

taining 3 per cent pentane, 6 per cent hexane, 2.5 per cent heptane, 1.0 per cent octane, and the rest air (per cents by volume), the equation predicts that 48 per cent of the total solvent will be condensed at 20° C. and 30 lbs. per sq. in. abs. The average molecular weight method predicts a condensation of 46 per cent and thus checks the equation. The residual vapor will now contain about 2.4 per cent pentane, 3.3 per cent hexane, 0.66 per cent heptane, and 0.09 per cent octane (by calculation), which shows that considerable fractionation has taken place with consequent increase in relative proportions of the two more volatile components. When this gas is compressed to 100 lbs. per sq. in. gage and cooled to 20° C., the equation predicts a condensation of 56 per cent, while the condensation should yield 73 per cent of the total solvents, according to the calculation based on original average molecular weight.

One other example may be offered to show the application of the equation for three or more components. In dealing with benzol vapor it is usual to treat the benzol as if it were pure benzene. The usual solvent benzol, known as "90 per cent benzol," actually contains about 84 per cent benzene, 13 per cent toluene, and 3 per cent xylene. If we consider a gas mixture containing 15 per cent by volume of "90 per cent benzol" of this composition, and cool it to 20° C. at atmospheric pressure, the equation predicts a condensation of 50 per cent of the weight of the benzol, whereas for pure benzene the calculated value is only 38 per cent.

We realize that no *direct* experimental evidence is adduced to show the validity of the equations developed, but, on the other hand, they are based on nothing but very simple and well-established laws, and furthermore, they do lead to results which are in general accord with experience in the field of solvent recovery.

Early Chemical Industry in America—A Few Comparisons of Past and Present Conditions¹

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THE SUBJECT "Early Chemical Industry in America" may perhaps appear a misnomer, for what is known to-day as chemical industry, with its organization of chemists for research and control, is of very recent origin. It has been said that there were no industries in the United States that could be termed strictly chemical until after the Civil War, and this is probably true if we limit our meaning to those industries that are controlled by chemical supervision. Chemical control requires a quantitative inventory of this or that valuable ingredient as it enters and leaves a factory, and quantitative analysis was not generally taught in American colleges until after the Civil War. It was only in private laboratories, such as that of Dr. J. C. Booth in Philadelphia, that such instruction could best be acquired. Probably no one did more than Dr. Booth toward making American manufacturers realize the importance of chemical control, yet this leader, as late as 1860, was unable to induce the iron masters of Eastern Pennsylvania to contribute jointly the small annual sum of \$1200 for controlling the work of their furnaces by a chemical analysis of the ores.² Such was the general attitude of industry toward chemistry in the United States only sixty years ago.

But while chemically controlled industry in the United States is relatively modern, a large number of industries were established before 1800 which present nomenclature would term chemical. According to a report made by Coxe³ in 1792, the following chemical industries were existing at that time in the United States: candles and soap; chemicals (such as Glauber salts, saltpeter, etc.); distillery products; drugs; fermentation products; glass, bricks and pottery; gunpowder; indigo; leather; lime and plaster; metals; naval stores (turpentine, tar, rosin, etc.); oils, fats, and waxes; paint and varnish; paper; potash; salt; sugar, molasses, etc.; and various miscellaneous products, such as glue and lampblack. In the present paper a brief ac-

count will be given of the rise of a few of these early chemical industries.

THE INDIANS

The early pioneers of industry in this country were in many ways indebted to the Indians, who gave them their first knowledge of rubber, maple sugar, chocolate, vanilla, cochineal, and other commodities. The more advanced Aztec and Inca tribes had acquired a considerable knowledge of dyeing and other chemical operations. The modern chocolate manufacturer, for example, simply repeats on a large scale the various steps of curing, roast-



FIG. 1—INDIANS ROASTING, POUNDING, AND ROLLING CACAO BEANS IN MANUFACTURE OF CHOCOLATE. (FROM OGILBY'S "AMERICA," LONDON, 1671)

¹ Condensed from papers read before the Section of History of Chemistry at the 63rd Meeting of the American Chemical Society, Birmingham, Ala., April 3 to 7, 1922, and before the joint meeting of the New York local chemical societies under direction of the American Section of the Société de Chimie Industrielle, New York, N. Y., May 12, 1922.

² "Notes and Comments," by James M. Swank, Philadelphia, 1897, p. 151.

