.	Open House Informal Tours and Cocktails Chemical Heritage Foundation 315 Chestnut Street
7:15 - 8:15 p.m.	Dinner Sheraton Society Hill, Hamilton Room (Second and Walnut Streets)
8:15 - 8:20 p.m.	Sheldon Isakoff - Opening Remarks and Introduction
8:20 - 8:45 p.m.	Arnold Thackray Slide Presentation
8:45 - 9:00 p.m.	Discussion
9:00 p.m.	Adjourn

****

I [ ] will attend the reception/dinner on Wednesday, 24 April 1996

[ ] will not

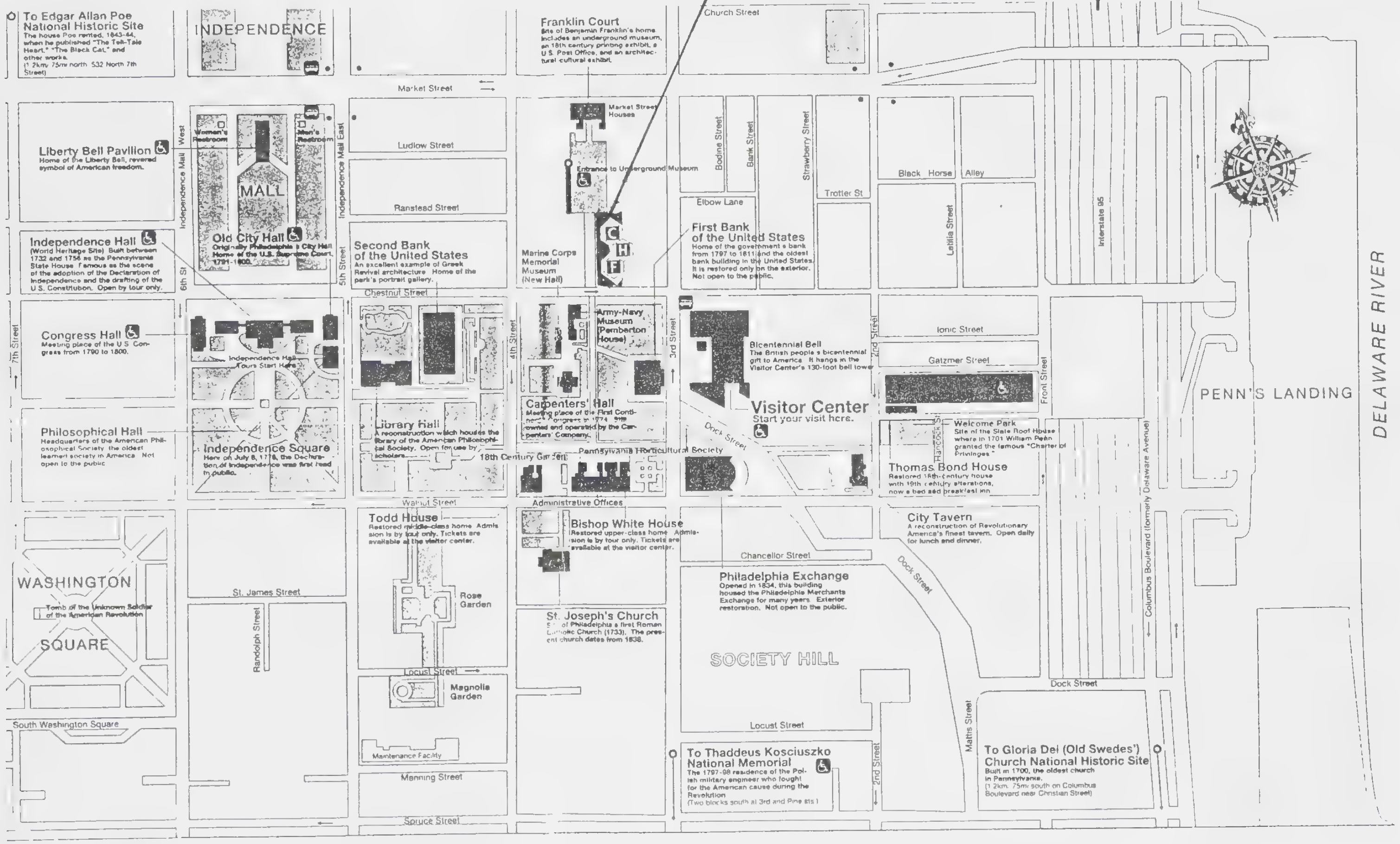
NAME:____

PHONE:____________________________________FAX:___________________

Please return this form to Terri Hubbard (CHF) by 15 April, by mail or by fax (215-925-1954). **Limited parking is available at the Chemical Heritage Foundation on a first-come, first-serve basis. If you need parking please let us know.**

Please note: If you plan to stay in Philadelphia overnight please call either the Independence Park Inn (215-922-4443) or the Sheraton Society Hill (215-238-6000) as soon as possible. We have a block of rooms reserved at both hotels on a first come, first serve basis.

THE CHEMICAL HERITAGE FOUNDATION (CHF) seeks to advance the heritage of the chemical sciences by discovering and disseminating information about historical resources; encouraging research, scholarship, and popular writing; publishing resource guides and historical materials; conducting oral histories; creating traveling exhibits; and taking other appropriate steps to make known the achievements of chemical scientists and the chemical process industries.



To Edgar Allan Poe National Historic Site
The house Poe rented, 1843-44, when he published "The Tell-Tale Heart," "The Black Cat," and other works.
(1.2km/.75mi north. 532 North 7th Street)

Liberty Bell Pavilion
Home of the Liberty Bell, revered symbol of American freedom.

Independence Hall
(World Heritage Site) Built between 1732 and 1756 as the Pennsylvania State House. Famous as the scene of the adoption of the Declaration of Independence and the drafting of the U.S. Constitution. Open by tour only.

Congress Hall
Meeting place of the U.S. Congress from 1790 to 1800.

Philosophical Hall
Headquarters of the American Philosophical Society, the oldest learned society in America. Not open to the public.

Old City Hall
Originally Philadelphia's City Hall. Home of the U.S. Supreme Court, 1791-1800.

Independence Square
Here on July 8, 1776, the Declaration of Independence was first read in public.

Second Bank of the United States
An excellent example of Greek Revival architecture. Home of the park's portrait gallery.

Library Hall
A reconstruction which houses the library of the American Philosophical Society. Open for use by scholars.

Todd House
Restored middle-class home. Admission is by tour only. Tickets are available at the visitor center.

Franklin Court
Site of Benjamin Franklin's home. Includes an underground museum, an 18th century printing exhibit, a U.S. Post Office, and an architectural-cultural exhibit.

Carpenters' Hall
Meeting place of the First Continental Congress in 1774. Still owned and operated by the Carpenters' Company.

Bishop White House
Restored upper-class home. Admission is by tour only. Tickets are available at the visitor center.

St. Joseph's Church
Site of Philadelphia's first Roman Catholic Church (1733). The present church dates from 1838.

First Bank of the United States
Home of the government's bank from 1797 to 1811 and the oldest bank building in the United States. It is restored only on the exterior. Not open to the public.

Bicentennial Bell
The British people's bicentennial gift to America. It hangs in the Visitor Center's 130-foot bell tower.

Visitor Center
Start your visit here.

Philadelphia Exchange
Opened in 1834, this building housed the Philadelphia Merchants Exchange for many years. Exterior restoration. Not open to the public.

To Thaddeus Kosciuszko National Memorial
The 1797-98 residence of the Polish military engineer who fought for the American cause during the Revolution.
(Two blocks south at 3rd and Pine sts.)

Welcome Park
Site of the Slate Roof House where in 1701 William Penn granted the famous "Charter of Privileges."

Thomas Bond House
Restored 18th-century house with 19th century alterations, now a bed and breakfast inn.

City Tavern
A reconstruction of Revolutionary America's finest tavern. Open daily for lunch and dinner.

To Gloria Dei (Old Swedes') Church National Historic Site
Built in 1700, the oldest church in Pennsylvania.
(1.2km/.75mi south on Columbus Boulevard near Christian Street)

CHEMICAL
HERITAGE
FOUNDATION

[illegible]
[illegible]

To [illegible]
3711 N Shepard Ave
Milwaukee WI 53211

Greetings

Ted Benfey

[illegible]

3401 Walnut Street ☐ Suite 460B
Philadelphia PA 19104-6228 ☐ USA

Telephone (215) 898-4896
Fax (215) 898-3327

Dr. Alfred Bader
924 East Juneau, Suite 622
Milwaukee, Wisconsin 53202
Phone: 414/277-0730
Fax: 414/277-0709

A Chemist Helping Chemists

April 3, 1996

Dr. Arnold Thackray
Executive Director & Librarian
Chemical Heritage Foundation
Suite 460B
3401 Walnut Street
Philadelphia, PA 19104-3327

Dear Arnold:

Just a couple of notes about two matters, one important and the other unimportant.

The important matter deals with a history of the American Chemical Society. I have often wondered why the ACS doesn't have such a history. It wouldn't have to be very elaborate, but it would certainly be a most useful handbook for a great many.

A little while ago, I learned just by chance that one of the ablest historians of science I know, Professor George Kauffman at Cal State in Fresno, has actually written such a history which originally was meant to be published by the Hexagon of Alpha Chi Sigma. It is an involved story with the editor of the Hexagon first promising to publish this study and then reneging.

As I am getting more and more interested in the history of chemistry, I asked Professor Kauffman to loan me his manuscript which he has kindly done.

My question to you: How could such a study best be published? Wold Beckman Center be interested? It is an obvious venue because so much of the early history of the ACS centers on Philadelphia and Pennsylvania. If not your center, who at the ACS would really be the decision-maker, if I were to suggest that the ACS publish it?

The much less important matter relates to that painting of the teacher showing Michael Faraday how to make Prussian blue. You will remember that you were the first to identify the teacher as Brande, and I enclose some relevant correspondence and a photo after careful restoration.

Dr. Arnold Thackray

Unfortunately, I have still not determined who commissioned the painting (perhaps Brande?) and where it was first described. It is hard to believe that such a large work would not have been recorded somewhere, but finding that in the English literature is like looking for a needle in a haystack.

With all good wishes, as always,

AB/cw

Enclosures

FAX FROM:

Dr. Alfred Bader
924 East Juneau, Suite 622
Milwaukee, Wisconsin 53202
Phone: 414/277-0730
Fax: 414/277-0709

A Chemist Helping Chemists

November 7, 1995

TO: Dr. O. Theodor Benfey
Chemical Heritage Foundation
FAX: 215/898-3327

Dear Ted:

If you plan to use the photograph of Isabel and me at Herstmonceux, which I sent you recently, please credit the photographer, Alex Mayboom.

Best wishes,

AB/cw

TRANSMISSION REPORT

[illegible] FIRE DEPT. [illegible]

SENT

[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]

Ted This is fine Thanks. A

ISBN 0-297-[illegible]

[5 October 1995 (bkrvbadr.132)]

He Gathered Chemicals and Still Collects Paintings

Alfred Bader. Adventures of a Chemist Collector. London:

Weidenfeld and Nicolson. North Pomfret, VT: Trafalgar Square.

Also available from the American Chemical Society. 1995. 289 pp.

$25.95; £14.99 in UK.

10/16/95

Dear Alfred, Is the above satisfactory as bibliographic detail for your book?

Could you send me a glossy print, color or black & white, preferably 5 x 7" or larger, of you on your castle? (If yours is smaller we can make an enlargement.)

Enclosed is the Loschmidt stamp picture. Thanks for the loan.

Best wishes,

Ted

Dr. Alfred Bader
924 East Juneau, Suite 622
Milwaukee, Wisconsin 53202
Phone: 414/277-0730
Fax: 414/277-0709

A Chemist Helping Chemists

November 1, 1995

Dr. Theodor Benfey
Editor
Chemical Heritage Foundation
Suite 460B
3401 Walnut Street
Philadelphia, PA 19104-3327

Dear Ted:

A long trip to Canada has delayed my reply.

I enclose the entry to my book in the Trafalgar Square catalog. In Canada, it is offered by Little, Brown.

Do you know for certain what the ACS is charging for the book?

I enclose a photograph of Isabel and me at Herstmonceux Castle, which I hope you will find acceptable.

While in Toronto, we discovered to our happy surprise that we are very distantly related. A second cousin of Isabel's married your nephew, Mathias Benfey. We had dinner with him and his family, and he seemed like a very likable fellow.

With all good wishes, I remain,

Yours sincerely,

AB/cw

9.12.95
To Alfred Bader
from Ted Benfey
re Loschmidt - and a possible visit
FAX 414/962-8322

Dear Alfred,

I have enjoyed greatly reading your Loschmidt paper and will list some of my comments below to save telephone expense. I will not be in the office tomorrow, Wednesday, or Thursday but will be back Friday. You can reach me at home at 215/953-9069.

Arnold remembers your invitation and wonders if he and I can visit you in Milwaukee, perhaps have dinner with you and Isabel Thurday evening October 26th and then talk more on Friday morning. Arnold has to be at the History of Science Society annual meeting in Minneapolis that Friday by 6 p.m. but I could stay longer. Our own Board Meeting at CHF concludes around 1 p.m.that Thursday and we are hoping we can find a plane that still arrives in Milwaukee at a convenient time.

Here are some comments regarding the Loschmidt paper:
Figure 10: The Couper formula needs an extra vertical bond from the first Az to C. Perhaps it was left out in the Annales paper but it is definitely in the Comptes rendu of 1858.
Figure 19: Cinnamyl alcohol and Cinnamic acid.

ms. p.3. line 1: Would it read better: It was not until 1912 that Richard Anschütz, the first chemist to study Loschmidt's book critically and objectively, pointed out ...
p.1 middle: I would avoid "orbital overlap" to avoid being accused of reading too much into Loschmidt's formulas. What about "overlapping atomic regions" or simply overlapping atoms.
p.1 next paragraph: Cyclopropane was the first cabocyclic compound: First to be isolated, depicted, proposed? Needs clarification.
p4 3 lines from end: Unfortunately they were not clear...: I would have said they were either not known or not appreciated. They seem remarkably clear and unambiguous, but as you point out, chemists were not ready to think in those terms.
p5 line 4: I would put a colon at the end of the paragraph.
NB
p6 top: I find this confusing. It reads as if Loschmidt would have been considered great if he had not confused things with his aromatic section. I take it what you want to say is that the first half was enough to make him great yet he did far more.
p6 last section: As Alan Rocke and Schiemenz, and, I believe, I also interpret Loschmidt, he chose schemes 184 and 185 because he did not feel there were enough facts to decide how the six carbons were arranged. So he drew a big circle to represent a six-carbon nucleus, leaving the bonding to be worked out in the future. I like Eschenmoser's comment on page 7. There are certainly hints that if Loschmidt had had some encouragement to continue further in this area that he might well have come up

with the C6-ring and even the cyclohexatriene structure.
p8 line 1: This figure schows Loschmidt and K's formula and a conventional modern structural formula but not a molecular modelling representation. Had you intended to add that? Later in the paragraph you seem to suggest that Loschmidt already talked about three kinds of phenylenediamine. I think that is misleading.
p.9 middle. K's dream, I would suggest, was based on seeing the endless rings in Loschmidt's aromatic structures plus Loschmidt's and Couper's proposals that structures could be cyclic.
p.9 end. I would delete the Kirchhof reference since your seeming approval of it negates the more measured and nuanced position you have explained in detail earlier.
References :
4: Editor or publisher rather than Herausgeber.
18b. In Sudhoff should the u have an Umlaut? — NO
32. zur Erichtung rather than zu?

[[bader912.95]

Hope this helps,
all the best,
Ted

CHEMICAL HERITAGE FOUNDATION

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Fax (215) 898-3327

Dear Alfred 9/4/95

Here is a first draft of my review of your book. Please comment, edit, delete etc. We'd love to show the castle with you on its battlements.

Best wishes,

Ted

Dr. Alfred Bader
2961 North Shepard Avenue
Milwaukee, Wisconsin 53211

A Chemist Helping Chemists

September 5, 1995

Dr. Theodor Benfey
Editor
Chemical Heritage Foundation
Suite 460B
3401 Walnut Street
Philadelphia, PA 19104-3327

Dear Ted:

Thank you for your thoughtful letter of September 21st and the draft of your very kind review of my autobiography, which I return.

My autobiography is distributed in the United States by Trafalgar Square, at Howe Hill Road, North Pomfret, VT 05053 (ph: 802/457-1911). Trafalgar sells it for $25.00 and supplies it to the ACS at a 50% discount.

I made a few very minor annotations. I know a fair amount about paint chemistry, enough not to dare doing any serious restoration myself. That I leave to trained restorers.

The Rembrandt portrait bought on July 8, 1992 cost a little over £4 million and was sold to the Rijksmuseum shortly thereafter. I saw it there in July, and the Museum is really very happy with it. So am I, of course.

With all good wishes, I remain,

Yours sincerely,

AB/cw

Enclosures

[18 September 1995 (bkrvbadr.132)]

He Gathered Chemicals and Still Collects Paintings

See letter X

Alfred Bader. Adventures of a Chemist Collector. London: Weidenfeld and Nicolson. American distributor, Washington DC: American Chemical Society. 1995. 289 pp. $; £14.99 in UK.

"Alfred," exclaimed Harvard's Louis F. Fieser, "you ha~~s~~ven't made up your mind yet whether you want to be a chemist or an art collector." Fieser encountered Alfred Bader, the future founder of the Aldrich Chemical Company, taking a break from his doctoral work in the late forties to attend a lecture at the Fogg Museum. Evidently he wanted to be both and in fact in the end became both.

When Aldrich began, Eastman Kodak was the one convenient supplier of organic research chemicals. If it wasn't in the Eastman catalog, you made it from something that was. No longer. Bader, as head of Aldrich, asked chemists in their labs what they would like~~d~~ to have and proceeded to satisfy their need. They in turn helped build the Alfred Bader Chemicals Library, now including famous sample collections, among them Henry Gilman's and Robert B. Woodward's. Compilers of spectra found the ABC samples an organic goldmine.

Bader grew up in Vienna amidst paintings at home and all around. His collecting instinct focussed first on stamps, then broadened out to paintings and chemicals. When leaving his family in the *Kindertransport* for England in December 1938, he had one

American dollar in his pocket but in his small suitcase he also carried his best stamps to help him, a fourteen-year old, to survive. He was ever resourceful. At sixteen he was shipped off to Canada in response to Britain's fear of a 'fifth column'.

His life as an art dealer at first involved paintings overlooked by the big collectors some of which~~, through his chemical restoration skills,~~ proved to be ~~of~~ by important artists. He moved up to art auctions and tells of acquiring a Rembrandt at Sotheby's, ~~for £3 800 000~~ sold to the Rijksmuseum. Alfred Bader Fine Arts now buys, sells, trades, or gives away two hundred or so paintings a year.

Bader describes the growth of Aldrich, its acquistions of other domestic and foreign companies, its joint ventures, its linking with Sigma to enter the biochemical field, and the painful sad story of his eviction from the company he created. He tells also of his fascination with two chemists spurned by August Kekulé but nevertheless never totally forgotten, the Viennese Josef Loschmidt, and the Scotsman, Archibald Scott Couper, and his admiration of and respect for two of his contemporaries, Herbert C. Brown and Woodward. He loaned some of his paintings to Purdue for an exhibition for Brown's eightieth birthday, and talked CHF into mounting a Woodward travelling exhibit for which he raised most of the funds from corporate and individual Woodward enthusiasts.

Last, but not least, Bader and his wife Isabel are generous philanthropists, making major contributions to the ACS Project

SEED and similar research opportunities for disadvantaged young people at University College, London, and elsewhere, creating university fellowships, and making art donations to his Alma Mater, Queen's University, Kingston, Ontario. To top them all, he purchased for Queen's the vast, partly medieval, moated Herstmonceaux Castle in Southern England for use as an international study and conference center. It had earlier been the home of Britain's Astronomer Royal and the Royal Greenwich Observatory.

The book, written in a most engaging style, shows the warmth of the author's personality and the depth of his affection for his friends and the members of his family.   OTB

CAPTIONS

To be discussed

1. Alfred Bader. – to be selected.

2. Herstmonceaux Castle, once the home of the Royal Greenwich Observatory and now, thanks to Alfred Bader, an internationl study and conference center. Courtesy (both) Alfred Bader.

CHEMICAL
HERITAGE
FOUNDATION

3401 Walnut Street ☐ Suite 460B
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Telephone (215) 898-4896 ☐ Fax (215) 898-3327

THE BECKMAN CENTER FOR HISTORY OF CHEMISTRY ☐ THE OTHMER LIBRARY OF CHEMICAL HISTORY ☐ PUBLIC EDUCATION

21 September, 1995

Alfred Bader
2961 North Shepard Avenue
Milwaukee WI 53211

Dear Alfred,

Too bad we couldn't arrange for a meeting in late October. But other occasions will present themselves. I am glad you are in touch with Al Pinkus. He was one of the first to contact me after my Couper publications.

Regarding Wurtz, it has always been my impression that Wurtz simply procrastinated. One can of course speculate as to the reasons for this - a suspicion of theories other than one's own, a doubt whether a chemical novice from Scotland can have anything useful to say, etc. How Couper managed to get Dumas to present his paper I don't know. I guess it suggests that Couper and Dumas had become friends and that they appreciated each others' ideas.

Given that my book was written in 1964, I am relieved that I was aware of Loschmidt's impressive contributions and did not ignore him totally.

I greatly enjoyed reading your book and we will report on it in CHEMICAL HERITAGE. - see attached.

With my best wishes,

Sincerely yours,

Theodor Benfey

Theodor Benfey
Editor

FAX FROM:

Dr. Alfred Bader
2961 North Shepard Avenue
Milwaukee, Wisconsin 53211

A Chemist Helping Chemists

August 8, 1995

TO: Dr. O. Theodor Benfey
Chemical Heritage Foundation
FAX: 215/898-3327

Dear Ted:

I had to sleep fast last night because I so enjoyed reading *From Vital Force to Structural Formulas* and just couldn't put it down.

One of the many important points of your book is the last sentence of your preface to the new edition that we must recognize "that the only responsible way to teach science is to present it in its human, cultural and historical context."

I don't know why the ACS is so slow delivering my autobiography, but I have sent you another copy under separate cover.

Also, earlier this week, I mailed a rough draft of my paper for Plenum on Loschmidt. I found your comments on the Anschütz/Couper/Loschmidt paper so helpful that I would appreciate your glancing over the Loschmidt paper also. I sent that paper without the figures, but these are so important that I will fax them to you as soon as they are completed.

I am off to give several lectures at Baylor University, where Professor A.G. Pinkus has invited me. I accepted because I was familiar with his work on Couper's chlorination of salicylic acid.

I will be back in Milwaukee on Wednesday and will then take the liberty of telephoning you to discuss my Loschmidt paper, which I will then send on to Vienna.

I very much hope that we will be able to meet either in Philadelphia or Milwaukee before very long.

With all good wishes, as always,

AB/cw

[illegible]

FOR: [illegible]

END

[illegible]

[illegible]

FAX FROM:
Dr. Alfred Bader
2961 North Shepard Avenue
Milwaukee, Wisconsin 53211

A Chemist Helping Chemists

August 8, 1995

Page 1 of 3

TO: Dr. O. Theodor Benfey
Chemical Heritage Foundation
FAX: 215/898-3327

Dear Ted:

Thank you so much for your most helpful fax of yesterday.

Unfortunately, Isabel and I have to be in Canada from October 18th to the 29th, in part for my 50th reunion at Queen's University.

I very much hope that you will find some other time soon to come and visit us.

We just spent three delightful days with Al Pinkus at Baylor University, and I spent my free time rereading from Vital Force to Structural Formulas more carefully.

Here are a few comments:

In the last paragraph on page 87, it seems that you are suggesting that Wurtz deliberately delayed the presentation of Couper's paper until after Kekulé's paper had been submitted. Only after Couper was expelled from Wurtz' lab did he* persuade Dumas to present it. Do you have any proof for this sequence?

* Cooper

I have always suspected that Wurtz, being a friend of Kekulé's, may have done just that, but how can we be certain? In the literature, there is the suggestion that Wurtz wanted to give Couper's paper to Ballard, but just procrastinated.

This is a very important point, of course, and I much look forward to your comments.

How very much Loschmidt has been neglected is so clear from your pages 99 to 101. Surely Loschmidt's structures preceded those of Crum Brown. Also, Loschmidt's *Schema 185* does not correspond to yours on page 101.

I was wryly amused by your last paragraph on page 100: "Double and triple bonds first appeared in papers by J. Loschmidt (1861), E. Erlenmeyer (1862), etc." Of course, now we know for certain that Erlenmeyer had seen Loschmidt's book before January 1862!

To turn now to your comments one by one:

Of course, there should be the vertical bond in the Couper formula in figure 10. That figure just takes Anschütz' footnote, and the bond got lost through Xerox copies.

Of course, the cinnamyl spelling will be corrected; my secretary is very good but not a chemist, and to save time, I had asked her to fax you the figures in my absence.

Your next comments are all very clear, and I will follow your suggestions.

Regarding page 6, what I do, of course, want to say is that the first half of Loschmidt's work was enough to establish his reputation. I will sharpen that language.

I believe that Rocke just echoes what Schiemenz tells him, and both say that Loschmidt thought of benzene as *Schema 182*. Do you really believe that also? Keep in mind that none of his over 100 aromatic structures are based on *182*.

I discussed this at length with Albert Eschenmoser, who does not, I think, believe that *182* was Loschmidt's basis, and of course, Anschütz made that very clear also. Eschenmoser is just not certain whether Loschmidt thought of benzene as an indeterminate ball or as 6 carbons in a circle. Only in that one point does Eschenmoser believe that Schiemenz could be correct. What specifically do you think about *182*?

I started out thinking that I wanted to show molecular modeling, but I have taken that out from all of the structures except ethylene and acetylene. In my little office, I just find them impossible to draw clearly, and I don't think they are important.

1

I do believe that Loschmidt considered the possibility of ortho-, meta- and para-phenylenediamine and certainly not, as Schiemenz thinks, of phenylenediamine isomeric with phenylhydrazine.

Of course, you are right that a number of circular structures, not just Loschmidt's, but perhaps also Couper's, were the basis of Kekulé's dream.

Sudhoff, quite surprisingly, is not spelled with an umlaut.

To come now to one of the most difficult of your suggestions: Hafner and Kirchhof.

I was invited to speak about Loschmidt in Darmstadt, and trying to be a nice fellow, I deliberately left out the slide showing that Hafner plagiarized the exact sentence from Kirchhof. After the talk, Hafner got up and said to the audience that the most dangerous lies in the world are half-truths and they had just heard half-truths. I just don't think this is correct and want to point out from whence came Hafner's quotation. But perhaps I should add a question mark to the last three words after the quotation, i.e.: Loschmidt or Kekulé?

Incidentally, Lichtenthaler was at that meeting, and yet in his long paper on sugars, he never showed Loschmidt's amazing sugar structures.

Ted, an argument could be made that there has really been a conspiracy among German chemists to say as little as possible about Loschmidt.

Did you receive the inscribed copy of my autobiography, which I sent you under separate cover, and incidentally also, the copy which you ordered from the ACS? Surprisingly, I have had a number of comments from chemists who have told me that they have ordered it from the ACS but not yet received it.

