

A FORGOTTEN CHAPTER OF INTERNATIONAL TRADE: MEXICAN
COCHINEAL AND THE EUROPEAN DEMAND FOR AMERICAN
DYES, 1550-1850

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In the mid 1520s, shortly after the conquest of Mexico, Charles V wrote to Cortes urging him to send much-solicited information on a new red dyestuff of high quality known as cochineal that was cultivated and produced by Indian peasants in the Mexican meseta. That the emperor should request a report of this nature is indicative of the high value placed in Europe on this quite special commodity. It is of major significance- in this context- to indicate that cochineal ("grana cochinilla") became, after silver, the most important Mexican export for over three hundred years, or down to approximately 1850. A still unanswered question, however, is why this was so.

A few studies have described important aspects of the production of cochineal in Mexico but virtually none have explained the reasons why this product consistently had such a strong, secular demand in Europe. One reason for the paucity of studies on this specific subject would appear to be the relative neglect of economic

historians with regard to a major chapter in international commerce, namely, the study of the history of the trade in dyes from the Americas, (including indigo, Brazil wood, Palo de Campeche and cochineal) all of which were of critical importance for European textile industries from the 16th century down to the late 19th century.

Since this is a vast subject, I have chosen to focus on cochineal, which was the most expensive and important of all the dyes exported from the Americas. The subject is also of interest, in my opinion, because it can help illustrate how from the early sixteenth century, European demand for a particular commodity- in this case a valuable and labor-intensive dyestuff- directly affected the livelihood of tens of thousands of members of Mexican indigenous peasant communities who devoted a large amount of labor to cultivating the cochineal which was used to dye the finest fabrics used by popes, princes nobles, military officers and wealthy residents of European cities and towns. The economics of an early international commodity chain thus can help elucidate the complex transatlantic social dynamics which it also generated.

The essay that follows is organized around three themes: 1) the origins of demand in Europe for cochineal in the sixteenth century and the rise of the international trade in this commodity, with special emphasis on analysis of trends of production and prices in the period

1750-1850; 2) the specific characteristics of the production of cochineal in Mexico, principally in the Oaxaca region; 3) the role of both Spanish American and European merchants and merchant bankers in the international commerce of cochineal and their control of the complex networks (commodity chains) which developed around this branch of transatlantic trade. We conclude with a few observations on the gradual decline of Mexican cochineal as an international commodity in the first half of the nineteenth century.

European demand for cochineal and international trade trends, 1550-1850

It is the hypothesis of this essay that the valuable cochineal trade originating in Mexico was demand-driven from the early 16th century onwards. It was the high premium which European elites were willing to pay for this deep scarlet dye that impelled the development of an extraordinarily complex transatlantic commodity chain that prospered for over three centuries.

To understand the origins of the international trade in cochineal, it is necessary to focus attention first and foremost on the sixteenth century and particularly on the European luxury textile industries and their multiple connections to the Spanish and Spanish-American economy. It is well known that Spanish merino wool was already among the most valued and expensive primary goods consumed by the leading cloth

manufacturing centers of the period. It is less well known that from this period, the ecclesiastical and secular elites all over Europe also came to depend upon dyestuffs imported from Mexico by Spanish merchants for their most luxurious and long-lasting fabrics.

The importance of cochineal was reflected in price, the fact being that expensive dyes often represented a higher proportion of final costs of fine cloth than the other materials essential to their manufacture, including the raw or processed fibers (wool, silks, linens). But why were dyestuffs so expensive ? Scarcity of high-quality dyestuffs, of course, played a major role but it is also worthwhile underlining that certain colors had great socio-economic significance in traditional society in affirming hierarchies. In this regard, it is worthwhile recalling that from the medieval era, one of the colors most prized by crown, church and nobility in Europe for their finest fabrics was that of carmine or deep crimson. That this should be so was due in part to its symbolic importance as representative of the preeminence of the upper orders in human society.¹ Other colors- in particular deep blue, gold and silver- had perhaps similar prestige, as may be observed in the Renaissance paintings of the princes of state and church, but undoubtedly the crimsons stood out. Whether for cloaks, robes, uniforms, dresses or

¹ Two works are especially illuminating in this regard, namely Arthur Lovejoy's classic The Great Chain of Being, Harvard University Press, 1936, and Manlio Brusatin, Storia dei colori, Einaudi, 1983.

stockings, or for cushions, curtains or canopies, it is clear that silks, linens and woolens of a deep red color were always in heavy demand by wealthy and powerful Europeans of the ancien regime.