³ "View of the United States," 1794.

ing, crushing, and rolling as they were first learned from the Indians. Another illustration of the chemical technology of the American aborigines is the manufacture of tapioca starch from Cassava. The crushed roots of this plant contain from 0.02 to 0.03 per cent of hydrocyanic acid, owing to the hydrolysis of a poisonous glucoside. The Indians, without knowing the chem-

istry of all this, first reduced the Cassava roots to a pulp on a rude grinding machine, then washed the starchy material in a pan, after which the poisonous water was removed by filtering through a sack and squeezing. The residue of starch was then dried. Other examples could be cited to show that many operations of modern industrial chemistry, such as roasting, grinding, pounding, washing, filtering, and drying, were performed by the Indians, although of course on a very primitive scale.

THE SPANIARDS

The first Europeans to conduct experiments in chemical industry within the present borders of the United States were the Spaniards. Their inquiries were limited almost entirely to the precious metals. De Soto is said to have had metallurgists in the expedition which he led through the southern states in 1539 and 1540, and ancient diggings in Alabama are thought by some to have been made by De Soto's party. No records, however, of the metallurgical operations of this expedition have been discovered. The earliest definite account which the author has thus far been able to find of a chemical operation performed within the present boundaries of the United States is an unpublished report,⁴ in a transcript of documents from the Spanish archives.

In the latter part of the year 1598, during the expedition of General de Oñate into New Mexico, a party of Spaniards noticed some bright-colored pigments of blue, green, yellow, and red, which the Indians were using. Suspecting that these pigments might be ores of precious metals, several Spaniards had the Indians conduct them to the source of the minerals, which was a three days' journey distant. Here with their knives they dug out lumps of ore which were carried back to the pueblo where the main body of the expedition was staying. The ores were assayed at this pueblo by an accountant, Alonzo Sanchez, and a purveyor, Diego de Cubia. These two officers made separate assays and reports. The deposition of Alonzo Sanchez is the more complete and, in substance, is as follows:

From a stone received by Sanchez from the soldier Miguel Montero, and which weighed half a pound, more or less, he obtained in an assay, made by treating the stone with mercury for 8 days and then expelling the mercury, a lump of silver equivalent to about 12 ounces, more or less, to the quintal (or hundred weight) of ore. Sanchez stated, however, that because the assay was made during a spell of very cold weather and for only 8 days, he felt absolutely sure that the ore contained much more silver than he was able to extract. From his extensive past experience in the assaying of other ores by means of mercury, he believed the present mineral to be very rich in silver.

While this analysis by Alonzo Sanchez may lack something as regards exactness, his record should be allowed to stand until an earlier and better one is discovered. Ruins of old furnaces in Arizona and New Mexico indicate that mining and smelting operations were carried on there by the Spaniards at a very early date.

With regard to the extraction of silver from ores by mercury as mentioned in the old document of the Spanish Archives, it should be recalled that in 1557, forty years before Onate's expedition, the cold amalgamation, or *patio*, process of silver extraction was invented at Pachuca, Mexico, by Bartholomew de Medina.⁵ This process, which for several centuries yielded the greater part of the world's production of silver, ranks as one of

the most remarkable discoveries in metallurgy. It was particularly adapted to districts where fuel was lacking. In this process the silver ore, in the form of sulfide or other combination, was finely pulverized in a stone drag mill, or *arrastra*, which was the earliest form of pulverizer to be used in the western states. The wet powdered ore was then thoroughly mixed in a *patio*, or paved court, with common salt and the so-called *magistral*, which consisted of roasted copper pyrites. After the wet mass, or *torta*, had stood for some days, mercury was added and the whole well mingled together by tramping mules. At the end of a month or more, the earthy matter was washed away from the