With many, many thanks for your help and all good wishes, I remain,

Yours sincerely,

AB/cw

TRANSMISSION REPORT

[illegible]

SEND

RECEIVER	PAGES	[illegible]
[illegible]	[illegible]	[illegible]

Dr. Alfred Bader
2961 North Shepard Avenue
Milwaukee, Wisconsin 53211

A Chemist Helping Chemists

To Dr. Theodor Benfey
by fax

26 pages

Dear Ted:

Here are the figures (very rough) for the Loschmidt rough draft which I sent you last week.

I'm with Prof. [illegible] in Vienna right now, but back home on Wednesday. I'll call you to discuss.

Many thanks
Alfred

Written on Sept. 8
faxed on Sept. 11

Dr. Alfred Bader
2961 North Shepard Avenue
Milwaukee, Wisconsin 53211

A Chemist Helping Chemists

September 5, 1995

Dr. Theodor Benfey
Editor
Chemical Heritage Foundation
Suite 460B
3401 Walnut Street
Philadelphia, PA 19104-3327

Dear Ted:

Now that I have sent both essays on Couper and Loschmidt to Vienna, I feel much better and can finally catch up on my work.

One could really write a very long essay about how much Loschmidt's chemical work has been ignored, even after Anschütz' work of 1912-13. Actually I think that chemists today know more about Couper than about Loschmidt, but perhaps with the Symposium behind us, this is now changing. Some "neglect" is truly sad, so for instance Hafner plagiarizing a quote about Loschmidt and using it to glorify Kekulé. Or Lichtenthaler hearing about Loschmidt and yet then not citing Loschmidt's structures for sugars.

Some of the neglect is downright funny. I enclose a page from Bull. Hist. Chem. of 1992 in which the author misspells Loschmidt's name without actually citing the 1890 paper. When I pointed this out to Professor Paoloni, he denied ever mentioning Loschmidt's name in his paper! Yet there it is, black on white. I am sure that Professor Paoloni didn't do this deliberately; he just knew so little about Loschmidt and what little he did know as second or third-hand.

I presume that you have not seen Schiemenz' long paper in Sudhoffs Archiv, and so I enclose a copy.

Do you know that character, Beckmesser, in the Meistersinger? Please look, for instance, at Table 1 on page 53 and so many irrelevant footnotes. How could Anschütz make mistakes like using a ß instead of a double-S (footnote 64)?

Of course, I have asked myself, 'What have I really learned from the Symposium in Vienna?' On the one hand, I am certain that Schiemenz and Rocke are mistaken thinking that Loschmidt based his aromatic structures on *Schema 182*. On the other hand, I am not absolutely certain that Loschmidt thought of benzene as a monocyclic, six-carbon structure, though I think that he did. However, that question is not nearly as important as the fact that Loschmidt came up with so many correct structural formulae at a time when most chemists believed that to draw such was just impossible.

I much look forward to discussing all of this with you when I see you.

With all good wishes and best personal regards, I remain,

Yours sincerely,

AB/cw

Enclosures

bc: Dr. Christian Noe
Dr. Robert Rosner

Dr. Alfred Bader
2961 North Shepard Avenue
Milwaukee, Wisconsin 53211

A Chemist Helping Chemists

September 5, 1995

Via facsimile: 215/898-3327

Page 1 of ____

Dr. Theodor Benfey
Editor
Chemical Heritage Foundation
Suite 460B
3401 Walnut Street
Philadelphia, PA 19104-3327

Dear Ted:

Thank you so much for your long letter of August 25th, sent by mail and fax. The letter sent by mail has finally reached me, a surprising credit to the Milwaukee Post Office.

I am so glad that you like my second paper, dealing with Couper, and under separate cover, I am sending you a rough draft of the first paper, dealing mainly with Loschmidt. That paper covers a 40-minute talk in Vienna, while the Couper paper covers a 20-minute talk.

I would love to be able to write for *Chemical Heritage*, but I don't think that that would be possible as long as Jensen and Rocke are the editors. I remember asking Jensen whether he would permit a paper on Loschmidt in *Chemical Heritage*, and he told me that he would send the manuscript to Rocke for approval. A good friend of mine, Robert Rosner, and I have had immensely long discussions by letter with Rocke. He is a very pleasant man, but his views are immovable. He really believes that Loschmidt thought of benzene as based on Structure 182, an opinion he shares with Schiemenz. It was clear to Anschütz - and to most everyone else who has really thought about this - that Loschmidt just advanced 182 as a hypothesis to be discarded.

Rocke does know a good deal about Kekulé, but really very little about Loschmidt, and his German is by no mean perfect.

You once wrote that you're not convinced about the claims put forward for Loschmidt, but you certainly don't strike me as a man who is immovable, and of course, I particularly look forward to your comments about the longer paper.

I will incorporate most of the suggestions in your August 25th letter.

I do have your paper with the translation of Kekulé's 1890 speech and note that in the very first sentence, you wrote that Kekulé and Couper "almost simultaneously enunciated in 1858 the two principles of ... the tetravalence and self-linking of carbon." I don't have your paper, *"From Vital Force to Structural Formulas"*, but do have Herbert Brown's interesting *"Foundation of the Structural Theory"* with an excellent introduction by you.

In any case, I think to discuss Odling's work of 1855, Kekulé's work of 1857, and the even earlier work with Rochleder's *luckentheorie* would lead too far for this paper. The quadrivalence of carbon is implied in Rochleder's work, but he didn't do anything with it later.

What is missing from Wotiz' book is a chapter on Kekulé as a politician, and you might be amused in seeing Seidel's letter commenting on the speech you translated so carefully. Kekulé did, indeed, stand on the shoulders of others, and when they were important to him, he gave them credit. Wotiz over-does the stressing of the accent on Kekulé's name; of course, in any French-speaking country, he had to stress the accent because without the accent, Kekulé means "what an asshole". Can you imagine someone in Gent or Paris introducing a young Professor Kekulé without the accent? In Gent and Paris and London, he was the international; in Prussia in 1870, he was anti-French; but at all times, he was mainly pro-Kekulé.

May I ask you for your advice about reproducing an illustration from someone else's paper? In 1992, Lichtenthaler described what he believed were the first sugar formulae, around 1870, and I attach his table. He said nothing whatever about Loschmidt's structures nine years earlier, and when I brought these to his attention, he didn't reply. And yet Lichtenthaler should have known about Loschmidt's formulae because he was in the audience when I spoke in Daumstadt well before 1992. May I simply use the enclosed as a figure in my paper, referring of course to Lichtenthaler's paper exactly as shown?

I am sending you this letter and two enclosures by fax, but then the rough draft of my longer paper by mail.

With many, many thanks for all your help and best personal regards, I remain,

Yours sincerely,

AB/cw

Enclosures

August 25, 1995

Alfred Bader
961 North Shepard ~~Street~~ Avenue
Milwaukee WI 53211

Dear Alfred,

I like your paper very much. You seem to have a flair for writing in an interesting way to hold the reader's attention. I'll need to find a way for you to write some day in *Chemical Heritage*. Here are some detailed suggestions for the paper. First of all I think it would be good if you could give first names and initials wherever possible to avoid future confusions. For instance Dumas should not be M. Dumas - the French title - but Jean Baptiste André. Stefan needs to be identified etc. Also I hope you have my "From Vital Force to Structural Formulas" where I discuss the Couper and Kekulé(abbreviated as K in what follows) episodes in great detail and show Loschmidt's benzene formula on page 101.

P.1 middle. Quadrivalence: William Odling had proposed the methane type CH4 in 1855 and K presumably independently put forward the same view in 1857. K in another paper in 1857 then explicitly stated the quadrivalence of carbon (From Vital Force page 72). It would be interesting to check whether K knew of Odling's paper. He had two years to come across it! The importance of the 1858 papers was that C and K recognized the chain-forming capacity of carbon.

p.2 middle: "and the legal sense of others". Is "legal" the best translation? I don't have the German in front of me, but wonder if he doesn't just mean sound judgment.

p.2 last line of RBW's first paragraph: ...and these are the most fundamental ... rather than ...these are of.... Again I don.t have the speech with me but if my draft really says that, I need to check it against the hand-written original. Please let me know.

p.3 first line after RBW quote: One of the "for the" phrases needs to be deleted.

Finally I imagine you want to hear my thoughts on the benzene ring. In my paper in the ACS volume *Kekulé Centennial* page 122, I include Laurent's hexagonal diagram for benzoyl chloride which K used in his seminal 1858 paper with full credit to Laurent. (Laurent's paper is given in full in my *Classics in the Theory of Chemical Combination).* Thus here might be another source of the six-carbon ring. Edward Farber, I believe, mentions a lawsuit involving a lady's ring in the form of a snake biting its tail in which K I believe had to appear as a witness. And of course, K's vision of the benzene ring was a daydream, a reverie, not a dream. My own reconstruction is that K had endlessly been involved with 6-carbon units and was mentally struggling how to cope with them; he had seen Loschmidt's and Laurent's representations and the law-suit snake-ring, and in a moment of relaxation (since as an earlier

architecture student he tended to visualize things), all these aspects came together and he saw that one solution was a six-membered ring. He then got all excited figuring out all the consequences. And of course also he knew of Loschmidt's cyclopropane ring. Thus it didn't take much to propose a valence bond structure for benzene for which I think he does deserve credit. Much too much has been made of his contribution since it was just one more step in a step-wise progression in which many had taken part. Also someone has pointed out that Couper's salicylic acid formulas use single bonds and double bonds between carbons (or rather Couper uses C=2 and C=4) and with a slight relocation of bonds he might have produced a ring - which he did with cyanuric acid.
It seems to me that Loschmidt, thanks to Anschütz and now to you, has a secure place in the history of organic structural theory, quite apart from the benzene question. Both Ernest Eliel and I are amazed at the vast number of correct structures Loschmidt represented within three years of the enunciation of the structural theory and particularly at the large number of aromatic compounds. K must have been impressed by all those big rings representing benzene in that vast array of compounds.

Best wishes,

Ted

Theodor Benfey

CHEMICAL HERITAGE FOUNDATION

[illegible] Walnut Street ☐ Suite [illegible]
Philadelphia, PA 19104-6228 ☐ USA
Telephone 215 898 4896 ☐ Fax 215 898 532[illegible]

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Name: Alfred Bader
Firm:
City: Milwaukee, WI
Tel. No.: 9-1-414-277-0709
FAX#: 9-1-414-277-073[illegible]

FROM:

Name: Ted Benfey

Dear Alfred,

NOTES: Enclosed is a copy of my letter.
Many thanks for the hospitality
[illegible] and [illegible].
I'll return the [illegible]
Ted

Dear Alfred,

I like your paper very much. You seem to have a flair for writing in an interesting way to hold the reader's attention. I'll need to find a way for you to write some day in *Chemical Heritage* Here are some detailed suggestions for the paper. First of all I think it would be good if you could give first names and initials wherever possible to avoid future confusions For instance Dumas should not be M. Dumas - the French title - but Jean Baptiste Andre Stefan needs to be identified etc Also I hope you have my "From Vital Force to Structural Formulas" where I discuss the Couper and Kekulé(abbreviated as K in what follows) episodes in great detail and show Loschmidt's benzene formula on page 101

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It seems to me that Loschmidt, thanks to Anschutz and now to you, has a secure place in the history of organic structural theory quite apart from the benzene question. Both Ernest Eliel and I are amazed at the vast number of correct structures Loschmidt represented within three years of the enunciation of the structural theory and particularly at the large number of aromatic compounds. K. must have been impressed by all those big rings representing benzene in that vast array of compound

Best wishes

Theodor Benfey

[Bader] [illegible]

CHEMICAL HERITAGE FOUNDATION

3401 Walnut Street ☐ Suite 460B
Philadelphia, PA 19104-6228 ☐ USA
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Arnold Thackray, *Executive Director and Librarian*

7 June 1995

Dr. Alfred Bader
2961 N. Shepard Avenue
Milwaukee, WI 53211

Dear Alfred:

Your recent friendly note was appreciated.

If you can find a minute to call me, I'd be glad to chat extensively about the <u>Bulletin</u>, etc.

You will recall how John Adams wrote to Abigail in 1780 that "I must study politicks and war that my sons may have liberty to study mathematicks and philosophy"--in a modern equivalent it does seem that a great deal of my effort necessarily goes to finding resources for the likes of Bill Brock (Leicester), Sy Mauskopf (Duke), Pap Ndiaye (the Sorbonne) and others yet to come!

Looking forward to your cheering presence.

Sincerely,

Arnold

AT/c

You'll be glad to know that the Woodward exhibit is off
to Cambridge (UK)

Dr. Alfred Bader
2961 North Shepard Avenue
Milwaukee, Wisconsin 53211

June 21, 1995

Dr. Arnold Thackray
Executive Director & Librarian
Chemical Heritage Foundation
Suite 460B
3401 Walnut Street
Philadelphia, PA 19104-3327

Dear Dr. Thackray:

Thank you for your letter of June 7th to Dr. Bader. He is traveling in the Czech Republic this week, lecturing at the Loschmidt Convention in Vienna next week, and then returning to his home in Bexhill in England for most of the month of July. He will reply after his return to Milwaukee on July 28th.

Best wishes,

Cheryl Weiss

Cheryl Weiss
Office Manager

CHEMICAL
HERITAGE
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[illegible]
Philadelphia PA 19104-6228
Telephone (215) 898 4896 Fax [illegible]

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Name: [illegible]

NOTES: [illegible]
[illegible]
[illegible]
[illegible]
[illegible] till you need [illegible]
[illegible]
I am sending you [illegible]
Your book still hasn't come! though ordered [illegible]
Ted

Dr. Alfred Bader
2961 North Shepard Avenue
Milwaukee, Wisconsin 53211

A Chemist Helping Chemists

August 15, 1995

Dr. Arnold Thackray
Executive Director & Librarian
Chemical Heritage Foundation
Suite 460B
3401 Walnut Street
Philadelphia, PA 19104-3327

Dear Arnold:

Thank you for your note of August 11th with that curious letter from Leo Slater.

I am sure that you will teach him what real research is all about, and he will then not write that 'the significance of Woodward and Doering's [synthesis of quinine] is further complicated' by not having a practical application. Bob Woodward would cringe reading that letter.

I have had some really helpful conversations with Theodor Benfey recently.

The distance from Milwaukee to Philadelphia is exactly the same as that from Philadelphia to Milwaukee, and it would give Isabel and me great pleasure if you and Dr. Benfey could visit us here.

With all good wishes, I remain,

Yours sincerely,

AB/cw

Dr. Alfred Bader
2961 North Shepard Avenue
Milwaukee, Wisconsin 53211

A Chemist Helping Chemists

August 14, 1995

Dr. Theodor Benfey
Editor
Chemical Heritage Foundation
Suite 460B
3401 Walnut Street
Philadelphia, PA 19104-3327

Dear Dr. Benfey:

I have just completed a rough draft of my paper on Anschütz, Couper and Loschmidt for Plenum. I would appreciate your glancing at this and giving me your kind comments.

I first heard about Couper from Bob Woodward, but didn't pay as much attention as I should have. Then a number of people - first and foremost, you - refreshed my memory.

With all good wishes, I remain,

Yours sincerely,

AB/cw

Enclosures

Dr. Alfred Bader
2961 North Shepard Avenue
Milwaukee, Wisconsin 53211

A Chemist Helping Chemists

August 8, 1995

Via facsimile: 215/898-3327

Phone –
215/898 –
4896

Dr. Theodor Benfey
Editor
Chemical Heritage Foundation
Suite 460B
3401 Walnut Street
Philadelphia, PA 19104-3327

Dear Dr. Benfey:

I have been invited to give a talk on Couper at the Chemistry Department of Baylor University in Waco, TX and then also at Queen's University and the University of Sussex.

Could you please help me by sending me the entire manuscript of Bob Woodward's Cope lecture, of which you sent me pages 6 through 8?

Where was this talk published, and if it was not, what would be the correct reference to that manuscript?

With many thanks for your help and best personal regards, I remain,

Yours sincerely,

[illegible]

AB/cw

Arthur Cope Award Lecture 197[illegible]
unpublished
courtesy Chem H. 7.

Dr. Alfred Bader
2961 North Shepard Avenue
Milwaukee, Wisconsin 53211

A Chemist Helping Chemists

August 8, 1995

Via facsimile: 215/898-3327

Dr. Theodor Benfey
Editor
Chemical Heritage Foundation
Suite 460B
3401 Walnut Street
Philadelphia, PA 19104-3327

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With many thanks for your help and best personal regards, I remain,

Yours sincerely,

AB/cw

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Name: [illegible] Dempsey

NOTES: I called Roald Hoffmann, he gave his permission, [illegible] that you [illegible] from the [illegible] of the [illegible] [illegible]

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11 Aug 95

WITH COMPLIMENTS

Dear Alfred,

The enclosed letter from this year's Edelstein Student (a Princeton grad. student) may interest you: I hope you'll come to CHF and give him the benefit of your insights.

Ted B. shared with me your thoughtful letter — your concern is appreciated. Let's talk when we meet, soon! Sincerely

Arnold

Leo B. Slater
Dept. of History
Princeton University
Princeton, New Jersey 08544-1017

AUG 0 7 1995

July 31, 1995

Arnold Thackray
Executive Director
Chemical Heritage Foundation
3401 Walnut Street--Suite 460B
Philadelphia, PA 19104-6228

Dear Professor Thackray:

As you know, I will be at the CHF this year as the Edelstein International Student. I wanted to drop you a note to let you know how much I am looking forward to the year, and to bring you up to date on my progress.

I am currently in Cambridge working at the Harvard Archives reading the R. B. Woodward papers. As a result, my dissertation topic has narrowed to a more manageable scope. I will focus on Woodward's early career, in particular on his syntheses of three compounds: quinine, 1944; cortisone, 1951; and reserpine, 1956. (I may include work on strychnine and the tetracycline antibiotics as well.)

My thesis addresses the nature of materials, specifically chemical compounds in organic chemistry. I am examining what it meant to synthesize molecules. Quinine, for example, which was synthesized in the laboratory for the first time by Woodward and Doering, is a natural product with a long history. The laboratory synthesis, important in its own right, did not obviate the need for natural quinine; in fact, the laboratory product was a mixture of isomers, not suitable for medicinal use. The significance of Woodward and Doering's achievement is further complicated by the fact that it was not directly a part of the Committee on Medical Research's war-time project on antimalarials.

The cortisone story further refines the nature of synthetic chemistry. Woodward was the first to synthesize this steroid, but his was a total synthesis starting from simple materials (in principle, from air and coal). This transformation of the simplest compounds into the most complex was the basis of much of academic organic chemistry. However, this approach was impractical for producing the quantities of material needed for medical use. At Merck, Max Tishler and others successfully carried out a partial synthesis of cortisone — that is a synthesis starting from complex and readily

available steroid intermediates. This approach was not considered as elegant as total synthesis, but was much more practical. Cortisone illustrates how setting, academic versus industrial, influences the practice of science.

My final compound, reserpine, was of interest as an anti-hypertensive and anti-psychotic drug. Once again Woodward was the first to synthesize it. This synthesis, planned and carried out within a year, was quintessential Woodward, rational, clear, and practical. The methods devised by Woodward at Harvard were the same as those used by the pharmaceutical industry to synthesize reserpine for medical use. The tension between elegance and utility was often at the center of chemical enterprise, particularly in the career of a man like Woodward who was involved heavily with both academe and industry. Broadly, I hope my work will increase understanding of basic and applied science and help to foster public appreciation of chemical science in all its guises.

The opportunities for research and professional interaction at the CHF in Philadelphia and the Edelstein Center for the History and Philosophy of Science, Technology and Medicine in Jerusalem are outstanding. In particular, I am interested in meeting Professor Roy Macleod and excited about reading in the oral history collection at CHF and in the Edelstein Library.

I plan to arrive in Philadelphia at the beginning of September — see you then!

Sincerely,

Leo

Leo B. Slater

Dr. Alfred Bader
2961 North Shepard Avenue
Milwaukee, Wisconsin 53211

A Chemist Helping Chemists

August 21, 1995

Dr. Theodor Benfey
Editor
Chemical Heritage Foundation
Suite 460B
3401 Walnut Street
Philadelphia, PA 19104-3327

Dear Ted:

In response to your note of August 15th, I have several first-day postmarks of the Loschmidt stamp, with a description of his life. One of these, a gift to you, is enclosed.

There is one factual error in the description of Loschmidt's life. As I know from Loschmidt's diary of that period, which I own, he did not come to Vienna in 1850, but in 1853.

I found it very difficult to get larger prints of the stamp from the Austrian postal service, and enclose the one which I have. Could you please return this after you have used it in the spring issue of *Chemical Heritage*?

While I was very happy to see the Loschmidt stamp with cinnamic acid, you really need a magnifying glass to ascertain that it is cinnamic acid, and I would much have preferred the Loschmidt Number to that clumsy test tube.

With all good wishes, I remain,

Yours sincerely,

AB/cw

Enclosures

CHEMICAL HERITAGE FOUNDATION

3401 Walnut Street □ Suite 460B
Philadelphia, PA 19104-6228 □ USA

Telephone (215) 898-4896
Fax (215) 898-3327

8/15/95

Alfred,

I'd like to reproduce the Loschmidt stamp - showing cinnamic acid - and the cancellation in a future issue of *Chemical Heritage* (next spring issue). Could we have a glossy 5×7" or 8×10" picture of the stamp & the first-day cover?

Thanks,

Ted Benfey

PS, I shared your letter with Arnold. He'd love to get back to scholarship as soon as circumstances permit! Ted

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13 June 1995

Alfred Bader
Astor Hotel Suites 622
924 East Juneau Avenue
Milwaukee WI 53202

Dear Alfred Bader,

I am amazed and overwhelmed as I peruse the contents of your two mailings. My profoundest thanks. I think you sensed that I became very much emotionally involved in Couper's life and fate as I slowly learned of the details. Now, going through the Crum Brown and Anschütz correspondence, I relive my original excitement and involvement. Amazing that even the document from the institution Couper went to for his mental health has been preserved.

Your second letter begins "As you know, I have been very much influenced by your...". In fact I had no idea! You may be interested to know that Woodward began his award lecture, when chosen with Roald Hoffmann for the Cope Award, by paying tribute to Couper. He did so not so much for his enunciating the concept of the chain-forming capacity of carbon atoms but for his introducing the bond-line in structural formulas into organic chemistry. I enclose the relevant section. I am wondering what led Woodward to Couper. Did he read my writings on him or did he even attend the Kekulé/Couper Centennial? ACS and CHF together will publish RBW's Cope lecture with my commentary together with RBW's most important papers annotated by Peter Morris.

Finally you mention that you have just learned of the "legal hassle" initiated by John Wotiz. I am deeply perturbed by what is going on, partly because I count Bill Jensen, Alan Rocke, and John as my friends, but more particularly because it was my Festschrift in the Bulletin that led to the hassle. The Winston Salem symposium in my honor was a joyous occasion and Bill Jensen was most kind to gather the more historical papers for the Bulletin. Now all this has become the cause of a most painful train of events. You may be interested to know that when I was first informed of the lawsuits I made the comment that the one person who, I thought, could bring peace - or at least a cooling of the tempers and emotions - was you. But I never could think of

a way to approach you about this - until this moment. Perhaps even at this stage you might be able to see a way of bringing people together, or better still to bring them and others to work together on some significant project in the history of chemistry.

With my very best wishes,

Sincerely yours,

Ted Benfey

Theodor Benfey
Editor

ALFRED BADER FINE ARTS

DR. ALFRED BADER

ESTABLISHED 1961

June 21, 1995

Dr. Theodor Benfey
Editor
Chemical Heritage Foundation
Suite 460B
3401 Walnut Street
Philadelphia, PA 19104-3327

Dear Dr. Benfey:

Thank you for your letter of June 13th to Dr. Bader. He is traveling in the Czech Republic this week, lecturing at the Loschmidt Convention in Vienna next week, and then returning to his home in Bexhill in England for most of the month of July. He will reply after his return to Milwaukee on July 28th.

Best wishes,

Cheryl Weiss
Office Manager

By Appointment Only
ASTOR HOTEL SUITE 622
924 EAST JUNEAU AVENUE
MILWAUKEE WISCONSIN USA 53202
TEL 414 277-0730 *FAX 414 277-0709*

Dr. Alfred Bader
2961 North Shepard Avenue
Milwaukee, Wisconsin 53211

January 4, 1995

Dr. Theodor Benfey
Chemical Heritage Foundation
3401 Walnut Street
Philadelphia, Pennsylvania 19104 6228

Dear Theodor:

I do hope you will be able to attend the Loschmidt Symposium in Vienna from the 25th to the 27th of June.

Couper will not be forgotten. I will give two lectures, one (40 minutes) on Loschmidt's Chemische Studien, and the second (20 minutes) relating Anschütz to Couper and Loschmidt. Abstract for the second paper is enclosed.

Before that symposium, my autobiography will have been published by Weidenfeld in London, which contains a long chapter, No. 16, dealing with Couper and Loschmidt.

All good wishes for the New Year.

Sincerely,

Enclosure

Dr. Alfred Bader
2961 North Shepard Avenue
Milwaukee, Wisconsin 53211

May 8, 1995

Dr. Arnold Thackray
Executive Director & Librarian
Chemical Heritage Foundation
Suite 460B
3401 Walnut Street
Philadelphia, PA 19104-3327

Dear Arnold:

It was indeed very nice to see you in Anaheim, and I now want to thank you for your letter of April 26th.

Perhaps your move to new quarters will greatly improve the scholarship in the history of chemistry in this country. Right now, it seems in such disarray: for instance, I haven't received any issue of the Bulletin for many months. You know that we are very much involved trying to help chemists in four countries - the United States, Britain, the Czech Republic and Canada - and of course we wonder whether the Royal Institution is not a far better place for research into the history of chemistry than any of our institutions here.

Isabel and I hope to be in Philadelphia sometime this autumn and would very much like to discuss this with you then.

With best wishes, as always,

AB/cw

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3401 Walnut Street ☐ Suite 460B
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26 April 1995

Dr. Alfred Bader
2961 N. Shepard Avenue
Milwaukee, WI 53211

Dear Alfred:

It was a pleasure to see you and Isabel at ACS Anaheim, and an honor to be present when you received the Parsons Award. Thank you for including me, and thank you especially for your thoughtful and moving acceptance speech.

Sin, overpopulation and chemaphobia. As you rightly observe, though the first two are daunting, it lies in our power as a chemical community to address the third of these, and to see that talent continues to flow to the chemical sciences.

We are of course grateful for all you have already done to help CHF research and make known the story of chemical achievement. We hope you'll do more! In particular, my colleagues and I would love to review with you how we might develop a fellowship for UK or European graduate students to come to CHF for dissertation research/exposure to the American chemical community. CHF's move to new, permanent quarters at Independence Mall, and our developing research resources, make this timely.

Please write or call me (215-898-1805) to suggest how and when we might meet to discuss this.

With all best wishes to you and Isabel,

Sincerely,

Arnold

Arnold Thackray
Executive Director and Librarian

AT/c

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16 January 1995

Dr. Alfred Bader
2961 North Shepard Avenue
Milwaukee, Wisconsin 53211

Dear Alfred,

Thank you so much for your letter of 4 January. I am delighted that you will speak on Couper in Vienna and thus continue to keep him in scientists' awareness. It seems Woodward was much inspired by Cooper as shown in his Cope lecture which ACS-CHF will, I hope, shortly publish. It will be part of our book on some of RBW's most famous papers.

Thanks for suggesting that we include Couper's and Loschmidt's birth dates in the ACS chemistry calendar. I thoroughly agree and will urge the ACS people to do it.

Unfortunately I won't be able to attend the Loschmidt celebrations. I will be in Europe in March when the weather will be much less hospitable. The roster of speakers for the symposium is most impressive.