The leading luxury textile centres of Europe- in particular Florence and Flanders from the 14th century- produced crimson cloth (in various shades and tones) by using a variety of red dyestuffs. According to John Munro, the "medieval scarlets" owed their "splendor, fame and high cost to the dyeing process."² This was so largely due to the fact that such dyestuffs (particularly derived from insects, such as the *kermes* from the Mediterranean) were relatively rare and because the dyeing processes were complex and required great artisinal skills.

In an extraordinarily detailed analysis of medieval scarlet textiles, Munro has demonstrated that the dyeing process was generally a large proportion of the final cloth price, sometimes the largest single component of production costs. At the luxury textile center of Malines in the fourteenth century, the scarlet dye known as "kermes" accounted for 40% of total costs of total costs of production of the cloth. The variety of colors or tonalities were obtained by the use of mordants, including alum, tin, chrome or copper which respectively produced hues

² John Munro "The Medieval Scarlet and the Economics of Sartorial Splendor" in Harte and Ponting (1983),p.39.

of crimson, scarlet, purple and claret and, furthermore, allowed the dyes to fix fast to the cloth and to last for decades.³

The expensive scarlet or crimson fabrics could only be acquired by the wealthiest members of late medieval society. Munro cites the case of Henry VI's wardrobe account of 1438-39 in which the cheapest scarlets cost more than fourteen pounds sterling. He notes:

"A master mason, then earning six pence a day would have had to spend his full wages for 565 workdays (about 2 years and nine months) to buy one... For that same amount of money in 1440, the following goods could have been purchased at the Antwerp market: approximately 2,720 kilos of Flemish cheese, or 850 kilos of butter; or 22,000 smoked red herrings or 1,100 litres of good quality Rhine wine.."⁴

Despite these high costs, from the early sixteenth century the demand for luxury crimson and scarlet cloth continued to climb all over Europe although perhaps most noticeably in England, Flanders, France and Italy. And, inevitably, the demand for high-quality and long-lasting red dyestuffs also rose. From the late 1520s Mexican cochineal began to appear on European markets in small quantities but soon gained wide acceptance as the finest crimson dyestuff for textiles. According to one historical study: "Cochineal possessed from ten to twelve times the dyeing properties of kermes; it also produced colors far superior in

³ Judith H. Hofenk-De Graaff "The Chemistry of Red Dyestuffs in Medieval and Early Modern Europe" in N.B. Harte, and K. G. Ponting, eds. Cloth and Clothing in Medieval Europe (London, Heinemann, 1983), p.73.

brilliance and fastness.”⁵ This dyestuff thus quickly won growing markets in the leading luxury textile manufacturing centers of Europe, including Segovia in Spain, Suffolk in England, Florence, Milan and Venice in Italy, Rouen, Malines and Lyon in France and various centers in Flanders. Recent interdisciplinary studies provide concrete evidence on the rapid expansion of European demand for cochineal. A laborious chemical research programme on hundreds of samples of medieval and early modern dyed textiles has provided “concrete evidence to substantiate the historical assertion that Mexican cochineal within fifty years of its introduction into Europe (c. 1520-30) fully displaced kermes in scarlet textile dyeing.”⁶

The luxury textile industries of Italy were among the most important of sixteenth century Europe and hence were among the major markets for expensive dyes. Substantial quantities of the “grana cochinilla” sent from Veracruz to Seville and Cadiz made their way to the port of Livorno. Spanish economic historian, Felipe Ruiz Martín, has used the correspondence of contemporary Spanish merchant bankers to trace the exports to Florence where a booming luxury textile industry consumed large quantities of dyes. But he also notes that a not unsubstantial volume of cochineal was transshipped from Livorno to

⁴ Munro (1983), p.66.

⁵ Lee (1951), p.206.

⁶ Judith H. Hofenk-De Graaff “The Chemistry of Red Dyestuffs...” p.75.

Venice where it was used to dye the cheaper textiles -"pannina"- sent to Constantinople as well as for the famous Venetian "fez". According to both Spanish and Genoese merchants heavily involved in this trade, this crimson dyestuff was always profitable, and in fact its price quadrupled over the sixteenth century even as the volume of trade rose rapidly.