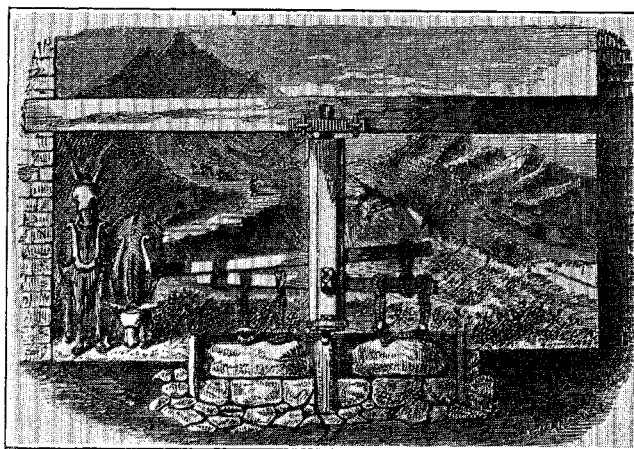


FIG. 2—MEXICAN ARRASTRA, OR STONE DRAG MILL, FOR PULVERIZING SILVER ORES. (FROM PEPPER'S "PLAYBOOK OF METALS," LONDON, 1862)

amalgam and the silver recovered from the latter by pressing through skins and retorting. The *patio* process, as Humboldt once remarked, is one of those chemical operations which were discovered and worked for centuries before the theory of the procedure was understood. Humboldt and Gay-Lussac spent much time in studying the chemistry of the process, and even now opinions differ as to the series of reactions in the *torta* by which the silver sulfide is changed to the chloride and the chloride to metallic silver. The *patio* amalgamation process and the Bustamante mercury furnace are among the first of the long series of industrial chemical processes which originated in the New World. The scientific work of the old Mexican metallurgists is not to be despised. It was a Mexican, del Rio, who first called the attention of the world to the element vanadium.

Over a century after the early work of the Spaniards in the Southwest came the smelting operations of the French in the old territory of Louisiana. In 1712, Louis XIV, king of France, looking with covetous eyes upon the precious metals which the Spaniards were acquiring in the New World, granted letters patent for developing the gold and silver mines of Louisiana. This was the origin of the famous Mississippi Bubble which afterwards burst and brought ruin to so many. The so-called "Company of the West" was formed and in 1719 a French metallurgist, Philip Renault, sailed from France with two hundred workmen. At San Domingo, Renault purchased five hundred slaves to work his mines, and then sailing up the Mississippi River arrived in 1720 at Kaskaskia, a French settlement in Illinois. From here he conducted prospecting expeditions, on one of which the famous lead mines⁶ of Missouri were discovered. Renault, disappointed in his quest for gold, turned all his attention to lead smelting, and extracted considerable quantities of this metal which, after transporting by pack horses to the Mississippi

⁴ The report is entitled "Relacion de los ensayes que se hicieron de ciertas minas" and can be found in the Library of Congress at the end of Vol. III of the Lowery transcripts of documents relating to New Mexico in the Spanish Archivo General de Indias at Seville. The report is referred to on page 208 of H. E. Bolton's "Spanish Explorations in the Southwest."

⁵ For a full account of this process see Humboldt's "Political Essay on the Kingdom of New Spain," Black's Translation (London, 1811), Vol. 3, pp. 253-280. See also Pepper's "Playbook of Metals" (London, 1862), pp. 213-216, which gives a good illustration of the *arrastra* and a scheme of the complicated chemical reactions which take place in the *torta*. For a more modern view of these reactions see the article by Vondracek, *Rev. metal.*, 5 (1908), 678, and the recent works on the metallurgy of silver.

⁶ For a history of early lead smelting in Missouri see Schoolcraft's "View of the Lead Mines of Missouri," New York, 1819, which gives a full description of processes and illustrations of furnaces.

and sending by boat to New Orleans, were shipped to France. But the inability to find gold and silver created such disappointment in Europe that the charter of the "Company of the West" was cancelled and Renault was left without means to continue his work. He returned to France with his workmen, his slaves were sold, and the lead mines abandoned. In 1762, when Louisiana was ceded to Spain, lead smelting at the Missouri mines was revived, but the methods of extraction were imperfect and not more than fifty per cent of the lead in the ore was obtained. It was not until after the Louisiana Purchase in 1803, and the entrance of Americans into Missouri, that the methods of extraction were improved.

The furnace used by the French and Spaniards was of the simple log hearth type built upon a slope. The fuel consisted of oak logs, which, after filling in with the sulfide ore, were lighted. The sloping gutter of the hearth carried the melted lead into a pit below the front, from which it was ladled into iron molds and cast into pigs. After the entry of Americans into the field, the slag from the log furnaces was resmelted in a so-called "ash furnace," which consisted of a hearth with a long sloping flue. The lead slag was washed from wood ashes, crushed, mixed with a siliceous flux, and then fed into the top of the flue. The heated charge as it reached the bottom of the flue was melted: the fluid slag above the metal was drawn off on one side of the hearth and the lead tapped into molds on the other. The ash furnace was a great improvement over previous methods, but it was also primitive and wasteful and long ago went its way with other relics of the past.