With my very best wishes,

Sincerely,

Ted Benfey

Theodor Benfey
Editor

TB/lda

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THE AMERICAN ASSOCIATION FOR CLINICAL CHEMISTRY, INC. ☐ ALPHA CHI SIGMA FRATERNITY ☐ THE AMERICAN INSTITUTE OF CHEMISTS, INC.

Dr. Alfred Bader
2961 North Shepard Avenue
Milwaukee, Wisconsin 53211

July 25, 1994

Dr. Theodor Benfey
Chemical Heritage Foundation
3401 Walnut Street
Philadelphia, Pennsylvania 19104 6228

Dear Dr. Benfey:

A long trip to Europe has delayed my thanking you for your note with Chapter 4 of the Kekulé Centennial publication.

There, indeed, is a reference to Loschmidt, albeit only to his 1890 paper and not to *Chemischestudien*. Actually, that 1890 paper has not been studied sufficiently and will be discussed in great detail at the Loschmidt Symposium next June in Vienna, which I hope you can attend.

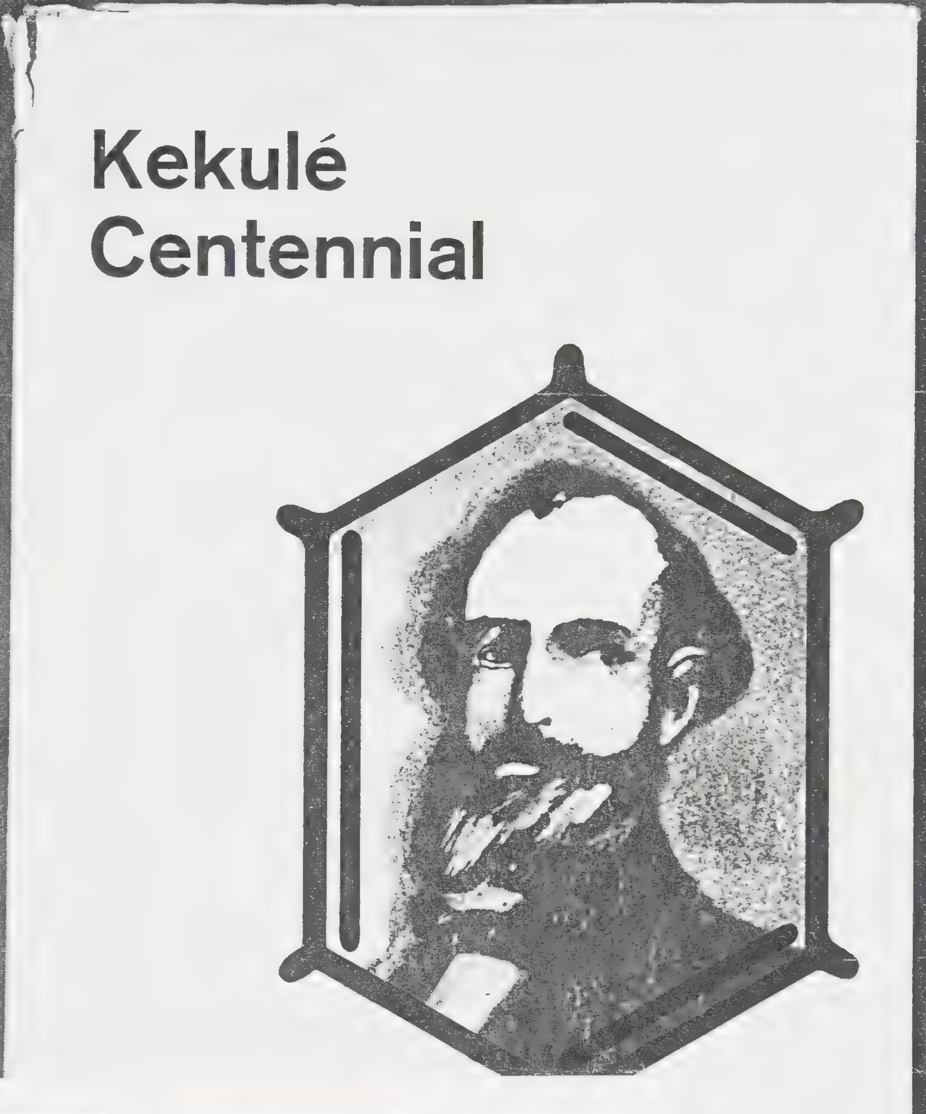
By the time I heard from A.C.S. Books that they might be interested in publishing my autobiography, my negotiations with a good English publisher Weidenfeld were far advanced, and then completed during my trip. However, with the interest of A.C.S. Books in mind, I negotiated with the publisher that A.C.S. Books could obtain my autobiography at a 50% discount, and I enclose copy of my letter to A.C.S. Books describing terms.

In the autobiography, I discuss Couper in some detail, and during the Loschmidt Symposium in June I plan to present a paper dealing with Couper in considerable detail. I believe that I have told you that I had the good fortune of acquiring a great deal of correspondence between Anschütz and Crum Brown leading to the discovery of many of the details of Couper's life.

All good wishes.

Sincerely,

Enclosure



Kekulé Centennial

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WITH COMPLIMENTS

Dear Alfred Bader
– I did find one Loschmidt
reference – an interesting
one in the Kekulé book,
I wish you had discovered
Loschmidt in 1965!

Best wishes,
Ted Benfey

I hope you've heard from ACS Books.

Loschmidt, p. 76, 80.

4

The Spatial Configuration of the Benzene Molecule and the End of the Kekulé Formula

A. SEMENTSOV

Lafayette College, Easton, Pa.

Three-dimensional models of benzene correspond to the structural formulas with double, diagonal, and centric bonds. The most interesting is the formula of Sachse, which corresponds to the formula containing three-electron bonds. The recently synthesized three-dimensional isomers of benzene are not aromatic, and the less stable, the more double bonds they contain. Hence, the Kekulé formula with three double bonds can not express the benzene properties and is only a "Bildungsformel." It is accepted that hydrogen atoms are located in the same plane which contains carbon atoms, but some experimental data contradict this presumption.

Kekulé's formula for benzene was criticized almost as soon as it was published. Alternative formulas were proposed, beginning in 1867 when Claus (*5, 6, 7*) advanced his well known diagonal formula. Some of these formulas were three dimensional.

Ladenburg (*21*) wrote in 1869 that he had told Kekulé several years before that the positions 1,2 in his formula are not identical with the positions 1,6. Markovnikov (*27*), in his thesis published in the same year, does justice to the enormous usefulness of the Kekulé formula. However, he suggests that it is much less important than Kekulé's hypothesis about the structure of saturated compounds. Furthermore, he assumes, as did Kekulé (*19*), that only the synthesis of benzene can prove this formula. It is interesting to note that all benzene systheses correspond to the Kekulé formula, but they did not confirm it. We will see this later.

The properties of benzene limit the configuration of its molecule to three possibilities—hexagon, triangular prism, and octahedron. Hence, all three-dimensional models must be reduced to the prism and octahedron.

Both of these models were suggested in 1869. Koerner (*20*) proposed the model shown in Figure 1.

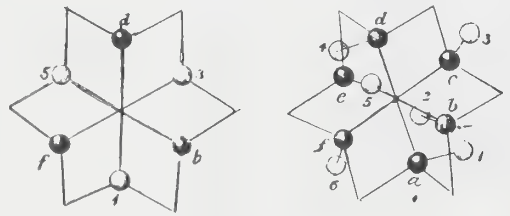

Figure 1. Koerner's model

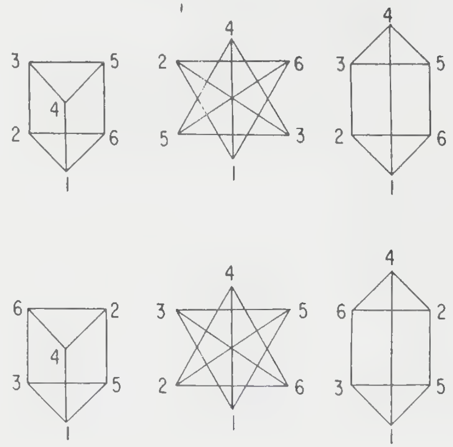

Figure 2. Ladenburg's models

Ladenburg (*21*) proposed the prismatic model and also a model in the form of a twisted prism. The last one, as well as Koerner's model, was octahedral (Figure 2). The original numbering of Ladenburg was later changed to that in the lower left of Figure 2 to meet the experimental data.

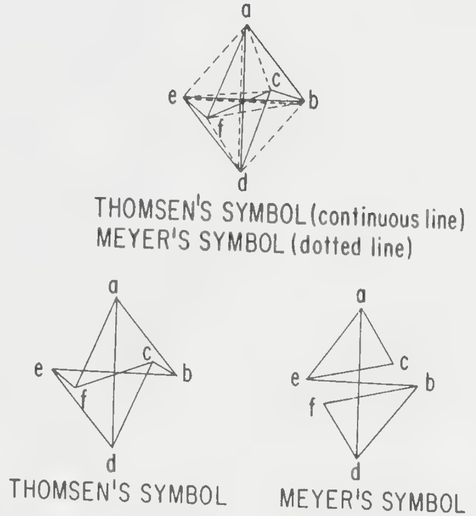

Figure 3. Octahedral models of Thomsen and Meyer

Octahedral models were also offered by Richard Meyer (*29*) and Thomsen (*37*) (Figure 3). The only difference between them is the direction of the axial bonds. Meyer proceeded from the model of Ladenburg while Thomsen kept the direction of the diagonal bonds in Claus' formula.

Sworn (*36*) in 1889 strongly favored the octahedral model of Thomsen. He assumed that this configuration ensures the most stable equilibrium and explains the remarkable fact that only molecules containing six atoms show aromatic properties. He also emphasizes the necessity of diagonal bonds to give the molecule the needed compactness and explains the difference of the ortho and para positions from the meta ones. It is interesting to note that Pauling (*32*) used the same argument in favor of diagonal bonds as late as 1926. Sworn also proposed a projection which is not octahedral but prismatic (Figure 4).

In 1888 Herrmann (*15*) proposed an octahedral model with the positions of hydrogen atoms different from all others (Figure 5).

Much later, Collie (*8*) suggested a dynamic octahedral model, in which two octahedral configurations are transformed into each other through an intermediate flat hexagonal configuration. He repeated this

idea again in 1916 (*9*) and tried to confirm his model by the study of the ultraviolet spectra of benzene (*2*).

All these models contradict the fact that carbon atoms in the benzene molecule are located in one plane, or almost in one plane. That was

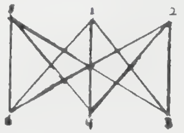

Figure 4. Sworn's prismatic model

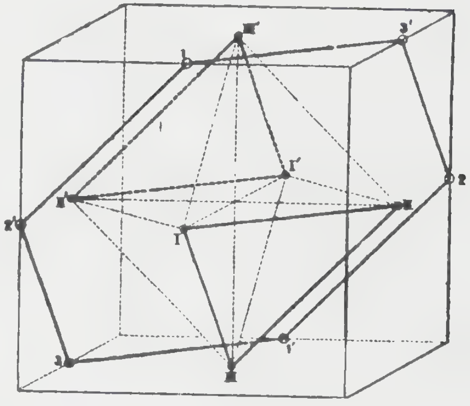

Figure 5. Herrmann's octahedral model

established by x-ray diffraction (*10, 26*), electron diffraction (*33, 41*), infrared and Raman spectra (*17*). In all models mentioned, the authors consider the carbon atoms as material points.

Seven authors proposed models constructed of tetrahedral carbon atoms. In these models, we see the application of the van't Hoff theory to the formulas of Kekulé, Armstrong-Bayer, and those with the three-electron bonds (Figure 6).

The model corresponding to Kekulé's formula was considered and rejected by Marsh (*28*) and defended by Graebe (*14*). Marsh rejected it because it did not express the specificity of aromatic compounds—e.g., in the sharp change of properties by the dihydrogenation of phthalic acid.

Marsh, Loschmidt (*25*), Erlenmeyer (*12*), Vaubel (*39*), and Huggins (*16*) proposed the tetrahedral interpretation of the Armstrong-Bayer formula. In the first three models, the centers of six carbon tetrahedra are in the same plane. Baeyer (*1*) adhered to this model. In the models of Vaubel and Huggins, the centers of tetrahedra are located alternately in two parallel planes.

Graebe (*14*) criticized all these models, claiming that they cannot explain why only phthalic acid, but not iso- and terephthalic acids, gives an anhydride. He indicates that it is difficult, if not impossible, to construct models for condensed aromatic substances, proceeding from these models.

Another fact which contradicts the models of Vaubel and Huggins is the known planarity of the benzene nucleus. The most interesting is the model proposed by Sachse (*34*) in 1888. In this model every carbon atom tetrahedron is bound to two neighboring tetrahedra by an edge. It implies that each C—C bond contains three electrons.

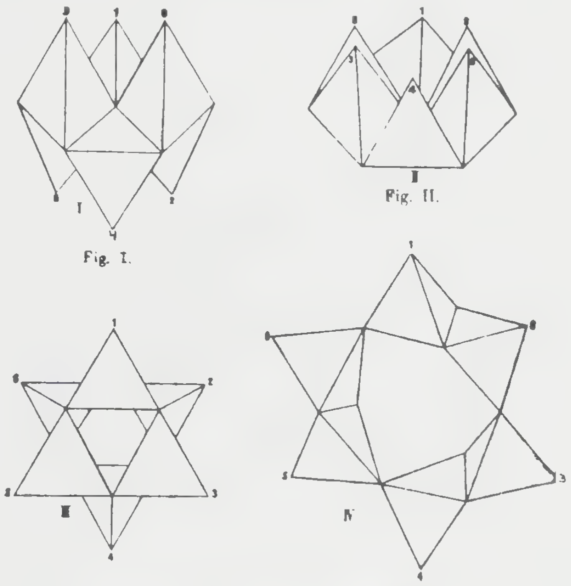

Figure 6. Tetrahedral carbon models

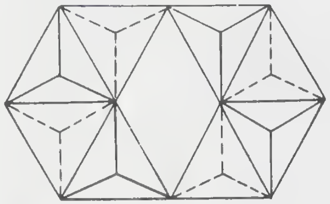

Figure 7. Sachse's model

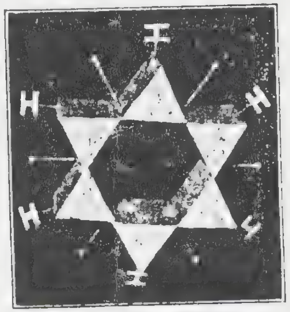

Figure 8. Cracker's model

Formulas containing three-electron bonds were suggested by Kauffman in 1911 and Thomson in 1914 and again in 1921.

Recently, Linnett (*24*) proposed a new benzene formula with three-electron bonds. It is based on the assumption that the electron octet consists of two tetrahedra, one of which contains electrons with a positive spin, the other with negative spin.

In the Sachse model, the electron positions correspond to the Linnett formula (Figure 7). It is interesting to note the way Huggins explains the lack of aromatic properties in cyclooctatetraene. Proceeding from Erlenmeyer's stereochemical interpretation of the conjugation, he assumes that in its molecule the cyclic conjugation is impossible.

Another model with three-electron bonds was proposed by Crocker (*11*) (Figure 8). Here, two neighboring carbon atoms are bound by the electron pair and an additional "aromatic" electron.

I will not describe the complicated model of Morse (*31*), based on the idea of the cubic form of the electron octet.

Several recently published papers describe polycyclic valence isomers of the benzene derivatives. All these isomers were nonaromatic

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RECEIVED September 24, 1965.

Dr. Alfred Bader
2961 North Shepard Avenue
Milwaukee, Wisconsin 53211

October 3, 1994

Professor Charles C. Price
Chairman, CHF Board
Chemical Heritage Foundation
3401 Walnut Street
Suite 460B
Philadelphia, Pennsylvania 19104 6228

Dear Charles:

Thank you for your kind invitation to be with you on Wednesday, October 19th.

Isabel and I wish we could attend, but our younger son Daniel is getting married in Milwaukee on October 23rd and we are expecting a lot of family to visit us.

Please understand.

All good wishes.

Sincerely,

CHEMICAL
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PUBLIC OUTREACH ☐ THE OTHMER LIBRARY OF CHEMICAL HISTORY ☐ THE BECKMAN CENTER FOR HISTORY OF CHEMISTRY

September 27, 1994

Dr. and Mrs. Alfred R. Bader
2961 North Shepard Avenue
Milwaukee, WI 53211

Dear Dr. and Mrs. Bader:

This note brings you fall greetings and a special invitation to a reception and dinner on Wednesday, 19 October.

For several years now it has been our tradition to precede our Board Meetings with an informal evening for some of our closest friends, sponsors, and key leaders of the chemical community. It is an opportunity for you to visit with old friends and colleagues or to meet new ones, and to learn about the latest happenings at CHF. For us it is a warm and friendly occasion to express how much we value your continued friendship and support.

We will be meeting at the Sheraton Society Hill, Cook Room, One Dock Street (between Walnut and Second Streets) for drinks at 6:15 p.m. This will be followed by dinner at 7:00 p.m.

We very much hope that you will join us. Fiona Ross will call you shortly to check your availability and to give you the final details.

Sincerely yours,

Charles C. Price

Charles C. Price
Chairman, CHF Board

Dr. Alfred Bader
2961 North Shepard Avenue
Milwaukee, Wisconsin 53211

May 8, 1995

Dr. Arnold Thackray
Executive Director & Librarian
Chemical Heritage Foundation
Suite 460B
3401 Walnut Street
Philadelphia, PA 19104-3327

Dear Arnold:

In response to your letter of May 15th, I like to make a contribution to the Chemical Heritage Foundation once a year and did so last December, and of course, I plan to do so again at year-end.

I hope that you know me well enough that you will not mind my writing to you frankly: You are an excellent scholar and one of the best historians of chemistry I know. But now you seem to spend so much of your time on fund-raising rather than on scholarly pursuits.

As I have asked you once before: What is happening to the bulletin? I haven't had a copy for many months.

I understand that PBS had an excellent discussion on television, an hour long, on the life and work of Bob Woodward. Could we purchase a tape of that from you or from anyone else? I don't have to tell you how interested I am in Bob Woodward!

Will anyone from the CHF attend the Loschmidt Symposium in Vienna in June? I plan to give two lectures, one on Loschmidt, the father of molecular modeling, and the other on the work of Anschütz discovering Couper and Loschmidt.

With all good wishes, I remain,

Yours sincerely,

AB/cw

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3401 Walnut Street ☐ Suite 460B
Philadelphia, PA 19104-6228 ☐ USA
Telephone (215) 898-4896 ☐ Fax (215) 898-3327

Arnold Thackray, *Executive Director and Librarian*

15 May 1995

Dr. Alfred R. Bader
2961 North Shepard Avenue
Milwaukee, WI 53211

Dear Alfred:

CHF is making great strides in our public education work, even as we prepare for the move to CHF's new home at **Independence National Historical Park.**

CHF fulfills its educational responsibilities in several ways. Through our **"Chemical Notables"** project we are developing visual materials on eminent men and women in chemical history, as our school-teacher friends have requested. ***Chemical Heritage*** continues to grow in size and popularity. We offer prestigious annual events such as the Othmer Luncheon and the Connor and Ullyot Lectures. And, we are making progress in developing our **sixth** traveling exhibit, **"Colors, Culture and the Chemical Sciences,"** which will join our existing exhibits in circulating to schools, science museums, and professional societies. Most recently we are exploring plans for a museum which, among other things, will highlight how instruments play a central role in the development of science, industry, and civilization.

Our enthusiasm for providing these public education services is sharpened by the anticipated move to **Philadelphia's** historic and cultural district within the year. CHF's new facility will allow us the unique opportunity to "scale up" educational activities for a broader audience, including **thousands of school children** who visit **Independence National Historical Park** each year. Securing a permanent home further underscores our commitment to **putting the past to work for our future!**

CHF's ability to offer unique educational opportunities and to celebrate chemical achievement is dependent on the generosity of Friends like ***YOU*** -- especially during this transition period when capital commitments are constraining our cash flow. Your support is more than a donation - it is an **investment** in education, the chemical community, and our children's future!

With your help we have raised almost $50,000 toward our 1994-95 annual fund target of $80,000. A Haas family trust doubled the value of these gifts and will continue to do so for gifts received before the end of our fiscal year. May I ask that you consider an additional gift before 30 June 1995? We would be most grateful. With your help we will meet our projected goal and deliver the excellence you have come to expect from us. A donor card and return envelope are enclosed for your convenience.

Thank you in advance for your vote of confidence and support of our chemical heritage!

Sincerely,

Arnold

Enclosures

Hoping to see you and Isabel soon!

FOUNDING MEMBERS: AMERICAN CHEMICAL SOCIETY ☐ AMERICAN INSTITUTE OF CHEMICAL ENGINEERS

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CHEMICAL HERITAGE FOUNDATION
1992-1993 PROGRAM HIGHLIGHTS

* Our publication program has been extremely active with the release of several noteworthy items: ***The First Century of Chemical Engineering: A Timeline of Discoveries and Achievements***; and ***Nobel Laureates in Chemistry 1901-1992***--the first in the **History of Modern Chemical Sciences Series.** Our **University of Pennsylvania Series** will soon unveil its third publication, ***Chemical Sciences in the Modern World.*** And, of course, there is ***Chemical Heritage***, which carries the message of chemical achievement around the globe.

* Our fall program season was launched with the **Second Ralph Connor Lecture** on the development of the chemical process industries, featuring noted chemical engineer, entrepreneur, and economist **Ralph Landau** who spoke on **Strategy for Economic Growth: Lessons from the Chemical Industry.** The event, which attracted a large and diverse audience of senior executives from the broad spectrum of the chemical sciences and industries, members of academe, and students, also helped celebrate the centennial of Chemical Engineering at the University of Pennsylvania.

* Following up on the success of our previous workshops designed to **Incorporate the History of the Chemical Sciences into the Introductory Chemistry Curriculum** our high school teacher activity consisted of a pilot program to create a small package of curricular modules and supplementary materials for teachers of introductory chemistry, and the creation of an electronic network for the on-line exchange and modification of these materials.

* Our traveling exhibits which highlight the positive contributions of chemical scientists and the chemical industries to society, continue their tours worldwide to museums, science centers, schools, and corporate headquarters. Our latest efforts are focused on developing an educational module (a traveling exhibit and associated hands-on activities) on **Colors, Culture, and the Chemical Sciences.**

* Additions to our unique oral history collection, which numbers over 100 completed interviews of prominent chemical scientists and engineers, include interviews with chemical engineers **Chalmer Kirkbride** and **Jerry McAffee,** and biochemists **Herbert Tabor** and **Konrad Bloch.**

* Some twenty historians of the chemical sciences, sociologists, and political scientists gathered for our fall **BIMOSI (Biomolecular Sciences Initiative)** conference **Private Science: The Biotechnology Industry and the Rise of Contemporary Molecular Biology** to review and debate the transformation of molecular biology, from an academic endeavor whose goal is to elucidate the obscure processes guided by DNA to a corporate commodity of significant agricultural and medical value. Our ***Guide to the Human Genome Project*** was published in conjunction with this activity.

* Immediately after Labor Day we welcomed three international scholars: **Horst Romane,** Professor of History of Chemistry at the University of Halle, Germany, who spoke on the **History of Chemistry in East Germany, Then and Now; Michael Chayut** of the Hebrew University of Jerusalem, who studied the work of **Paul Flory** and innovation in industry; and **William Brock,** Professor of History of Science at Leicester University, England, who researched a book on **Liebig** and the British. The 26 September ***New York Times Book Review*** devoted a full page to praising Dr. Brock's ***The Norton History of Chemistry*** (much of which was written during his tenure as an Edelstein International Fellow here in 1990-1991,) as a book to be read by the literate public.

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THE BECKMAN CENTER FOR HISTORY OF CHEMISTRY ☐ THE OTHMER LIBRARY OF CHEMICAL HISTORY ☐ PUBLIC OUTREACH

29 November 1993

Dr. Alfred R. Bader
2961 North Shepard Avenue
Milwaukee, WI 53211

Dear Dr. Bader:

Too many people still confuse "chemical" with "deadly toxin" and think that the heritage of chemical achievement and the story of superfund sites are one and the same. As a leading member of the chemical community you know that many thoughtful actions are required to change negative perceptions, recruit bright youngsters to the chemical sciences, maintain the international competitiveness of our chemical industries and technologies, and decipher the molecular wonders of our increasingly-complex universe. With your generous help, the Chemical Heritage Foundation is doing its part--with public outreach, information resources, and academic programs.

Our public outreach activities continue to enlighten audiences nationwide, while the academic work of the Beckman Center for the History of Chemistry is attracting scholars from around the world. I am pleased to share with you highlights of our programs for 1992-1993, which were made possible with your support (see attached).

Underlying the vitality and success of all our programs are the growing collections of the Donald F. and Mildred Topp Othmer Library of Chemical History. The increase in Othmer Library resources and the growth of CHF's outreach and academic programs are fundamental to the future of our chemical heritage. It now appears that we will shortly be able to purchase our own building--taking prudent advantage of a favorable real estate market. Such action will allow us to house all our collections in one place and will have enormous positive implications for the future of OLOCH and CHF.

The extent and quality of CHF's educational outreach depend in large part on our good friends' participation in our annual fund. Your generous contribution for 1992-1993 gave us the resources and confidence to deliver another year of first-rate public lectures and seminars, high school teacher training, traveling exhibits, oral histories, publications, and academic programs. With your continued support we can do even more and better. As a **CHF Benefactor** you contributed $1,000 to our 1993/1994 campaign. May I request that you join me in this 1993/1994 campaign by making a major increase in your annual contribution?

We are most grateful for your continued interest and willingness to help us meet our educational mandate--to record and make known our heritage of chemical achievement, to ensure a bright future for our chemical sciences and industries. As a token of our sincere gratitude for your confidence and support, we are pleased to enclose a copy of our most recent **BIMOSI** publication, ***A Guide to the Human Genome Project***, and ***Milestones in Chemistry***, the 1993 Calendar prepared jointly with the ACS. I trust that by now you have also received your copy of our Winter newsletter, ***Chemical Heritage***, which proudly displays a list of all our individual donors beginning on page 26. Please accept these with our warmest wishes for the holidays and the new year.

Yours sincerely,

John Haas
John C. Haas
Member, CHF Advisory Board

Enclosures

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Dr. Alfred Bader
2961 North Shepard Avenue
Milwaukee, Wisconsin 53211

April 28, 1993

Mr. John C. Haas
Chairman, Othmer Challenge Committee
Chemical Heritage Foundation
3401 Walnut Street, Suite 460B
Philadelphia, Pennsylvania 19104 6228

Dear Dr. Haas:

In response to your kind invitation of April 21st, I am sorry that I will not be able to join you on May 21st because I will be in England at that time.

All good wishes.

Sincerely,

CHEMICAL
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Philadelphia, PA 19104-6228 ☐ USA
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THE BECKMAN CENTER FOR HISTORY OF CHEMISTRY ☐ THE OTHMER LIBRARY OF CHEMICAL HISTORY ☐ PUBLIC OUTREACH

April 21, 1993

Dr. Alfred R. Bader
2961 North Shepard Avenue
Milwaukee, WI 53211

Dear Dr. Bader:

This note brings you warm greetings and an invitation to a breakfast meeting which I will be co-hosting with John Eckman at the Yale Club (50 Vanderbilt Avenue at 44th Street, 18th Floor - Room 1 - New York), at 9:00 a.m. on Friday, May 21, ahead of the Othmer Luncheon. The Luncheon will feature Gordon Cain as the guest speaker, and promises to be yet another first-class event--so I hope that you will be there!

