Indigo in World History: Production, Distribution & Consumption

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Human beings respond warmly to the bright colors in nature: to the sea, the sky, verdant landscapes and bright flowers. In the artificial environments we create, we have since ancient times painted or dyed artifacts with natural colorants to stimulate the positive feelings inspired in us by color in nature. In this context, no color has been more important to the cultures which could contrive to recreate it than a deep, bright blue. In ancient India, the Mediterranean world and elsewhere, an intense blue was often associated with royalty or divinity.[1]

Blue colorant is available in nature as indican, a substance found in perhaps a hundred and fifty varieties of plant world-wide. Of these Indigofera tinctoria, indigenous to South and Southeast Asia and named (along with three other Indigofera varieties) in the 18th century by Linnaeus, is the plant that produces it in greatest abundance. Europe's blues were for many centuries derived primarily from the less generous woad plant (Isatis tinctoria), which as students of Latin have always known from Caesar's Gallic Wars, was used by the ancient Celts as a skin-dye. In the tropical Americas, the principal native plant for this purpose was Indigofera suffruticosa, a probable source of the brilliant "Maya blue" of ancient Mesoamerican mural paintings.[2] But these plants can be converted into a substance usable for the blue-dyeing of cloth only by means of complex technical processes. Experiments leading to the discovery of those processes appear to have been carried out by people of ancient times in many places around the globe, and on many different plants -- but nowhere earlier or more successfully than on Indigofera tinctoria in the Indus Valley of Northwestern India.

The chief requirements of any dyestuff are that it be readily absorbed by the plant or animal fibers to which it is applied and from which textiles are woven, and that once applied it be "fast" enough to withstand frequent washings. Indigo, when applied to animal fibers such as wool or silk, permeates them with relative ease and will suffuse them with a remarkably fast color. It permeates vegetable fibers such as cotton or linen, however, only with the help of carefully administered quantities of metallic oxides or mordants that can "bite" the fiber in combination with the dyestuff in order to fix the color. Mordants such as alum or urine were employed by dyers everywhere; but the discovery and use of those

appropriate for dyeing cotton fibers with an extraordinary fastness was another great technological break-through by the Indus Valley peoples in ancient times.

Origins

The transformation of indigo into a colorant for vegetable fibers was closely associated with the discovery in the same region of techniques for the transformation of cotton into cloth. The tree-cotton plant (Gossypium arboreum) was indigenous to the Indus Valley, among many other places on earth; and it was there that the techniques first for spinning into yarn the fibers found in its fluffy bole, and then for weaving that yarn into cloth, were developed more than four thousand years ago. Further experimentation perfected the selection of indigo and a great variety of other natural dyestuffs and mordants, and the development of techniques for blending and applying these colorants to cloth. Finally, the Indian textile pioneers learned to color their cloth in intricate patterns by applying "resists" of wax or resin to protect portions of the cloth against coloring during the several stages of an elaborate dyeing process, and by coordinating the images impressed on the cloth by multiple carved stamps. All of these techniques were perfected by craftspeople to the point of enabling the mass production by an extensive "cottage" industry of the astounding variety and quantity of beautifully dyed and patterned cotton fabrics with which India supplied the world economy, and delighted consumers in many countries, for the two thousand years and more prior to the industrial revolution. Archeologists have recovered a remnant of mordant-dyed indigo blue cloth from Mohenjo-Daro in the Indus Valley, dated at 1750 B.C. [3]

Northwest India exported its plain and dyed cotton cloth both overland and by sea, to markets as far afield as the Mediterranean, China and Russia; and the cloth industry eventually prospered in other Indian regions as well -- most notably on the Coromandel Coast of the Bay of Bengal. Before the 18th century, Indian calicoes and chintzes displayed a wider array of colors, and a greater degree of fastness, than cloth produced anywhere else in the world. The Northwest was also for many centuries the world's principal exporter of high-quality indigo (known in the Indian languages and to Arab traders as nil, or "blue," hence añil in the Iberian tongues), processed into small cakes by peasant producers for many centuries, and greatly valued abroad. Herodotus wrote of it in 450 B.C.; in the first-century Periplus of the Erythraean Sea (comp. 60-80 A.D.) an Egyptian Greek writer on regional trade spoke of its export along with cloth and gemstones through the port of Barbarikon at the mouth of the Indus to the Roman Mediterranean. There this indikon (L. indicum, named for its source, later "indigo" in most Western European languages) was sold at a price that suggests that though widely sought after, it was even at that early date more readily available than some of the truly exotic plant products that were reaching the

Mediterranean market from afar. The use of indicum as a paint pigment was noted in the first century by Vitruvius in De architectura and Dioscorides in De materia medica, as well as by Pliny the Elder, who observed in his Historia Naturalis that it came "from India, where it occurs as slime adhering to foam on the reeds. When first separated it is black, but on treatment with water, it gives a wondrous blend of purple & blue."[4] Indigo was not then yet used for dyeing cloth in the Mediterranean world, because the technical knowledge necessary for its employment had not yet reached there from India.

