Chemistry 4990- Senior Seminar  
Fall 2011

Course Leader: Prof. J.L. Hubbard  
John.hubbard@usu.edu  797-1641 Maeser Lab 361  
Office Hours by appointment

Class Times:  Friday, 2:30- 4:20, Widtsoe 007,  Wednesday Dept Seminars (3 days total) 4-5pm, W330

Learning Objectives:
Course is designed for Senior Undergraduate Chemistry Majors. Students are expected to master the following:

- Scientific literature searches
- Resume Preparation
- Technical writing
- Critical Analysis of Scientific Presentations
- Presentation of a scientific topic via oral and poster format

Texts:  There is no assigned text for the course. Recommend are books like *Elements of Style*, Strunk and White, 4th edition and *The ACS Style Guide: A Manual for Authors and Editors*, Dodd editor. Additional sections from books, reviews, and primary literature will be provided as necessary.

Blackboard: Information essential to the course will be available through the course Blackboard Vista page. This site is found at www.bb.usu.edu. username = banner ID; password = banner pin. Only students who are registered for the class will have access to the course Blackboard Vista pages

Attendance: Attendance is required for all scheduled activities, including the seminar practice, poster session, and the seminar presentations of your classmates. In addition, three science-related seminars must be attended, and written critiques prepared. A missed activity can be made up at the discretion of the Professor. The Professor, in consultation with the student, will devise make-up assignments. For each unexcused absence, 5 points will be lost. More than three unexcused absences will result in a failing grade.

Resume: Following the guidance from Hubbard and Donna Crow (Director of Career Services) you will prepare a 1-2 page resume. After direction in class, drafts are prepared. Afterwards, students are to make an appointment with Ms. Crow to go discuss career directions, strategies, interview skills, etc., on an individual basis

Seminar Critiques/ Discussions: Attendance at Three departmental seminars is required. After each seminar attended, a one-page detailed type-written critique must be submitted within One Week. When time permits, we will discuss seminars as a group and participation is expected.

Literature Homework: For the homework you will need to do a complete literature search on a scientific topic related to the Poster and Seminar presentations you will present (vide infra). Topic selection is subject to the approval of the Instructor. Using the methods described during our meeting with the reference librarian, you will need to turn in a document including the following:

1) A 1-2 page description of the search methods and strategy used,  
2) 1-3 references for book chapters, conference proceedings, encyclopedias, or review articles,  
3) A list of 3 websites providing information about your topic,  
4) At least five citations for articles from peer-reviewed scientific journals.  
5) A Title and Abstract of your Presentation

Note: see attached rubric for assessing Information Literacy

Poster: You will first present your topic as a poster presentation. The poster will be presented on a 3 ft x 6 ft board and should follow the guidelines passed out in class. The grade will cover clearness and organization of the poster and the student’s ability to discuss the contents with students and faculty.

Seminar: You will present your topic as a seminar. It should be 15 minutes long, including 3 minutes for questions, and be presented using PowerPoint slides. You will be assigned a faculty mentor, who can help advise you about your presentations. Each student is required make an appointment to present a practice version of the seminar to the Instructor.

Assessment: Students will be administered an exam meant to aid in the assessment of the chemistry program. The exam is divided into six sections involving analytical chemistry, biochemistry, general chemistry, inorganic chemistry, organic chemistry, and physical chemistry, each with roughly 20 min of multiple-choice questions. Students scoring above 50% will
receive 20 pt. In addition, faculty members on the Assessment and Curriculum Committee will interview students during the 
poster presentations to help assess their strengths and weaknesses, in addition to questioning students about their impressions 
of the chemistry program at USU. Finally, students will have the opportunity to give input about the course on the normal 
course evaluation forms.