As in previous years, we would like to use this breakfast gathering as an opportunity to bring our friends up-to-date on the progress of the Chemical Heritage Foundation. There is much encouraging news to share with you. And, of course, we wish to hear your comments and advice on our long-range plans.

We very much hope that you will be able to join us. Irene I. Lukoff will call you in a few days to check your availability.

Sincerely,

John C Haas

John C. Haas
Chairman, Othmer Challenge
Committee

cc: Mr. John W. Eckman

Dr. Alfred Bader
2961 North Shepard Avenue
Milwaukee, Wisconsin 53211

February 15, 1993

Dr. Arnold Thackray, Director
Chemical Heritage Foundation
3401 Walnut Street
Philadelphia, Pennsylvania 19104 6228

Dear Arnold:

Thank you so much for your note, which is the only piece of mail I received to my post office box during the last few months. Could you from now on please write to my home address.

How sad that the Royal Society of Chemistry is so very slow, particularly now that Jack Gow has retired.

Best wishes.

As always,

A41

Secretary (Scientific)

THE ROYAL SOCIETY OF CHEMISTRY
Founded 1841

Burlington House, Piccadilly,
London W1V 0BN,
☎ 071 437 8656
Fax: 071 437 8883

Ms Lisa A Kazanjian
Marketing Co-ordinator
Chemical Heritage Foundation
3401 Walnut Street
Philadelphia
PA 19104-6228
USA

31 December 1992

Our ref: JFG/PJE/PSC

Dear Lisa

Thank you [illegible] your fax in connection with my visit to the Chemical Heritage Foundation. I have discussed the possibility of the Woodward exhibit in Oxford in July 1993, but on balanace, we feel that it might be a little bit too soon to ensure that the appropriate arrangements are made. However, no firm decision has been taken, so do you think you could still keep July 1993 reserved for the exhibit, recognising though that we might not call upon it then?

We are fairly clear in our minds that we would require the exhibit in July 1995, and I wonder then whether you would be prepared to make a booking for this on our behalf.

I shall be contacting you again towards the middle of February when a firm decision regarding July 1993 will be taken.

With every good wish for 1993.

Yours sincerely

John F Gibson

Dr John F Gibson
Secretary (Scientific)

To Alfred Bader

Dear Alfred

Things move slowly!

Trust all is well with you and Isabel. Come and see us soon.

Best wishes for 93

Arnold

Dr. Alfred Bader
2961 North Shepard Avenue
Milwaukee, Wisconsin 53211

October 21, 1992

Dr. Charles C. Price
Chairman, CHF Board
Chemical Heritage Foundation
3401 Walnut Street
Philadelphia, Pennsylvania 19104 6228

Dear Charles:

Thank you for your gracious invitation.

Isabel and I are travelling so much that we cannot be with you on October 28th, but our thoughts and good wishes will be with you.

Best personal regards.

Sincerely,

CHF Chemical Heritage Foundation

[redacted] 3401 Walnut Street • Philadelphia, PA 19104-6228 USA • Telephone (215) 898-4896 • Fax (215) 898-3327
Charles C. Price, *Chairman*

6 October 1992

Dr. Alfred R. and Isabel Bader
P.O. Box 93225
Milwaukee, WI 53203

Dear Alfred and Isabel:

This note brings friendly greetings, and a special invitation to a reception and dinner on Wednesday, 28 October, beginning at 6:00 p.m., here at CHF.

As you know, for several years now it has been our tradition to precede our Board Meetings (which take place on the morning after) with an informal evening for some of our closest friends, sponsors, and key leaders of our chemical community. It is an opportunity for you to visit with old friends and colleagues or to meet new ones, and to learn about the latest happenings at CHF. For us it is a warm and friendly occasion to express how much we value your continued friendship and support.

Should your travel schedule permit it, we very much hope that you will join us. You would of course be welcome observers at the Board meeting on Thursday morning, or you might like to view the new home of CHF (at the Philadelphia Divinity School site). Irene Lukoff will call next week to follow up on this letter.

With all best wishes.

Yours sincerely,

Charlie

Charles C. Price
Chairman, CHF Board

Founding Societies: American Chemical Society • American Institute of Chemical Engineers

Affiliated Societies: American Society for Biochemistry and Molecular Biology • The Chemists' Club • The Electrochemical Society, Inc. • American Society for Mass Spectrometry • American Association of Textile Chemists and Colorists • Société de Chimie Industrielle • American Association for Clinical Chemistry, Inc. • Alpha Chi Sigma Fraternity

CHF operates through the Beckman Center for the History of Chemistry and the Othmer Library of Chemical History.

[illegible] compliments

and my good wishes

Ted Benfey

see p. 6.

the
Beckman
Center for the
History of Chemistry

[illegible]
[illegible]

NEW NAME, NEW LOGO
(see page 20)

CHEMICAL HERITAGE
VOLUME 10 ■ NUMBER 1 ■ WINTER 1992–93

The History of Chemistry Summer Workshop

Fifty high school teachers from all parts of the country gathered at Princeton University on the last evening of the 4 July weekend, for the first Chemical Heritage Foundation–Woodrow Wilson summer institute on history of chemistry. The four-week program was directed by Purdue's Derek A. Davenport with assistance from CHF's Associate Director Lawrence B. Friedman; its aim was to present chemistry's historical background—from its alchemical beginnings to our own time—so that it could be used in the classroom to enrich as well as to clarify the subject matter of chemistry.

The principal lecturers, apart from Davenport, were William Jensen (University of Cincinnati), on the development of the periodic table; Theodor Benfey (CHF), on the rise of organic chemistry and on the use of modular origami for learning three-dimensional geometric relations; John Kenly Smith, Jr. (Lehigh University), on Wallace Carothers and the development of the plastics industry; and Jeffrey L. Sturchio (Merck & Co., Inc.), on the growth of the chemical and pharmaceutical industries. Diane L. Gerlach (Tremper High School, Kenosha, Wisconsin) and David Olney (Lexington High School, Massachusetts) were in charge of the laboratory and computing activities.

The workshop will lead to the creation of several lesson modules, which the Woodrow Wilson Foundation will then publish for the teachers to disseminate in various presentations and activities in their home regions. The teachers transcribed six of Michael Faraday's

Continued on page 20

CHF—Building the Future, Using the Past

"CHF'S OPPORTUNITIES AND RESPONSIBILITIES are great and increasing." That is why the Chemical Heritage Foundation (CHF), explains Charles C. Price, the chairman of its board, has spent the last several months refining its mission, restructuring its operations, and reviewing plans and progress. "The Chemical Heritage Foundation is destined to play a growing role in the chemical community as that community draws on its proud history. It will also play an increasing role in the community at large, as public understanding of science and technology becomes ever more urgent in our ever more interdependent world, which must make ever more effective use of limited resources."

It was in 1982 that an initiative within the American Chemical Society prompted the creation of the Center for the History of Chemistry. That initiative, in which the American Institute of Chemical Engineers soon joined, led to the incorporation of the National Foundation for History of Chemistry (predecessor to CHF), the emergence of the Beckman Center for History of Chemistry, and the first exciting plans for an Othmer Library of Chemical History. Extensive discussions within the executive, finance, and development committees of the CHF have resulted in a new strategic plan. Sheldon E. Isakoff, vice chairman of the Foundation board, describes it as "a strong plan, because it addresses our *programs*, our *facilities*, and our *funds*. And it will allow us to recognize and respond to the growing importance of the chemical sciences to health, to material prosperity, and to deeper understanding of our physical world."

The programs of the Chemical Heritage Foundation will be grouped under three heads. The Beckman Center for the History of Chemistry (BCHOC), a unit of the University of Pennsylvania funded by CHF, will continue to emphasize basic research, scholarly publication, and the building of a strong chemical presence in the world of academic history. The Othmer Library of

Continued on page 20

FOUNDING SOCIETIES: AMERICAN CHEMICAL SOCIETY ■ AMERICAN INSTITUTE OF CHEMICAL ENGINEERS
AFFILIATED SOCIETIES: AMERICAN SOCIETY FOR BIOCHEMISTRY AND MOLECULAR BIOLOGY ■ THE ELECTROCHEMICAL SOCIETY INC ■ THE CHEMISTS' CLUB ■ AMERICAN SOCIETY FOR MASS SPECTROMETRY ■ AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS ■ SOCIÉTÉ DE CHIMIE INDUSTRIELLE ■ THE AMERICAN ASSOCIATION FOR CLINICAL CHEMISTRY, INC. ■ ALPHA CHI SIGMA FRATERNITY

CHEMICAL HERITAGE FOUNDATION

THE CHEMICAL HERITAGE FOUNDATION (CHF) was established by a joint action of the American Chemical Society and the American Institute of Chemical Engineers. Affiliated societies include Alpha Chi Sigma, The American Association for Clinical Chemistry, Inc., the American Association of Textile Chemists and Colorists, the American Society for Biochemistry and Molecular Biology, the American Society for Mass Spectrometry, The Chemists' Club, The Electrochemical Society, Inc., and the Société de Chimie Industrielle.

CHF seeks to put our chemical heritage to work by discovering and disseminating information about historical resources; encouraging research, scholarship, and popular writing; publishing resource guides and historical materials; conducting oral histories; creating traveling exhibits; and taking other appropriate steps to make known the achievements of chemical scientists and the chemical process industries.

CHF operates through public outreach programs and through the Arnold and Mabel Beckman Center for the History of Chemistry and the Donald F. and Mildred Topp Othmer Library of Chemical History.

CORPORATE HISTORY

Phillips Petroleum Company

Phillips Petroleum Company has records encompassing more than seventy-five years of company history, and in February 1991 it established a corporate archives to hold them. The collection traces the company's accomplishments and its relations with employees, clients, labor, government, and the communities in which Phillips operates, and it contains documents dating back to the early 1900s, when Frank and L. E. Phillips first entered the oil business.

The environmentally controlled repository (1,500 square feet) holds company publications, organizational charts, advertisements, oral histories, an extensive photograph and negative collection, executive speeches, press releases, and biographical files. In addition, a public reference area displays company artifacts, as well as books about the company and its founders and on the history of the petroleum industry.

Phillips is the only major oil company that today retains the name of its founders. The brothers incorporated Phillips Petroleum Company on 13 June 1917, with assets of $3 million and twenty-seven employees. Frank Phillips realized early in the company's history that research was the key to its future. In 1927 he recruited some of the nation's leading scientists to establish one of the world's first hydrocarbon research laboratories. This was a time when the industry was still being run for the most part by "rule of thumb."

The research done by the "whiz kids" he hired led to distinctive advances. They devised an innovative way to process natural gas liquids, of which Phillips has long been the nation's largest producer; pioneered the liquefied petroleum gas business; invented processes critical to the manufacture of high-performance aviation gasoline during World War II; discovered revolutionary plastics; and made technological history by finding a way to drill for oil and gas in the hostile environment of the North Sea and to bring them up from those deep waters. These important events are documented in the archives.

Susan Box, a certified archivist, manages the archives, which she was instrumental in establishing. The archives are open to all employees and by appoint-

The Phillips process discoveries resulted in production of 100-plus octane aviation gasoline, a significant contribution to winning World War II. This ad from 1944 features the role played by the Phillips researchers.

ment to outside researchers. For information contact Corporate Archives, C20 PB, Phillips Petroleum Company, Bartlesville, OK 74004; (918) 661-7326.

SUSAN BOX
Phillips Petroleum Company

Nalco Chemical Company

The story of Nalco Chemical Company really began in 1922, when Herbert A. Kern of Chicago Chemical Company and P. Wilson Evans of Aluminate Sales Corporation first met. Both companies were selling sodium aluminate to treat water fed to boilers: Chicago Chemical sold predominantly to industrial plants and municipalities, Aluminate Sales to railroads for steam locomotives.

Chicago Chemical, founded in 1920, did well for a time with its original water treatment compound, "Colline." When the company tried to extend sales to other parts of the Midwest, however, it found Colline did not always work. To remedy its shortcomings, Kern investigated the merits of sodium aluminate. His research led to the marketing of what he called Kern's Water Softener (K.W.S. Sodium Aluminate).

Wilson Evans discovered the benefits of sodium aluminate as an employee of the Engineering Department of Armour and Company, whose principal business was meat packing. Evans found that the efficiency in Armour's power plants increased if the water used in steam boilers was treated with sodium aluminate. The method proved so successful that it was introduced in Armour's plants throughout the United States.

Evans suggested that Armour move into boiler water treatment, but the firm decided not to market something so unrelated to its basic business. In 1922 Evans secured permission from Armour to form an independent operation to sell sodium aluminate.

Evans and Kern both held patents on sodium aluminate solutions, and it was inevitable that they should meet. At first Kern sought out Evans because he needed another source of the product for his own water treatment business. Within a few years, however, the sodium aluminate for both companies was manufactured at a plant erected in 1926 by Chicago Chemical Company in the Clearing Industrial District of Chicago.

In early 1927 Evans and Kern began to explore the advantages of a merger. They also approached the Aluminum Company of America, which dominated the U.S. market for bauxite, the essential raw material for manufacturing sodium aluminate. A proposal to consolidate resources was developed in a meeting with Arthur Vining Davis, president of ALCOA. In 1928 National Aluminate Corporation (later known by the contraction "Nalco") was incorporated and inherited the entire business of Chicago Chemical and Aluminate Sales. In exchange for 27.5 percent of its capital stock, Nalco received certain United States patents held by ALCOA and its municipal water-treating accounts. What began as a small, two-division company manufacturing a single product is today the world's largest producer of specialty chemicals and services for water and waste treatment, pollution control, petroleum production and refining, papermaking, mining, steelmaking, metalworking, and other industrial processes.

In 1982 Nalco's president sent a letter to its long-service employees, both current and retired, requesting donations of historical materials and anecdotal information for a company archives. It was the formal beginning of Nalco's endeavor to preserve its past. The employees responded enthusiastically. A complete collection of the company newspaper, *Nalco News* (published since 1936), was compiled, and a variety of company artifacts acquired. The collection includes advertisements dating back to 1922, news releases, technical manuals, speeches and correspondence, organization charts, company reports, product bulletins and brochures, catalogs and price lists, employee handbooks, flow charts, chemical test kits, and early payroll records. Another valuable donation was a comprehensive thirty-seven-volume set of photographs and negatives

Continued on page 21

A 1936 advertisement for a Nalco consumer product using ion-exchange resins.

Now, thousands of homes are enjoying the luxury of really soft water. The Nalco Softener does away with hard water or the need for breaking chemicals and soon pays for itself in soap savings alone.

THE Nalco Water Softener is so portable, LOW IN PRICE and softens hot or cold water so quickly and efficiently that every home can have plenty of soft water for laundering clothes, washing dishes, cooking, shampooing, baby's tub, etc. Nothing is added to the water for hardness is removed by Nalcolite (which does NOT DISSOLVE) and softened water is recommended by doctors. The Nalco Softener gives years of service.

Ask your dealer about this wonderful, portable softener or write for full information, sent free.

National Aluminate Corp.
6216 W. 66th Place, Chicago, Ill.

NEWS from the Arnold and Mabel Beckman Center for the History of Chemistry

The Beckman Center is sponsored by the Chemical Heritage Foundation and the University of Pennsylvania. The Center is an academic unit of Penn, working closely with the Department of History and Sociology of Science and with the Departments of Chemistry, Chemical Engineering, and Biochemistry and the Laboratory for Research on the Structure of Matter. The Center's mission is to undertake scholarly research, publish materials on the history of the chemical sciences, support senior-level and graduate fellowships, and conduct a variety of scholarly events of interest to the academic community.

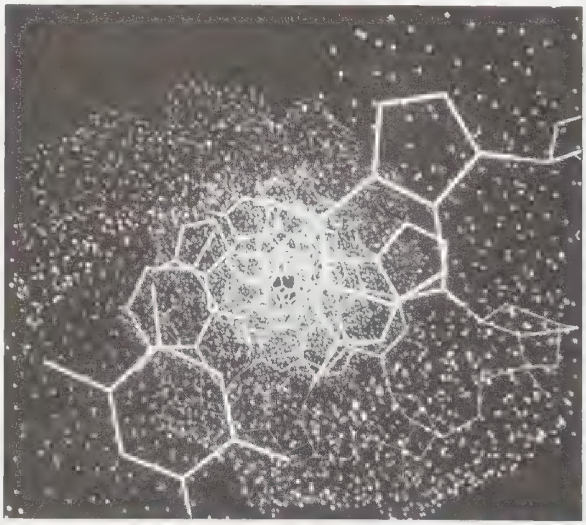
The BIMOSI Human Genome Project

Making sense of the Human Genome Project—as science, politics, ethical dilemma, and historical "event"—was the core problem discussed at the Beckman Center's May BIMOSI advisory committee meeting. Advisers to the Center's Biomolecular Sciences Initiative—scholars, scientists, archivists, and one "consumer" of genetic information (Priscilla Ciccariello, chair of the National Marfan Foundation)—came together for a lively two-day discussion of the effort to map the human genome and of the Beckman Center's study of this effort. The group agreed that the Center plan to develop a documentation strategy for the genome project was a crucial contribution to scholarship, public understanding of the project, and science policy analysis.

But our advisers had varying perspectives on precisely what made the Human Genome Project and the Beckman Center plan important. Some, such as the Rockefeller University biologist Norton Zinder and the Case Western Reserve ethicist Thomas Murray, emphasized the need to capture information immediately about the (intentionally) unrecorded planning meetings that have shaped the development of the genome project, its funding and its acceptability to Congress. Murray pointed to the unprecedented 3 percent of the overall HGP budget set aside for studies of ethical, legal, and social issues relating to the project. He expressed concern about the effect this funding could have on the community of biomedical ethicists, who have previously found little federal support for their research. Stephen Hilgartner, a sociologist at the Columbia Center for the Study of Science and Medicine, urged that the Beckman Center attend more to the international effort, since the U.S. project cannot be understood in isolation, as he discovered in the course of his own work on technologies for mapping genes. In response to concerns about the availability of the records of private industry, Jeffrey L. Sturchio, Merck's corporate archivist, noted that many corporations are already preserving—for their own purposes—the industrial records that will be crucial to understanding the story of the Human Genome Project. Victoria A. Harden, an NIH archivist, pointed out that historians and others interested in corporate science need to become more aware of the records that appear in less conventional archival collections, such as court records and patent applications. From a different perspective Priscilla Ciccariello emphasized the enthusiasm of members of volunteer health organizations for the genome project and their general expectation that its findings will benefit those suffering from genetic disease.

The group enthusiastically endorsed the Center's draft "Observer's Guide to the Human Genome Project," to be published by the Beckman Center and made widely available to journalists, high school teachers, and others who need a clear, concise introduction to the genome project. Compiled by Susan L. Speaker of the University of Pennsylvania's Department of History and Sociology of Science, the guide features short biographical sketches of key players, descriptions of molecular-biological techniques, a short explanation of the project's history and goals, a listing of important scientific resources and systems of communication, and a summary of ethical, legal, and social questions raised by the project.

Participants also responded to an outline by Elizabeth Sandager, CHF field archivist, of some immediate documentation problems she identified in a series of site visits to genomics laboratories. These problems included the changing nature of "documentation," for example, the increasing importance of e-mail and other electronic records, the multi-institutional nature of the genome project, and the complex relationships between private industry and academic laboratories. Conference participants suggested that a documentation strategy should focus on aspects of the genome project that are likely to be left undocumented (such as some aspects of the biotechnology industry); that the public impact of the project might be ad-



A computer-generated image of the DNA double helix, looking down the helical axis. Modeling and photography by Arthur J. Olson. Courtesy Arthur J. Olson and the Scripps Research Institute. © 1985 dressed by preserving the records of disease-specific patient groups (the volunteer health organizations); and that a focused oral history program should be undertaken to help supplement the written record, particularly for those activities that have been intentionally kept off the record.

The meeting was extremely productive for the Beckman Center team and will shape BIMOSI's emerging documentation strategy. It was funded with a grant from the Andrew W. Mellon Foundation as a part of the Center's BIMOSI initiative.

Other members of the advisory committee attending were Richard Burian, National Humanities Center; Mildred Cohn, University of Pennsylvania; Clark Elliott, Harvard University Archives; Beverly Emanuel, Children's Hospital of Philadelphia; Nancy McCall, Johns Hopkins Medical Institutions; William Summers, Yale University School of Medicine; Kenneth F. Thibodeau, National Archives; and Joan Warnow-Blewett, American Institute of Physics.

CHF Exhibits on the Road

Our traveling exhibits are becoming widely known, and reservations need to be made early. The only cost is that of return shipping. Write to Exhibits at the Chemical Heritage Foundation.

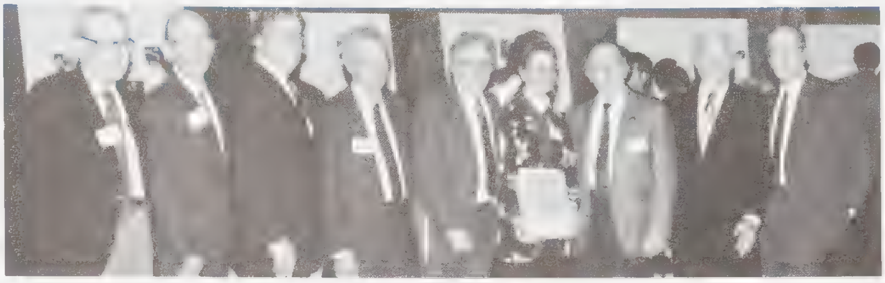
Exhibit itineraries for 1993 are as follows:

Polymers and People
1 December 1992–31 January: Savannah Science Museum, Savannah, GA
April: Syracuse University, Syracuse, NY
22–27 August: ACS National Meeting, Chicago, IL

Scaling Up
February: Science Museum of West Virginia, Roanoke, VA
April: University of Rhode Island, Cranston, RI
November: Marathon Oil Company, Littleton, CO

Structures of Life
1 December 1992–15 January: University of Texas, Austin, TX
1 February–15 March: Pharr–San Juan–Alamo, San Juan, TX
25 March–25 April: East Stroudsburg University, East Stroudsburg, PA
15 September–31 October: University of Tennessee, Martin, TN
November: AIChE Fall National Meeting, St. Louis, MO

Woodward and the Art of Organic Synthesis
1 March–30 April: University of Tennessee, Martin, TN
13–17 June: ACS National Organic Symposium, Bozeman, MT



Some of the participants at the Woodward festivities, from the left: Charles C. Price, CHF; John C. Haas, Rohm & Haas; Mark A. Wuonola, Du Pont Merck Pharmaceutical Co.; Frank H. Westheimer, Harvard University; Harry H. Wasserman, Yale University; Crystal E. Woodward, Lacoste School of the Arts; Roald Hoffmann, Cornell University; Joseph Dixon, American Chemical Society; and Arnold Thackray, director, CHF. Courtesy Stuart Borman and Chemical & Engineering News.

Reminiscences of the International Woodward Symposium

At first we expected fifty for the symposium banquet, and planned to decorate each of five tables with a model of one of the molecules RBW had synthesized—quinine, strychnine, penicillin, reserpine, chlorophyll—models with the polyhedral atoms that would have appealed to his aesthetic sense. But the count of diners rose to 100—then to 150—and finally approached 200, leading to further rapid syntheses!

Among highlights of the event were the reminiscences of Harvard's Frank H. Westheimer, who spoke movingly of his friend and colleague Woodward, and the speech of Albert J. Eschenmoser, architect with RBW of the vitamin B_{12} synthesis. Eschenmoser gave the audience the flavor of RBW-type research, presenting, as Amos Smith (University of Pennsylvania) put it, pyrotechnics—a brilliant demonstration of synthetic theory and practice at its finest. Eschenmoser's topic was hexose nucleic acids, and he explored the effect of replacing the five-ring pentose sugars in DNA by hexoses. The base-pair rungs of the ladder remain intact, but the ladder is flat, no longer a helix.

Arnold Thackray's opening slide lecture at the University Museum, "Organic Connections: Perkin to Woodward," explored the many chemical strands linking William Henry Perkin's attempt to prepare quinine forty-four years before 1900 with Woodward and William von E. Doering's successful quinine synthesis forty-four years after the century's turn. Beginning with Perkin's mentor, A. W. Hofmann, and that mentor's mentor, Justus Liebig, the lecture surveyed the professionalization of chemistry, the development of chemical industry, and the establishment and growth of chemistry in America. Paralleling that social history was the saga of chemical ideas: from the jungle that the organic world presented to early chemists; through early syntheses, by chance and then planned; to the halting path to the structural theory, electronic interpretations, and the flowering of physical organic chemistry—culminating in Woodward and Roald Hoffmann's promulgation of the rules for conservation of orbital symmetry in electrocyclic reactions.

In the session on art and creativity, RBW's daughter Crystal Woodward, who teaches at the LaCoste School of the Arts in southern France, pointed to the artistic in Woodward's work. The molecular world was his landscape, and absorbing himself in it had a transmuting effect on him. He saw molecules as dynamic and visualized them in endless ways, yet he always emphasized the physical restraint imposed on his imagination by reality. His quickly drawn diagrams on manila papers have the qualities of works of art, as did the blackboard displays of structures and reactions in his lectures. He sought beauty and elegance in the paths to his syntheses. The speaker drew parallels between her father's approaches and her own work as an artist, identifying elements from her experiences which she then integrated into a harmonious whole. Roald Hoffmann of Cornell—poet and art connoisseur as well as chemist—briefly shared his own reflections on the theme of chemical art and creativity.

Continued on next page

RBW's daughter-in-law Hilary, son Eric, daughter Crystal, and widow Eudoxia joined in the Woodward celebrations.

Alfred Bader at the Woodward exhibit. After participating in the symposium, Bader spoke to the chemists at Penn on Josef Loschmidt (1821–1895) and his pioneering "Konstitutionsformeln" (right) of 1861.

WOODWARD—*continued*

In the next session, attention turned to the links between chemistry and industry, specifically the pharmaceutical industry. George M. Milne, Jr., senior vice president at Pfizer Inc., spoke on "The Central Role of Synthetic Chemistry in the Academic-Industrial System of Biomolecular Science and Drug Discovery." He recalled RBW's appreciation of Marcelin Berthelot's comment of 1860: "Chemistry creates its object. This faculty, similar to that in art, distinguishes it in essential ways from the natural and historical sciences." He reminded his audience of Woodward's collaboration with Pfizer chemists in their work on terramycin and the tetracyclines. He then explored the present state of chemistry and its prospects, particularly in the biomedical field, drawing insights from Pfizer's work with renin and spider venoms. He ended with RBW's own words: "The evidence is overwhelming that the creative function of organic chemistry will continue to augment nature, with great rewards for mankind and the chemist in equal measure."