A thousand years later, in the wake of the Crusades against Muslim power in the Holy Land, Venetian and Genoese pioneers organized the first slave-based "colonial" plantation agricultural enterprises of modern times on the island of Cyprus in the Eastern Mediterranean. There it appears that for a time endigo, which could not be grown elsewhere in Europe, may have been grown alongside sugar cane on the great estates. In general for Europeans, however, the dyestuff remained for long an expensive product imported for the most part by Italian traders through Syria and Egypt from the mysterious East, somewhat better-known in the Mediterranean countries than in Western Europe, but available only sporadically even there to workers in the textile trades.[51] Europe's cloth was then woven primarily from wool and flax; and the comparatively dull blue dye from Isatis tinctoria (Fr. guède or pastel) with which it was traditionally colored was less than satisfactory because disappointingly "fugitive." Woad-growing, however, was a vital source of income for peasant communities in Provence and Picardy, as well as in Italian Lombardy and German Thuringia; the European dyers were also familiar with its use, so the old habits would die hard. The inescapable temptation of the oriental product for dyers, however, arose from the fact that the concentration of indican in indigo was about thirty times greater than in woad.[6],

It was not until the 16th and 17th centuries, thanks to the carving out by Portuguese, Dutch and English sailors of a regular seagoing trade route between Gujerat in Northwest India and the European markets, that indigo came to be available toWestern European dyers on a regular and increasingly on an economically competitive basis. The Portuguese were doing a brisk business in the sale of the dyestuff to Spain, the Netherlands and England by the 1560's. It was received with enthusiasm almost from the start by the textile industries of those countries, which had previously been large-scale importers of woad; but it was excoriated by others as the "Devil's color," and for a long time resisted furiously by the woad-growers -- to the point at which the French and various German governments forbade its importation in the interest of protecting the livelihoods (and the ability to pay taxes!) of both peasants and artisans from a potentially ruinous competition. The clandestine use of indigo by dyers grew apace, however, until in France, Colbert's decree of 1669 known as the Ars tinctoria fundamentalis at length relented to the extent

of providing legal guarantees to the woad-men by allowing the use of indigo only in combination with woad. [7] Some form of protectionist legislation remained in force there, despite increasing protests from dyers complaining that it put them at a disadvantage with their British competitors, until 1737. Meanwhile, from the beginning of the 17th century, the English and Dutch East Indies Companies had largely supplanted the Portuguese as transporters of Indian indigo to the European market.

The great shift in European attitudes towards indigo arose during the 17th and 18th centuries from the rapidly increasing importation of colorful Indian cotton cloth, the lightness and beauty of which opened up a wide market, and the fastness of which at first seemed no less than miraculous to European technicians. This circumstance inspired a great "industrial curiosity" within the European textile trade, one which over the next century would lead Europe to study the Indian production techniques closely, in a systematic attempt to outdo the cottage weavers and dyers of Hindustan at the Indians' own trade.

Indigo, Plant & Process

Indigofera tinctoria as a cultivated plant was either broadcast or planted in rows on level, well-watered but also well-drained, carefully prepared fields. It grew into a bush two to four feet high with single racemes, small reddish yellow pea-like blossoms, and seeds enclosed in small pods. Given an adequate rainfall and a warm climate, it could produce three or four cuttings during each growing year, and for greatest productivity needed to be pulled up and replanted every three or four years. When the crop was planted in rows, cattle might graze in the field as it grew to help keep the weeds down, and would not touch the plant itself. Indian producers got the best results by harvesting the plant early in the morning, tying it into enormous bundles five feet in diameter, and placing it quickly in the fermentation-vat, before chemical changes provoked by hot sunshine could lower the quality of the product. Alternatively, it could be cut and dried in the sun for two days, then thrashed to separate leaves from stems, and the blueish-gray dried leaves placed in the vat of warm water.