**Grading:** Grades will be based on points awarded for the elements described below. Final grades will be assigned based upon 
a percentage of the total points in the following manner: A’s 100-90%, B’s 90-80%, C’s 80-70%, D’s 70-60%, F below 60%. 
**Assignments turned in after the deadline will have 2 points deducted for each day that it is late.**

**Point Distribution**

<table>
<thead>
<tr>
<th>Component</th>
<th>Points</th>
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<tbody>
<tr>
<td>Attendance</td>
<td>15</td>
</tr>
<tr>
<td>Resume</td>
<td>20</td>
</tr>
<tr>
<td>Seminar Critiques (3x10)</td>
<td>30</td>
</tr>
<tr>
<td>Literature homework</td>
<td>25</td>
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<tr>
<td>Seminar practice</td>
<td>10</td>
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<tr>
<td>Seminar</td>
<td>40</td>
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<tr>
<td>Poster</td>
<td>40</td>
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<td>Assessment Exam</td>
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<td><strong>Total</strong></td>
<td><strong>200</strong></td>
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**Provisions:** This course will adhere to the USU Academic Policies and Procedures Manual found at the web site 
http://www.usu.edu/policies/. Any student with a disability who requires accommodation must contact the instructor. The 
disability must be documented by the Disability Resource Center. Course materials may be requested in alternative 
formats.
Sept 2 Organization Meeting, Widtsoe 007

Sept 7 Wednesday Departmental Seminar 4 pm Widtsoe Library - Prof. Julia Brumaghim, Clemson University "The Metals Matter: DNA Damage Prevention by Polyphenol of Antioxidants"

Sept 9 Flora Shrode - Head of Reference Services, USU Library - Meet in Library Room 122 (Please be there promptly at 2:30 pm!) (Hands-on training with electronic data bases)

Sept 14 Wednesday Departmental Seminar 4 pm ESLC 046 Dr. Patrick Lam, Bristol-Myers Squibb Co "Structure-based Discovery of Apizaban, a Novel Factor Xa Inhibitor:

Sept 16 Resume Workshop-

Sept 21 Wednesday Departmental Seminar 4 pm Widtsoe Library - Professor Eckhard Jankowski, Case Western Reserve University "Roles and Functions of RNA Helicases"

Sept 23 Dr. Kent Morrill, Tennessee Eastman Chemical Corporation

Sept 30 Dr. Stephen Lee, USDA Research Lab (Poisonous Plants) USU, Logan UT

Oct 7 In-Class discussion of Seminars and follow-up discussion of careers of Drs. Morrill, Lee

Oct 12 Wednesday Departmental Seminar 4 pm ESLC 046 Widtsoe Library - Professor Robert Tabita, The Ohio State University "Metallobiochemistry - Applications for CO2 Sequestration and Biofuels"

Oct 14 Resumes Drafts -

Oct 19 Wednesday Departmental Seminar, 4 pm, Widtsoe Library - Professor Anastassia N. Alexandrova, University of California-Los Angeles "Computational Chemistry for Nanomaterial Science"

Oct 20 No Class (Fall Break on Friday Oct 21)

Oct 26 Wednesday Departmental Seminar, 4 pm Widtsoe Library - Professor Steven Castle, Brigham Young University, "New Strategies for the Synthesis of Unusual Peptides and Alkaloids"

Oct 28 Workshop- presentation preparation

Nov 4 Workshop- presentation preparation

Nov 9 Wednesday Departmental Seminar 4 pm Widtsoe Library - Professor Liang Tong, Columbia University- "Enzymes Involved in Fatty acid Metabolism"

Nov 11 Preview of presentations, Assessment Exam

Nov 18 Preview of presentations, Assessment Exam

Nov 24, 25 Thanksgiving Holiday

Dec 2 Student Poster Session, Widtsoe Balcony Lobby, 1:30- 3:30 pm (Held Jointly with Biochemistry)

Dec 10 Student Oral Presentations 2:30- 4:30 pm

Due Dates:

- October 3- Literature Homework
- October 14- Resume
- Seminar Critiques- Due One Week after the Seminar date
- Practice seminar- No later than November 18
Chemistry 4990 Information Literacy Assessment Rubric

Purpose
- Provide you with criteria that define effective use of information for research.
- While all of the items listed below will be assessed in final papers and presentations, elements 1 – 4 are relevant to the report you will write about your process and experience of searching for information sources.