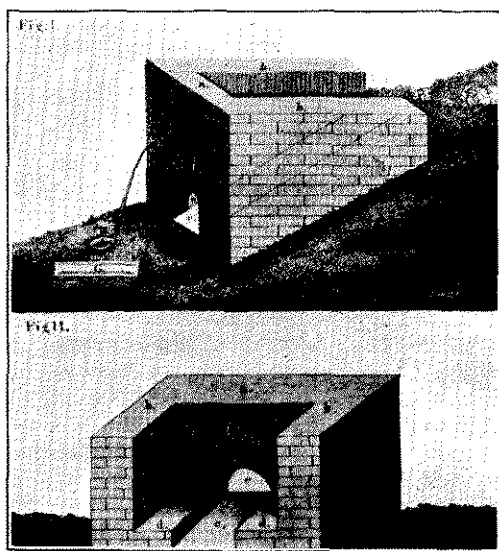


FIG. 3.—LOG HEARTH FURNACE FOR SMELTING LEAD ORE. (FROM SCHOOLCRAFT'S "VIEW OF THE LEAD MINES OF MISSOURI," NEW YORK, 1819)

THE ENGLISH

Industrial chemistry before 1800 reached a higher development in Massachusetts than in any other North American state or colony. In 1792 Massachusetts led in the exportation of nineteen chemical commodities, New York followed with seven, and Pennsylvania with five. Before 1800, Massachusetts led in the number of chemical patents, Pennsylvania was second, and Connecticut was third. The lead in industrial chemistry which Massachusetts held for over 150 years originated with one of its early colonists, John Winthrop, Jr., who landed in Boston in 1631 at the age of twenty-five. He is the man who deserves to be known as America's first industrial chemist. His interest in chemistry is shown by the fact that only a few months after his arrival he began to receive from England chemicals and apparatus

for starting a laboratory. It is remarkable what Winthrop attempted to do in the establishment of chemical industries in the New England colonies. He was interested in the production of salt, iron, glass, potash, tar, black lead, saltpeter, copper, alum, and other chemicals. He read reports upon some of these industries before the Royal Society, of which he was a member, and these are the first contributions to be made by an American chemist before a scientific association. In view of the present efforts to establish a home dyestuff industry, it may be of interest to know that Winthrop and his uncle, Emanuel Downing, made what were probably the first experiments upon the manufacture of indigo within the present border of the United States.

In the library of the Massachusetts Historical Society of Boston, among the unpublished papers of John Winthrop, is a document⁷ which should be of great historic interest to chemists. It is Winthrop's outline of a plan, the first of the kind in America, to form a chemical stock company, and reads in part as follows:

If any desirous to promote a publique good shall see cause to accomodate that businesse with a stock of 3000 £ or 4000 £ I shall indeavour (God permitting) to raise such commoditee as may be convenient for returns, and in particular that staple of saltpeter of which some (blank) of tunes are yearly carried into England, Holland, Portugall and other parts; and that no adventure of detriment may be to any, doe hereby ingage that the said stock shalbe within (blank) yeares duly repaied to them, with some convenient consideration (if God please to add a blessing to the designe so farre as it be profitably effected); and when it shall appeare demonstratively incouraging, they may, if they please to joyne in the business and to a further proceeding, advance to a stock of 10,000 or 20,000 £ or more.

Winthrop had a clear idea of the importance of saltpeter manufacture as a basic protective industry. Through his influence, in 1642, the General Court of Massachusetts passed an order for promoting the public safety to the effect that in order to raise and produce such materials "as will perfect the making of gunpowder, the instrumental means that all nations lay hould on for their preservation....every plantation within the Colony shall erect a house in length about 20 or 30 foote, and 20 foote wide within one half year next coming....to make saltpeter from urine of men, beastes, goates, hennes, hogs and horses dung."

This ordinance may be said to mark the birth of our modern nitrate and munition industries. The correctness of this early colonial policy was afterwards exemplified in the days of the American Revolution, when a Congressional Tract upon the manufacture of saltpeter was issued by John Hancock in 1776. As a result of this tract and the methods therein described, the manufacture of saltpeter and gunpowder made such rapid advancement that when the Revolution was over these commodities appear as articles of export.