Despite the few stimulating pages by Ruiz Martín (1965) and two pioneering articles by Raymond Lee (1948 and 1951) on mercantile aspects, historians have not devoted much attention to the subject of Mexican cochineal in the European textile industry of the sixteenth century nor to the consumption patterns of these deep crimson fabrics.⁷ This seems to be a somewhat striking lacuna since the Mexican "grana cochinilla" became for three centuries the most demanded and expensive luxury dyestuff in the western world.

According to an old but classic article by Raymond Lee, it may be estimated that by 1600 average annual imports of cochineal to Spain ranged from ten to twelve thousand arrobas (each arroba being 25 pounds). The dyestuff was later transshipped from Seville and Cadiz to

⁷ Felipe Ruiz Martín, Lettres marchands échangés entre Florence et Medina del Campo, (Paris, Ecole des Hautes Etudes, 1965). Raymond Lee, "American Cochineal in European Commerce, 1526-1625", Journal of Modern History, 23 (1951), and "Cochineal Production and Trade in New Spain to 1600" The Americas, 4 (1948).

a number of ports in Northern Europe, as well as to Marseilles, Livorno and Venice in the Mediterranean. Leading merchant banking firms from as early as the late sixteenth century handled this highly lucrative commerce, as we will have occasion to note later in this essay.

The published data and information on the cochineal trade is scarcer and much more scattered for both the 17th century and the early 18th century. Louisa Hoberman has, however, provided some important information with regard to the cochineal trade in the early seventeenth century in her excellent study on the merchants of New Spain of the period. According to her research, on average, it can be estimated that one pound of cochineal would cost anywhere between 4 and 6 silver pesos in the early 17th century. Hoberman adds that the high unit-value of cochineal can, perhaps, be best judged by comparing it with other commodities. In the decade of 1610-1620, for instance, 25 pounds of cochineal cost 60 times more than an equivalent weight of sugar; in the 1630s, cochineal was worth 30 times the value of an equivalent weight of sugar.⁸

Hoberman also notes that prices for cultivated cochineal in the decade of 1610-1620, for example, varied from a low of 110 silver pesos per *arroba* (25 pounds) to a high of 150 pesos. This price range appears to have continued to remain remarkably stable for a

⁸ (Hoberman, pp. 121-122).

very long time: this may be confirmed by looking at information from the end of the eighteenth century when, according to data published by Alicia Contreras, the prices registered for cochineal at Cadiz varied from lows of 80 silver pesos per *arroba* to a high of 150 pesos between 1780 and 1800.

While the seventeenth century data is scarce, there is more abundant statistical information on the Mexican cochineal trade for the second half of the 18th century and the first half of the 19th century, which we will briefly comment in order to provide an overview of the final century of the international cochineal trade. The most complete series are based on data registered at the local treasury of Oaxaca on annual production by weight and value, as well as annual prices trends. The long-term tendencies are quite clear. Overall, physical production declined, as did the total value of the harvests of cochineal, at the same time as prices moved downwards but with marked fluctuations. The analysis of the data, however, suggests a need for a further breakdown from the century-long trend to shorter time periods.

Analysis of a first quarter century spanning the years 1758 to 1783 demonstrates that this was clearly the age of prosperity as far as cochineal was concerned: annual production averaged 922,600 pounds which, at a price of almost 20 silver reales (2 and half silver

pesos=10 shillings) per pound, produced over 2 million pesos per year for local producers and merchants. [See Graph 1.] However, a marked drop in production levels took place from 1784 and took it to slightly less than half a million pounds per year until 1803: at the same time, prices declined slightly, hovering at an annual average of 16.4 silver reales per pound until the turn of the century. The reasons for the steep reduction in the production of Oaxaca cochineal were apparently not related to the rather modest price decline, but rather have been ascribed by historians to two causes: 1) the terrible impact of the plagues and demographic crisis of 1784-1785 (during which over 300,000 people died in New Spain), that is believed to have deeply affected the Oaxaca peasant communities and disrupted production; 2) the impact of fiscal and administrative reforms which restructured traditional forms of commercialization of cochineal locally and, at the same time, implied higher taxes on this commodity.⁹ At any rate, it is evident that a complex series of new conditions (demographic, fiscal, administrative and mercantile) disrupted traditional levels of local production of cochineal in Oaxaca and initiated a phase of relative decadence.