Scoring Rubric
1. Effectively search the chemical literature and retrieve background information relevant to the project.

<table>
<thead>
<tr>
<th></th>
<th>Excellent =3</th>
<th>Good/Adequate =2</th>
<th>Needs Work =1</th>
<th>Not evident = 0</th>
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</thead>
<tbody>
<tr>
<td>Find chemistry-specific sources of background information such as encyclopedias, treatises, compiled works, and review articles, if relevant.</td>
<td>Sources or text include reference to several chemistry-specific sources of background information.</td>
<td>Sources or text include reference to a few chemistry-specific sources of background information.</td>
<td>Minimal number of chemistry-specific sources of background information evident.</td>
<td>No chemistry-specific sources of background information evident.</td>
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2. Use SciFinder (Chemical Abstracts) and other databases to conduct a comprehensive subject search to find research-based sources.

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<tr>
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<tr>
<td>Use reviewed articles (a.k.a. refereed) or authoritative sites to fulfill research needs.</td>
<td>All sources from reviewed publications (peer-reviewed or editor-reviewed) or authoritative websites.</td>
<td>Some sources from reviewed sources (peer-reviewed or editor-reviewed) or authoritative sites, and some sources from out-of-date, biased, or questionable sources.</td>
<td>Many sources from out-of-date, biased, or non-professional sources, and few peer-reviewed sources.</td>
<td>No peer-reviewed sources used.</td>
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3. OPTIONAL: Augment research by pursuing both cited references in relevant papers and more recent papers that cite those relevant papers.

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<tr>
<td>Use the Web of Science database or SciFinder Scholar’s “get related” command to identify and locate papers citing a specific paper and/or author.</td>
<td>The report on literature searching explains how cited and citing references were used to discover additional useful publications.</td>
<td></td>
<td>No mention of exploring cited and citing references to discover additional useful publications.</td>
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4. Evaluate websites and other information resources.

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<tr>
<td>Evaluate the authority and appropriateness of a web site or other information source.</td>
<td>Identifies and/or acknowledges all authors’ credentials and acknowledges the purpose or bias of each source.</td>
<td>Identifies and/or acknowledges most authors’ credentials and acknowledges the purpose or bias of most sources.</td>
<td>Does not identify or acknowledge authors’ credentials for most sources or does not acknowledge the purpose or bias of most sources.</td>
<td>Does not identify or acknowledge authors’ credentials or does not acknowledge the purpose or bias of sources.</td>
</tr>
<tr>
<td>Corroborate information found in websites with information from reviewed sources, if relevant.</td>
<td>Corroboration in every case.</td>
<td>Corroboration in many cases.</td>
<td>Corroboration in few cases.</td>
<td>No evidence of corroboration.</td>
</tr>
<tr>
<td>Sources published within appropriate time frame for current and/or historical reference.</td>
<td>All sources published in appropriate time frame.</td>
<td>Most sources published in appropriate time frame.</td>
<td>Few sources published in appropriate time frame.</td>
<td>All sources out of date.</td>
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5. Read, digest and synthesize the information that is found.

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<tr>
<td>Select information that provides evidence for the topic.</td>
<td>All sources clearly related to topic.</td>
<td>Most sources clearly related to topic.</td>
<td>Many sources unrelated to topic or relevance is unclear.</td>
<td>Virtually all sources unrelated to topic.</td>
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<tr>
<td>Synthesize and integrate information by paraphrasing and quoting effectively.</td>
<td>All quotes and paraphrases are integrated into the text appropriately and effectively.</td>
<td>Most quotes and paraphrases are integrated into the text appropriately and effectively, with some placed into text without any connections drawn.</td>
<td>Many quotes and paraphrases placed in text without any connections drawn or comments included.</td>
<td>Most quotes and paraphrases placed in text without any connections drawn or comments included.</td>
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6. Follow appropriate protocol to cite information sources and acknowledge copyright for graphs, charts, or other material from published sources.