Indigo is present in Indigofera plants as the water-soluble, bitter-tasting brown glucoside of indoxyl, or indican, which is easily extracted by steeping the leaves & stems in warm water. [8] When the resulting solution was allowed to ferment for ten or twelve hours (or was artificially acidified), the indican broke down by the elimination of glucose with the help of an enzyme present in the leaves of the plant, so that the colorless indoxyl remained in solution. The fermentation process was both violent and malodorous, with the liquid "heaving and swelling" in the steeping vat so forcefully that a bamboo grill was kept on top of the vat to prevent its spilling over, all the while giving off a vile odor that made it nasty work for the vat-tenders, responsible later on for disposing of the stinking mass of fermented leaves

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and stems. In New World plantation conditions, "the stench of the work vats, where the indigo plants were putrefied, was so offensive and deleterious, that the 'work' was usually located at least a quarter of a mile away from human dwellings. The odor from the rotting weeds drew flies and other insects by the thousands, greatly increasing the chances of the spread of disease."[9]

The indoxyl, upon exposure to the air, would then oxidize into insoluble indigo, the quality of which varied with the proportion within it of the essential coloring principle indigotin ($C_{16}H_{10}N_2O_2$). Controlling exposure to the air was a critical requirement of this process, accomplished at a critical moment in the fermentation process (determined by an experienced workmen using a variety of taste and smell-tests), by draining the fluid off through a bung-hole into a second, "beating vat" built at a lower level. There the fermented liquid was flailed for a period of some hours by workers standing inside the vat with great paddles, or in later years by a mechanical flailing apparatus moved by animal or water-power. The resulting oxidation process, which had also to be closely supervised by an experienced hand to avoid over- or under-beating, resulted in the precipitation from the liquid of a mudlike substance that gathered at the bottom of the vat and was revealed when the water was drained off from the mixture once more. This was the much sought-after indigo which, after being scooped up, dried and then cut or shaped into small cakes, was packed up and shipped to wherever it was needed for dyeing. The drying process might be accelerated (and destructive fermentation inhibited) by heating the final residue in a copper boiler until it assumed a viscous and oily texture, and then pouring it into flat frames equipped with filters, or by hanging it in bags to drain and then pressing the indigo dry before cutting and packing it.

The end product of this cottage industrial process was a hard, light-weight lump whose surface was a "pretty matt blue. Cracks and broken surfaces showed up copper-red and, if the quality of the indigo was good, had a gloss."[10] Its purity varied greatly through the centuries with the country of origin and the specific details of its production; and the temptation for producers to adulterate the product with dust, fiber wastes or resin, or to store it damp so as to raise its weight, was always present. The quality was in fact difficult to establish before it was actually placed in the dye-vat, since indigo had neither taste nor odor and was insoluble in either water or alcohol; and sometimes it might yield as little as 20% of the colorant by volume. But the best-made indigo, sold at a premium price for its deep violet blue color and fine grain, contained up to 90% indigotin (the rest being "glue-substances and impurities"). Low-grade indigo was useful for dyeing wool; the middle grades were preferred for cotton; and the finer grades were reserved for silk and fine woolens. Whatever the quality, the cakes were packed for shipping either in wooden cases, or in serons (Sp. zurrones, untanned cattle-hides); and so

long as they neither got wet (and rotted) nor were left for long periods in the sun, they could be stored and retained their chemical properties for long periods of time.

To serve as a dye, the indigo had first to be reduced to a powder and mixed once more into an alkaline (mordant) dye-bath which would release its colorant into solution. Then when the fabric soaked in the solution was removed from the bath into the open air, the indigo was transformed once more by its contact with oxygen into an insoluble, fast dye. This ancient Indian manufacturing method was followed in its essential characteristics wherever indigo was made around the world between the 16th and the 19th centuries; the Indian processes for applying the dye to cloth also remained standard, though susceptible to incremental improvement by experimentation in other parts of the world, until the full industrialization of the dye-making and dyeing processes was accomplished by the joint efforts of European scientists and manufacturers in the late 19th century.

Production & Trade in Gujerat

Marco Polo wrote that in 1292 indigo was plentiful in Gujerat and Cambay; and at Quilon on the Malabar Coast near the southern tip of India, he took note of the process of its production. The dye, he says,

> is produced from a herb: they take this herb without the roots and put in a big tub and add water and leave it till the herb is all rotted. Then they leave it in the sun, which is very hot and makes it evaporate and coagulate into a paste. Then it is chopped up into small pieces, as you have seen it.[11]

In the 16th & 17th centuries, when armed and aggressive European buyers invaded the trading world of the Indian Ocean, indigo production was still centered in the Northwestern provinces of India, though some was made on the Coromandel Coast and elsewhere as well. Indigo was manufactured for the most part at home by peasants who cultivated the plant on their own land, though in some places the harvest might be sold to specialists for transforming into dye. Most of the product was consumed regionally by the Indian cottage textile industry, but considerable quantities were exported by Indian merchants overland to Persia and Russia, or by sea to the Red Sea and Persian Gulf ports of the newly created Ottoman Empire. In the 16th and 17th centuries, a vigorous maritime trade in indigo to Europe developed through the offices first of the Portuguese at Goa & Diu, and later through the English & Dutch factories at Surat, the principal port of Gujerat and of the Mughal Empire.