From RBW's Cope Award Address

In chemistry one's ideas, however beautiful, logical, elegant, imaginative they may be in their own right, are simply without value unless they are actually applicable to the *one* physical environment we have—in short, they are only good if they work! I personally very much enjoy the very special challenge which this physical restraint on fantasy presents.—Courtesy Harvard Archives

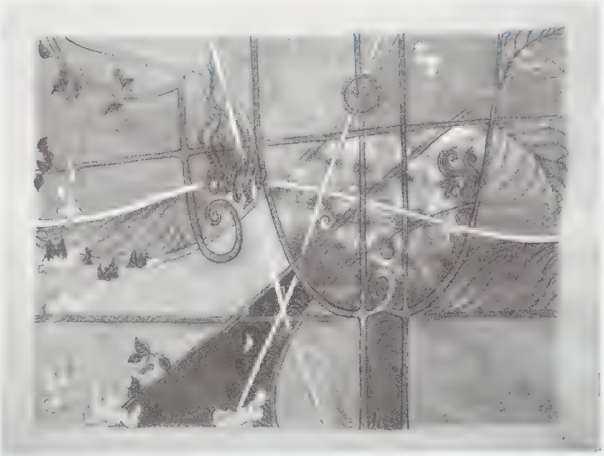
John L. Zabriskie, senior vice president of Merck & Co., Inc., chose as his provocative title "Research in the Real World." He indicated the many links Merck had with RBW, particularly through Max Tishler and Lewis Sarett, friends of RBW and successive presidents of Merck research, as well as through students and colleagues who moved to Merck. Using examples from his experience at Merck, Zabriskie pointed to the key roles chemists play today not only in discovery and synthesis, process design, and development, but also in addressing questions relating to safety, environmental protection, personnel, and management.

From the Symposium . . .

Nothing fails like success. The European chemists and their followers were so delighted with their accomplishments that they were locked into the past; they failed to look for—no, they actively rejected—considerations of mechanism, and so failed to advance the art of synthesis. Then Woodward stepped into this intellectual vacuum, and showed a better way. . . .

Bob insisted on the highest level of experimental work from his coworkers. For example, to guard against error or even any sloppiness in preparations, he demanded that infrared spectra, designed to show the identity of two samples, agree within the width of the pen lines on the charts—a demand that sent his students looking for broad pens.

Bob's results also stem from enormous effort. In the final productions—the beautiful syntheses, the brilliant deductions of structure, the polished lectures—the rough places have all been sanded down and polished so that they don't show; everything looks straightforward, even inevitable. But Woodward himself slept only three or four hours a night; he was in his office early and stayed late at least six days a week. If one calculates that he utilized a sixth of the day lesser mortals waste sleeping, he really lived to seventy-three, not sixty-two. And he was always intellectually hungry; his own great accomplishments failed to satisfy him. . . .



Crystal Woodward, "The Landscape of the Hand" (1979), colored pencils and ink on paper. Created through her "Visual Language" system, in which images are formed by combining separate "molecular" elements, the work evokes RBW's thought processes and the aesthetic pleasure he took in his art in chemistry.

Woodward's own lectures are famous, or perhaps notorious would be a more suitable adjective. Until late in his career, he abjured slides and relied on colored chalk and his memory for detail. He would start in the upper left-hand corner of a large blackboard and present his synthesis, ending at the lower right-hand corner with a display that would have been perfect for publication. Every square inch of the board was covered neatly with elegant formulas, and the whole performance presented casually, as if everything naturally turned out that way. In fact, his lectures had been carefully rehearsed.—**Frank H. Westheimer** (Harvard University)

Robert and I met when he was twelve and I was fifteen. I already had a home lab, and he heard about it and started his own. He invited me over to see what was apparently his first experiment. He proposed to make hydrogen gas. On a card table he had some solid reagents and a large Erlenmeyer flask fitted with a thistle tube and an exit tube. He poured in some hydrochloric acid on the zinc in the flask. Before I could stop him, he ignited the issuing gas. A big explosion occurred, smashing the equipment and the bottles of reagents. We were not hurt and washed ourselves off and cleaned up the mess. This experiment sealed our friendship. I noticed that his mother, who was present, did not complain nor seem disturbed.—**Robert C. Putnam** (Mountain Lakes, New Jersey)

Another Opinion

In 1963 a senior Stanford professor tried to explain the singular phenomenon of Robert Burns Woodward:

Woodward . . . was a problem to many, if not to most, of his colleagues in organic chemistry. If they happened to be in Boston and dropped by R.B.'s office at Harvard for a friendly chat, they sometimes mentioned a chemical problem which had been occupying their minds. R.B. looked at the problem and . . . quite often presented a convincing solution within a few minutes. This had the result that these colleagues, after they left R.B., were hopping mad with themselves, wishing they had continued pondering their problem for some additional days or weeks to find the solution by themselves.—**Helmut Vorbrüggen** (Schering AG, Berlin). From an *Aldrichina Chimica Acta* reprint, 1992.

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wenn jeder Topf den
Namenszug
J. Liebig
in blauer Schrift
quer durch die Etiquette trägt.
Man hute sich vor Falschungen
• und Nachahmungen. •

Die practische Verwerthung
LIEBIG COMPANY'S
FLEISCH-EXTRACT
EINE SAMMLUNG VORZUGLICHER
Kochrecepte.
von
KATHARINA PRATO
EDLE VON SCHEIGER
Verfasserin des Kochbuches
„Die süddeutsche Küche"
der „Haushaltungskunde" etc.

This cookbook for users of Liebig's meat extract warns its readers that the extract is the genuine product only if Liebig's signature in blue ink appears on it. Courtesy Elisabeth Vaupel.

Liebig and Erlenmeyer, Industrialists: Studies at the Center

During my three months at the Beckman Center, I explored several examples of cooperation between scientific chemistry and the chemical industry during the nineteenth century. It is well known that initiatives taken by chemistry professors helped many industries develop and diversify. The professors in turn improved their salaries considerably by acting as advisors to, or even as silent partners of, chemical plants. I focused on two German chemists, Justus von Liebig (1803–1873) and Emil Erlenmeyer (1825–1909), whose personal papers contain rich material.

Liebig took an active part in various chemical enterprises, for example, a mirror-silvering plant in Doos, near Nuremberg, and a fertilizer plant in Heufeld, Bavaria. I looked at Liebig's role and financial interests in the Liebig's Extract of Meat Company, in Fray Bentos, Uruguay. The factory was founded in 1865 and ceased operation in 1981, but it still exists; plans are currently under way to use its historic buildings as an industrial museum. During the 1850s Liebig carried out intensive studies on food and nutrition. After his research on the ingredients of meat and muscle fibers, Liebig, basing his work on studies by Joseph Louis Proust and Antoine-Augustin Parmentier, developed an efficient method of manufacturing meat extract from different sorts of meat. He vigorously promoted it as a restorative for wounded soldiers, claiming they would have a better chance of surviving the transport to a hospital if strengthened by the meat extract.

Liebig and the German-Brazilian engineer Georg Giebert decided to manufacture meat extract in Uruguay, as a way for Europe to exploit South America's cattle population. Food production and distribution were a major problem at that time, especially in the large European cities. Since today's methods of transporting and conserving meat (refrigerator ships, etc.) were still unknown, Giebert and Liebig's plan was received with enthusiasm, and in 1865 a company bearing Liebig's name was founded—the Liebig's Extract of Meat Company, Ltd., with various branches in Europe (Antwerp, London, Cologne). The parent company in Fray Bentos pro-

Continued on next page

RBW Exhibit Begins Travel

The traveling exhibit "R. B. Woodward and the Art of Organic Synthesis" opened in the Museum's Egyptian Gallery for the occasion of the Woodward symposium. John Haas of Rohm and Haas paid special tribute to Alfred and Isabel Bader for the vision and inspiration that made the exhibit possible. Mark Wuonola of Du Pont, a Woodward doctoral and postdoctoral student, recalled RBW's highest commendation for tasks well done—"carried out in the manner *expected* of members of my group"—and suggested that the exhibit also had that quality. He hoped it would help future generations of scientists experience RBW as a mentor.

The exhibit moved to the Beckman Center after the symposium and then to the fall ACS meeting in Washington, completing the year at Pfizer, Du Pont, Eli Lilly, Merck & Co., and Harvard. For future showings see p. 5.

Liebig's meat extract was produced in Fray Bentos, Uruguay. Courtesy Elisabeth Vaupel.

LIEBIG—*continued*

duced not only meat extract but also other products such as fertilizer, soap, leather, and corned beef, thus making use of production residues—bones, hoofs, skin, and meat. Liebig, who was responsible for controlling the quality of the meat extract, spared no effort in promoting the sale of the product. For example, he convinced famous German cookbook authors to write recipes that worked only when Liebig's meat extract was used. Furthermore, he gave "his" meat extract as a present to nearly every friend as well as serving it to his guests.

Erlenmeyer also had industrial connections, primarily with a small chemical plant in Ödenwald, Württemberg, directed by his friend Hans Weidenbusch. Erlenmeyer invested several thousand gulden in the enterprise and received 10 percent of the profits. In connection with his work for the firm Erlenmeyer was in close contact with Carl Clemm-Lennig (1818–1887), well known as one of the founders of the chemical industry in Mannheim. Clemm-Lennig in turn was related by marriage to Charles Lennig, owner of a chemical plant in Bridesburgh near Philadelphia.

ELISABETH VAUPEL
Deutsches Museum, Munich

GRANTS & AWARDS

Kathryn Steen Is First Edelstein International Student

Kathryn Steen, a graduate student in the University of Delaware's Hagley program in the history of technology, is the first holder of the Edelstein International Studentship, created by Sidney M. Edelstein of the Dexter Chemical Corporation as a companion program to the Edelstein International Fellowship. Steen will complete her dissertation on the development of the United States synthetic organic chemicals industry, working first at the Beckman Center, then at the Sidney M. Edelstein Center for the History and Philosophy of Science, Technology, and Medicine in the Hebrew University of Jerusalem.

Although the United States was a major industrial power on the eve of World War I, it was weak in synthetic organic chemicals. The U.S. government collaborated with business leaders in establishing a domestic industry to fill the gap. Steen hopes her study of the industry from 1910 to 1933 will supply historical perspective on government-industrial relations, a topic of considerable importance today.

Steen is a Phi Beta Kappa graduate in history and economics from Luther College, Iowa, and has taught U.S. history at the University of Delaware. She recorded historic structures for the Historic American Engineering project for three summers.

John Stock Wins Dexter Award

John T. Stock, Professor Emeritus of Chemistry at the University of Connecticut, won the Dexter Award for 1992. Educated at the University of London, Stock did postdoctoral research with Izaac M. Kolthoff at the University of Minnesota. For some years he ran the laboratory and semi-scale plant at Fuller's Ltd., a London foodstuffs manufacturer.

Stock has developed and published numerous improvements in chemical analysis and instrumentation and studied their historical development. His most recent book, coedited with Mary Virginia Orna, is the American Chemical Society's *Electrochemistry: Past and Present*. He holds a concurrent appointment as Honorary Research Fellow of London's Science Museum.

The Dexter Award, given annually by the American Chemical Society's Division of History of Chemistry, honors outstanding accomplishment in the history of chemistry. For instructions or to send nominations (due 1 January 1993) write Derek A. Davenport, Chemistry Department, Purdue University, Lafayette, IN 47907.

Ralph Hirschmann of Merck and Penn Honored at Seventy

Four weeks after our Woodward commemorations, our neighbor, the University of Pennsylvania chemistry department, celebrated the seventieth birthday of Ralph Hirschmann with its own galaxy of symposium speakers. A native of Germany educated at Oberlin and the University of Wisconsin, Ralph Hirschmann rose to be senior vice president of Merck & Co.; on retirement he became a research professor at Penn. He is well known for his steroid and protein researches.

At the celebration a member of our Woodward Advisory Board, Derek H. R. Barton of Texas A&M University, reviewed his own work on reactions that mimic nature in their speed, specificity, and mildness of conditions—by using not enzyme analogues but the much simpler free-radical reagents. Stuart L. Schreiber of Harvard, who is depicted in the Beckman Center's Woodward brochure as one of RBW's young sedan-chair carriers, also spoke. Particularly memorable among the slides illustrating the various talks were those of Cornell's Jerry Meinwald, which showed the gala displays of insects responding to pheromone signals, and the recurring slide honoring Hirschmann and using the letters of his name:

Happy
Innovative
Research
Scientist
Creates
Harmonious
Memories
And
Never
Neuroses

NEWS from the Donald F. & Mildred Topp Othmer Library of Chemical History

On File: Oral Histories

From Page Boy to President: William Wishnick and the Witco Chemical Company

When William Wishnick was twelve years old, he was hired to appear as a page boy like the one often featured in commercials for Phillip Morris cigarettes. But instead of selling cigarettes, he was to work at the Chemical Exposition of New York, in the Grand Central Palace exhibition hall. His employer was displaying little jars of chemicals for the paint industry. As he recounted in an oral history interview, he always knew he would work for this employer. In fact, his high school vacations were often spent pushing barrels around in the company warehouse, and summer vacations from college were spent in the laboratory or plant. And less than thirty years after his debut as page boy, he was chairman of the board.

When Wishnick speaks about his life with the company, his voice is filled with pride as he extols its founder, his father, Robert I. Wishnick. Describing the company's history in a 1976 address to the Newcomen Society, Wishnick said, "It is difficult to imagine what the Witco Chemical Corporation would be without the guiding strength of Robert Wishnick. . . . All of us have in one way or another been affected by him in our personal and business life."

The company began in 1920, when Robert Wishnick and David and Julius Tumpeer formed a small chemical jobbing concern, reselling in small lots the chemicals they bought in bulk. Specializing in chemicals to make paints, printing inks, rubber goods, and other products, they called their new enterprise the Wishnick-Tumpeer Chemical Company. Wishnick is quick to point out that "nepotism never played much of a part" at Witco. After the early years, no other Wishnick relatives worked for the company. "My father personally asked his son-in-law to leave when he wasn't working out too well, and the same

Continued on page 14

The Othmer Library site, from the northeast.

Building the Othmer Library

THE PERMANENT HOME of the Donald F. and Mildred Topp Othmer Library of Chemical History is coming closer to reality. Thanks to the far-sighted generosity of Donald F. Othmer of Brooklyn, New York, and the vision of the University of Pennsylvania, the Othmer Library will occupy the magnificent neo-Gothic chapel of the former Philadelphia Divinity School at 42nd and Spruce Streets. As the centerpiece of the new site for the Chemical Heritage Foundation, the Othmer Library of Chemical History provides the library and archival resources that underpin the public outreach component of the Foundation and the academic programs of the Beckman Center for the History of Chemistry.

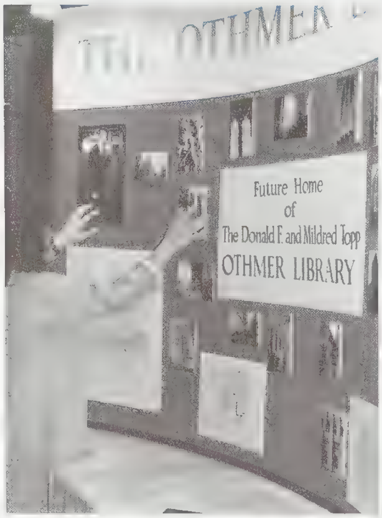
A selection committee made up of representatives of the Chemical Heritage Foundation and the University of Pennsylvania's Department of Facilities Planning has completed its review of architectural proposals, and has appointed the prize-winning architect Richard Conway Meyer to prepare the designs and oversee the phased renovation of the Divinity School Site. Meyer is working closely with a building committee chaired by Arnold Thackray. The first task is to develop a master plan for the Divinity School site—one that will allow the Othmer Library to grow as its collections and influence increase and as the work of the Chemical Heritage Foundation expands.

The Othmer Challenge Committee, headed by John C. Haas, is delighted with this announcement and with progress in raising funds for this project. The committee is particularly encouraged by its ability to secure the immediate cash necessary for minimal renovations and an early move to the site.

The Othmer Library serves as the preeminent national repository for books, photographs, diaries, manuscripts, videodiscs, and audiotapes that

Continued on page 12

NEWS FROM THE OTHMER LIBRARY

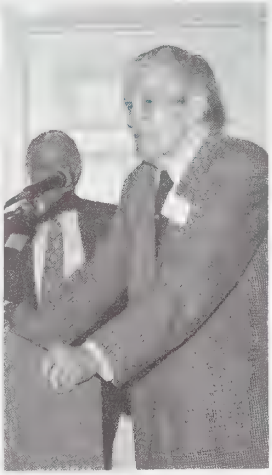


Left: CHF's Lisa Kazanjian makes preparations for the luncheon . . .

Chemical communicators Theodor Benfey (CHF) and Patrick McCurdy (ACS) conferred . . .

. . . as did Herbert "Ted" Doan (Dow) and William Helfand (Merck).

. . . in honor of Don Othmer.



The 1992 Othmer Celebration

Donald Othmer is still as upbeat about the twentieth century as he was at the first Othmer luncheon in 1990. This century (he said on that occasion), with all its ups and downs and busts and booms, is still the most wonderful century to be living in and unlikely to be equaled in the future. In his greetings to the assembled company of well-wishers at the third Othmer luncheon, held 10 May in New York, Othmer recalled those sentiments and repeated his hope and expectation that he would see the century to its end.

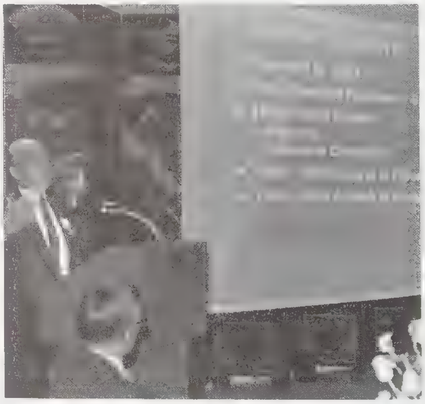
The third Othmer luncheon was held at the Princeton Club, particularly suitable since it now houses the offices of The Chemists' Club, of which Donald Othmer has for long been a leading member. The elegant building was recently renovated by Robert Venturi, and a mural of Princeton's green surroundings along one wall of the dining room accorded with the joyful mood of the event.

Vincent A. Calarco, chairman of the Crompton and Knowles Corporation, introduced the main speaker, Alan Heininger. First, however, he expressed his thanks to Don Othmer, his former teacher at Polytechnic University. Don Othmer, through his extensive involvement with industry, provided in his lectures that sense of reality that students seek so desperately but so often in vain.

Alan Heininger, immediate past president of the American Chemical Society and former vice-president for resource planning at Monsanto, explored the topic "Corporate Strategy and Chemical Industry: Yesterday, Today and Tomorrow." In a superb slide presentation he looked at the American chemical industry during the years in which it was reaching technological maturity, a setting very different from the era of innovation, the industry's beginnings. He showed the remarkable success of the industry in maintaining a positive trade balance through the years since 1976, during which the country posted large deficits in its overall balance of trade. Heininger described Monsanto's strategy for remaining competitive around 1979: it increased its commitment to research and development from 8 percent to 17 percent of profits with a major emphasis on innovation in the life sciences. The strategy seems to have paid off.

The Chemical Heritage Foundation provided a booth that showed scenes and events from Don and Mildred Othmer's life and work, as well as architects' drawings of and specifications for the permanent home of the Othmer Library of Chemical History.

Other participants included (from the right) John Haas (Rohm and Haas), sitting next to Donald and Mildred Othmer; Charles Price (CHF); the speaker, Alan Heininger (ACS); Abraham Zoss (Société president); Paul Kohnstamm (General Color); and Vincent Calarco (Crompton and Knowles).



Alan Heininger used his experience at Monsanto to illustrate his talk.

ARCHIVES

Percy Julian, seen enlarged in the insert and with fellow students in a chemistry class at DePauw, about 1920. Courtesy Donald J. Cook and DePauw University Archives and Special Collections.

Witkop Papers and Percy Julian

Bernhard Witkop, Institute Scholar at the National Institutes of Health and former chief of the Laboratory of Chemistry of the NIH National Institute of Arthritis and Metabolic Diseases, has given CHF his correspondence, which extended from 1947 to 1973, with the noted biochemist and industrial chemist Percy Lavon Julian (1899–1975). Regarding their friendship, Witkop once wrote that "in the treasury of letters received from Percy Julian over a time span of thirty years, the woof of chemistry and the warp of the human condition, private and collective, interweave to a fabric that shows Percy Julian the scientist to be as great as, and inseparable from, Percy Julian the humanist." Witkop delivered the Percy L. Julian Memorial Lecture, entitled "The Humanist as a Chemist," at NIH and at DePauw University in 1978.

Witkop, a student of Heinrich Wieland in Munich who later worked with Robert B. Woodward at Harvard, nominated Julian, the first black scientist to be so honored, to the National Academy of Sciences. He also wrote the Academy's memoir on Julian, which elicited additional correspondence.

Witkop also donated two photographs, one of Woodward visiting with Witkop and one of Paul Ehrlich surrounded by his large family.

The Enzyme Club: The Philip Siekevitz Papers

Philip Siekevitz, Professor Emeritus at Rockefeller University, has deposited in our archives a major collection of papers of the Enzyme Club of New York, of which he was the prime mover for more than thirty years. The club met monthly for fifty years, first at Columbia and after 1958 at Rockefeller, until it was disbanded in 1992. Seminar series in numerous subdisciplines do now what the club did earlier.

In 1942, when the club began meeting, "you could fit all the biochemists in New York City into one small room," according to Siekevitz. Since then most of the leaders in protein and nucleic acid chemistry, including more than twenty Nobel laureates, have addressed the club. On its dissolution the club donated $2,000, the amount left in its account, to Rockefeller University's High School Outreach Program to help young people who "may not even have thought of going into science."

Included among the papers donated are Siekevitz's published history of the club through 1982 and his other historical writings, as well as founding correspondence, early and later membership lists, a complete list of speakers and topics since the club's beginning, financial records (including correspondence with Merck, Ciba-Geigy, Schering, Lederle Laboratories, Hoffmann–La Roche, Sandoz, and Squibb, all of whom supported the club's activities), as well as papers on the twenty-fifth and fiftieth anniversary celebrations.

John Ferry Adds to Flory Papers

John D. Ferry of the Chemistry Department of the University of Wisconsin has added his correspondence with Paul J. Flory and related papers to the Flory archive at CHF. The letters, written from 1950 to 1984, during which time Flory moved from the Mellon Institute to Cornell and then to Stanford, cover technical topics and scientists working in the polymer field as well as nominations for several awards. Ferry nominated Flory for the Nobel Prize in 1950, an award he did not receive until 1974. In a letter from 1957 Flory comments on the inscrutability of the selection process for the Fulbright Award: "I was turned down, but a few months later one of my former students who flunked out for a Ph.D. got one." Included is Ferry's informative introduction of Flory as the 1973 Willard Gibbs medalist of the ACS Chicago section.

Bartlett Course Notes Donated

On reading of CHF's acquisition of Paul D. Bartlett's papers, Ralph B. Thompson of Hinsdale, Illinois, contributed his notes of Bartlett's Chemistry 17a lectures at Harvard for 1938, one of the early courses in physical organic chemistry, complete with lists of references. The first part of the notebook is a partial translation by Thompson of Paul Karrer's *Lehrbuch der organischen Chemie*, carried out to improve his German.

News of Other Collections

At the suggestion of CHF staff **R. Bruce King,** Regents' Professor of Chemistry at the University of Georgia, placed thirty-five boxes of his papers in the University of Georgia archives. Representing the first phase of transmittal, these boxes relate to editorial correspondence for the *Journal of Organometallic Chemistry*, correspondence with granting agencies, and various aspects of the University of Georgia.

William D. Williams of Harding University's chemistry department and

Continued on page 12

NEWS FROM THE OTHMER LIBRARY

Von dem Golt.

Wie man das Silber widerumb auß dem Scheidwaſſer bringen vnd fellen ſol.

WAnn man das Silber durchs Scheidwaſſer vom Goldt ſoluirt / vnnd das Scheidwaſſer ſolches in ſich gezogen hat / vnd man wil daſſelbig widerumb auß dem Scheidwaſſer bringen/

Equipment for liberating silver from a nitric acid solution, from Lazarus Ercker, Beschreibung allerfürnemisten Mineralischen Ertzt und Bergwercksarten. *From the Othmer Library.*

OTHER COLLECTIONS—*from page 11*

Wyndham D. Miles, science historian for more than forty years for several U.S. government agencies, have created the Williams-Miles Rare Chemistry Collection at Harding University. Miles was the 1971 Dexter Award winner and is currently completing the second volume of his *American Chemists and Chemical Engineers.* In the collection of over fifteen hundred volumes published between 1600 and 1900 are six books by Robert Boyle, sixteen by Humphry Davy, four by Michael Faraday, twelve by William Henry, forty by Justus Liebig, and twenty-five by Joseph Priestley. Over two-thirds of all chemistry titles published in the United States before 1880 are included, among them twenty-five by Robert Hare and twenty-eight each by John Comstock and Jane Marcet.

A list of books in the collection is available for $3 from William D. Williams, Harding University, Box 602, Searcy, AR 72143.

Books Keep on Coming

Ercker Joins Agricola. Through the generosity of the historian of metallurgy Cyril Stanley Smith, the Othmer Library now owns a beautiful copy of the 1598 edition of Lazarus Ercker's *Beschreibung allerfürnemisten Mineralischen Ertzt und Bergwercksarten.* It joins thee copies of Agricola's *De Re Metallica* (the 1621 and 1657 editions and the translation by Herbert C. and Lou Henry Hoover, 1912), so that the library now has two of the three comprehensive mining and metallurgical treatises of the sixteenth century. The third, Vannoccio Biringuccio's *De la pirotechnia,* is not in our collection. Ercker, who died in 1593, was inspector general of mines in the Holy Roman Empire. His book emphasized assay methods more than Agricola's. According to Aaron Ihde, no metallurgical book in the ensuing century went much beyond these classics.

History in Stamps and a Fritz Welsch Festschrift. From Horst Remane of the Pädagogische Hochschule Halle came his and Hans Wussing's *Wissenschaftsgeschichte en Miniature* (Berlin: VEB Deutscher Verlag der Wissenschaften, 1989), a philatelic history of science with major sections on chemical industry and the chemical sciences. He also sent an issue of *Manuskripte zur Chemiegeschichte,* published by the Halle institute, honoring Fritz Welsch. The issue includes papers by Remane (on Julius A. Stöckhardt's popularization of chemical experiments), G. P. Muzzo, L. Beyer, and Remane (on Wilhelm Ostwald), and Wolfgang Göbel (on Welsch and the history of chemical industry). On Welsch's biography of A. W. Hofmann see p. 23.

Found in the Othmer Library III

Browsing through any large collection of books always produces at least one curious title that intrigues and gives pause. We all know that chemistry has diversified into myriads of tiny specialisms. But who among us who does not work in an insurance office would expect to find a book entitled *Harris's Technological Dictionary of Insurance Chemistry*?

This interesting tome was published in Liverpool, England, in 1890 by the Phoenix Fire Insurance Company; it has 407 pages, with alternate pages left blank for the owner to write notes on. The author, William A. Harris, who was the secretary of the Phoenix Insurance Company, had already compiled *A Technical Dictionary of Fire Insurance* in 1886. His *Insurance Chemistry* was addressed to insurance managers, underwriters, and insurance agents; surveyors and government officials; captains, shippers, stevedores, and harbor masters; railway, dock, and traffic managers; merchants and warehouse keepers—to explain the various risks from "spontaneous combustion, oxidation, chemical affinity, fermentation, friction, expansion of gases, inflammability of vapors, dust-explosions, steam-heating and drying, oils, fibers, coal, cotton, and mixed cargoes, etc." Clearly the book is the equivalent of today's list of hazardous chemicals.

The Othmer Library copy was originally presented by Harris to the Franklin Institute, of which he was a member. The entries contain quite a few references to American chemical fires and explosions—it seems, for example, that Philadelphian gentlemen in the 1880s lit their cigars with pieces of sodium!