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<tbody>
<tr>
<td>Correctly cite sources according to the style specified by one of the journals published by the American Chemical Society (ACS).</td>
<td>All references cited in correct format with virtually no errors in format.</td>
<td>Most references are identified, with some errors in format.</td>
<td>Insufficient or incorrect information for many sources, with frequent errors in format.</td>
<td>No bibliography or list of cited sources.</td>
</tr>
<tr>
<td>Correctly identify and acknowledge original source(s) of paraphrased elements.</td>
<td>All paraphrased entries correctly cited.</td>
<td>Most paraphrased entries correctly cited.</td>
<td>Some paraphrased entries correctly cited.</td>
<td>No paraphrased entries correctly cited.</td>
</tr>
<tr>
<td>Properly cite figures, drawings, and quotes in presentation.</td>
<td>All figures, drawings, and quotes correctly cited.</td>
<td>Most figures, drawings, and quotes correctly cited.</td>
<td>Some figures, drawings, and quotes correctly cited.</td>
<td>No figures, drawings, or quotes correctly cited.</td>
</tr>
</tbody>
</table>
Sources:

Chemical Information Retrieval (ACS Division of Chemical Information): http://chemunder.chemistry.ohio-state.edu/under/programs/acsdsc4.htm


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Comments on writing Critiques of Seminars
Jihubbard 9-2011

Chem 4990
1. Make sure you attend seminar with paper and writing implement.
2. Note the title of the lecture, and the speaker’s name and affiliation.
3. Pay attention to the “big picture” by noting down key words, key topics, and key questions posed.
4. Attempt to formulate questions while you are listening. Make notes of these.
5. Summarize your questions into one or two that you could or would ask the speaker.

Format for critique: (Short paragraphs)
Paragraph 1: Speaker, name, affiliation, and details of their reputation (or their local host)
Paragraph 2: Paraphrase the general area of the talk. What type of scientific literature is involved? What kind of instrumentation, synthesis, and related issues were important? What are the central questions posed by the speaker?
Paragraph 3: What did you learn from the lecture? What specific question(s) did you leave with?
Paragraph 4: Give a rating of the lecture quality, including speaker’s ability to articulate verbally, quality of visual aids (slides), and their ability to engage the audience and address questions.

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Library / Database work
CHEM 4990, Friday, Sept. 9
2:30pm in Merrill-Cazier Library, Room 122

We will look together at the primary database for research literature in all areas of chemistry, SciFinder Scholar (from the Chemical Abstracts Service).

SciFinder is a database that the library makes available through a paid subscription; unfortunately, only one person from USU at a time may log in to use it. On Friday afternoon, however, we’ll have temporary accounts so that all of us can log in and experiment. You may create your own personal account to use this database by registering at this website: https://scifinder.cas.org/registration/index.html?corpKey=FCE7C2FF-86F3-50AB-6441-B84D6C01D90E (you’ll need to do this from a campus computer or a computer running the VPN; and use an email address that has @usu.edu… it’s not necessary to do this before Friday’s class).

There are several online tutorials about the SciFinder database online at this URL: http://www.cas.org/support/scif/etutorials.html Some of the tutorials are kind of long and quite specific.

I recommend looking at the 4-minute glimpse of how to search in SciFinder for research literature at this link: http://www.cas.org/support/scif/etrain/topic.html

Other databases we will look at in class include Web of Science, which is useful because it tracks citations to help locate relevant research publications, PubMed, which is especially useful for biochemists and for bioinformatics and genomics information, and the ACS online journals collection.

This following webpage points out the databases mentioned above as well as some others for chemistry and biochemistry: http://libguides.usu.edu/chem-biochem. The page also provides some information about using the USU Library.

Flora.Shrod@usu.edu
Flora G. Shrode
Head, Reference & Instruction Services
Merrill-Cazier Library
GUIDELINES FOR PAPER WRITING

1. What question(s) have been asked?
   Why worth writing?
   Write things down!
   Which are the best questions? Weed out weak ones.

2. What are the relationships to the existing body of knowledge?
   What's in the literature?
   Collect all relevant literature.

