served on the chemistry faculty at University of Maine, from 1909-1919, and then became Professor of Chemistry at Syracuse University. One of Kraus's doctoral students, Charles B. Hurd, after one-year appointments at Colby College and Trinity College, began a career at Union College, where over the next 30 years he directed an outstanding undergraduate research program in colloid chemistry (7).

This historical account of the evolution of the chemistry department at Clark University has focused on the first 50 years, for which archival information was examined. Despite a turbulent beginning a century ago, when the stability and continuity of the department were severely threatened, the department went on to enjoy periods of professional activity for which it has earned justified recognition.

**References and Notes**

Acknowledgments: Information on the faculty and students in chemistry at Clark has come from two sources: the excellent recent history of Clark University by William A. Koelsch (1); and the Clark University Archives. I am grateful to University Archivist Stuart W. Campbell and his assistant, Betty A. Bacinskas, for their willingness to provide a roster of chemistry faculty and staff from university catalogs during Clark's first 30 years. Information on students was acquired by searching a student file compiled by Professor Koelsch, from commencement programs, and alumni class lists.

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6. A complete listing of all graduate and undergraduate degrees in chemistry given by Clark for the period 1892-1940 is available from the author upon request.

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## CHEMICAL INDUSTRY IN COLONIAL VIRGINIA

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In the latter part of the 16th century many Englishmen advocated the founding of a colony in North America, and a number of reasons were put forward. These ranged all the way from extending Christianity to strengthening the defenses of England against Spain. Probably foremost in the minds of the members of the London Company was the discovery of gold and of a direct route to the South Seas, but it was also hoped that the new country would supply England with tar, pitch, rosin, glass, soap-ashes (potash), copper, iron, steel, and wine.

English settlers first landed at Jamestown in May, 1607. Early in 1608 the "first supply" of about 100 additional settlers, including a perfumer, was landed. In the fall of 1608 the "second supply" - including eight Dutchmen and Poles - was landed. The Dutch and Poles were sent over to establish the glass and naval stores industries. Evidently they got right to work, because a few weeks later samples of pitch, tar, glass, frankincense and soap-ashes (potash) were shipped to England. These industries did not survive long, principally because the colonists were too busy fighting off starvation and the Indians. Captain John Smith (1580-1631) did not approve of attempting to establish industries before sufficient food and shelter had been provided for the colonists. He asked for carpenters, masons, farmers, fishermen, blacksmiths and common laborers.

About the time the Pilgrims were landing in New England, the colonists in Virginia were attempting to revive the glass works. In 1621 six Italian glass workers came over, primarily to make beads for use in the Indian trade, but also to produce bottles, table glass, and other glassware for sale in England. Great precautions were taken to keep the process secret, because the beads were the money used in trading with the Indians and the Company was anxious to keep their value up. It was emphasized especially that the Virginians must not know the process. The glass works, located at Jamestown, escaped the general destruction accompanying the massacre of 1622 and continued in operation until 1624. At that time the Italian workmen, who were anxious to return to Europe and who had been sabotaging production by means of slow-down tactics, wrecked the plant and broke the furnace by striking it with an iron bar. That ended the manufacture of glass in that plant. The original site of this glassworks at Jamestown was located in 1931.

From the beginning, many people had been interested in locating iron ore and setting up plants for its reduction. One of the strongest motives for colonization was the expectation that Virginia would furnish England with plenty of cheap raw iron. Early on, Smith recognized the adaptability of the colony to iron manufacture, and in 1609 a quantity of ore was shipped to