WILLIAM H. BROCK
Edelstein International Fellow 1991–92
University of Leicester

OTHMER LIBRARY—*continued from page 9*

tell the story of chemical achievement and of the men and women responsible. The core of the library consists of over 40,000 volumes donated by The Chemists' Club. These volumes span the era from the Civil War through World War II and form an unrivaled resource for the history of American chemical business and technology. Since March 1991 almost 200 individuals from throughout the United States and abroad have donated about 1,000 additional titles, ranging from Lazarus Ercker's *Bergwercksarten* (1598) and Robert Boyle's *Usefulness of Experimental Natural Philosophy* (1664) to Humphry Davy's *Elements of Agricultural Chemistry* (1813), George E. Davis's *Handbook of Chemical Engineering* (1904), and the classic Walker-Lewis-McAdams text *Principles of Chemical Engineering* (1923). In addition CHF has received the research archives of such noted individuals as William J. Bailey, Paul Flory, Daniel Fox (inventor of Lexan), and C. S. "Speed" Marvel.

On File: Oral Histories

J. Franklin Hyde

Organic Chemist in a Glass Factory, Part II

Part I, which appeared in issue 9:2 (Summer 1992), told of Franklin Hyde's decision to become the first organic chemist at Corning—a leap into the unknown—rather than join the well-established research organization at Du Pont.

While completing his work at Harvard, Franklin Hyde prepared for his new position, designing a new organic lab at Corning and stocking it with books and supplies, including the fundamental chemical silicon tetrachloride.

When Hyde arrived in August 1930, he found that the commercially available silicon tetrachloride contained "some titanium and a few other impurities in small amounts," and needed to be purified before it could be used to make organosilicon compounds. He noticed that during the distillation of silicon tetrachloride an iridescent film formed if there was moisture on the glass. At just this time another Corning laboratory group was developing high-voltage insulators of Pyrex glass and needed "thin semiconducting coatings to spread out the voltage drop and reduce the possibility of arcing." "Too timid to ask them exactly what they were doing," Hyde did observe their attempts at trying to get thin iridescent films on glass and asked if the film he formed in the silicon tetrachloride distillation might be of any use. Although his idea was immediately rejected, Hyde kept thinking, "Why didn't they at least try it?" Finally he decided, "If they're not going to try it, I will." Blowing some silicon tetrachloride on a heated glass test sample gave an iridescent film that proved to be conducting. Just three months after his arrival, Hyde filed his first Corning patent application. He refuses to call this an example of serendipity. "I don't like that word. You have to have some insight to recognize something that's useful." Another expression that Hyde disdains is "anomalous behavior." He explains that "molecules will always do what they are supposed to do. It's our conceptions that are anomalous."

After carefully reviewing all of Frederick Stanley Kipping's papers, Hyde began his synthetic work by selecting the phenyl derivatives of silicon tetrachloride because they were crystalline compounds that were easy to work with and could be characterized by melting point and molecular weight. The products were "a long way from glass," but "these experiments were part of trying to learn something about what I could get out of the organosilicon compounds." Initially he did not have a specific goal in mind. However, hydrolysis of one crude reaction mixture gave a "resinous, low-melting, low-molecular-weight material" which became quite fluid when melted. Hyde heated this liquid in a thick-walled Pyrex tube, and even when the glass started sagging, "a nice clear liquid" remained inside. This striking thermal stability signaled the completion of the first step towards what would eventually become a major chemical industry.

While continuing to prepare other derivatives, Hyde also studied the urea-formaldehyde resins, phenol-formaldehyde polymers, and polyvinylacetate (PVAc). In 1932 Corning had been commissioned to install a large window over the entrance to the RCA Building in Rockefeller Center, depicting a relief map and a man with calipers measuring off the universe. As Hyde recounts the problem, the window, fifteen by forty feet overall, was actually a series of smaller cast panels. "Almost every one of them was different. If you cast glass panels of a size around eighteen by twenty-six inches and can get it to the same dimensions within an eighth of an inch, you're doing pretty well. They didn't know how they were going to put them together. PVAc has the same refractive index as Pyrex glass to within the third decimal place. I did some loading tests that showed that it would hold the weight without too much flow. Union Carbide made big slabs of PVAc and cut them into slices. We put these against the glass, and brought hot platens in to melt them onto the glass. That brought the glass out to accurate dimensions. Still something had to be put in between them while in place. But what? I came up with a very viscous, sticky solution of PVAc dissolved in its monomer." After getting permission from the glaziers' union, Hyde spent a month in New York, "squeezing out this stuff that was going in between" the panels. "This is the way that we put that window together. This 'glue' was easy to work and fitted perfectly between the other slabs. Then the monomer would slowly polymerize and make a solid seal." Sixty years later the window is still there, and Hyde acknowledges that he looks at it whenever he is in New York.

Other immediate Corning interests got Hyde "off the track of organosilicon compounds." When "there was talk of

Continued on next page

Polychromatic stone and glass decoration at the main entrance of the RCA building in Rockefeller Center, New York, designed by Lee Lawrie and installed in 1933. Wisdom personified uses calipers to gauge the cycles of light and sound. Hyde solved the problem of mounting the individual glass blocks. Photo courtesy of Rockefeller Center.

© The Rockefeller Group, Inc.

HYDE—*continued from page 13*

building a large telescope for Mt. Palomar," he "knew it would be difficult trying to fuse powdered quartz" because of its high melting point. In a patent filed in 1934, Hyde outlined his technique for "vaporizing a hydrolyzable compound of silicon into a high-temperature flame of combustible gas combined with oxygen, impinging the flame on a refractory core to deposit a layer of silica in the shape of the desired article, and vitrifying the layer to a transparent article." The method has become an important industrial process for making components in radar relay systems, telescopes, and fibers for fiber-optic communication.

When Sullivan told Hyde confidentially that the fiber products divisions of Corning and Owens-Illinois would be merged to form the Owens-Corning Fiberglass Corporation and asked him what he would like to do, Hyde replied, "There are two important things, as far as I'm concerned. One of them is the chemistry of glass surfaces, and the other is this organosilicon chemistry, which I think has quite a lot to offer." He proceeded to "rescue some of my equipment that I liked, such as a nice analytical balance" from the fiber-products laboratory and took it to the main laboratory "before these Owens-Illinois guys descended on the place. They put a tag on everything. This gave me a chance to get back full-time on organosilicon chemistry."

In 1938 he "started making phenylethyl siloxanes and looking for ways to polymerize them. Making the Grignard reagent, separating the solids, and then distillation wasn't easy. We were able to cause polymerization by acid treatment." Hyde confesses that he "wasn't sure just what was going on when we did it, but at least I could get a polymeric resinous material out of the hydrolysis." When the Macbeth Evans Glass Company of Charleroi, Pennsylvania, was acquired by Corning, which had been supporting research at the Mellon Institute, Hyde was joined in his pioneering work at the Mellon by Rob Roy McGregor and Earl Warrick of Macbeth Evans. Warrick has ably described the events that subsequently led to the formation of the Dow Corning Corporation in 1942, in his *Forty Years of Firsts* (McGraw-Hill, 1990).

Hyde remained with Corning until 1951, when he moved to Midland, Michigan. He spent the next twenty-four years with Dow Corning as a research scientist, which he preferred to pursuing a management position. In 1955 Eugene Sullivan described Hyde as "the man who was the first in the world to produce a useful silicone and on whose work an industry was founded."

JAMES J. BOHNING

WISHNICK—*continued from page 9*

with my brother. They never had any hard feelings. They just weren't happy with the company."

Wishnick notes that "I made it on my own because I was good," but his "rise to the top wasn't exactly jet-propelled." After serving in World War II with an engineering battalion building airstrips in the Pacific, he completed a business degree at the University of Texas. He began his Witco career in 1949 by staffing the sales order desk in Chicago. His advice to young people includes the admonition, "Don't ever work for your father directly in the beginning, because you're pretty dumb and your father is pretty smart."

In 1950 he left Chicago for the asphalt division in Perth Amboy, where he led the rebuilding of a plant that had been shut down by an explosion, then moved to chemical sales in New York—always working for somebody other than his father. Within a few more years, during a management reorganization, Wishnick became the executive vice president of the company, his father became chairman of the board, and Max Minnig, a long-time employee, became president.

Part of Wishnick's job was to get rid of the jobbing aspects of the company and add more manufacturing. The company had three very simple old asphalt plants. "We oxidized asphalt and spilled it on the ground and that was that." Maintaining a fine balance to keep the commissioned salespeople motivated, he slowly sold the jobbing back to the principals, offering to sell them "the names of the accounts, volumes, prices, and bids." In 1958 his father asked, "Son, what do you think we ought to do? We can stay as we are, we can go public, or we can sell the business." Wishnick knew his father well. As he recalls, "If I had said, 'Sell the business,' he would have fired me on the spot. We knew we couldn't stay the same. So we went public, and that is when we decided we were going to use being public as a way to grow. From 1958 on we bought mostly good companies with good people, getting rid of the jobbing as we added manufacturing."

"When I did acquisitions there were not many around," Wishnick concedes. "People just did not sell; it was almost

Trucks from three stages of the history of Witco. Left to right: 1930s, 1940s, 1980s. From the Chemical Heritage Foundation photographic collection.

an admission of poor management. When the raiders got more accustomed to it, then everybody sort of liked selling out. The 1980s were so easy. The 1980s were mind-boggling." Noting that he "wouldn't want to marry a girl that didn't want to marry me," Wishnick boasts that he "never bought a company that didn't want to be bought."

Robert Wishnick had in fact made one unsuccessful attempt at acquisition during World War II. While aboard the Twentieth Century train to New York, he wrote a letter to his lawyer with a list of all the chemical companies then secured by the Alien Property Custodian, with an eye to acquiring them. Among the seven companies he was particularly interested in were the Schering Corporation, General Aniline and Film, and Rohm and Haas! Wishnick says his father's thinking was, "If the government owned the chemical companies, then let's go buy a chemical company from the government."

In reflecting on his long career with Witco, from which he retired in 1991, Wishnick expresses his convictions in plain words. "I find business very simplistic if you follow certain lines. You can't go to the left one day, and go straight the next day; there's a certain way you've got to run your personal life and your business. You can't shade it this way one day and then decide you're going to do it differently. You've got to earn a reputation. It takes a lot of years to earn a reputation, and then overnight it can go. Once it's gone, it's gone forever."

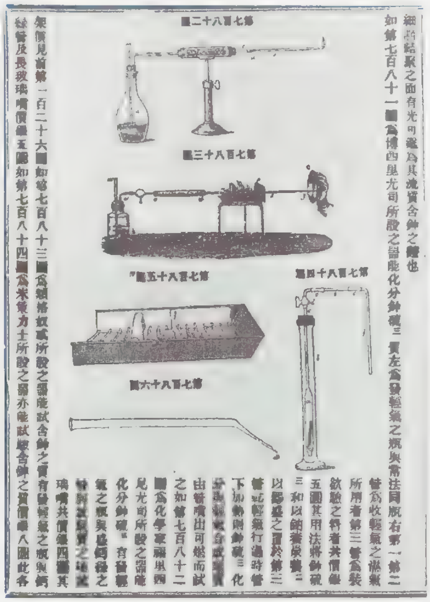
JAMES J. BOHNING

Our Hundredth Oral History

Chemically historic Havemeyer Hall on the campus of Columbia University was recently the site of the one-hundredth interview in the Chemical Heritage Foundation's oral history program. James J. Bohning, Assistant Director, and Leonard Fine of Columbia's chemistry department spent over six hours with Professor Gilbert Stork, recording his recollections of an illustrious career in synthetic organic chemistry. In addition to his childhood in France, his education at the universities of Florida and Wisconsin, and his academic career at Harvard and Columbia, Stork also reviewed his diverse scientific accomplishments. He is widely recognized as a creative, boldly imaginative, and penetratingly thoughtful contributor to organic chemistry—one with few peers.

Other recent interviews include sessions with Norman Hackerman (Welch Foundation), Charles Hurd and Fred Basolo (Northwestern), Madeleine Jouillé (University of Pennsylvania), William Wishnick (Witco Corporation), Elkan Blout (Harvard Medical School), and Rudolph Marcus (Caltech). William Gauvin (McGill University and William H. Gauvin Technologies), considered one of the leading chemical engineers in Canada, was interviewed in Montreal. A bound copy of the edited transcript was presented to him at the December meeting of the Montreal Section of the Canadian Society for Chemical Engineering by Edwin J. Bassler, AIChE Vice President for 1992.

PUBLICATIONS



Western chemical equipment illustrated in the science magazine Ko-chih hui-pien, *1881.*

Chemistry in Modern China

James Reardon-Anderson. *The Study of Change: Chemistry in China, 1840–1949.* New York: Cambridge University Press, 1991. 444 pages. $59.50.

Whereas our word *chemistry* derives from the Chinese *kim* for gold, or at least from the Arabic *al-chymia,* the word for modern chemistry in Chinese (*hua-hsueh*) and in Japanese (*kagaku*) is written with two characters meaning "the study of change," a phrase proposed by Western missionaries. The new chemistry was clearly different from the traditional practices and thought forms represented by Chinese characters for the crafts of ennobling metal and producing elixirs.

James Reardon-Anderson has written the first full-length account of chemistry in modern China, from its introduction by missionaries in the middle of the last century through the toppling of the Manchu dynasty and the successive republican, Kuomintang, and Communist governments. Based on extensive Chinese, Japanese, and Western sources, the book focuses not only on chemistry as it unfolded in China, but also on its impact on Chinese language, industry, education, culture, and politics.

Continued on next page

NEWS FROM THE OTHMER LIBRARY

The Edelstein Collection

Moshe Ron. *Bibliotheca Tinctoria: Annotated Catalog of the Sidney M. Edelstein Collection in the History of Bleaching, Dyeing, Finishing, and Spot Removing.* Jerusalem: Jewish National and University Library, 1991. $110.

Sidney M. Edelstein, chairman of the Dexter Chemical Corporation, chemist, industrial leader, benefactor, and scholar, has been collecting the historical sources of the dye industry for half a century. His collection, now housed in the Hebrew University, Jerusalem, reflects his expertise and discrimination. It is a remarkable achievement and all the more so for a busy entrepreneur.

This meticulously researched and beautifully crafted volume is a worthy companion to the superb collection it describes. Far more than a catalog, it can also serve as a scholar's entry into the history of dyeing and textile finishing. The 1,220 books, manuscripts, documents, and periodicals in numerous languages are listed with full bibliographic detail, followed by helpful translations where needed, notes, and references to other historical collections and to published commentaries.

The first printed book exclusively devoted to professional dyeing, Gioanventura Rosetti's *Plictho de larte de tentori*, is present in all six editions from 1548 to 1911 as well as in its celebrated translation by Edelstein himself and Hector C. Borghetty. Included also is the first edition of the first book on dyeing published in America, *The Country Dyer's Assistant*, by Asa Ellis, Jun. (1797), and forty-one items by the organic chemist and director of the Gobelins tapestry works Michel Eugène Chevreul. Helpful name, title, and subject indexes are included.

Sidney Edelstein's foreword describes the chance beginnings and further development of his collection, and Melvin Kranzberg's introduction points to the cultural significance of the dyeing industry and of the collection that preserves its history.

The author of the work, Moshe Ron, who was born in Hungary and managed to survive under the Nazi occupation, is the twentieth-century equivalent of a Renaissance man—photographer, journalist, and broadcaster, with degrees and diplomas in history, philosophy of science, and library science. Head of the Edelstein Library since 1976, he has given historians of science and technology a major new scholarly resource.

Sidney Edelstein's bookplate

PUBLICATIONS—*continued from page 15*

To do justice to the topic, Reardon-Anderson, not trained in science, went back to school. Thanks to Ronald Breslow and others in the Columbia chemistry department, he could proclaim, "I want to begin with a tip for my fellow sinologists: Science is not that hard!"

The author, on leave from Georgetown University, is director of the Committee on Scholarly Communication with the People's Republic of China.

Canadian, Japanese, and Anglo–U.S. Profiles

The latest chemical autobiographies to appear in the Profiles, Pathways, and Dreams series (Jeffrey I. Seeman, editor; Washington, D.C.: American Chemical Society) are Michael J. S. Dewar, *A Semiempirical Life;* Raymond U. Lemieux, *Explorations with Sugars: How Sweet It Was;* Koji Nakanishi, *A Wandering Natural Products Chemist;* and Tetsuo Nozoe, *Seventy Years in Organic Chemistry.*

Books to Note

Clark K. Colton, editor. *Perspectives in Chemical Engineering: Research and Education.* (Advances in Chemical Engineering, 16). Boston: Academic Press, Inc., 1991. 606 pp. $99.95.

The cover announces "A Century of Chemical Engineering, 1888–1988," and the introductory chapter by Clark K. Colton explains that chemical engineering can be considered as having originated in September 1888 at MIT, when eleven sophomores enrolled in Lewis Mills Norton's course of that title. The subject also had a prehistory, which Colton outlines by surveying the heavy chemicals industry, coal tar dyes, and electrochemistry. He discusses and shows pictures of the early giants of the field—William H. Walker, Warren K. Lewis, and Arthur D. Little—and then considers the succeeding frontiers—petroleum refining and high-pressure and catalytic processing, followed in the second half-century by synthetic detergents, plastics, and synthetic rubber.

The historical perspective and overview section continues with Ralph Landau's analysis of early academic-industrial interactions in chemical engineering at MIT, and concludes with James Wei's look into the future of the discipline. The book then examines various specialties, each section ending with comments by participants who attended the centennial symposium that launched the book.

Tomlinson Fort; Karol J. Mysels, editors. *Eighteen Years of Colloid and Surface Chemistry: The Kendall Award Addresses, 1973–1990.* Washington, D.C.: American Chemical Society, 1991. $59.95. 398 pp.

This is the second volume of award addresses by the recipients of the Kendall Award, established in 1952 by the Kendall Company "to recognize and encourage outstanding scientific contributions to colloid or surface chemistry in the United States or Canada." Since a complete list of each individual's publications is included, the volume presents an unusual access to the technical literature. More important, it is an excellent review of almost two decades of surface and colloid chemistry, and it reflects the change and development that is the trademark of any healthy branch of science. The first volume covered topics such as thin films, rheology, and aerosols (K. J. Mysels et al., eds., *Twenty Years of Colloid Chemistry*, Washington, D.C.: American Chemical Society, 1973); this one discusses surface spectroscopy, electrochemistry, and computer simulations. Unfortunately, while the volume describes the scientific details more than adequately, there is a lack of autobiographical information, and no sense of the personalities and camaraderie that permeates the award ceremony. The result is a volume that will appeal mostly to other surface and colloid scientists who speak the same technical jargon.—**James J. Bohning**

J. G. Fyffe; R. G. W. Anderson. *Joseph Black: A Bibliography*. London: Science Museum, 1992. 125 pages. £9.95.

The Scottish chemist Joseph Black (1728–1799) was born in Bordeaux, France, schooled in Belfast, and trained in medicine in Glasgow and Edinburgh. He made extensive studies on alkalis and on the nature of heat. He distinguished fixed air (CO_2) from atmospheric air, and thereby carbon dioxide became the first gas to be chemically characterized. Robert Anderson, winner of the 1986 Dexter Award, and his colleague at the Science Museum completed this exemplary annotated bibliography just as Anderson was called to become Director of the British Museum. The bibliography covers works by Black and his contemporaries, works on Black, and works on the controversy between Black and J. F. Meyer regarding the nature of causticity. A detailed family tree and index complete the book.

Hélène Metzger. *Chemistry*. (Women in the Sciences series, 1.) Translated and annotated by **Colette V. Michael.** West Cornwall, Conn.: Locust Hill Press, 1991. 151 pages. $25.

The celebrated and influential historian Hélène Metzger (see *Beckman Center News* 7:2, Summer 1990, p. 12) wrote a history of chemistry in 1930, *La Chimie*, which was published by E. de Boccard as part of *La civilization européenne moderne*, Volume 13 of *Histoire du monde*. Metzger, a philosopher as well as historian, taught historians of science to put themselves in the context of the scientists they describe instead of arrogantly judging the past in the light of the present. The book surveys in some detail chemical developments from the time of Stahl through the chemical revolution and rather more briefly the nineteenth century to the periodic table and the structural theory of organic chemistry.

The translator has added footnotes, expanded the author's biographical notices, enlarged the bibliography, and supplied an index.

Hugh W. Salzberg. *From Caveman to Chemist: Circumstances and Achievements*. Washington, D.C.: American Chemical Society, 1991. 294 pages. $24.95 (cloth), $14.95 (paper).

Hugh Salzberg is a physical chemist who has worked in industry and at the Naval Research Laboratory; for over thirty years he has taught chemistry at the City University of New York. He has also taught history of chemistry to interest undergraduates and answer his own questions. The book is a readable narrative of chemical knowledge and exploration from ancient times and Greek, Roman, Islamic, and Chinese civilizations through the chemical revolution to the end of the nineteenth century. Salzberg places chemical developments in their social and political settings and seeks to bring to life the chemists whose work he relates.

The Chemical Sciences Book for the Coffee Table

Otto Krätz. *Faszination Chemie: A 7,000-Year Cultural History of Materials and Processes*. Munich: Verlag Georg D. W. Callwey, 1990. 332 pages. DM 148.

At last what many of us have been looking for has appeared—a lavishly illustrated presentation of "7,000 years of the cultural history of materials and processes," *Faszination Chemie*. After 124 pages of text with small illustrations comes a picture section of almost 200 pages. The author, Otto Krätz, was from 1971 to 1987 head of the chemistry section of the Deutsches Museum, Munich, where he is now in charge of outreach and public information. He also teaches history of chemistry at the universities of Munich and Stuttgart.

A note on the back cover presents the book's philosophy:

> Without chemistry there would be no industry, no modern medicine, no adequate food production. Thus chemistry is life, but it is also hazards, materials, and processes, which on the one hand are useful, but can also do harm. Taking this contemporary reality as a starting point, the author presents an all-encompassing overview of the history of chemistry from its beginnings in the ancient East and antiquity to the latest developments of the twentieth century.

The book's only drawback for most readers in North America is that its language is not English. The pictures, however, go far to compensate.

Pharmaceutical companies commonly used postcards between the world wars to promote their products. Here Nitroscleran is recommended for arteriosclerosis, angina, and hypertension. From Faszination Chemie. *Courtesy Otto Krätz.*

NEWS FROM THE OTHMER LIBRARY

Other Recent Publications

Social, Institutional, Disciplinary, and Policy Studies

Günther Beer. "Die Gründung des Lehrstuhles und Instituts für Anorganische Chemie der Universität Göttingen 1903, der ersten Einrichtung dieser Art an einer preussischen Universität." *Mitteilungen der GDCh: Fachgruppe Geschichte der Chemie* No. 7 (1992), 34–49.

Bettina Löser. "Zur Gründungsgeschichte des Kaiser-Wilhelm-Institutes für Faserstoffchemie in Berlin-Dahlem." *NTM: Schriftenreihe für Geschichte der Naturwissenschaften, Technik und Medizin* 28 (1991), 73–93.

D. T. Zallen. "The Rockefeller Foundation and Spectroscopy Research: The Programs at Chicago and Utrecht." *Journal of the History of Biology* 25(1) (Spring 1992), 67–89.

Biography and Autobiography

Boris A. Arbuzov. "Our Path in Science." *Reviews on Heteroatom Chemistry* 5 (1991), 1–2. On Alexander E. and B. A. Arbuzov and phosphorus organic chemistry.

Theodor Benfey; Tony Travis. "Carl Schorlemmer: The Red Chemist." *Chemistry & Industry* (15 June 1992), 441–444.

Brian Bowers; Lenore Symons, eds. *Curiosity Perfectly Satisfied: Faraday's Travels in Europe, 1813–1815.* London: Peregrinus, 1992. U.S. distributor: IEEE, Piscataway, NJ.

Robert Boyle. *Selected Philosophical Papers of Robert Boyle,* ed. **M. A. Stewart.** Cambridge, Mass.: Hackett Publishing Company, 1991.

Geoffrey Cantor. *Michael Faraday, Sandemanian and Scientist.* New York: St. Martin's, 1991.

Carl Djerassi. *The Pill, Pygmy Chimps, and Degas' Horse.* New York: Basic Books, 1992.

Thomas A. Edison. *The Papers of Thomas A. Edison.* ed. **Robert A. Rosenberg et al.** Vol. 2: *From Workshop to Laboratory (June 1873–March 1876).* Baltimore: Johns Hopkins University Press, 1992.

Eugene Garfield. "The Restoration of Frantisek Sorm: Prolific Czech Scientist Obeyed His Conscience and Became a Nonperson." *Current Contents / Physical, Chemical & Earth Sciences* 32(15) (13 April 1992), 3–8. With reminiscences by Vladimir Prelog and Carl Djerassi.

Iwan Rhys Morus. "Different Experimental Lives: Michael Faraday and William Sturgeon." *History of Science* 30 (1992), 1–28.

John Meurig Thomas. *Michael Faraday and the Royal Institution: The Genius of Man and Place.* Bristol, U.K. / Philadelphia: Adam Hilger, 1991.

Tony Travis; Theodor Benfey. "August Wilhelm Hofmann: A Centennial Tribute." *Education in Chemistry* (May 1992), 69–72.

Petra Werner. *Ein Genie irrt seltener . . . Otto Heinrich Warburg: Ein Lesbensbild in Dokumenten.* Berlin: Akademie Verlag, 1991. Based in part on papers previously believed lost.

Bernhard Witkop. "Remembering Heinrich Wieland (1877–1957): Portrait of an Organic Chemist and Founder of Modern Biochemistry." *Medicinal Research Reviews* 12(3) (1992), 195–274. Also in German, as "Erinnerungen an Heinrich Wieland." *Liebigs Annalen der Chemie* (1992), i–xxxii. Includes complete Wieland bibliography.

The Lessons of IG Farben

The IG Farben Study Group has now produced three issues of its newsletter. They look ever more like copies of a journal about to make the transition from typescript to printed page. The first, dated 1989, contains articles by Tony Travis ("Artificial Alizarin: Rivals for Invention and Innovation") and Peter Reed ("The Early Years of Indigo Manufacture in Britain"), as well as book reviews, meeting notices, and a bibliography.

Newsletter 2 (1990), titled "IG Farben and the State," provides us with four symposium papers from the 18th International Congress for History of Science, held in Hamburg and Munich in 1989: Eric Elliott, "The IG Farbenindustrie: Is There Science Here for the Historian of Science?"; John Beer, "How Contemporary Scholars View the History of the Relations between the German Chemical Industry and the German Government in the Period 1871–1951"; Peter Morris, "IG Farben and the Third Reich: The Example of Synthetic Rubber"; and Raymond G. Stokes, "The Successors to IG Farben and the State, 1945–1961." These papers, together with Frank Bechtoldt's "Die IG Farben und die Politik Hitlers," appeared in German in *Mitteilungen, Gesellschaft Deutscher Chemiker, Fachgruppe Geschichte der Chemie* 5 (1991), 10–46.

Newsletter 3 (1991) focuses on East Germany: Herbert Bode, "Works on the History of Chemical Fibers at IG Farbenindustrie AG"; Rainer Karlsch, "Research on IG Farbenindustrie in Germany's East: At an End or Facing a New Beginning?"; and Peter Morris: "A Recent Fieldtrip to the Former German Democratic Republic."

For further information on the *IG Farben Study Group Newsletter* contact Raymond G. Stokes, Rensselaer Polytechnic Institute, Department of Science and Technology Studies, Troy, NY 12180.