3. Write a title and synopsis.
   A rough draft of abstract

4. Organization of sections-
   Look at sample papers from prospective journals,
   i.e., Intro., Exp., Results/Discussion, etc.

5. Build section reservoirs - outline each section.

6. Construct tables and figures.

7. Reorganize sections - don't overdevelop any one area.
   Bring it all along together, with an iterative approach.
During my days as a graduate student at the University of Arizona, I had the pleasure of working down the hall from "Speed" Marvel. Here is an auto-biographical sketch from him, published in 1980 in Chem.Tech.

J. L. Hubbard

My 69 years of chemistry

C. S. Marvel

I was introduced to chemistry as a freshman at Illinois Wesleyan University in 1911. My uncle, who had been a high school teacher, advised me to take this subject if I expected to be a farmer; he felt the next generation of farmers was going to need scientific knowledge to get the most out of their work. My professor in chemistry was a young Ph.D. from the University of Illinois named Alfred W. Homberger. He was a pleasant person, much interested in chemistry and in his students, so I came into the field in a most friendly atmosphere.

Professor Homberger, as an undergraduate at Wisconsin, had been taught by Professor Louis Kahlenberg, who was one of the last to admit that the ionic theory might be useful. He transferred this attitude to his students, so even though Homberger taught the theory, he let us know that he wasn't too sure of its practicality. He taught us mostly descriptive material with "mathematics" limited to problems of simple proportion. The course was not difficult and I found the facts presented interesting. The second semester lab part of the course was the old style of qualitative inorganic analysis. Solving the unknowns was what I really liked. Thus, my introduction to chemistry was fun, and it still continues to be.

In my sophomore year I took quantitative analysis, which was a bit of a chore—much less fun than the beginning course. But as a junior I found what I really enjoyed doing—making organic compounds. I spent most of my spare time in the organic laboratory doing synthesis and, as I recall, I did 65 preparations during the year. In this way I became familiar with many chemicals, and especially with their odors. I accumulated quite a "library of smells" which proved useful to me later. My nose was my infrared spectrosope.

As a senior, I was an assistant in the general chemistry lab and did a small piece of research under Dr. Homberger. About the middle of that year, he asked me if I would accept a $250 scholarship to go to Illinois to study chemistry as a graduate student. I was expecting to return to the farm; there still weren't many jobs for chemists. But I liked the idea of further study. And my father said, "If someone wants to pay you to go to school perhaps you'd better do it."

When I entered grad school in 1915, Germany was the center of chemical manufacture and research. But the start of the war in Europe had cut down the flow of chemicals to America, so attempts were being made to start a chemical industry in this country.

When I registered at Illinois, David Kinley was dean of the graduate school. He looked over my credentials and apparently was not greatly impressed: "You apparently do not know very much chemistry, so I'll have to give you an overload of work to catch up." Instead of the standard four courses, my first semester consisted of five, and of these four were lab courses. The long hours in the laboratory really put the pressure on and brought me the nickname that's stayed with me ever since. When I wasn't studying, I worked late at night in the laboratory. As a result, I slept as late as I could but still got to the breakfast table before the dining room door closed at 7:30. My fellow dorm inhabitants decided that was the only time I ever hurried and tied the name "Speed" onto me.

One of my courses during that hectic semester was qualitative organic analysis with Derick and Kamm. Here, my junior year experience with its variety of compounds was a great help, for I could classify most of my unknowns by their odor. This didn't especially please Kamm who, when he gave me my last unknown mixture, said, "I don't believe you'll identify this one by odor." I told him it would not be too hard, for I could smell a low aliphatic alcohol, a volatile fatty acid, and an aromatic amine. These all proved to be present, but there was one constituent I had not smelled, water, I got it anyhow.

The shortage of research chemicals in America led Professor Derick to set a group of graduate students to work during the summer of 1916 making chemicals to fill
the needs of the department research programs. I tried to
get a place in the preps group but was told those jobs were
being saved for the good students and that I didn’t qualify.