During the following fifteen years, 1804-1819, production of Oaxaca cochineal continued to decline (stabilizing at a plateau of 328,000 pounds per year) but was compensated in good measure by

⁹ Hamnett (1971), Contreras(1996) and Silva (1998) take this view.

the rise in the international price of the dyestuff which rose to an average of 26 silver reales per pound during these years of war and intermittent interruption of navigation between Mexico and Europe. Oaxaca peasants and merchants benefited as international conflict pushed the prices of this relatively scarce commodity steeply upwards but, paradoxically, local production still continued to fall in these difficult years.

After the independence of Mexico in 1821, the international price of cochineal dropped steadily, presumably because of the end to the Mexican monopoly on cochineal and the emergence of competing production in other regions of the world. Despite the fall in prices, it may be noted that annual production of Oaxaca grana (as measured in pounds) increased, a fact which would appear to suggest that peasant producers sought to maintain income levels by intensifying their labors in spite of the drop in profitability and continued to do so for decades. (See Graphs1-4).

The Oaxaca Indian communities and secular production of cochineal

Up to this point, this essay has concentrated attention upon the origins and long-term evolution of the international trade in cochineal. However, in order to understand the complete commodity chain of this dyestuff, it is worthwhile devoting attention to the specific locale and social conditions of production. We will begin with a few

comments on the ecology of cochineal and then summarize some features of the peasant labor involved and local commercial mechanisms.

The name of the most expensive American dye of the ancient regime, “grana cochinilla”, was imported directly from Europe, being derived originally from the old Latin term of *coccina* (in Spanish *cochinilla*), which was used from ancient times to refer to the rich, red colors produced by insects which when desiccated were described as *grana* (little grains). The modern scientific name of the little Mexican insect, which produces the famous dye, is “*Coccus cacti*” which refers to the fact that it thrives upon the cactus known as *nopal*, so abundant in central and southern Mexico.¹⁰

During the colonial era, a natural, wild variety of cochineal, called *Grana silvestre* was found and cultivated in relatively small quantities not only in Mexico but also in Guatemala and in South America (in Peru and Tucumán, Argentina) with up to six annual harvests per year, but producing a relatively low-grade dyestuff. The truly valuable and important variety of cochineal was the domesticated type known as *Grana fina*, being twice the size and producing a much richer dye. However, as Munro notes it could only yield three harvests (May, July

¹⁰ In the colonial era Miño (1994), p.74, notes that it was also known as *Nopalae coccinifera*.

and October) with production levels of about 250 kilos of these insects per hectare of planted nopals. The enormous amount of peasant labor expended can be indicated by the fact that one pound of the final dye known, as "grana cochinilla" required the desiccation of 70,000 of the tiny insects.

The cochineal insects were cultivated with extraordinary care by Mexican Indian peasants on the nopal plants and later killed directly by hot water and then dried (red-brown) or, alternatively, were baked slowly in the hot sun, making them a silver color, or were baked in hot pans or ovens which made the final color of the grains black. Subsequently the grains were packed together using diverse procedures, until, finally, the valuable "bricks" (*zurrones*) of dried dyestuff were ready for shipment.

Originally cultivated in Tlaxcala and several other regions of New Spain, production came to be concentrated in Oaxaca by the late sixteenth century. The high population density of peasant communities in this mountainous territory was an important precondition for the highly labor-intensive cultivation of the *cochinilla* on the nopal plants. Colonial descriptions of the cultivation of cochineal recall evoke the enormous amount of meticulous peasant labor required for the production of silk worms in China and in Europe in the same era.

A complex incentive structure was gradually put in place by the Spanish colonial regime, which made it attractive for Oaxaca peasants to specialize in the production of cochineal. Local agriculture was relatively unproductive due to poor soils and limited markets and high transport costs. The high prices of cochineal, however, allowed Indian families to obtain modest but welcome income from the dyestuffs. In many Oaxaca towns they also obtained income from sale of cotton produced in the valleys and from the manufacture of richly colored textiles.