Indigo was one of the few products of the Indian hinterland that could successfully make its way into long-distance early modern trade. This was because despite the recent unification and pacification of northern India under the enlightened administration of the Mughals, and the establishment of

comparatively efficient communications throughout the "subcontinent," the virtual absence of roads, and the necessity of moving all goods by pack-train rather than by cart, made transport costs for the bulkier goods prohibitive. Indigo, however, was a product of low bulk and high unit value.[12] The best grade was sold at Bayana, a small town near the Mughal capital at Agra in Rajasthan , where the Dutch traveller Pelsaert observed early in the 17th century that the trade was dominated by wealthy resident Indian and Armenian merchants. These men advanced money to the indigo farmers during planting season, thereby guaranteeing themselves large stocks of the best product at harvest time -- in addition to fixing the price at which it would be sold when the market at length opened for spot purchases by smaller Indian and foreign traders.[13] The supply of premium quality indigo at Bayana was always decidedly limited, though the acreage planted to it there may have increased somewhat during the 17th century in response to European demand.[14] An only slightly inferior grade of indigo could be obtained in greater quantities from the town of Sarkhej, near Ahmedabad in Gujerat. Other interior markets were in Oudh and Lahore. Once the European buyers or their Indian agents were on the scene in any of these places, the competition for a chronically limited supply of top-grade indigo grew keen.

Indigo had superseded woad in northern European textile dyeing by the late 16th c., or was at least widely used there in combination with woad, thanks to the comparative reliability of Portuguese imports and a consequent decline in its price. The newly established English East India Company installed its factory at Surat in the first decade of the 17th century; and following their expulsion by the Dutch from the Spice Islands of Indonesia after 1620, the Company placed its greatest hope for profits on exporting pepper and indigo from Gujerat.[15] Soon it went so far as to prohibit the shipment of indigo by private traders; and by 1620 the Company was shipping some 200,000 lbs. of the dyestuff to Europe each year, in addition to unspecified amounts sold in the Persian and Ottoman ports. Indigo from the Coromandel Coast, bought primarily by the Dutch during most of the 17th century, was of somewhat inferior quality but also very well-received in Europe to the tune of 100,000 to 150,000 lbs. a year.

This trade sometimes put buyers in direct contact with the peasant producers; but for the most part the European trading companies preferred to "latch on" to an efficient pre-existing commercial organization managed by Indian merchants, both Muslim and Hindu. This was conducted according to the dadni system, under which merchants advanced cash and raw materials to small producers, something that "in practice had the effect of binding particular groups of manufactures to a merchant or a European company.[16] In 1620's and 30's, both the British & the Dutch companies acquired and exported large quantities of indigo in competition with the Armenian and other overland traders of Gujerat, until between them by mid-century the European trading companies were taking perhaps five-sixths of India's total export production. But following on a terrible famine in the 1630's, the Indian output went into

steady decline -- as food grains came to fetch higher prices for farmers in the Indian marketplace, and perhaps as the more experienced peasant producers of indigo & other inedible crops succumbed first to starvation![17]

After about 1640 the production of indigo from mainland Spanish America and, by the late 17th century, from the British and French West Indies, competed increasingly successfully with the Indian product, now viewed increasingly in the European markets as unreliable in both quantity and quality. With this the trade in indigo from its home country declined precipitously, to a mere trickle after the British East India Company stopped buying it 1729. This left Britain, with its rapidly-expanding and increasingly mechanized cotton textile manufacturing industry dependent on foreign sources for its indigo; and major efforts were therefore made to encourage colonial production. By the mid-18th century there were large indigo-producing establishments in Dutch Java, British South Carolina and Jamaica, French St.-Domingue and Guadaloupe, Portuguese Brazil and Spanish Venezuela, as well as in the long-time chief colonial production center in Guatemala (see below). This 18th-century explosion in colonial indigo production occurred just as the European demand for hand-woven Indian dyed piece-goods was skyrocketing, however; so it must be kept in mind that a great deal of Indian indigo continued to go to Europe and elsewhere in the form of blue-dyed cloth. Colonial production in America was for the most part the work of forced laborers and slaves, rather than of an independent peasantry as in India; production in the colonies was centralized in larger-scale industrial establishments, and they were capable of exercising both a more supple response to shifts in market demand than the Indian producers, and a more rigorous discipline over the product purity and quality.