Before that summer ended, Derick and our top man in
inorganic chemistry, Clarence Balke, left for industrial
jobs, and our top physical chemistry professor, Edward
Washburn, left to become head of the university ceramics
department. But organic chemistry fared well in the
turnover because Professor Noyes, the department head,
persuaded Roger Adams to come to Urbana to look after
the organic group. I think Adams left Harvard rather
reluctantly but found it attractive at Urbana and stayed
there to complete his career.

The chemical industry grew greatly during the 1916–
1917 period; the biggest growth was in the dye industry.
There were many new jobs for chemists and many
university chemists transferred to industry. There were
also jobs for graduating B.S. chemists in numbers. As a
result, good students turned to chemistry as a major. I
recall Oliver Kamm saying that really good B.S. men did
not need to do graduate work because there were so many
good industrial opportunities for them without the
additional training. An indication of the growth in the
profession is shown by the increase in membership in the
American Chemical Society from 7471 in 1915 to 10,603
in 1917. (*Ed.: It’s now well over 100,000.*)

Since the shortage of research chemists continued,
Adams increased the size of the organic preparation
group. In the summer of 1917, I had a chance to get in
and I stayed at it for two years. The war demands for
special chemicals had become serious, especially for the
new chemical warfare which the Germans had introduced.
I started working on the preparation of prospective
chemical warfare agents, which was quite a task
considering the poor ventilating hoods in the university.

This kind of work became so important that Eastman
Kodak Company was persuaded to set up a synthetic
laboratory. They sent Hans Clarke to Illinois for about
two months to study our setup before he started his
synthetic group. Even after Kodak took up the work, we
continued to make chemicals not only for our own
research but also to supply materials to Kodak. It was an
excellent way for a chemist to get an idea of the expense
of materials.

After America got into the war, many university people
transferred to the chemical warfare service, and Adams
became a major in that unit. He kept in close contact with
us at Illinois and used us to furnish chemicals on a rush
basis. We also supplied dimethyl glyoxime to the
steelmakers to analyze nickel steel. Once our lab unit got

Awards presented to
C. S. Marvel
Nichols Medal, New York Section, ACS—1944
Willard Gibbs Medal, Chicago Section, ACS—1950
Gold Medal Award, American Institute of Chemists—1955
Priestley Medal, ACS—1956
Award in Plastic Science, Society of Plastic Engineers—
1964
Wilco Award In Polymer Chemistry, ACS—1964
Perkin Medal, American Section, Society of the Chemical
Industry—1965
Madison Marshall Award, North Alabama Section, ACS—
1966
Air Force Materials Laboratory, Distinguished Service
Award—1966
Chemical Pioneer Award, American Institute of Chemists—
1970
John R. Kuebler Award, Alpha Chi Sigma Fraternity—1970
Borden Award, Chemistry of Plastics and Coatings, ACS—
1973
Alumni Achievement Award, University of Illinois Alumni
Association—1976
Creative Science Award, Presidents Club, University of
Arizona—1978
Division of Polymer Chemistry Award, ACS—1978

Prep gang, University of Illinois, Summer, 1926. This group includes one future Nobel
laureate and two research directors of major chemical companies. Top Row, I–r: M. E.
P. Friedrich, W. M. Stanley, C. S. Marvel, (name not known), Wendell Moyer. Middle Row,

to operating, it produced about two
pounds a day of this critical reagent. Two
juniors, Norman Krase and Ivar Hultman,
were the operators at the first of this work.
Krase joined the university staff and then
went into industry. Hultman went directly
to Kodak and eventually became its chief
executive officer.

Armistice

With the end of the war came a
slackening in the chemical industry as it
reorganized for peacetime. Quite a few
laboratories released chemists and there
was a period when it was not easy for
chemists to find good work. The ACS
membership tells the story: Between 1920
and 1921 there was a drop from nearly
16,000 members to just over 14,000, and it
wasn’t until 1927 that there were over
15,000 members again.
I went back to full-time graduate work in 1919 and completed my degree work in 1920. I'd always thought that I didn't want to teach, that I wanted to work in industry. However, in 1920 industrial jobs were indeed difficult to find and the only job offered me was an instructorship at Illinois. That turned out to be a better job than I had expected because my superior, Oliver Kamm, left shortly after to be research director at Parke Davis and Co., creating an opportunity for me.