For the Spanish Crown, there were clear fiscal advantages to the large-scale production of cochineal. Since the Indian communities (called “repúblicas de indios”) were obliged to pay tribute from the sixteenth century to tax collectors of the colonial administration, it was soon stipulated that in Oaxaca they should do so preferentially in cochineal. The royal functionaries made substantial profits by selling the dyestuffs to merchants for silver or gold whereas they had more difficulties in selling other commodities produced by the Indian peasant communities.

But the mechanisms of the colonial administration also included a complex dynamic of mercantile control of the cochineal production and trade, which operated on the basis of a close alliance between

merchants and local bureaucrats who exploited the Indian communities as far as they could. Brian Hamnett and Carlos Sánchez Silva have underlined the coercive methods that were employed to force Oaxaca peasants to produce cochineal from the 16th century through to the end of the colonial regime.

However, coercion was not the only factor involved. Jeremy Baskes has argued that incentives (provided by both merchants and the vice regal administration) help explain the continued specialization of Oaxaca peasants in the cultivation of the cochineal insects and the production of the dyestuff. Certainly, it would appear that the *repartimiento* system (which lasted until 1787) proved quite successful in assuring a consistently large cochineal harvest each year. In very basic terms, *repartimiento* functioned as follows: leading Mexico City merchants advanced funds to Oaxaca merchants who, in turn, provided funds to local bureaucrats (*alcaldes mayores*) in the cochineal producing towns and villages. The functionaries would lend the monies to the peasant in order that they could plant nopal plants or pay for sustenance until the cochineals were harvested and sold. In exchange for the funds advanced the peasants, the latter agreed to return payment to the *alcaldes mayores* with cochineal at a fixed price (lower than the current international price). [See Chart 1.]

That production should have fallen so abruptly after 1784 and continued to remain depressed despite the continuing Oaxaca monopoly of cochineal would seem to suggest that it was the disruption of this complex credit-mercantile mechanism which contributed to the decline of cochineal. But other authors have also insisted that additional factors were involved, such as increasing taxation in the final decades of the 18th century. At any rate, the subject would appear to merit future research.

3) The international networks of trade: merchants and the cochineal trade in America and Europe

While the local production and trade of cochineal inside Mexico had many facets, the international commerce in this valuable dyestuff was of perhaps greater complexity. Its axis originated in Mexico because the Spanish crown made it policy to stimulate a virtual production monopoly of *Grana fina* in the region of Oaxaca. It should also be noted, however, that New Spain was simultaneously important as intermediary for other American dyes, in particular indigo (some produced in Mexico but mostly in neighboring Guatemala) and Campeche wood (Palo de Campeche). Indigo was in particular demand in Europe for the making of blue cloths, while Campeche wood dyes were used for deep blacks, in much demand for religious reasons (in both Catholic and Protestant countries) as well as for the clothing of the expanding middle classes in Europe.

Cochineal was distinguished from the other dyes because of its greater (and more specialized) demand and higher prices. This probably explains why it appears more prominently in the correspondence of international merchants from the sixteenth down to the early nineteenth century. Moreover, the possibility of cornering the market in cochineal was apparently greater than in the case of the other dyestuffs and, hence, was generally seen as offering more potential for profit-taking by those in a position to invest large sums in such speculations.

From the mid-16th century, leading European merchants and merchant bankers became as interested in cochineal as they were in other high value commodities with low weight such as precious metals, pepper or alum, which made them easily transportable and the object of financial speculation (although they could also lead to strong losses if prices did not evolve as predicted). At any rate, the relatively small volume of cochineal stocks facilitated frequent price manipulations by the oligopoly of mercantile firms, which controlled the bulk of cochineal stocks in European ports.

Felipe Ruíz Martín has described clear examples from the late sixteenth century of attempts to corner the cochineal markets in Europe. According to this distinguished Spanish economic historian,

the cochineal trade inside Europe was very soon dominated by groups of Spanish and Italian merchant bankers, a number of them closely linked to the finances of the Habsburg monarchy. These merchant bankers were engaged in the trade circuits linking Seville/Cadiz, Genoa, Livorno and Florence. The cochineal arrived from Mexico to Seville and Cadiz and from there was redistributed to the rest of Europe. Most of the cochineal which went to Italy went to Livorno was transported in the same ships that brought the famous merino wool that was also a primary commodity for the Florentine luxury textile manufacturing sector. A close look at the Livorno trade—following the classic studies by Braudel and Romano could prove fruitful in this regard.