Production & Trade in Guatemala

Sixteenth and seventeenth-century Spain had operated at a disadvantage in the developing European trade in Indian dyestuffs and cloth, lacking as it did any regular route of access to the eastern Mediterranean outlets of the ancient overland trade, or a direct maritime link to the trading world of Asia. Imports from Portugal were costly, at least before the joining of the crowns of Portugal and Spain from 1580 to 1640. Spanish royal agents in America were from the beginning, therefore, on the outlook for potential sources of blue (as well as of red) dye. Beginning in the 1540's they even conducted a hopeful experiment in cultivating the European woad plant on Mexican soil.[18] Soon, however, an indigo-producing plant (Indigofera suffruticosa) was found growing wild in many parts of Mesoamerica, and it was learned that this plant, known to the Mayans as ch'oh and to the Aztecs as xiquilite, had long been in use by the natives of the country to produce dyes for their homespun cotton cloth.[19] In 1558, the King asked that samples of this very interesting plant be sent along to Spain, together with descriptions of the

process by which the Indians transformed it into dye. A little later, an unsuccessful effort was made to introduce the cultivation of this species of Indigofera in the motherland itself.

Spaniards resident in New Spain, meanwhile, were quick to take note of the indigenous procedures, and to conduct their own experiments in organizing this production on a commercial basis. Within a very few years it was established that the indigo they could produce in New Spain was a superior product for dyeing; and the cultivation of woad in the New World was abandoned forthwith. Beginning in the 1560's with a few dozen establishments in Yucatán, and extending quickly to Michoacán, Oaxaca, Chiapas & Guatemala, the indigo production of New Spain was organized from the start along all-out colonial entrepreneurial lines: on great estates under Spanish ownership, and with a servile Native American and/or African slave labor force. Production in these enterprises was accomplished by means of the closely supervised cultivation of the plant on extensive fields, the installation of elaborate (and comparatively expensive) equipment for processing the harvest into a dyestuff, and the transportation overland of great quantities of the product to the colony's few ports for transhipment to Europe.[20] Within a short time indigo came to constitute a very significant sector of the colonial economy, vying in most years of the late 16th and 17th centuries with cattle-hides for third place on the list of New Spain's exports -- after silver, of course, and the exceptionally valuable indigenous Mesoamerican red dyestuff, cochineal.

The main production sites within the Viceroyalty of New Spain by the century's end were those of the Captaincy of Guatemala to the south -- on the Pacific Coast lowlands of Nicaragua, and above all in what is today the Republic of El Salvador. The lowlands had been the scene of a cacao "boom" during the first decades of Spanish colonial rule; but cacao cultivation there had plummeted as a result of the catastrophic decline from epidemic disease and social dislocation, of the Indian population and labor force of the region. In the last quarter of the 16th century, cacao was entirely supplanted by indigo as the principal generator of wealth in that coastal region.

Guatemala's Pacific Coast was handicapped for the development of an export-oriented commercial agriculture in two fundamental ways. First was the difficulty of access to any European market. The shipment of goods by way of the Pacific involved a long and dangerous journey around the Horn or a circumnavigation of the globe; and in either case the transport costs to Europe were prohibitive. Shipment through one of the small Central American ports on the Caribbean required an arduous overland trip by pack train through difficult terrain; and during the long periods when Spanish shipping from Central America was regularly harried by British or French privateers on the high seas, it was necessary to ship goods overland several hundred miles to Veracruz so that they might accompany the annual silver fleet to Cadiz with its Spanish naval escort. In each case the costs and hazards of

transport contributed substantially to raising the selling-price (or lowering the profit margin) on Central America's product.

The second and even greater handicap to the establishment and particularly the continuing expansion of the large-scale plantation of indigo for export was the chronic shortage of labor in colonial Central America. The Indian population of the tropical coast regions of the Americas declined by more than 90% during the first century of Spanish rule, due to the ravages of newly introduced epidemic diseases (smallpox, measles, typhus, influenza – all of these perhaps complicated by the also newly introduced malaria.[21] And although elsewhere African slaves were introduced in large numbers to replace them, the relative poverty of Central America combined with the high cost of slaves to keep the immigration of Africans to the regions specializing in indigo production to little more than a trickle throughout the colonial period. A limited population of sedentary Pipil Indians did survive in the mountains adjacent to the Salvadoran coastal plain; and it was on their shoulders that the industry's demand for a labor force primarily fell.

During the years of peak production in the 17th century, Guatemala was supplying some half a million pounds of indigo to Europe each year (not including regular shipments via the Pacific to the busy textile-mills or obrajes of Quito and Central Mexico in the same period); and when the industry was restored to vigor in the 18th century those exports were approximately doubled.

Production & Trade in the West Indies

Once the Spaniards in Central America had demonstrated the possibility of organizing the production of indigo on a commercial basis under European proprietorship and by means of compulsory labor, once the Indian sources of supply had largely dried up and the French government's policy of protection for the woad-growers had been abandoned in the late 1730's, the competing imperial establishments vied with one another to organize the production of indigo on colonial plantations on a large enough scale to meet the demands of the burgeoning European market. Slaves in Jamaica and Barbados were producing considerable quantities of a high-quality indigo by the end of the 17th century for the ever-receptive British market; and in the third decade of the 18th century, production got underway and grew very quickly in South Carolina, Venezuela, Brazil and French St.-Domingue.