the mother country. About ten years later the first real attempt was made to manufacture iron in Virginia. An anonymous benefactor had given the London Company the sum of £550 to be used in the education of Indian children as Christians. The Company was anxious to escape this obligation and persuaded a private group of investors, known as the "Southampton Adventurers", to accept and administer the gift. This group hit upon the idea of adding some of its own money and using the whole amount to set up an iron works and then spending the return pro rata of the gift on Indian education. Laborers and experienced iron workers were sent over, a successful mine was opened, and the works was built on Falling Creek, seven miles below the falls of the James River. In 1621 the cost of setting up the iron works was calculated to be £4000-5000. By 1622 it was confidently expected that within a few months the works would be capable of shipping large quantities of raw iron to England. The great Indian massacre of that year ended the attempt. All of the workmen, managers and their families - except two children - were killed, and the machinery was broken up and thrown in the river. It was claimed that the only practical return on the enormous investment was an iron shovel, a pair of tongs and a bar of iron. The Southampton Adventurers were determined to try again, but before they could act, Virginia became a royal colony. No sustained attempt was made to produce iron until about 100 years later, when Alexander Spotswood (1676-1740) started building furnaces.

A late 16th-century glass furnace


Captain John Smith

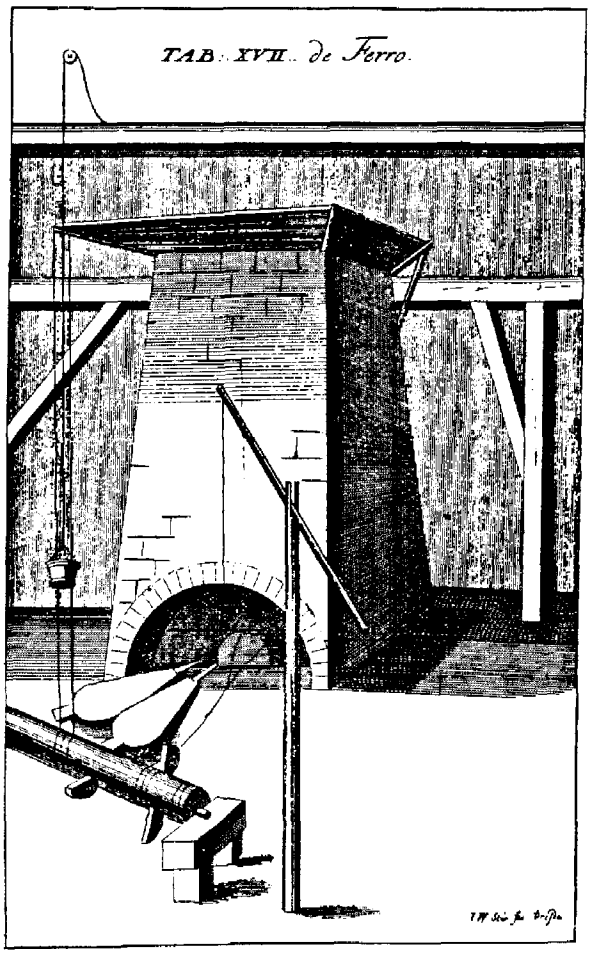
The cultivation of tobacco was started in 1612 by John Rolfe (1585-1622), the husband of Pocahontas, and the tobacco rapidly assumed a dominant position in the economy of the colony. It was a fine source of revenue for both the planters and the home government. The Virginians became an agricultural people by force of circumstances - the power of the English government was used to divert their attention from manufacturers and toward the cultivation of tobacco. By 1720 the Privy Council was definitely encouraging tobacco and forbade the colonists to apply their labor to other produce or manufactures. It rejected a Virginia act for the advancement of manufactures.