Two recent books fill us in further on the history of IG Farben:

Jens Ulrich Heine. *Verstand & Schicksal: Die Männer der IG Farbenindustrie in 161 Kurzbiographien.* Weinheim, Germany /New York: VCH Publishers, 1990. $60.

Gottfried Plumpe. *Die IG Farbenindustrie AG: Wirtschaft, Technik und Politik 1904–1945.* Berlin: Duncker & Humblot,1990.

Chemistry in Finland, 1891–1991

For a centennial commemoration of Finland's chemical society, *Kemia-Kemi* (18 [(1991)], 999–1026) has issued, among others, articles by L. Niinistö and V. Komppa on Gustav Komppa and the Finnish chemical industry; by George B. Kauffman on Edvard Hjelt; and by A. Lundgren on Swedish chemistry at the turn of the century.

Chemical Industry; Chemical Engineering; Chemical Technology

Andrew Dequasie. *The Green Flame: Surviving Government Secrecy.* Washington, D.C.: American Chemical Society, 1991. A personal account of the government-sponsored boron fuels project and its ultimate collapse. Based in part on recently declassified documents.

Roger Firmenich. *From Chuit & Naef to Firmenich S.A.* Princeton, N.J.: Firmenich Inc., 1990. The history of the Swiss fragrance supplier.

Harold B. Friedman. "DDT (Dichlorodiphenyltrichloroethane): A Chemist's Tale." *Journal of Chemical Education* 69 (1992), 362–365.

Chikayoshi Kamatani. "The Chemical Industry in Meiji Japan: The Case of the Artificial Fertilizer Industry" (Part 2) (in Japanese with English summary). *Kagakushi* 19(1) (1992), 14–35.

Tony Travis. "Indigo: Putting the Blue in Blue Jeans." *Chemistry Review* 1(4) (March 1992), 2–6.

Analytical Chemistry; Environmental Chemistry; Instrumental Techniques

John R. Ferraro; Robert Jarnutowski; David C. Lankin. "Fifty Years of Commercial Instrumentation in Absorption Spectroscopy, Part I: Landmark Instruments in Infrared and Raman." *Spectroscopy* 7(2) (1992), 30–42.

C. J. Keattch; D. Dollimore. "Studies in the History and Development of Thermogravimetry: 1. Early Development; 2. Hannay's 'Time Method.' " *Journal of Thermal Analysis* 37 (1991), 2089–2102; 2103–2107.

Lauri Niinistö. "Analytical Instrumentation in the 18th Century." *Fresenius' Journal of Analytical Chemistry* 337 (1990), 213–217.

Ann Ratcliffe; Horacio A. Mottola. "A Chronicle of Instrumentation as Seen from the Table of Contents of Seven Editions of the Same Textbook." *Journal of Chemical Education* 68 (1991), 543–544.

Hamish Small. "Twenty Years of Ion Chromatography." *Journal of Chromatography* 546 (1991), 3–15.

Organic, Biomedical, and Pharmaceutical Chemistry

David P. Adams. *The Greatest Good to the Greatest Number: Penicillin Rationing on the American Home Front, 1940–1945.* (American University Studies, 9:95.) New York: Lang, 1991.

Ekkehard Höxtermann. "Berliner Botaniker in der Geschichte der Biochemie." *Mitteilungen der GDCh, Fachgruppe Geschichte der Chemie* No. 7 (1992), 20–33.

Susan E. Lederer. "Political Animals: The Shaping of Biomedical Research Literature in Twentieth-Century America." *Isis* 83 (1992), 61–79.

Giorgio Semenza; Rainer Jaenicke, eds. *A History of Biochemistry: Selected Topics in the History of Biochemistry: Personal Recollections* (Comprehensive Biochemistry, 37). New York: Elsevier Science Publishers BV, 1990. Includes recollections by Henryk Eisenberg, Herman M. Kalckar, and Max Perutz.

Understanding Our Genetic Inheritance: The U.S. Human Genome Project—The First Five Years, FY 1991–1995. NIH Publication no. 90–1590, April 1990. Available from the National Technical Information Service, U.S. Department of Commerce, Springfield, Virginia 22161.

T. Wieland; M. Bodanszky. *The World of Peptides: A Brief History of Peptide Chemistry.* Berlin / New York: Springer-Verlag, 1991.

Inorganic, Physical, and Theoretical Chemistry

R. F. Barrow; C. J. Danby. *The Physical Chemistry Laboratory: The First Fifty Years, 1941–1991.* Oxford: Physical Chemical Laboratory, 1991.

Michael Chayut. "J. J. Thomson: The Discovery of the Electron and the Chemists." *Annals of Science* 48 (1991), 527–544.

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Russell Harvey. "Fire, Phosphorus, and Matchsticks." *Philatelica Chimica et Physica* 13 (1991), 99–106.

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John T. Stock. "Robert Behrend's Foray into Electrochemistry." *Journal of Chemical Education* 69 (1992), 197–199.

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Harold F. Walton. "The Curie-Becquerel Story." *Journal of Chemical Education* 69 (1992), 10–15.

Alchemy and Chemistry through the Eighteenth Century

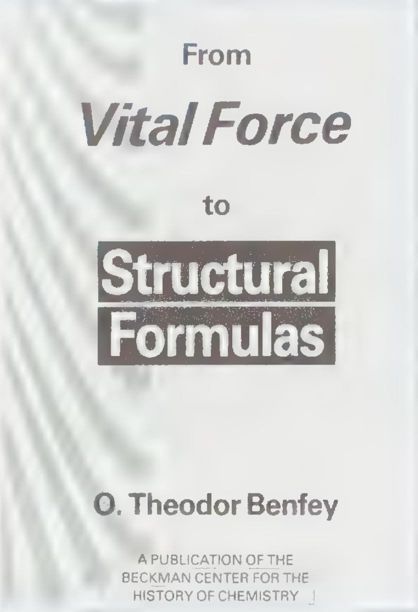
Constantine of Pisa. *The Book of the Secrets of Alchemy,* trans. and ed. **Barbara Obrist.** New York: E. J. Brill, 1990.

Allen G. Debus. *The French Paracelsians: The Chemical Challenge to Medical and Scientific Tradition in Early Modern France.* New York: Cambridge University Press, 1991.

Betty Jo Teeter Dobbs. *The Janus Faces of Genius: The Role of Alchemy in Newton's Thought.* New York: Cambridge University Press, 1991.

From Vital Force Reprinted by CHF

Theodor Benfey's *From Vital Force to Structural Formulas,* first published by Houghton Mifflin in 1964 and reprinted by the American Chemical Society in 1975, is back in print and available from the Chemical Heritage Foundation for $15. Using extended passages from the original papers of Friedrich Wöhler, Justus Liebig, Jean-Baptiste-André Dumas, Charles Frédéric Gerhardt, Auguste Laurent, Alexander William Williamson, Edward Frankland, Archibald Scott Couper, and Friedrich August Kekulé, the book traces the transformation of organic chemistry from 1800 to Kekulé and Couper's development of the structural theory and points to major gaps in the theory that were filled by later chemists.


From
Vital Force
to
Structural
Formulas
O. Theodor Benfey
A PUBLICATION OF THE
BECKMAN CENTER FOR THE
HISTORY OF CHEMISTRY

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Colin A. Russell. "Records of Chemistry: Combustion or Conservation?" *Bulletin for the History of Chemistry* No. 9 (Spring 1991), 3–7. The 1990 Dexter Address.

General

F. Abbri; F. Crispini, eds. *Atti del III Convegno Nazionale di Storia e Fondamenti della Chimica.* Cosenza, Italy: Walter Brenner Editore, 1991.

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Jan Janko; Soña Strbanova, eds. *Interrelations of Biology, Physics, and Chemistry in Historical Perspective.* Prague: Institute for Theory and History of Science, Czechoslovak Academy of Sciences, 1991.

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Tetsuo Shiba. "Organization and Activities of the Beckman Center for the History of Chemistry" (in Japanese). *Kagakushi* 19 (1992), 50–51.

Our New Name—Our New Logo

Chemical Heritage: the title reflects not only the Chemical Heritage Foundation's new name but its purpose: to articulate the ongoing significance of the chemical sciences. News of the Beckman Center and the Othmer Library will be prominent in its pages, as will news of CHF's public outreach programs. *Chemical Heritage* will also continue to report on events throughout the world.

CHF's logo is three fused hexagons, each inscribed with one of the initials in a square. The logo's nonlinear fused-ring system is that of phenanthrene, a close relative of anthracene, the first known chemical with three fused hexagons. Phenanthrene is an essential structural constituent of cholesterol, steroids, and hormones. Louis Fieser's classic "The Chemistry of Natural Products related to Phenanthrene" (1936) attests to the structure's importance.

The square ground defining each letter takes us back to a much earlier stage of our chemical heritage—the figure often used to depict Aristotle's four elements, earth, air, fire, and water.

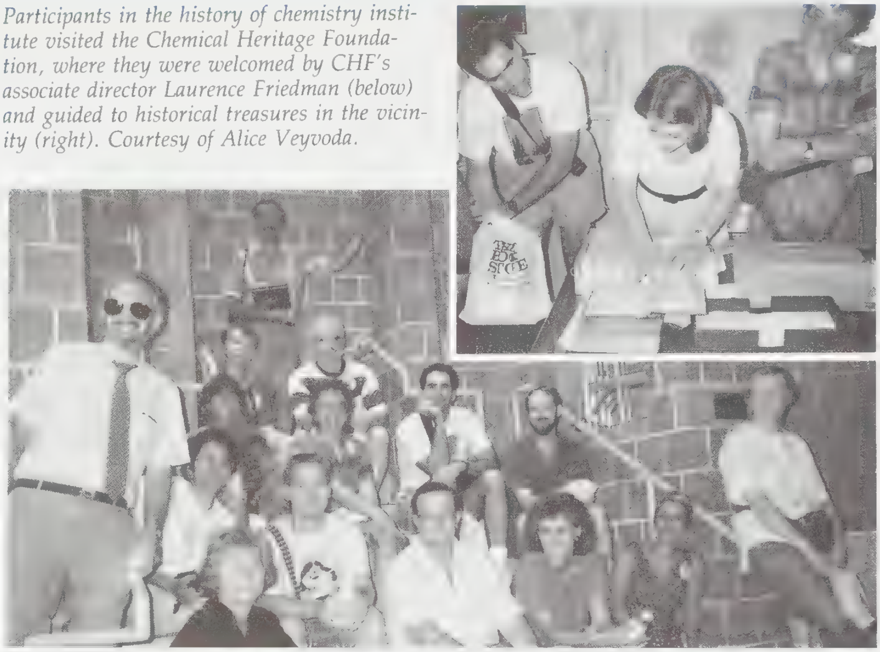
CHF—*continued from page 1*

Chemical History (OLOCH)—a product in part of the visionary generosity of Donald F. Othmer—will increasingly serve as an "information center," underpinning all Foundation activities. OLOCH will also be a resource for the media, the chemical community, and the world at large. In this it displays the third facet of CHF activities: public outreach. Joseph A. Dixon, chairman of CHF's finance committee, notes: "Our public outreach programs—examples are our traveling exhibits, publications, and workshops for high-school teachers—offer a highly cost-effective use of the chemical community's resources."

While CHF programs may be grouped under three heads—BCHOC, OLOCH, and public outreach—CHF facilities are all on one site. Soon that site will be the magnificent chapel and deanery of the former Philadelphia Divinity School at 42nd and Spruce Streets, on the campus of the University of Pennsylvania (see story on page 9).

To deploy our chemical heritage—to use our proud past to shape a fine future—necessarily requires financial resources commensurate with the importance of the task. John C. Haas, chairman of CHF's Othmer Challenge Committee, is "confident that we shall secure the 'bricks and mortar' necessary to house CHF, thanks to the example and generosity of individuals like Arnold Beckman and Donald Othmer." Finding the funds to underwrite the Foundation's operations requires a broad-based strategy—now under the aegis of John W. Eckman, chairman of CHF's overall Development Committee. "We expect that all the constituencies in the chemical community—corporations, associations, individuals, and foundations—will play appropriate roles," he notes. "We've been delighted by the experience of our first years. We believe that with each passing year our chemical heritage constitutes an ever-growing resource. Our task is to use that resource in ways that respond to our growing opportunities—to put the past to work in service of the future."

Participants in the history of chemistry institute visited the Chemical Heritage Foundation, where they were welcomed by CHF's associate director Laurence Friedman (below) and guided to historical treasures in the vicinity (right). Courtesy of Alice Veyvoda.



CHF WORKSHOP—*continued from page 1*

early published Christmas lectures (1827–28) from his handwritten notes, and at two closing sessions they presented the lectures as Faraday might have given them. Pairs of teachers also prepared biographies of notable chemists, emphasizing what might be useful in classroom presentations. For another module, to illustrate the dynamic nature of chemistry, the Othmer Library shipped to Princeton its collection of chemistry texts published over the last hundred years. The teachers used them to trace how various chemical techniques and concepts were introduced and modified as the decades passed.

Among the mentors on tap at the workshop were the computer expert Paul Schatz (University of Wisconsin) and the Nobel laureate Roald Hoffmann (Cornell), who looked at the concepts of pure and impure from the perspectives of science and some religious traditions. In addition, Mary Virginia Orna (College of New Rochelle) spoke on medieval pigments, Chem Source materials for experienced teachers, and crossword puzzle construction; Charles C. Gillispie (Princeton) spoke on the historiography of science; and Hubert N. Alyea (Princeton) gave an imaginary tour of Princeton that included encounters with Albert Einstein and other notable residents.

Between the lectures each morning the teachers presented their favorite demonstrations, from magic tricks to home-made cloud chambers and the secret of the absorbing power of disposable diapers. Group excursions to varied "chemical" locations rounded out the workshop—to the facilities of Merck & Co., Inc., the Priestley House in Northumberland, and the Chemical Heritage Foundation. The last, on 10 July, coincided with the opening of the exhibit "Chemistry Imagined" (see page 25).

NALCO—*continued from page 3*

covering 1953 through early 1980. The set includes employee portraits, picnics, sporting events, banquets, and company facilities, though most of the photos are of research tests and samples.

A Corporate History and Archives project was begun in January 1989. The goals were to produce a book on the history of Nalco, establish a functioning archives, and develop historical exhibits. An aggressive oral history program was undertaken involving retired and current employees. Transcripts of these interviews proved a valuable resource for the book, and they are now deposited in the archives. The history took over three years to complete; it has been submitted to management for approval.

The archives have proved invaluable throughout the company—to the Legal, Corporate Communications, Administration, and other departments as well as the Marketing and Research Groups. Historical information has been gathered there to use in speeches generally and at employees' anniversary, service award, and retirement celebrations; to verify the company's marketing slogans; and to create time lines of the history of the company's involvement in specific industries. Archival pictures and artifacts have been incorporated in customer presentations and exhibits.

The Nalco archives are managed by the Corporate Communications Department. Inquiries should be directed to the company's corporate office at One Nalco Center, Naperville, IL 60563.

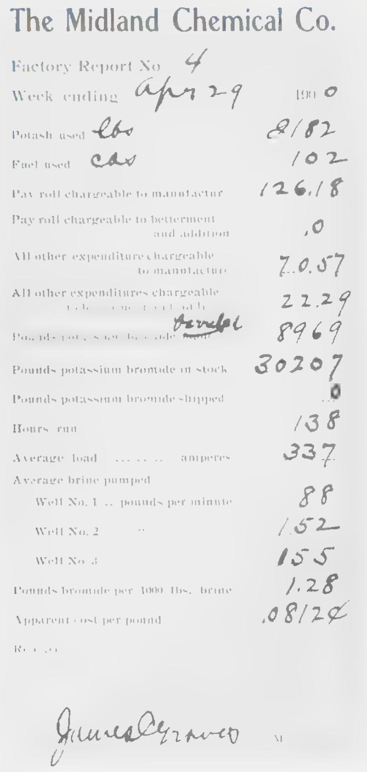
ANN FRANCZYK
Nalco Chemical Company

Nalco Waterlabs were installed in railway stations so that the engineers could determine the condition of the steam locomotive boiler water. Here a Nalco service representative (right) reviews product test records with a maintenance crew.

Dow's Early Years

The design of a company's cost-accounting system can both influence and reflect company attitudes toward research and marketing, as a recent study of the Dow Chemical Company shows. In the 1890s a struggle took place among the company's first stockholders over whether the company should simply live off Herbert Dow's initial invention of a new electrolytic process for making potassium bromide, benefiting from the high prices charged by an existing bromine cartel, or invest in research on and marketing of new products. Herbert Dow argued for the latter course. His views were eventually adopted early in this century, when Dow broke with the bromine cartel and created an organization that could support continued innovation and mass production.

Once Herbert Dow wrested control of the company from other investors and pushed forward his innovative strategy, the company began to use accounts in its management. During its earlier incarnations as the Midland Chemical Company and then the Dow Process Company, the firm collected almost no cost information regularly. Instead, the general manager filed a weekly statement of his own "personal account" with the company's treasurer, as though he were another of the firm's outside suppliers. When the Dow Chemical Company was formed in 1897, this general manager's account was replaced by new reports that gave company management information about the quantity and quality of output, as well as measures of cost and efficiency. These data were used by plant management to make decisions about what and how much to produce and how to go about it as well as by the company's board of directors to advise and compensate Dow himself. In 1900 the company introduced one of the first profit-sharing plans in U.S. history to include all company personnel. This tool further motivated employees to improve quality and cut costs and encouraged long-term employment with the firm. The introduction of these new management techniques, some borrowed from other firms and others developed by Dow itself, created incentives for technological change and prepared the firm for the challenges of growth during the twentieth century.



The Midland Chemical Co.

Factory Report No 4
Week ending Apr 29 1900

Potash used lbs	8182
Fuel used cas	102
Pay roll chargeable to manufactur	126.18
Pay roll chargeable to betterment and addition	.0
All other expenditure chargeable to manufacture	70.57
All other expenditures chargeable [illegible]	22.29
Pounds potassium bromide [illegible] develpd	8969
Pounds potassium bromide in stock	30207
Pounds potassium bromide shipped	0
Hours run	138
Average load .... amperes	337
Average brine pumped	
Well No. 1 .. pounds per minute	88
Well No. 2 "	152
Well No. 3	155
Pounds bromide per 1000 lbs. brine	1.28
Apparent cost per pound	.0812¢

[illegible]

James Graves M

An early weekly report of the Dow Chemical Company (29 April 1900) shows chemical output and provides data for analyzing cost and efficiency. Dow apparently could make a pound of potassium bromide for eight cents. Courtesy Post Street Archives.

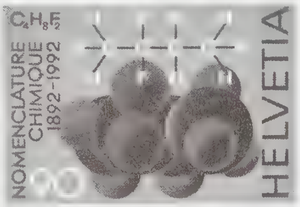
MARGARET LEVENSTEIN
University of Michigan

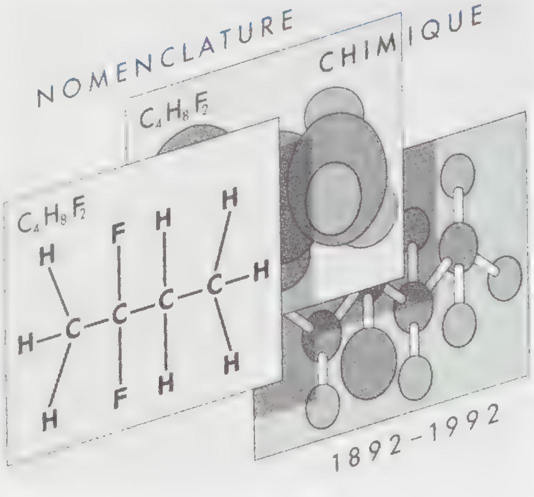
Drawn from Margaret Levenstein, "Information Systems and Internal Organization: A Study of the Dow Chemical Company, 1890–1914" (dissertation, Yale University Department of Economics), based on materials in the Herbert and Grace Dow Collection, Post Street Archives, Midland, Michigan.

CONFERENCE REPORTS

Centennial of 1892 Geneva Conference Celebrated

The Swiss postal authorities issued a commemorative envelope and stamp for "Nomenclature Chimique 1892–1992" that depict 2,2-difluorobutane.





The Geneva Conference of April 1892 was convened in response to the internationally acknowledged need for clear and unambiguous naming of chemical compounds. The hundredth anniversary of that first international conference devoted to chemical nomenclature was marked by a commemorative symposium, "Organic Chemistry: Its Language and Its State of the Art," in Geneva, Switzerland, 22–24 April 1992, with emphases on both history and current developments in the field. The Geneva Conference of April 1892 was a significant focus of the historical presentations, and its results clearly still guided those concerned with ongoing research in various areas of organic chemistry.

Over 400 attended and were quickly drawn into the commemorative spirit of the event by an extensive poster exhibition focused on the earlier conference. Included were photographs of chemists associated with the conference, reproductions of their letters, newspaper accounts, and handwritten minutes. One newspaper reported the seating at the official banquet in 1892 at the Hotel Metropole, where the banquet for the 1992 meeting was also held.

The first lecture of the symposium, "Organic Nomenclature: The Geneva Conference and the Following Fifty Years," by James G. Traynham, traced the development of standards for organic nomenclature from the late nineteenth century through the 1930s. He emphasized the evolution of the rules for naming compounds and the intellectual challenge of developing the rules of nomenclature. To sum up: "Better nomenclature means better communication means better chemistry."

Following this historical overview, the thirteen remaining papers focused instead on activities in which the speaker was a principal participant. Kurt L. Loening (Chemical Abstracts Service, retired), active in the IUPAC Commission on Nomenclature of Organic Chemistry (CNOC) since 1961, spoke on "Organic Nomenclature: The Geneva Conference and the Second Fifty Years." His personal observations included brief accounts of how his interest in languages, stimulated by his emigration from Germany as a teenager in 1937, led to his unplanned career in chemical nomenclature; recollections of the personalities of the CNOC participants, which had significant influence on the commission's work; and candid opinions about the desirability and efficacy of various rule changes. He also noted the indebtedness of the worldwide chemical community to private institutions, such as industries, chemical societies, the Chemical Abstracts Service, and the Beilstein Institute, which have given significant financial support to IUPAC through the intensive unpaid involvement of their employees in the work of the nomenclature commissions.

"Forty Years of Ferrocene," by Jack D. Dunitz (Eidgenössische Technische Hochschule, Zurich) was a fascinating mixture of history, contemporary science, and nostalgia. Dunitz was originally highly skeptical about the structure proposed by R. B. Woodward and set about to disprove it by X-ray crystallography studies; instead he confirmed it and was responsible for its being called a "molecular sandwich."

After pointing out that the names of many of the Geneva Conference delegates have become familiar as designations of important organic reactions, Vladimir Prelog (ETH) gave a highly personal and delightful account, "My 'Nomenclature Years.' " His keen sense of humor was much in evidence. He discussed the evolution of the Cahn-Ingold-Prelog sequence rules for *R* and *S* specifications of configuration and the nature of his interaction with the two Englishmen who developed the system with him. To the delight of the audience, Prelog included a slide of R. S. Cahn working at his desk in front of a mirror, showing "both R. Cahn and S. Cahn." The original paper was published in 1956 in *Experientia* (a rather new journal) after being rejected by the "usual journals." Robert Robinson condemned the proposals as altogether wrong, to which Prelog responded that a convention can be accepted or rejected, but it cannot be wrong; Robinson then asserted that, if not wrong, it was entirely unnecessary.

The language of organic nomenclature in different contexts was discussed by M. Volkan Kisakürek (editor of *Helvetica Chimica Acta* and chair of the committee that organized the symposium), who spoke on chemistry journals; Marjorie C. Caserio (University of California, San Diego), who noted how important language is in the teaching of chemistry, since unsystematic nomenclature can be familiar to chemists but frustrating to beginning students; and Edward Godby (Laboratory of the Government Chemist, U.K., retired, and current secretary of CNOC), who discussed nomenclature in the government laboratory.

Six chemists presented lectures on their current research, and Jack H. Stocker (University of New Orleans) closed the symposium with a mixture of lighthearted and more serious predictions about "Tomorrow's Organic Nomenclature." A volume of the invited lectures will be published later this year by Verlag Helvetica Chimica Acta.

Just before the symposium, on 21 April, the Swiss Chemical Society and the Association of Swiss Chemists joined to form the New Swiss Chemical Society. At the ceremony the Geneva Société de Physique et d'Histoire Naturelle awarded its annual Marc-Auguste Pictet Prize for an outstanding work by a young researcher in history of science to Diane L. Barkan (California Institute of Technology) for her article

"Walter Nernst and the Transition to Modern Physical Chemistry," and its annual Marc-Auguste Pictet Medal for a career of accomplishment in history of science to George B. Kauffman (University of California, Fresno).

The Geneva Conference of 1892 was worthy of a centennial celebration. Organic nomenclature and the chemistry it helps communicate are unfinished business and inseparable.

JAMES G. TRAYNHAM
Louisiana State University

Berlin Celebrates Hofmann Centennial

August Wilhelm Hofmann in Berlin, in his private laboratory attached to the university, 1870.

August Wilhelm von Hofmann (1818–1892) was uniquely the Anglo-German colossus of organic chemistry. As Heinrich Caro said in his 1892 history of the dyestuffs industry, Hofmann was the loyal gardener who for fifty years tended the soil of the great tree of academic and industrial chemistry.

Despite a public-sector strike in former West Berlin that made travel to the chemistry buildings of the Humboldt University in former East Berlin awkward, some 150 chemists and historians of chemistry assembled on 5 and 6 May 1992 to commemorate Hofmann's death. Sponsored by the reunited halves of the Deutsche Chemische Gesellschaft (which Hofmann founded in Berlin in 1867) and the Royal Society of Chemistry (of which he had been an extraordinarily active member during his twenty years in London), the meeting soon made it clear that in 1992 this cosmopolitan chemist symbolizes both the unity and the internationalism of chemistry.

The first day was devoted to a visit to Hofmann's grave (the present headstone replaces a grander monument destroyed during the war) and general lectures on Hofmann's influence on British and German chemistry (C. A. Russell and C. Meinel), the state of the German chemical industry in Hofmann's day (L. Burchardt) and the image of chemistry in literature—an amusing lecture demonstration by O. P. Krätz and his wife. The following day the meeting split into parallel sessions. In the first, chemists reviewed the progress made in those parts of chemistry to which Hofmann had particularly contributed. In the second, chemical historians investigated Hofmann's English years (W. H. Brock and G. K. Roberts); the state of chemistry in Prussia when Hofmann returned in 1865 (H. W. Schütt); Hofmann's role in perpetuating the Liebig tradition (R. Zott and S. Strbánová); the literary and medical milieu in Berlin, Hofmann's liberalism, and his opposition to anti-Semitism (G. P. Schiemenz and H. Fink); his creation of the German Chemical Society (M. Donke-Müller); his activities as a jury member of world fairs (E. Vaupel); and his support for the reform of chemistry teaching in high schools (H. Scholz). Finally, W. J. Hornix and J. A. Johnson reviewed Hofmann's strategic importance to relations between academics and industry in the British and German dyestuffs industries.

The conference proceedings will be published by Verlag Chemie. The meeting generated an exhibition catalogue, *Chemie und Chemiker in Berlin: Die Ära August Wilhelm von Hofmann 1865–1892,* edited by Michael Engel and Brita Engel of the Freie Universität, and a monograph, *August Wilhelm von Hofmann (1818–1892)* by Fritz Welsch. Articles on Hofmann also appeared in the May issue of *Education in Chemistry*, including one on Hofmann's impact on chemical education by Tony Travis of the Edelstein Center and Theodor Benfey of CHF. The reporter rejoiced that Hofmann's library, taken to Russia after the fall of Berlin in 1945, has been returned unharmed to the care of the Organic Chemistry Department of the Humboldt University.