Ruiz Martín edited a selection of the abundant correspondence of the Spanish merchant, Simon Ruiz, with Italian merchants which includes extremely frequent references to cochineal, there being 290 citations in the select correspondence published.¹¹ The most spectacular speculative operation related to cochineal cited was that carried out in 1585 by the Florentine merchant banking family known as the Capponi who, in alliance with the powerful Maluenda merchant bankers of Burgos, Spain, attempted to corner the entire shipment of cochineal from Mexico arriving at Seville that year of 1585 . They

¹¹ The mercantile correspondence of Simón Ruiz is among the richest in that of contemporary Europe, including over 6,000 letters, now in deposit

also bought up the bulk of stocks in other European ports in order to reinforce a strategy aimed at gaining a virtual monopoly of the valuable dyestuff. The ambitious plans of the speculators were quite successful and allowed them to push prices upwards, although there was stiff resistance by the artisans in the leading textile centers of Europe. Ruíz Martín notes that in some cases the decline in demand obliged the merchants to offer extended time spans for payment of the cochineal.¹²

A review of the trade in cochineal over the seventeenth and eighteenth centuries indicates that speculation continued to be an astonishingly common feature of the international trade in this dyestuff. In 1788, two centuries after the example cited of Italian merchant bankers who tried to corner the cochineal market, we can find that two of the leading merchant banks of Europe, Hope and Company of Amsterdam and Baring Brothers of London, were hard at work attempting the same feat, but with rather more mixed results.

Marten Buist, the historian of the merchant-banking firm of Hope and Company, has described the great cochineal speculation of 1788 in considerable detail. The operation involved buying up most of the stock of cochineal in all the principal European ports: Cadiz,

at the University of Valladolid: Ruíz Martín (1965).
¹² Ruíz Martín (1965), pp.125-128.

Marseilles, Rouen, Genoa, Amsterdam, London and even Saint Petersburg, with the object of obtaining a virtual monopoly. The transactions required particular attention to acquisition of practically all the dyestuffs received from Mexico in Cadiz. Failure there would condemn the whole, vast transaction. The agent of Hope at Cadiz was not entirely successful in this part of the project and there were other ports in which rival merchants were able to buy up substantial stocks of cochineal, probably because they had got wind of the aims of the Hope/Baring alliance. As a result, the monopoly was nowhere complete and attempts to rig prices failed, causing substantial financial losses to the main partners in the speculation.¹³

[INSAERT CHART 2]

But European merchants were not alone in the international cochineal business. Some of the great eighteenth century mercantile firms of Mexico City and Veracruz were also heavily involved in the management of this complex commodity chain on the American side and in its connections to both Europe and Asia. Studies by various historians on the operations of the wealthy house of the Iraeta merchant family of Mexico City reveal the complexity of the control of trade inside New Spain and of the connections to Cadiz merchants, on the one hand, and to Asian markets for cochineal via the Manila Galleon, on the other. Similarly, Brian Hamnett's pioneering work

¹³ Buist (1974), chapter 15, has a fascinating description.

describes the complex transactions of other Mexican merchant firms which were heavily involved in the cochineal trade in the late eighteenth century.¹⁴

International competition and the decline of Mexican cochineal, 1820-1870

The last and weakest part of this essay (at least at this stage) raises the issue of why the cochineal trade declined in the nineteenth century. It is well known that the Spanish Crown was remarkably successful in maintaining a virtual Mexican monopoly of cochineal production from the sixteenth century down to 1820. It is also known that already in the late eighteenth century, the French botanist Thierry de Menonville smuggled some cochineal insects out of New Spain and took them to Saint Domingue (Haiti) where he attempted to promote their cultivation, but without success.¹⁵

However, it is less well known that from the mid 1820s- after Mexican independence cochineal began to be cultivated successfully and on a large scale in nearby Guatemala and in the Canary Islands. Indeed, cochineal became the leading export from both Guatemala and the Canary Islands between the 1820s and the 1850s.¹⁶ The results of the increase in cultivation and production of the dyestuff were dramatic, causing a steady price decline per pound. Despite this

¹⁴ Hamnett (1971), *passim*.