There was no shortage of chemistry students and all seniors had to do a piece of research at that time. I had six seniors in research when I first took up my duties as a teacher.

I well remember my first class in organic qualitative analysis. Do you know who was in it? Well, there was Wallace Carothers, who went on to be the number one polymer chemist America has produced; Samuel McElvain, who became professor of organic chemistry at the University of Wisconsin; George Graves, who played an important part in the plutonium plant at Hanford, Washington in World War II; and several others who also became leaders.

In 1924, Carothers and John R. Johnson joined the organic faculty and we all had a wonderful time working together.

Some of the factors that made Illinois a strong school in organic chemistry should be recorded. We had good students. This, in part, was due to the close friendships of our staff with those of other Midwest schools. We sent our good seniors to Minnesota, Iowa, Wisconsin, Chicago, and Nebraska, and a lot to Cornell, Rochester, and Penn State, too. In turn, these schools sent us good students. Another important factor was our fellowship program. Supported by industrial companies and the university, we had 10 extra good fellowships supported by money derived from the licensing of German patents seized during the first war. We not only got top students from the big schools, but also from friends at smaller schools in the Midwest who learned that we were taking good care of the people they sent to us. At one time we had nearly 50 graduate fellowships. There was an excellent camaraderie between the faculty and the students, particularly in the "summer preps" laboratory.

In 1927, Carothers went to Harvard, and Johnson to Cornell, so for a semester the teaching and research load fell on Adams and myself, until Fuson and Shriner were added to the staff.

Times were good and jobs were plentiful. Even in the depression, chemistry suffered less than other professions. It was readily possible to find good positions for our Ph.D.'s, even though salaries were impaired a bit.

At the university, we took two cuts in our pay during the darkest days of the depression, but chemistry kept going ahead and almost none who had been with us were let out of their jobs.

The ACS membership kept climbing steadily from 1920-1935 in spite of recession conditions. In 1935, there began a tremendous growth in membership, which doubled over the next 10 years.

During the early years, chemists working for Ph.D. degrees usually weren't married, didn't have cars, and spent most of their waking hours in the lab. It became their second home. I won't say that all their time was devoted to hard work, just most of it. Some accidents occurred because safety regulations had not yet come to the university, and it's a wonder there weren't more. But there was one that proved to be useful. Vorhees was given some chloroplatinic acid from which he was to make platinum catalysts so we could study reductions, but he managed to spill it on the rubberoid floor. In collecting the spilled chemical, he also collected considerable contamination of organic material. Not wanting to admit what had happened to Adams, he tried to clean up the platinum salt by fusing it with sodium nitrate. The result of that experiment was the Adams platinum oxide catalyst, which has been so useful in hydrogenation.

Consulting

In the spring of 1928, I was invited to become a consultant to the DuPont Experimental Station. My selection was due to the kindness of Roger Adams. DuPont originally wanted him as a consultant, necessitating travel to Wilmington every month. He objected to so much travel and suggested that they hire two Illinois men so they could alternate. In between visits the two consultants could discuss the problems at home. Stein, who was then director of the station, agreed and asked Roger to name the second person. He named me, and in order to get Adams, Stein also took me, an unknown as far as he was concerned. This was a very fortunate occurrence for it has been a long and fruitful association.

After a slight slowdown in industry during the 1929-30 period, chemistry again boomed. The first synthetic rubber, neoprene, was manufactured and the first truly synthetic fiber came into being; both were discoveries of Carothers, who after a year left Harvard for DuPont. We all knew how fast the plastics industry developed after that. Chemists made many other major discoveries and the industry grew to be the foremost in America.

Then war in Europe broke out again and it was obvious that America would sooner or later be involved. The Office of Scientific Research and Development and the National Research and Development Committee were set
up in late 1941. The universities furnished the people for these agencies and most university laboratories accepted contracts to study problems related to defense. Adams had an important part in all this and was not often in Urbana.