In Carolina the pioneer was an enterprising teen-ager, sixteen-year old proprietress Eliza Lucas Pinckney, born in the West Indies, who introduced the cultivation of Indigofera on her Wappoo Creek plantation in 1739 and succeeded in shipping her first commercial crop to London in 1744. With the British government soon paying a subsidy to growers, while at the same time excluding foreign imports of the dyestuff during war-time in addition to offering naval protection to their shipments of the dye, the

South Carolinian growers and the slave laborers they imported from Africa for this purpose were producing 150,000 lbs. a year by the late 1740's, nearly 900,000 lbs. by the late 1750's, and over a million lbs. when the interruption of shipments from the West Indies by France and England during the Seven Years' War created a market niche which the Carolinians rushed to fill. This bonanza continued right down to the peak year of 1775, after which the South Carolina growers suffered major reverses through the destruction of their crops and plantations and the recruitment of their slaves by the Redcoats during the War for Independence, and through the wartime prohibition by the Continental Congress of exports to Britain and Ireland. By the time peace was restored, the growers there had turned their main energies to rice & cotton cultivation, and indigo was largely abandoned.[22] Thereafter the production of indigo under British auspices in America was limited, despite a continuing government subsidy, to a few plantations in the West Indies, and in the newly-acquired territory of East Florida.[23]

St.-Domingue, the western third of the Island of Hispaniola occupied by the French late in the 17th century, became during the 18th century and on the basis of a plantation economy staffed almost entirely by African slaves, the richest colony in the world. Its principal export was sugar, but considerable fortunes were made there in the 18th from the cultivation of coffee, cacao, tobacco and indigo as well.

Late 18th-century plantation production in the Americas revealed many technical improvements and efficiencies that were product of decades of experimentation, and of "rationalization" aimed at maximizing profits. The labor force by now consisted primarily in African slaves everywhere. The preparations for the cultivation of Indigofera suffruticosa (now apparently replaced in some localities with the higher-quality East Indian I. tinctoria, though it is hard to establish when or where) were quite laborious: maximum production was seen to require a rich, loose, moist soil on a level field. Seeds were carefully selected, and broadcast at four bushels to the acre. Sowing in Florida began early in March and continued until the wet season began in May. The plants were cut as soon as they bloomed (usually about ten weeks, so that there might be five cuttings before November), preferably carried out in rainy weather since the hot sun was understood to destroy cut plants. The main handicaps to indigo cultivation were drought (which might require expensive, labor-intensive irrigation) and caterpillars (which had to be hand-collected and drowned in lime water, but might then be squeezed through a horsehair sieve to produce a liquid that could be processed as indigo!).

The vats for steeping and beating were now built of thick cypress planks with seven-inch spikes; one set of them, with a steeper 16' sq. by 3' deep and a battery 12' sq. & 3' deep, could handle the harvest of seven acres of land in a single processing cycle. The beating was done by slaves, or on larger plantations by horses moving a large lever with one or two bottomless buckets at each end up and down.

Finally, by this time the precipitated indigo with a new admixture of water was being allowed to sit in a third vat for eight to ten hours, before being strained through a horsehair sieve into conical bags and hung in the shade to drain. These bags then contained pure indigo, which was poured into shallow boxes and left to dry in the shade under the indigo sheds. When nearly hardened, it was cut in to square pieces and these were dried and turned three or four times a day until they had hardened. While the drying proceeded, a slave was kept busy shooing the ever-present flies away from the cakes, to keep them from damaging the product.'[24]

After 1786 the entire production of indigo in the Americas faced ruinous competition from the British East India Company, which dumped 250,000 lbs. of Bengal indigo on the London market that year, and increased its shipments steadily from that time forward.[25]

Production & Trade in 19th-century Bengal & Bihar

In last quarter of 18th c., responding to faltering West Indian supply & greatly increased demand from the mechanization of textile production, several English private traders established indigo plantations in newly-occupied Bengal. In addition, they soon experimented with the granting of credits to small-scale producers – credits that bound people, and also led to land forfeitures. Both systems were successful in keeping essential production decisions in the hands of a new class of English and Bengali "planters," the new lords of the land.

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The exports of indigo through Calcutta averaged 5.5 million lbs. in 1805-14, 7.5 million lbs. in 1814-1830, and over 9.5 million lbs. in by 1897 – this by then the product of over a million and a half acres of Indian land.