In the war of 1812, the recently discovered nitrate deposits of Mammoth Cave and other caverns were used as a source of saltpeter. The process of manufacture,⁸ as carried out at Mammoth Cave, was as follows:

The "peter earth," containing about four pounds of calcium nitrate to the bushel, was gathered in sacks from the remoter parts of the cave and brought to the leaching vats, transportation being accomplished so far as possible in wagons drawn by oxen. The leaching vats were 12 to 15 feet long, 8 to 10 feet wide and 4 to 5 feet in depth; the bottoms of vats consisted of logs cut from small trees, split into halves and hollowed out, and joined together so that the upper logs with convex surfaces up fitted into the grooves of the lower logs with convex surfaces down. The water for leaching the earth was brought in wooden pipes, made by boring through the long stems of trees, from a spring outside the cave. The leachings were caught in the grooves of the lower logs which being slightly inclined conveyed the dilute solution of calcium nitrate forward into a channel to a reservoir whence it was pumped through another wooden

⁷ Winthrop papers, Vol. 5, p. 9.

⁸ An account of the nitrate caves of Kentucky and other states and details of the method of manufacturing saltpeter are given by James Cutbush in his "System of Pyrotechny" (Philadelphia, 1825), p. 54.

pipe to the outside of the caye. Here the leachings were evaporated in kettles and the strong solution filtered through hoppers containing wood ashes. The calcium nitrate was in this way converted into potassium nitrate, which was crystallized from the filtrate, after again concentrating and cooling in wooden troughs. The crystals of potassium nitrate after drying were packed and transported by horses and mules to the seaboard.

ECONOMIC FACTORS

It is impossible within the limits of the present paper to extend these descriptions to the manufacture of potash, salt, iron, soap, paper, glass and other products, but a brief reference should be made to a few economic factors which influenced the growth and development of early American chemical industries.

There are still vivid recollections of the effects of the recent World War upon chemical industries in the United States,—of the extraordinary stimulus which was at first produced, of the brief but wonderful prosperity which ensued, of the terrible depression that followed, and of the strenuous efforts made to save the new industries which the war called into existence. Yet these recent events are relatively of minor significance when compared with what happened in the United States between 1806 and 1826. In order to understand the events of this critical period it is necessary to go back to colonial times.

The early Trading Companies, such as the "Company of the West" already mentioned, the "West India Company," and others, financed and started their colonies in the New World as simple business propositions. The "London Company," for example, sent over English, Polish, and German workmen to Jamestown in 1608 to make pitch, tar, and potash, and to exploit the country for metals, drugs, dyes, and other products. The mistake was made, however, of beginning manufactures too soon. The shareholders of the trading companies hoped for an immediate return on their investments, and, when the first settlers forsook industry for agriculture, were naturally disappointed. They had, however, lost sight of the fact that the basic needs of food, shelter, and clothing come before glass, potash, and iron. When the laborers who had been sent over tore up their indentures and forsook the furnace for the field, they were simply obeying a natural law, expressed upon the seal of one of our National Departments, that "agriculture is the foundation of manufacture and commerce." It was only after building his house and planting his fields that the early settler could turn his attention to simple industrial pursuits.

The manufacture by the colonist of simple products for his personal and domestic needs marked the first stage in the development of American industrial chemistry. The pioneer tanned his own leather, forged his own iron, made his own potash and soap, curdled his own cheese, dyed his own wool, and boiled his own sugar and salt. The processes were crude but they marked the inception of that idea of industrial independence which afterwards became of such momentous importance, and

which, similar to that other idea of political freedom, was the natural birthright of every pioneer.

As the country became more thickly settled, there was the natural division of labor, which always comes with social advancement, and this resulted in the second, or coöperative stage of American industrial chemistry. The farmer took his hides to the tanner to be made into leather, his homespun to the fuller for dyeing, and his tallow to the soapboiler for making into soap. He exchanged his farm products with the iron maker for unfinished rods which he wrought at home into nails or staples according to his needs. The intimate coöperation of agriculture and industry had an important bearing upon the shaping of policies in this country. There was a solidarity and unanimity of feeling between the farmer and manufacturer which unfortunately ceased when this coöperative period came to an end.