When the Japanese attacked Hawaii, the most critical chemical problem became the rubber shortage that resulted when our Far Eastern supplies were cut off. As I had become a bit of a polymer chemist during the years 1930–1940, I was drafted to help in the synthetic rubber program, which proved to be exciting and successful. The major rubber companies, some of the oil companies, and many universities pooled their research efforts and in about a year synthetic rubber was manufactured and used in the smaller tires.

When hostilities ended, I went with a group of rubber chemists to visit the German rubber industry to see what innovations they had made in butadiene-styrene rubbers. We learned of a new rapid polymerization technique known as redox-polymerization, which they were developing that hoped of getting a continuous process for synthetic rubber. We adapted this process to low-temperature polymerization and thus improved our synthetic product so that it is a most useful general-purpose rubber. Before the government program on synthetic rubber ended, two of the industrial laboratories developed synthetic methods enabling them to produce a polyisoprene which had almost all of the useful properties of rubber produced by trees.

Togetherness 1940’s style

I would like to record that this joint effort was a most cordial one. The competing rubber companies set aside their competitive spirit and cooperated in getting the job done. They accepted help from the universities when we could give it, and when the job was done and the plants were sold to industry, the entire program was reported in the black. All production and research costs had been recovered by the government.

In the war years, I had two other jobs. I helped organize the program on toxic synthetics for the National Defense Research Committee under Adams, and the malaria research program of the Committee on Medical Research. My part was mainly in writing contracts, so when the rubber program started I was back into chemistry, much to my relief.

After the disruption of the war, it took a little readjusting to get back to teaching and research in the university atmosphere. I had some doubt that I would be able to get a good program going again, but I was asked by the Air Force to help them develop high-temperature-resistant polymers. Doing so proved to be an interesting and lasting problem.

Most post war university research was financed by government agencies and gradually the fellowships which industry had supplied in prewar days were withdrawn. It was felt that government money would take care of the needs of the universities.

With the new synthetic rubber program, the big surge in synthetic textiles, and the growth of the automobile industry and its needs for new materials, the chemical industry profited in the fifties and sixties. Research laboratories expanded and new ones started up. The demand for chemists reached new peaks. Hence, the schools were loaded with students, faculty were added, and new graduate schools were started. Industry took all available personnel and things were rosy.

Prof. Marvel and C. H. Fisher of USDA

Then business slumped. Companies made less profits. Research was curtailed and even abandoned. Money became scarce for new projects. For the first time since the industry got its big start in the 1914–15 period, chemists were more plentiful than jobs. The pages of C&EN were filled with ads from good chemists looking for work. Earlier depressions had created minor job crises, but never had there been a time when a good candidate couldn’t find a place. The flow of money from government agencies also slowed and some new graduate schools closed. The number of students in strictly chemical studies in undergraduate work fell off. Fewer teachers were needed, which further crowded the market for chemists.

Both the universities and the chemical industry must take part of the blame for the sudden overproduction of chemists. Industry demanded more chemists and, with government encouragement, universities expanded to produce them. The quality of chemists dipped some, I’m sure, because many students went into the field expecting it to be a profitable one rather than because it was the one they really enjoyed. That was a mistake. It still is necessary in order to be a good chemist that one find fun in the job. There are many professions that pay better, but few where the worker can enjoy his daily job as much as a good research chemist can.

We’re still in a slump in chemistry, but there are a few active fields. Biochemistry has grown and generally expanded; analytical chemistry has found increasing applications in environmental areas, while in the synthetic field, agricultural chemicals has prospered. New insecticides, new herbicides, and new plant growth stimulants have been produced and used increasingly to promote the production of needed food. Companies are still looking for good people, but the number of jobs available is far less than it was at the peak of the industry. At this time it is difficult to foresee just when a turnaround may come. But when research laboratories function, new materials flow from them and they make jobs—jobs for everyone. And those jobs aren’t just in research. Not today. Chemists know how to solve problems, how to put ideas together to make new structures, and how to prove hypotheses. I am confident that Chemistry will again be a profession where we’ll need a lot of those kind of people.

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