Europe as Consumer of Indigo

Early modern European economy & society were to a very large extent organized around the production, distribution and consumption of textiles, and in particular of the woolen textiles essential for the survival in a cold climate of peoples who had long since given up clothing themselves in the skins of animals. The European colonial empires, it may be argued, were concerned even more fundamentally with acquiring goods with which to fuel the textile industry than with acquiring the gold and silver after which the conquistadores lusted. Among the most sought-after and fought-over foreign products, were dyestuffs such as indigo with which to render drab homespuns pleasing to the eye. Even before the rise of colonialism, Mediterranean traders had concerned themselves as much with obtaining Asian silk and cotton cloth, and Asian colorants with which to dye European cloth, as they had with the more celebrated pepper and spices.

Although there was a limited early interest in indigo as a pharmaceutical product, Europe mostly required it as a dyestuff. The knowledge there about how to make use of indigo for dyeing remained for a long time, however, in the empirical realm of practitioners by whom it was generally employed as supplement to strengthen dye-vats of woad. In 1560 the Venetian Giovanni Rosetti described the practice of dyers there in his Plictho dell'Arte dei Tintori, which was at length published in French for a broader readership in 1716. Richard Hakluyt of London sent the English dyer Hubblethorne to Persia in 1579 to learn how the beautiful Persian carpets and silks were dyed in such a way that "neither rain, urine, nor yet vinegar" could stain them, and in particular how indigo was used by those craftsmen.[26] Little by little the knowledge accumulated in Europe, and variety of practical manuals appeared during the 18th century, of which one example is Cajsa Warg's Hjälpreda uti Hushallningen för Fruentimber [Housekeeping Guide for Young Women], published in 1756, which contained expert recipes for dyeing with indigo and other substances, and was for decades the second most printed book in Swedish after the Bible. But the scientific study of the subject did not really get underway until 1750, with the publication of Jean Hellot's magnum opus on dye chemistry, L'Art de la Teinture [English trans. The Art of Dyeing Wool, Silk & Cotton, pub. in 1789]. Then, over the course of a century, publication in French, English and German of a dozen other great compendia impressed the rapidly expanding detailed knowledge of dye chemistry on generations of industrial practitioners.[27]

Urine, mentioned by Pliny, was required from ancient times for indigo dyeing – a surprising fact at first glance because urine is usually acidic, though eating greens can make it alkaline. But left to stand for a long time, it develops micro-organisms whose metabolism produces ammonia, a necessary reducing-agent for the indigo fermentation dye-bath. The early modern European notion was that the proper substance for this purpose was an aged human urine, preferably that produced by men (not women) who drank a lot. The "soft" water then available from rivers or public fountains, and not yet "hardened" by calcium salts or ferrous impurities as most water is today, was ideal for indigo dyeing. Hard water would precipitate the indigo in the dye-bath, leaving tiny granules of pigment on the surfaces of cloth fibers to rub off later. Cotton cloth dyed with indigo had to be carefully rinsed & washed when finished, in order to harden the color. Then it was "soured" in a rinse of sulphuric acid (risky stuff that could explode unless added in very small quantities to the rinse-water while stirring), to restore whiteness to the resist-painted cloth and so that it would stand up to rubbing.[28]

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The industrial synthesis of indigo was carried out in 1880 by German chemist Adolf von Baeyer, but cost of producing synthetic indigotin remained high until the accidental breaking of a thermometer at Badische Anilin und Soda Fabrik led chemists to discover the use of mercury sulphate as a catalyst – so that within a decade the synthetic could replace the natural product almost completely on the world market.[29] Synthetic indigo had precisely the same chemical composition, was produced in an easy-to-use fine powder or granule form, and was entirely free of impurities.

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Conclusions

This paper has reviewed very briefly some aspects of the history of the commercial exploitation of the indigo plant as a commodity in world trade, with an emphasis on the labor systems and the shifting economic geography of its production. But there is another story, or a multiplicity of stories, in the relationship between Indigofera and human kind, one that has run alongside the history of indigo as commodity from the beginning to the present day. That is the story of the many folk traditions of the preparation and utilization of natural dyes that lie behind the continuing production of beautifully dyed and patterned cloth in thousands of family and community workshops all over the planet – among both peasant communities who are practitioners of a craft inherited from their ancesters, and urban communities whose knowledge of the production and employment of natural dyes has been taken from books. The manufacture and utilization of indigo died a comparatively quick death once the European chemical industry had synthesized and learned to produce indigo in a chemically pure form just a

century ago. Nowhere since the era of the First World War have slaves, forced laborers or indebted peasants groaned under the oppressive weight of a world economic system determined to extract commercial quantities of the dyestuff from their labors at whatever cost to the well-being of workers, families and communities.