However, early in the 18th century, Spotswood revived the iron industry and by 1732 there were three blast furnaces and one air furnace in operation, but no forge. About 100 common laborers, including women cooks, were required to run a charcoal blast furnace. In addition, several skilled workmen were employed, including a founder, a collier (who made charcoal), a miner, a clerk and a stock-taker. The founder, collier and miner were paid according to production. A great wheel, 26 feet in diameter, turned by water power, worked the

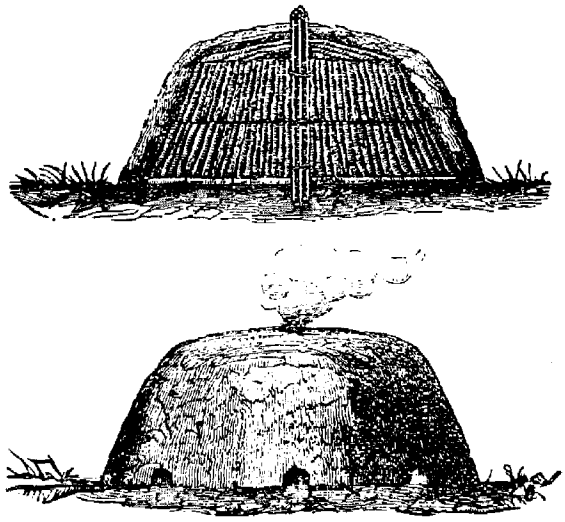
two pairs of bellows that blew the furnace at Fredericksburg - the air was not preheated. A blast furnace could run about 20 tons per week, and 800 tons per year was considered a good output. The expense of carting the ore from mine to furnace - even for one mile - was a heavy one, as was the expense of carting the pig iron from the furnace to the docks. It was customary to use eight oxen to draw a 3000 pound load. At the air furnace at Massaponax, Spotswood melted pig iron and cast pots, skillets, chimney backs, plates for hearths, andirons, fenders, mortars, etc. for sale in the colony.

The Principle Company of Maryland owned a furnace, built in 1726, in Stafford County, Virginia, on a plantation of Augustine Washington, the father of George. In 1750 Virginia and Maryland together exported 2400 tons of pig iron to England, of which this furnace produced one-sixth.

In 1768 three Baltimore capitalists bought land in Albemarle County and started the Albemarle Furnace Company with a capital of £2000. Thomas Jefferson was interested to the extent of £100. Three furnaces were built in the county. It is quite possible that this enterprise was in anticipation of the Revolution.




An early 18th-century blast furnace



A setup for the manufacture of charcoal, pitch and tar

In the Shenandoah Valley an iron industry grew up, starting early in the 18th century. German and Scotch-Irish immigrants began coming down the valley, where they found beds of iron ore in the form of hematite. They opened mines, built both furnaces and forges, and began making pig and bar iron and pots, pans and firearms for local use. Many of these small works endured for some time and were famous for their good craftsmanship. There are no good statistics for these young industries until 1781, when Thomas Jefferson stated that two of the furnaces in the valley each produced 600 tons of pig iron a year. Bruce (1b) lists 15 furnaces known to have been in action before the Revolutionary War within the bounds of the present state of Virginia.

Pitch and tar were produced in small quantities during the administration of the Company, several Poles having been brought over for that purpose. It was proposed that apprentices learn the art and that the industry be built up, especially for the benefit of the Royal Navy. However, there is no evidence that these products were made on a scale of importance during the subsequent history of the colony. About 1700 the only place in Virginia where pitch and tar were produced in considerable quantity was in Elizabeth City County and the amount did not exceed 1200 barrels annually. The industry was carried on principally by poor men who owned no slaves and who considered a few dozen barrels per year an excellent output. The method used was crude: first a circular floor of clay was laid down and on this were piled pine logs. These were covered with a layer of dirt and ignited through a small opening left for that purpose. This opening was then closed and the fire left to smoulder. As the tar trickled down the clay floor, it was drained off into barrels by means of a wooden pipe. If pitch was wanted, the tar was boiled in large iron kettles or burned in holes made in the clay. There were many attempts to make potash, and several samples were sent to England, but at no

time did the production of this commodity develop into an important industry.

There were scattered attempts to build up a wine industry, with both native and imported grapes. At several times French vine-dressers were brought over for the purpose of establishing vineyards, but for one reason or another they were usually not successful.