EFFECT OF COLONIAL TROUBLES WITH ENGLAND UPON CHEMICAL INDUSTRY

The great fundamental difficulty between Great Britain and the American colonies was whether the latter should send their raw materials to England to be manufactured into the finished products which they needed, or whether the colonies should save themselves from this

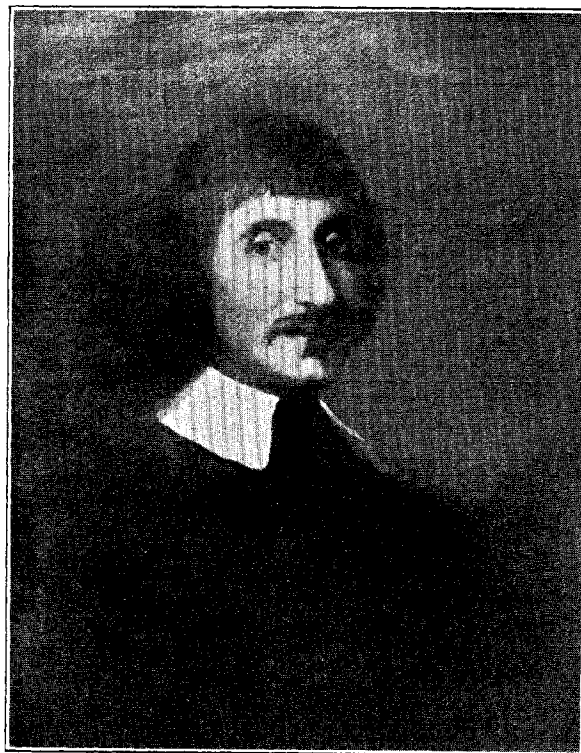


FIG. 4—JOHN WINTHROP, JR., IN EARLY LIFE. (FROM AN OLD PORTRAIT REPRODUCED IN T. F. WATERS' "SKETCH OF THE LIFE OF JOHN WINTHROP THE YOUNGER")

exploitation by utilizing their own natural resources. The passage, before the Revolution, of the Stamp Act caused the feeling of industrial independence, which had been constantly growing, to assert itself; the colonists voted in retaliation to import no more refined sugar, leather, starch, linseed oil, glue, glass, metalware, paper, dyed goods, or any other product which they could manufacture for themselves. The principle of industrial independence was considered to be worth defending, and when its recognition was won at Yorktown, steps were taken to secure the victory by necessary Congressional legislation. Through the wisdom of Hamilton our first protective tariff was passed; additional stimulus was given to industry by the establishment of patents; the different states awarded bounties and granted exemptions to start glass and other chemical manufactures; prizes were awarded by the numerous societies that had been formed to stimulate domestic production. Industry grew, commerce increased, and American ships began to appear on every ocean.

If the right of Americans to do their own manufacturing was one of the leading motives of the Revolution, the right to carry their manufactured products to other nations without hindrance was the chief motive which inspired the war of 1812. During the Napoleonic wars between 1806 and 1812, the position of the United States greatly resembled that in the recent European war between 1914 and 1917. Our manufacturers were first stimulated to supply the needs of foreign contestants. The start, thus acquired, received an immediate impetus in 1806 by the passage of an embargo upon the importation of British goods, and was still further intensified between 1812 and 1814

when the United States became involved in a conflict with Great Britain owing to interferences with American commerce.

After the downfall of Napoleon and the declaration of peace between the United States and Great Britain, the latter nation, with its thousands of discharged soldiers returning to the fields of industry, set out to recover its lost markets. Great Britain, by the early adoption of the steam engine and other labor-saving



FIG. 5—NITRATE VATS IN MAMMOTH CAVE, KY., USED IN 1812. (PHOTOGRAPH SUPPLIED BY M. B. WADE, RUSSELLVILLE, KY.)

machinery, had at least a twenty-year start over other nations in the contest for industrial supremacy. She had not only the skilled labor and the shipping, but she could turn out products in such quantities and at such low prices that competition was impossible. Great Britain was even ready to export products at a loss. Lord Brougham, in a speech before Parliament in 1816, declared, "It is well worth while to incur a loss upon the first exportation, in order by the glut to stifle in the cradle those rising manufactures in the United States, which the war has forced into existence contrary to the natural course of things." British products were shipped to New York for immediate sale at auction, and, before anti-dumping laws could be passed, an almost irretrievable damage had been inflicted upon American manufactures.