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[1] Gösta Sandberg, Indigo Textiles: Technique & History (Asheville NC, 1989), p. 13.
[2] Edwin R. Littman, "Maya blue – further perspectives & the possible use of indigo as the colorant," American Antiquity 47,2 (apr 1982), pp. 404-8.
[3] Sandberg, pp. 13-16; Dena S. Katzenberg, Blue Traditions: Indigo Dyed Textiles & Related Cobalt Glazed Ceramics from the 17th through the 19th C. (Baltimore, 1974), pp. 8-12; Mattiebelle Gittinger, Master Dyers to the World: Technique & Trade in Early Indian Dyed Textiles (Washington, 1982), pp. 5-20; Brooklyn Botanic Garden, Dye Plants & Dyeing: A Handbook (Brooklyn, 1964), pp. 4-7, 33-37 & 83-85.
[4] Lionel Casson (ed.) The Periplus Maris Erythraei. Text with Introduction, Translation, & Commentary (Princeton, 1989), n. on pp. 194-95, citing K. Bailey, The Elder Pliny's Chapters on Chemical Subjects (London, 1929); Katzenberg, p. 8,
[5] Jacques Heers, "La búsqueda de colorantes," Historia Mexicana 41 (1961), p. 2.
[6] Gittinger, p. 23-4. The preparation of woad during its heyday in the 13th to 16th centuries involved grinding its leaves to a pulp under great wooden rollers drawn by horses, heaping it up for draining, and then kneading it into balls to be dried on racks for one to four weeks. The balls were then ground to a powder under the same rollers, and the powder was spread two to three feet on the stone floor of a "couching house" to ferment for nine weeks with frequent sprinkling and turning. The dye was the resulting dark clay-like substance, which was then dissolved with alum or potash as mordant and heated in a vat for three hours before using. The fabrics removed from this bath then received their blue color from oxygenation when removed to the air. Brooklyn Botanic Garden, p. 34.
[7] Daurel Alden, "The growth & decline of indigo production in colonial Brazil: a study in comparative economic history," Journal of Economic History 25 (mar 1965), p. 37-38.
[8] Littman, p. 405.
[9] Kenneth H. Beeson, Jr., "Indigo production in the 18th century," Hispanic American Historical Review 44 (1964). p. 215, citing Bernard Romans, Natural History of East & West Florida (NY, 1775). Beeson adds that animals and poultry also suffered greatly from the stench, and were hard to keep anywhere near the production site.
[10] Sandberg, pp. 136-9
[11] The Travels of Marco Polo (trans. R. Latham; NY, 1958), pp. 287, 91-93.
[12] Dietmar Rothermund, An Economic History of India, Pre-Colonial Times to 1986 (London, 1988), p. 4.
[13] K.N. Chaudhuri, Trade & Civilization in the Indian Ocean: An Economic History from the Rise of Islam to 1750 (Cambridge, 1985), p. 200, citing traveller Francisco Pelsaert.
[14] Tapan Raychaudhuri, "The mid-18th century background," in D. Kumar (ed.) The Cambridge Economic History of India, vol. II (Cambridge, 1983), p. 19.
[15] The influential Dutch traveller Jan van Linschoten had observed in the 1590's that by then Portugal's trade in indigo was worth more to her "both in India and in Portingall" than the once-fabled trade in cloves. P.A. Tiele (ed.) The Voyage of John Huyghen van Linschoten to the East Indies, vol. II (Hakluyt Society, 1st ser. 71; London, 1885), p. 91.
[16] Raychaudhuri, "Background," p. 23
[17] Tapan Raychaudhuri, "Non-Agricultural Production l. Mughal India," in Habib & Raychaudhuri (eds.) Cambridge Economic History of India, vol. I: ca. 1200-1750 (Cambridge, 1982), p. 273.
[18] Jean-Pierre Berthe, "El cultivo del 'pastel' en Nueva España," Historia Mexicana 35 (1960).
[19] Mario Humberto Ruz, "El añil en Yucatán del siglo xvi," Estudios de Cultura Maya 12 (1979), pp. 126-27.
[20] Heers, pp. 4-5.
[21] Cf. Judith Friedlander, "Malaria & demography in the lowlands of Mexico: an ethno-historical approach," in R.F. Spencer (ed.) Forms of Symbolic Action. Proceedings of the American Ethnological Society (Seattle, 1969), pp. 217-33.
[22] G. Terry Sharrer, "Indigo in Carolina, 1671-1796," South Carolina Historical Magazine 72,2 (apr 1971):94-103.
[23] Kenneth H. Beeson, Jr. "Indigo production in the 18th century," Hispanic American Historical Review 44 (1964):214-18.
[24] Beeson, p. 216.
[25] Beeson, p. 218.
[26] Katzenberg, p. 20.
[27] Sandberg, pp. 176-77; Brooklyn Botanic Garden, pp. 98-100.
[28] Sandberg, p. 136.

[29] Joel Mokyr, The Lever of Riches. Technological Creativity & Economic Progress (Oxford, 1990), p. 120.