C410/610: History of Chemistry with Laboratory

The first half of this course is devoted to a survey of the manner in which different cultures and successive ages conceived of material change. We study the techniques used in history to analyze and transform matter; who engaged in the chemical arts and in research, and for what reasons. The development of chemistry is presented as an integral part of the intellectual, economic and cultural evolution of Western civilization, with emphasis on the last three centuries. The second half of the course is devoted to the reenactment of historical experiments in the laboratory. These may be recorded on film or slides or described in written reports.

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Description of course content and objectives

Many incidental things can be learned from this course but the instruction is aimed at deepening the student's knowledge of chemistry by illuminating the science from the perspective of history. Most students who sign up for this course quite rightly expect to gain an overall idea of the ways in which chemistry developed. Specifically this translates into questions somewhat like these:

- What was chemistry like at different periods of its evolution?
- What apparatus and materials were at its disposal?
- What concepts guided chemical investigations?
- How was chemical knowledge transmitted and furthered?
- What practical applications were made of chemical knowledge?
- What sorts of people engaged in chemical operations and who were the innovative movers of the science?
- What problems did they identify and how did they tackle the solutions?
- How was chemistry in each era related to concurrent events and the life and thoughts of the time?

To help you answer these questions we will use two approaches. We will spend the first half of the course quickly surveying the whole history of chemistry, essentially drawing on the historical findings of hundreds of individuals whose collective effort has given us our present picture of what chemical knowledge and practice was through the ages and in different cultures.

Grading:

Undergraduate:		**Graduate:**	
Quizzes:	25%	Quizzes:	20%
Exam:	25%	Exam:	25%
Lab:	50%	Lab:	45%
		Book review:	15%

Texts:

Henry M, Leicester *The Historical Background of Chemistry*
Jon Eklund, *The Incompleat Chemist*

Course Schedule

Week 1	Introduction
Week 2	Chemistry in antiquity *Read* Leicester, Chapters I-V
Week 3	Medieval and Renaissance Alchemy & Chemistry Transition to Chemistry in the 17th and 18th centuries *Read* Leicester, VI-XII, Eklund, pp. 1-19
Week 4	The Chemical Revolution: From Boyle to Dalton *Read* Leicester, XII-XVII
Week 5	Inorganic and Organic Chemistry in the 19th century *Read* Leicester, XVIII-XX
Week 6	Physical and Analytical Chemistry Education & the professionalization of science *Read* Leicseter XXI-XXIII
Week 7	TEST! Review the above assignments and also *read* Leicester X.XXV
Week 8	Start of Laboratory Projects (remaining seven weeks of term)

Historical Experiments in Chemistrry

Having surveyed the whole history or chemistry, what can we now learn from looking at specific events or detailed aspects of the subject? Obviously we learn to “think chemically” in a mode considerably different from the way we approach the subject today. We observe the limitations under which past chemists labored. Their theories and questions make greater sense to us, and may even still be useful, at least in part. We follow in the footsteps of these chemists and learn to appreciate the workings or the creative scientific mind. We find their achievements exciting, hopefully inspiring.

In consultation with the course instructor, each student should choose some historical discovery or process. She/he will then do a library search for relevant original sources, together with such broader historical literature as will help to explain the circumstances and significance of the discovery under consideration. The student is now ready to attempt a reproduction of the experiment or process. If successful, the experiment is demonstrated to the class accompanied by meaningful explanations. Finally the project is written up. Details on how to proceed follows.

Selection of a project

The possibilities here are vast since you seek to reproduce the original discovery of any element, compound, reaction or apparatus, industrial or technical process. You may also choose to retrace the steps of a chemist whose experiments led to the discovery of an important principle, for instance Faraday’s law of electrolysis, Wurtz’s discovery that the substituted amines belong to the "ammonia type'. Another possibility is to redo the laboratory experiments or the classroom demonstrations described in an antiquated textbook laboratory manual for school or industry.

Be prepared to preliminarily investigate several project topics before you settle on one that is feasible in terms of available literary sources and the time and the experimental materials at your disposal. Frequent consultation, by telephone if necessary, with the instructor may be necessary at this state of your work.

The library search

Your quest for source and background information should make full use of the card catalog and reference sections of the Norris Library und Chemistry Library. Dr. Beer has a copy of the catalog of books in the UNIDEL history of chemistry collection. Among the reference works that may be useful are *Chemical Abstracts*, *The Dictionary of Scientific Biography*, the cumulative indexes of the *Journal of Chemical Education*, the *Isis Cumulative Bibliography* and subsequent annual *Isis* bibliographies, and the annual index of *Ambix*. Before you can begin with the laboratory reenactment of your project, you will need to have done a substantial amount of reading particularly as related specifically to the experimental or manufacturing techniques involved, but the chances are that throughout the project you will have to continue reading for further experimental

information and to fully understand the historical setting and significance of the discovery or operation under study.

Experiments in the laboratory

You should come into each session of the laboratory with a written outline of the experiments to toe conducted, the equipment and materials needed. Avoid using valuable laboratory time to look up information or to seek it from a chemistry faculty member. Keep books well away from your work area and that of others. If you need to consult the text of some source on your laboratory bench, do it from a Xerox copy. I repeat: do not bring library books near the work area of the laboratory. You are encouraged to consult with the instructor in the laboratory or to request his assistance if an experiment needs an extra pair of hands.

When your equipment is operating properly, notify the instructor and he will call the class to your bench to observe and listen to your explanations of the nature and significance of your project.

Follow all safety rules carefully. Dispose of your waste chemical responsibly.

Your written report

Your account of the project and experiment should begin with a substantial introduction explaining the historical circumstances and train of thought leading to the original chemical discovery or process you are recreating. Cite precisely where in the literature these operations are recorded. If you are dealing with the work or a single chemist you can evaluate the extent to which she/he was moved by practical or purely scientific motives. Why did your chemist choose this particular experimental approach? What other approaches did he/she consider? Did the chemist research demonstrate any exceptional aptitudes? How did she/he interpret the results? And to what extent did these results differ from what had been expected? What role did luck play in the discovery? What really is the crux of the discovery under consideration? Can we establish exactly when it was made and who should have the credit? To what extent were external factors supportive or a hindrance to making this discovery; for instance: the immediate job & working environment, the scientific community, training & inspiration provided by teachers, family & social background, contemporary conditions in the political or economic environment, ideological influences (religious, personal philosophy, moral concern, ethnic sensitivity)? How fast and by what channels did the news of your chemist’s discovery spread? How effective was she/he in exploiting the discovery scientifically, economically, in terms of career advancement? Has history been just to the discoverer? Although your report need not necessarily answer all these questions it should deal with those for which the answer is fairly readily available in the historical sources at your disposal.

After this historical introduction you should provide an explanation of the adaptations you made in describing the reenactment of the original experiment. This might well be accompanied by drawings or photographs.

You are now ready to provide an account of your experimental results, comparing these with those reported in the original experiment. If there are differences, try to provide an explanation for these and suggest how they might be eliminated in future re-runs. Don’t forget that the fault may not be yours, but that of your historic chemist who may not have adequately observed or recorded his/her experiments.