The influence of these events upon our chemical industries can be illustrated in no better way than by following the course of chemical patents. The number of patents taken out in a given industry is an accurate index of the prosperity of that industry and the variation in the annual number of chemical patents from 1790 to 1840, shown in the diagram on p. 1071,⁹ gives a concise and reliable picture of the progress of chemical industry during this important fifty-year period.

In the diagram the continuous line represents the population of the United States as expressed in millions and the broken line the number of chemical patents. The two lines are fairly coincident until about 1802, when there is a sudden rise in the patent curve. This rise is due to the temporary repeal in 1802 of the duties upon stills and distillery products, and the increase at this point is for improvements in distilling and rectifying. In 1806, owing to interferences with American commerce, an embargo was placed upon the importation of British goods and a stimulus was imparted to American chemical manufactures which reached its climax during the war of 1812 to 1814. The years

⁹ In constructing the diagram, use was made of Class 4 of the "List of Patents issued by the United States from 1790 to 1847," compiled by Edmund Burke, Commissioner of Patents, Washington, 1847. Class 4 (pp. 99-119) comprises all patents relating to "Chemical Processes, Manufactures and Compounds."

1815 to 1824 marked the period of dumping cheap foreign goods upon unprotected American markets; and, as the diagram shows, the incentive to take out chemical patents was lacking. In 1824 the first effective tariff law was passed, and from this time dates the well-known "American System" of Henry Clay, the savior of American industries. The benefits of the "American System" lasted until 1836, when the growing opposition of the agricultural states of the South to tariff laws for the protection of industry resulted in the passage of compromise acts. These had a bad effect upon manufacturing and with the bank troubles and financial panic of 1837 plunged American chemical industries into a second long period of depression.

If there were time, it would be interesting to trace the development of the chemical industries which sprang into existence in the United States as results of the embargo of 1806 and of the war of 1812. Their development is reflected in the character of the chemical patents. Previous to 1806, these patents related chiefly to the old colonial industries of distilling, salt manufacture, potash making, and the utilization of sperm oil and other fats for soap and candles. But after 1806, when the importation of foreign goods was restricted, the inventive genius of American chemists began to be diverted into more modern channels. Between 1806 and 1814 there are noted for the first time inventions that relate to subliming sulfur, dyeing silks and calicoes, bleaching, refining camphor, waterproofing leather, making artificial mineral water, and manufacturing sulfuric acid, copper acetate, magnesia, and white and red lead. The year 1806 marks the awakening of industrial chemistry in the United States. The first American students, Benjamin Silliman and others, were returning from their chemical studies in Europe and contributed their share to the new movement. American publishers began also about this period to print practical treatises upon chemistry—works of native writers such as Dr. Thomas Ewell, and reprints of European authors such as Frederick Accum—and for the first time the attention of the public was called to the national importance of chemical industries.

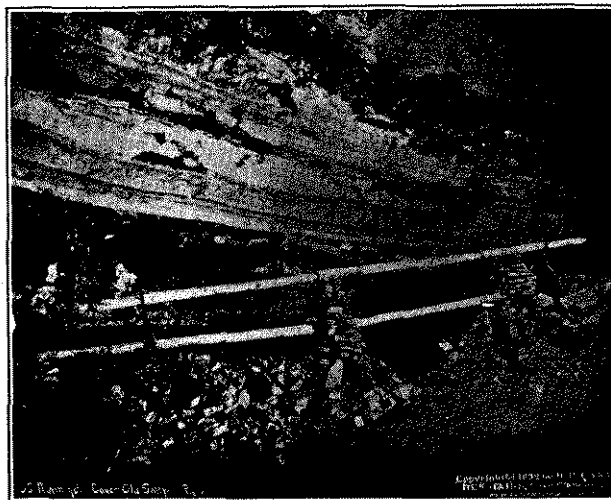


FIG. 6—WOODEN WATER PIPES FOR TRANSPORTING WATER AND NITRATE LEACHINGS IN MAMMOTH CAVE, KY. (PHOTOGRAPH SUPPLIED BY M. B. WADE, RUSSELLVILLE, KY.)

EARLY STRUGGLES FOR PROTECTION

It is a singular fact that the battle for domestic chemical industries, after the war of 1812, was waged largely, as it is being waged since the recent European war, upon the question of dyestuffs, and it is also singular that it was fought one hundred years ago, as it is being fought now, largely upon the issue of patriotism. When foreign dyed fabrics threatened the extinction of the domestic industry after the war of 1812, there