Copper and gold deposits apparently were not worked in colonial Virginia. Lead was discovered in Wythe County by a Colonel Chiswell, who worked the deposits until the beginning of the Revolutionary War, when he was arrested for his Tory sympathies.

Other industries included a salt works at Cape Charles on the Eastern Shore, and the cultivation of silk from the mulberry tree. It is said that Charles II at his coronation in 1661 wore a robe and hose of Virginia silk (2).

Generally speaking, Colonial Virginia was an agricultural community. To a large extent, manufactures were still in the handicraft stage, and most goods were produced for local and home use. Many of the colonial industries were carried on in the home. The industrial progress was not great by present day standards, but of course the conditions of pioneer life must be considered.

**References and Notes**

1. Sources used in this study: (a) J. C. Ballagh, *The South in the Building of the Nation*, Vol. 5, *Economic History, 1607-1865*, The Southern Historical Publication Society, Richmond, Virginia, 1910. (b) K. Bruce, *Virginia Iron Manufacture in the Slave Era*, The Century Co., New York, 1930. (c) P. A. Bruce, *Economic History of Virginia in the Seventeenth Century*, Macmillan, New York, 1907. (d) M. P. Hull, *Early Glass Making in Virginia*, Jones Printing Co., Richmond, Virginia, 1933.

2. E. F. Smith, "Venable Hall", *J. Chem. Educ.*, **1926**, *3*, 946-949. Smith, in an address given on the occasion of the dedication of Venable Hall at the University of North Carolina on 12 October 1925, tells briefly in two paragraphs something of the chemical industry in Colonial Virginia.

3. W. V. Sessions, "Some Early Industries in the United States", *J. Chem. Educ.*, **1928**, *5*, 922-928. Much of this article deals with other areas of the country and with post-Revolutionary War times, but there is some mention of Colonial Virginia.

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## OLD CHEMISTRIES

### Thomas Ewell's "Plain Discourses on the Laws or Properties of Matter"

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Thomas Ewell's *Plain Discourses on the Laws or Properties of Matter Containing the Elements or Principles of Modern Chemistry* was published in 1806 for an audience of artisans, farmers and fellow citizens and has been described as a nontechnical presentation of useful chemical knowledge (1). This was the first and only edition of a work which was used primarily in the Southern and Eastern United States in the first quarter of the 19th century (2). Despite the fact that it was intended for popular use, it was also used as a textbook at the College of William and Mary (3).

The book's arrangement and choice of subject matter resemble that found in other chemical publications of this time period, and Ewell admitted that, in writing his book, he had utilized the chemical works of Thomson, Chaptal and Murray, as well as numerous quotations from Accum's works (4). He also provided an extensive outline, placed a list of definitions at the end of the text, and stated that he had utilized as few technical terms as possible, since he felt that the use of such terms was confusing to the average citizen and irrelevant to an understanding of the basic principles (5). The text is also characterized by the lack of utilization of a large number of divisions and subdivisions and the omission of historical background on noteworthy chemists and their discoveries.

Ewell's text is divided into a dedication, a preface, an introduction, 15 chapters (which are called discourses) and a summary. In the dedication the book was inscribed to Thomas Jefferson. The introduction presents Ewell's view of chemistry and its value in society. The first discourse deals with physical and chemical properties, the nature of matter and an introduction to heat. The second discourse presents views of light, galvanism and electricity, while the third discourse describes the composition of the atmosphere and the versatility of water. The fourth and fifth discourses describe the chemical nature and uses of common inorganic compounds and the nonmetallic elements. The sixth discourse focuses on the elementary earths, while the next two deal with the metals. The ninth discourse restricts itself to a description of the nature, production and value of the most important minerals. The properties, growth and identification of vegetable substances are well treated in the next three discourses and the thirteenth and fourteenth do the same with animal substances. The final discourse introduces nutrition and the technology of dye use. The author concludes with a brief restatement of basic principles.

An examination of the textual material reveals that nearly all of the subject matter presented is in accord with prevailing