W. H. BROCK
University of Leicester

Plastics Museum Opens Its Doors

After sixteen years of consultation, planning, and finally construction, the dream of a National Plastics Center and Museum has become a reality. In preparation the museum's vice-president, Jack Keville, made many a visit to CHF. The grand opening was held on 14 June at the former Lancaster Street School House of Leominster, Massachusetts. The building, for which the museum paid one dollar, has been totally transformed, and the interior redesigned by Thomas Wong of Boston's Museum of Fine Arts. No better site could have been found than Leominster, widely considered the cradle of the plastics industry. Here in 1868 John Wesley Hyatt invented and developed celluloid, a cellulose nitrate material suitable for volume production, as a substitute for the ivory on piano keys.

In the museum's initial phase the exhibits, many of them interactive, are located at street level. Visitors can make their own souvenirs by operating a Dow Chemical Company molding machine. Children can satisfy their architectural yearnings with a vast collection of construction materials donated by Lego, headquartered in Denmark. The B. W. Doyle Historical Gallery surveys the astounding strides made by the plastics industry since Hyatt's discovery; it also shows pictures of members of the Plas-

Continued on next page

VISITORS & EVENTS

Visitors

▲ **Philip M. Jacobs,** senior vice president of **Huntsman Chemical Corporation,** visited CHF to explore ways in which the corporation and the foundation can support each others' activities. The chief executive officer of the corporation, Jon M. Huntsman, founded his company only ten years ago in 1982 in Salt Lake City, Utah. He is said to have brought it to its present eminence through his "appetite for calculated risk." He recently established the Center for Global Competitiveness at the Wharton School of the University of Pennsylvania, of which he is a trustee. Huntsman is a member of the Chemical Heritage Foundation's Advisory Board.

Jacobs was guided on a tour of the Foundation by John W. Eckman, James B. Bohning, Irene I. Lukoff, and John C. Haas, who also showed him the university's Edgar F. Smith collection.

▲ **H. Steffen Peiser,** former head of the International Division of the U.S. National Bureau of Standards, made a return visit, accompanied by **Thomas Murphy** and **Tyler B. Coplen.** They brought for deposit in the CHF archives the papers accumulated by the international headquarters of the Commission on Atomic Weights and Isotope Abundances of the International Union of Pure and Applied Chemistry. These now join the papers of the U.S. branch of CAWIA. Peiser has been active at both levels of CAWIA for many years.

▲ **James F. O'Brien** of Southwest Missouri State University returned to conduct further studies on mercury poisoning. He presented findings on poisoning in Faraday at the ACS Faraday Symposium in 1991. O'Brien treated the CHF community to portions of the lecture he gave when on tour for the ACS, "Famous Mad Hatters." He gave evidence of mercury poisoning in Isaac Newton; the German chemist Alfred Stock, who worked on silicon, boron, and mercury; Charles II of England; and the man who shot John Wilkes Booth, Thomas "Boston" Corbett. The evidence for Newton's being a mad hatter, a nuclear-activation analysis of his hair, was written up in *Science.*

▲ **Herbert T. Pratt,** a retired Du Pont scientist and frequent visitor to CHF, represents the American Association of Textile Chemists and Colorists on the Board of Directors of the Chemical Heritage Foundation. He has initiated a column, "I Remember When," in *Textile Chemist and Colorist*, AATCC's journal, in which readers can share memories of their work with other readers. In its April issue A. Durfee Damon tells of the manager of a mill who, when asked how things were going at the plant, replied "Mr. Damon, right now, I am as confused as the little boy who has just dropped his chewing gum in the hen house."

Scholars and Travel Grants

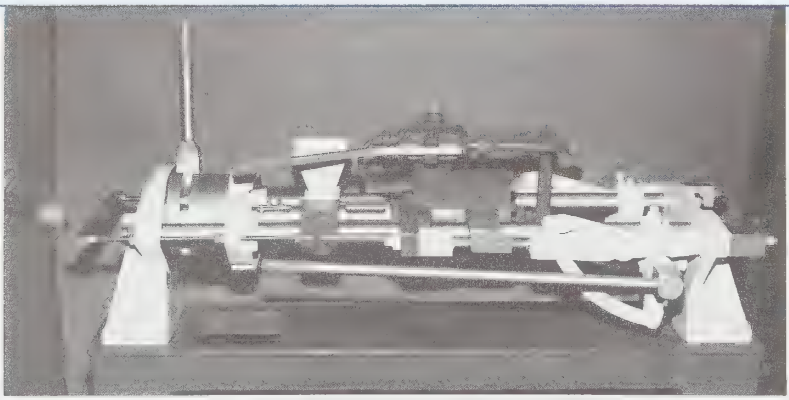
▲ **Yasu Furukawa,** historian of chemistry at Tokyo Denki University, has come to CHF as a visiting scholar for the 1992/93 academic year to continue his studies on the history of polymer chemistry. Furukawa, on the faculty of Yokohama College of Commerce for many years, is one of the leaders of the Japanese history of chemistry community and of its journal *Kagakushi.* In 1989 he published *Kagaku no Shakaishi,* a major social history of science. He was a visitor with us earlier during our work on the polymer project. He wrote his doctoral thesis, "Staudinger, Carothers, and the Emergence of Macromolecular Chemistry," under Mary Jo Nye of the University of Oklahoma.

▲ The longevity of chemical practices, compared with those of physics and biology, was the subject of the travel-grant studies of **Stephen J. Weininger** of Worcester Polytechnic Institute. The preparation of chemical elements, the order in which they are introduced, and such basic methods as distillation, sublimation, and crystallization persisted with remarkably little change from the directions given by Michael Faraday and Humphry Davy until well into the twentieth century.

▲ Another travel grant visitor, environmental historian **Edmund Russel** of the National Museum of American History, shared with us his reconsideration of the "miraculousness" of DDT in World War II. DDT was first synthesized in 1874 by a graduate student in Germany, Othmer Zeidler. Discovery of its insecticidal properties gained Paul H. Müller the Nobel Prize in 1948. Russell explored DDT's meteoric rise in popularity in spite of the availability of effective alternatives and questions from the start regarding its safety.

Our Far-Flung Correspondents

▲ **Harry J. Litsch** of Bethlehem, Pennsylvania, a former president of the American Electroplaters and Surface



A hand-operated Foster-Grant plastic injection molding machine from 1934 was among the earliest to produce a commercially marketed product—combs.

PLASTICS MUSEUM—*continued from page 23*

tics Hall of Fame, whose national home the museum soon hopes to become. A special gallery highlights environmental concerns that challenge the industry.

Valerie Wilcox, newly appointed executive director of the museum, entertained visitors during the week-long opening festivities with presentations characterized by humor, historical insight, and concern for improved education in science and technology. Her spectacular demonstrations included synthesizing nylon and carrying out other plastics processes.

Finishers Society (AESF), carries out teaching assignments for AESF. For that purpose he wrote to request a copy of our new electrochemistry brochure; he then sent us AESF's *Diamond Jubilee History, 1909–1984.* Formerly the American Electroplaters' Society, AESF expanded its name shortly after its jubilee. The society now has about 8,700 members; its executive director is J. Howard Schumacher, Jr. AESF's headquarters building, in the Central Florida Research Park in Orlando, was completed shortly after the jubilee celebrations.

▲ **The Gesellschaft für Unternehmensgeschichte,** Bonnerstrasse 211, 5000 Cologne, Germany, sent us the March 1991 issue of their *Zeitschrift für Unternehmensgeschichte.* As part of its coverage of the history of business and industry, the newsletter reports on archives, conferences, publications, museums, and oral history programs.

Conversazioni

▲ At an evening Conversazione **Peter Benoliel** described his life's work and the history of the Quaker Chemical Company, which he heads. He is now also chairman of the Philadelphia Orchestra Development Committee and of the Federal Reserve Bank of Philadelphia.

Benoliel graduated from Princeton, then worked as a chemist for Quaker Chemical, following his father and grandfather into the chemical industry. His grandfather Solomon Benoliel, an electrochemist, founded International Chemical Company, for which his two sons also worked until 1930, when they transferred to what was then Quaker Oil Products. The sons took over Quaker Oil the following year. In 1966 Peter Benoliel became president of the company, now Quaker Chemical, and in 1980 he became its chairman.

Joseph Schmuckler of Temple University and John C. Haas of Rohm and Haas with Conversazione speaker Peter Benoliel of Quaker Chemical Company.

Quaker Chemical manufactures cleansing and protecting agents for the textile, metals, and auto industries; it established a paper division in 1969. Since the 1960s it has been expanding globally and now has branches in Europe, South America, Asia, and Australia. Benoliel several times emphasized the strong ties of loyalty that bind the company and its employees.

▲ At a spring Conversazione **Arnold Frankel** of the Aceto Corporation told how he founded his specialty and fine-chemicals company in 1947, to secure chemical intermediates in this country for sale here and abroad. Because of Europe's needs after the war, extensive shipments of chemicals were sent there, financed to a large extent by the Marshall Plan. By the early 1950s shortages in the United States led instead to explorations in Great Britain and on the Continent for chemicals that could be imported. By the 1960s Japanese manufacturers of organic chemical intermediates were bringing their products to the States via Aceto. Frankel visited China's Canton fair in 1975—and Chinese imports were added to Aceto's offerings. Aceto also acquired companies such as Inmont and Pfalz & Bauer, and it now even carries out a certain amount of in-house manufacturing.

Frankel surveyed the way the U.S. chemical industry was transformed as the domestic economy gradually became global. He described the changing export and import patterns and the crucial role played by trading firms.

During the early hectic years of the company, Frankel and Seymour Mann, Aceto's cofounder, even managed to pursue graduate work. Frankel, whose first graduate courses in chemical engineering were at the University of Pennsylvania, chose Brooklyn Polytechnic Institute (now Polytechnic University), where Donald Othmer was teaching.

Torrence-Hoffmann Exhibit Visits CHF

Chemistry Imagined, the exhibit of collages by Vivian Torrence with accompanying poetry and prose commentaries by Roald Hoffmann, went on exhibit at the Chemical Heritage Foundation after a stop at the New York Academy of Sciences. The exhibit is at the National Academy of Sciences in Washington from September through December 1992.

"Beauty, elegance, deep understanding are sought by chemists just as much as they are by artists," in Hoffmann's view; and the exhibit's thirty panels, on themes ranging from the four Greek and the five Chinese elements to patterns, steps and processes, radium, and "the crystal scale," explore and exemplify this common search.

Torrence's talk at the opening of the exhibit, "Chemistry Imagined: A Collaboration of Art and Science," was attended by the high school teachers who took part in the Woodrow Wilson–CHF summer institute on history of chemistry in Princeton.

Chemistry Imagined will be available soon in published form from the Smithsonian Institution Press.

Thelma McCarthy (CHF) introduced the artist, Vivian Torrence, who spoke to participants from the history of chemistry institute and other guests.

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Friends (1 July 1991–30 June 1992)

The Chemical Heritage Foundation enjoys the support of many benefactors at home and abroad who donate time, advice, art, books, historic apparatus, and other resources. We list below those who have contributed since publication of our last list (see issue 9:1 Spring 1992, p. B-12); if we have inadvertently omitted your name, please let us know This list is our public acknowledgment of the help of the Friends of the Chemical Heritage Foundation and a token of our appreciation for their continued support

Benefactors contributed $1,000 or more, Patrons from $500 to $999, Sponsors from $100 to $499, Colleagues from $35 to $99, and Contributors up to $34. Listed also are those individuals who donated books and other materials to CHF's collections. If you would like to join the Friends of the Chemical Heritage Foundation, please write to us at 3401 Walnut Street, Philadelphia, PA 19104-6228

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MEETINGS

History of Science Society Annual Meeting, Washington, D.C., 26–30 December 1992.

Joint meeting with the American Historical Association.

205th ACS National Meeting, Denver, Colorado, 28 March–2 April 1993.

The HIST program includes a centennial symposium on coordination chemistry. HIST Program Chair: M. D. Saltzman, Department of Chemistry, Providence College, Providence, RI 02918-0001; (401) 865-2298.

AIChE Spring National Meeting, Houston, Texas, 28 March–11 April 1993.

Electrochemical Society Spring Meeting, Honolulu, Hawaii, 16–21 May 1993.

ASBMB National Meeting, San Diego, California, 30 May–3 June 1993.

ASMS Annual Meeting, Las Vegas, Nevada, 6–11 June 1993.

AACC Annual Meeting, New York, New York, 11–15 July 1993.

206th ACS National Meeting, Chicago, Illinois, 22–27 August 1993.

The HIST program includes a symposium, "C. K. Ingold, 1893–1970: Master and Mandarin of Physical Organic Chemistry," organized by Derek A. Davenport, Department of Chemistry, Purdue University, West Lafayette, Indiana, 47907; (317) 494-5465; and M. D. Saltzman. Titles of papers are due by 1 April 1993. To submit general papers contact the program chair, M. D. Saltzman, at the address given above.

XIXth International Congress of History of Science, Zaragoza, Spain, 22–29 August 1993.

AATCC International Conference and Exhibition, Montreal, Canada, 3–6 October 1993.

Electrochemical Society Fall Meeting, New Orleans, Louisiana, 10–15 October 1993.

Society for the History of Technology Annual Meeting, Washington, D.C., 14–17 October 1993.

AIChE Fall National Meeting, St. Louis, Missouri, 7–12 November 1993.

A special history program focusing on biochemical engineering on 10 November will include a plenary lecture, morning and afternoon sessions, and a presentation on oral history by James J. Bohning. The CHF booth and the traveling exhibit "Structures of Life" will be on display.

Bicentennial Commemoration of the Death of Antoine Lavoisier, Paris, France, 3–6 May 1994.

Included will be a visit to Lavoisier's laboratory, hosted by the Musée des Techniques, and a visit on 6 May to Lavoisier's former holdings in the Blois region, which will focus on his agronomic and political activities. For details contact Madame Michèle Goupil, Bicentenaire Lavoisier, Académie des Sciences, 23 Quai Conti, 75006, Paris, France.

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Chemical Heritage (ISSN 0736-4555), an occasional publication of the Chemical Heritage Foundation, reports on CHF's activities and on other news of the history of chemistry, chemical engineering, and the chemical process industries. Address inquiries and information to the Editor, *Chemical Heritage*, 3401 Walnut Street, Philadelphia, PA 19104-6228 USA; tel. (215) 898-0082; fax (215) 898-3327.

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Dr. Alfred Bader
2961 North Shepard Avenue
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December 31, 1992

Dr. T. Benfey
Beckman Center for History of Chemistry
3401 Walnut Street
Philadelphia, Pennsylvania 19104 6228

Dear Ted:

How very thoughtful of your to send me Chemical Heritage, Volume 10, No. 1.

On page 6 is shown a nice picture of my. Would it be possible to have a print of it?

Best wishes for 1993.

As always,

Dr. Alfred Bader
924 East Juneau, Suite 622
Milwaukee, Wisconsin 53202
Phone: 414/277-0730
Fax: 414/277-0709
E-mail: baderfa@execpc.com

A Chemist Helping Chemists

December 28, 1999

Sr. Mary Virginia Orna
Chemical Heritage Foundation
315 Chestnut Street
Philadelphia, PA 19106-2702

Dear Mary Virginia,

I always enjoy reading Chemical Heritage from cover to cover and in doing so with Vol. 17, No. 3, I was only saddened by the fact that you are stepping down as Editor. But then you are continuing in your work and will surely keep an eye on it.

I was particularly happy to see p. 20 "honoring R.B. Woodward" and, as promised, please find enclosed my check for $2,000.00 to be used to save R.B.'s many writings.

Please ask the lady in charge, Candice Nhu Tran, to let me know who is matching the gifts. Anyway, it is good to know that with my gift matched, you will have $4,000.00 to begin with.

Thank you also for your personal profile about myself, on p. 17. The photograph was taken some years ago and that probably misled you into thinking that I was born in 1928 rather than in 1924. Few personal articles limit themselves to such trivial mistakes.

Thank you also for your help with Professor Acherman in Colombia. It cannot be easy to be a historian of chemistry there and I am sure that he really appreciates your help. But so undoubtedly do thousands of people around the world.

With all good wishes to you and your associates I remain

Yours sincerely,

Alfred Bader
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Enc. – ck. $2000

<u>FAX TRANSMITTAL SHEET</u>

Dr. Alfred Bader
2961 North Shepard Avenue
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May 13, 1994

TO: Dr. Theodor Benfey
Chemical Heritage Foundation 215 898 3327

Dear Dr. Benfey,

Thank you for your fax of yesterday.

Could you please send me a copy of your standard contract for authors. Then, please do let me know who your in-house editor for my book would be.

My negotiations with a British publishing house are pretty far advanced, but not finalized. I will fly to London next month to discuss, but I would like to have the ability to consider the possibility of the ACS-CHF book series.

Best regards to you and Arnold.

Sincerely,

Alfred Bader

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Dr. Alfred Bader
2961 North Shepard Avenue
Milwaukee, Wisconsin 53211

May 18, 1994

Professor Charles C. Price
Chemical Heritage Foundation
3401 Walnut Street
Philadelphia, Pennsylvania 19104 6228

Dear Charles,

It was great to see your picture on page 25 of the latest *Chemical Heritage* publication and to know that you are a happy and healthy 80.

It couldn't happen to a greater guy.

Sincerely,

Dr. Alfred Bader
2961 North Shepard Avenue
Milwaukee, Wisconsin 53211

May 3, 1994

Dr. Theodor Benfey, Editor
The Chemical Heritage Foundation
Beckman Center for History of Chemistry
3401 Walnut Street, Suite 460B
Philadelphia, Pennsylvania 19104 6228

Dear Dr. Benfey:

Thank you for your most interesting letter of April 27th with the many enclosures and for sending me copies of the Woodward booklets. Will the exhibit travel to London and Zürich or Basle?

Allow me to respond to your letter, paragraph by paragraph.

I did not know that CHF and ACS are publishing a new book series. The only series I knew about was that of Eminent Chemists, and I wrote to Dr. Seeman last August, copy enclosed, but never received a reply.

I am not at all sure that you would be interested because about a third of my book deals with fine arts. Who would be the editor in charge of my publication? Right now, I am negotiating with two publishing houses, but have not yet finalized.

As you will be able to imagine, I am approached just about every day to make a contribution to this or that. I very much like to choose those causes where I feel that I can really make a difference. I felt that way when I put so much effort into raising funds for your truly beautiful Woodward Exhibit and Symposium. But I don't really think that it is very important whether the book on Woodward costs X dollars or 2X. Libraries and people really interested will buy the book at 2X dollars.

William Jensen is lucky to have you as his friend. Perhaps you can ask him whether it is ever right for a man to write as scathing and hurtful a letter as he sent to Chemistry in Britain. He must have been disappointed that the editor did not publish it, and I am doing my best to make the letter well known by having copies available at all my talks. I sent him a 10-page fax to which he never replied, and I saw him briefly the evening before my talk about Loschmidt at the recemt Chicago ACS meeting and specifically invited him to come to my talk. But he didn't have time.

Some chemists of today can be as vitriolic as Liebig and Kolbe were in theirs. The one historian of chemistry who is even worse than Jensen is Schiemenz. He has been going around giving a slide talk showing an open grave with a tombstone marked "William Wiswesser" and then saying during his talk that Wiswesser is dead and should be left to sleep in peace! How cheap can you get?

Yet, Schiemenz has it in him to write some very good papers. Have you had a chance to read his chapter in Wotiz's book showing pretty clearly that the first to come up with the hexagon for benzene, with carbons rather than hydrogens, in the corners, was Ladenburg and not Kekulé?

I know from your recent review of Wotiz's book that you are unconvinced about Professor Noe's and my arguments that Loschmidt was the first to come up with the idea of six carbons in a circle. Have you had a chance to read our chapter in Wotiz's book? What is important is to understand that we are not suggesting that Loschmidt was the first to come up with a cyclohexatriene, but the first to come up with the idea of six carbons in a circle. He did not know what to do with the double bonds and said that that had to be kept "in suspenso". Rocke and Schiemenz believe that Loschmidt preferred a diallene structure, but that simply is not so. He was in the habit of proposing various alternatives and then pointing to the one which he preferred. In this connection Robert Rosner's letter to Chemistry in Britain is very important, and I enclose a copy. To Loschmidt, the diallene structure was one alternative, but his many aromatic structures are all based on the circular structure of benzene with six carbons in a circle.

Of course I know Dobbin's paper "The Couper Quest" which is one of the best historical papers I have ever read. That is why I am so happy now to have much of the original correspondence between Anschütz and Crum-Brown which Dobbin quotes.

The chapter on Loschmidt in my autobiography connects Anschütz with Couper and Loschmidt, and I will also be submitting a paper of a much more scholarly nature on that same subject.

To return to your letter, I don't know why Jensen should be so concerned about Chemistry in Britain publishing the article by Professor Noe and me. After all, that paper was based practically entirely on our detailed chapter in Wotiz's book, and that chapter was certainly peer reviewed.

I hardly ever watch television, except the evenings of presidential elections, but I would certainly like to watch the program on Woodward and hope that you will know in advance and then let me know.

All good wishes to you and Arnold.

Sincerely,

Enclosure

CHEMICAL HERITAGE FOUNDATION

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27 April 1994

Alfred Bader
2961 North Shepard Avenue
Milwaukee, WI 53211

Dear Alfred Bader,

Arnold Thackray showed me your letter of 28 March and asked me to respond to it. We were fascinated to hear that you have written and almost completed your autobiography. Do you already have a publisher for it? I don't know if you are aware that CHF and ACS have just begun publishing jointly a book series in the history of the chemical sciences and the editorial board would no doubt be most interested in your manuscript. The first book jointly published in the series is Laylin James's "Nobel Laureates in Chemistry 1901-1992".

By separate mail we are sending you eight more copies of the Woodward booklet and two leaflets describing the travelling exhibit. We can send you more of those also.

We have no news about Crystal's efforts to preserve her father's notes. You may be interested in two of our own activities relating to Bob Woodward. We have obtained from Crystal, Eric, and Harvard Archives, six large boxes of RBW materials that were either duplicates or of no interest to Harvard. They contain a considerable amount of material that would interest RBW scholars, even though Harvard kept essentially all personal documents. Thus we now have what looks like a complete set of materials given to RBW by the Swedish Nobel organization for his attendance at Prelog's Nobel award, also Japanese business cards given to him, papers connected with his industrial consulting work, and a large collection of reprints and manuscripts from his friends, collaborators, and former students. We will need to find a way to organize these materials and prepare a listing of these holdings for use by researchers.

Our second project is the publication in the joint ACS-CHF series of "Robert Burns Woodward: Architect and Artist in the World of Molecules", which is to contain about a dozen of RBW's most famous papers, with commentary by Peter J.T.Morris of the Science Museum, London; Frank Westheimer's luncheon talk about RBW at our Woodward symposium when the exhibit was launched; a complete Woodward bibliography of his publications; and his Cope Award lecture, highly autobiographical, with commentary and footnotes which I have prepared, taking as much space as the lecture itself. There will also be a number of pictures, partly from the exhibit, partly new. It occurred to us that you might want to contribute to these two ventures. A contribution to the publication costs might significantly reduce the price of the book, thus making it accessible to more interested

readers.

You ask about William Jensen. He is a good friend of mine who single-handedly has converted the newsletter of the ACS History of Chemistry Division into a respected new journal, the "Bulletin for the History of Chemistry." He was trained in history of chemistry by Aaron Ihde and has a Ph.D. in inorganic chemistry dealing with fused and solid state systems, also from the University of Wisconsin.

I find the controversy regarding Kekulé quite sad, especially when it leads to tensions and accusations among concerned scholars. I admire Kekulé, organized the ACS Kekulé symposium, edited the ACS symposium volume, and completed the translation of K's Berlin speech beyond what Japp had put into English. But I am also well aware of his limitations, having done much to publicize Couper's significance, through biographies in Farber's "Great Chemists", and in the Dictionary of Scientific Biography. I also organized the 1958 ACS symposium, the Kekulé-Couper Centennial - see the enclosed. Are you familiar with Dobbin's marvellous "The Couper Quest" (ref.10 of enclosed)? I found your presentation on Loschmidt after our RBW festivities most impressive and have been particularly struck by his molecular diagrams, his "modelling" as you correctly call it. I don't agree with Bill Jensen that Loschmidt simply went back to Dalton in using spherical symbols. Loschmidt will always be famous for his contributions in physics and you are helping to show his great contributions to chemistry. However, I find the claim that he anticipated Kekulé with regard to the bonding of the six benzene carbons not at all convincing, although Kekulé may well have remembered Loschmidt's circle as well as Laurent's hexagonal diagram. Here I tend to agree with Alan Rocke. Bill's letter to "Chemistry in Britain" I think stems from his concern that it and other journals should subject articles in history of chemistry to the same scrutiny that they do to straight chemistry articles. As an editor, he is constantly facing papers with insufficient awareness of prior work. I have heard him comment vehemently on this topic before.

Do you know about the public television series on American Nobel prize winners, with the chemistry program centering on Woodward? I would think it should be airing soon. Do you know the date?

The Woodward exhibit schedule is enclosed.

With my very best wishes,

Sincerely yours,

Ted Benfey

Theodor Benfey
Editor

Dr. Alfred Bader
2961 North Shepard Avenue
Milwaukee, Wisconsin 53211

April 27, 1994

Dr. Arnold Thackray
Executive Director
Chemical Heritage Foundation
3401 Walnut St., Suite 460B
Philadelphia, Pennsylvania 19104 3327

Dear Arnold:

Thank you for your letter of April 20th with your many questions, which I would like to answer, one by one.

Isabel and I are fine, but there are so many travels planned, mainly to visit chemist friends around the world, that we have no plans to visit Philadelphia soon.

I am just negotiating with two publishers about the autobiography and hope the decision will be made soon. There are so many chapters, 23 in all, that I don't want to burden my friends with drafts.

Regarding Professor Jensen, of course all of us are overzealous sometimes, but I hope and think that neither you nor I are ever quite like that.

Thank you so much for sending me <u>The Chemical Sciences in the Modern World</u>, which I much look forward to reading.

Much of the Anschütz/Crum Brown and related correspondence which I acquired has already been published very competently in Dobbin's article on Couper, which surely you know. But seeing the original letters reinforces my conviction that Anschütz was an unbelievably thorough and good person.

All good wishes.

Sincerely,

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20 April 1994

Dr. Alfred Bader
2961 N. Shepard Avenue
Milwaukee, WI 53211

Dear Alfred:

Please forgive this belated reply to your welcome missive of 28 March, which arrived on my desk when I had first left for two weeks in England and Israel.

It's good to hear from you: when shall we see you and Isabel?

I'm delighted to hear of the autobiography. Do you have a publisher in mind? Are you letting friends see drafts?

Crystal Woodward has sent some archival materials to the Chemical Heritage Foundation, which we shall catalog. And CHF is at work on a book of essays/reprints of RBW's classic papers. I don't know what progress the people at Harvard have made.

Bill Jensen is a serious and industrious, but on occasion over-zealous, fellow (which of us is not?). His phrasing was injudicious to say the least. To cast a better light on professional history of chemistry, I'm sending you a copy of The Chemical Sciences in the Modern World, under separate cover.

Tell me more of the Anschutz Crum-Brown correspondence... soon!

Your support is appreciated.

Sincerely,

Arnold

Arnold Thackray
Executive Director

AT/c

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