¹⁵ Sarabia Viejo (1994), pp.35-36.

turn of events, Oaxaca peasants responded by increasing production after 1824 , although profitability was falling, year by year.

Then, at mid-century came advances in the chemical dye industries in Germany, and progressively natural dyes were substituted by synthetic ones until cochineal became something of a curiosity. This last chapter in the declining history of cochineal is a subject on which further research is required.

¹⁶ See Heers (1961) and Rubio Sanchez (1994).

Chart 1
The Cochineal trade:
Mercantile networks in Mexico

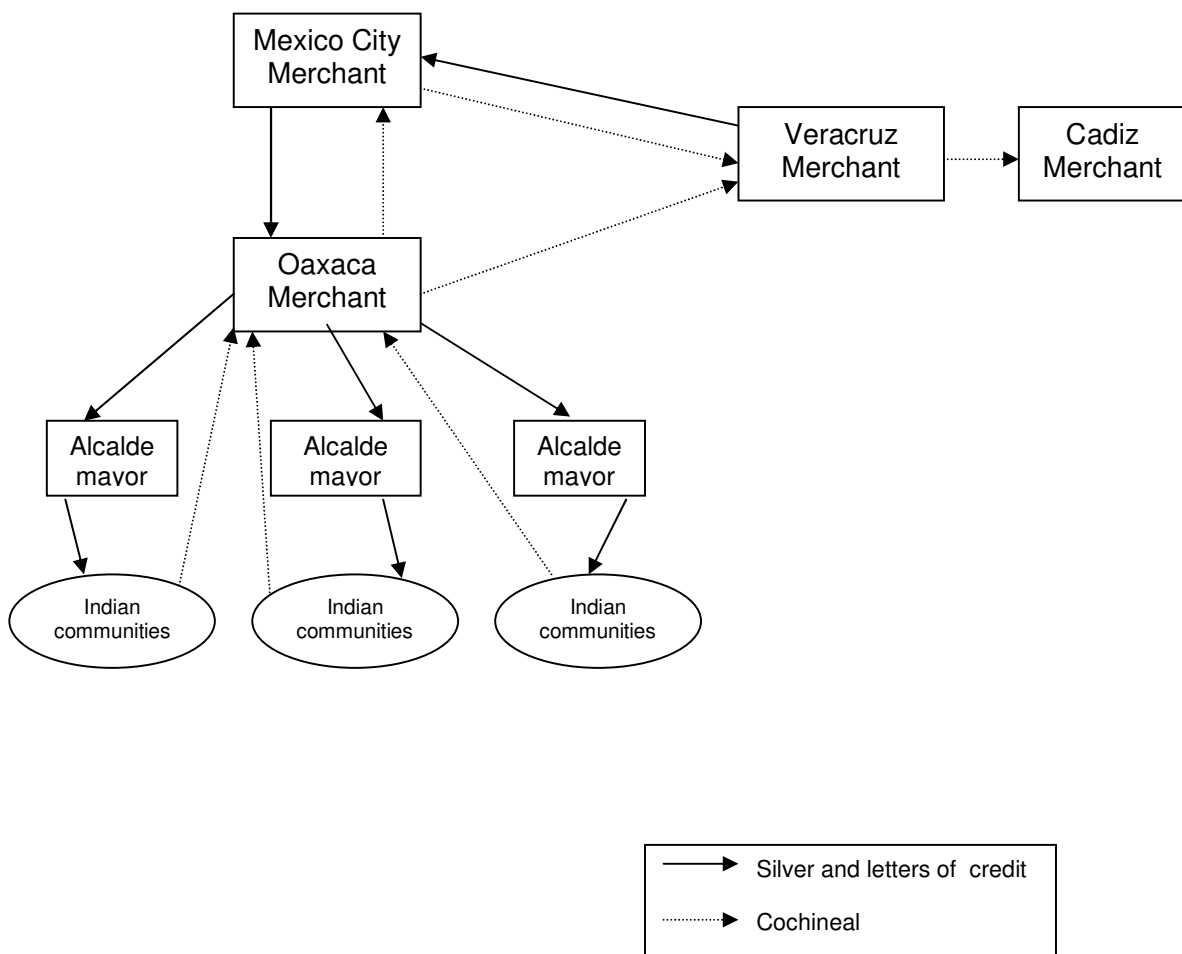
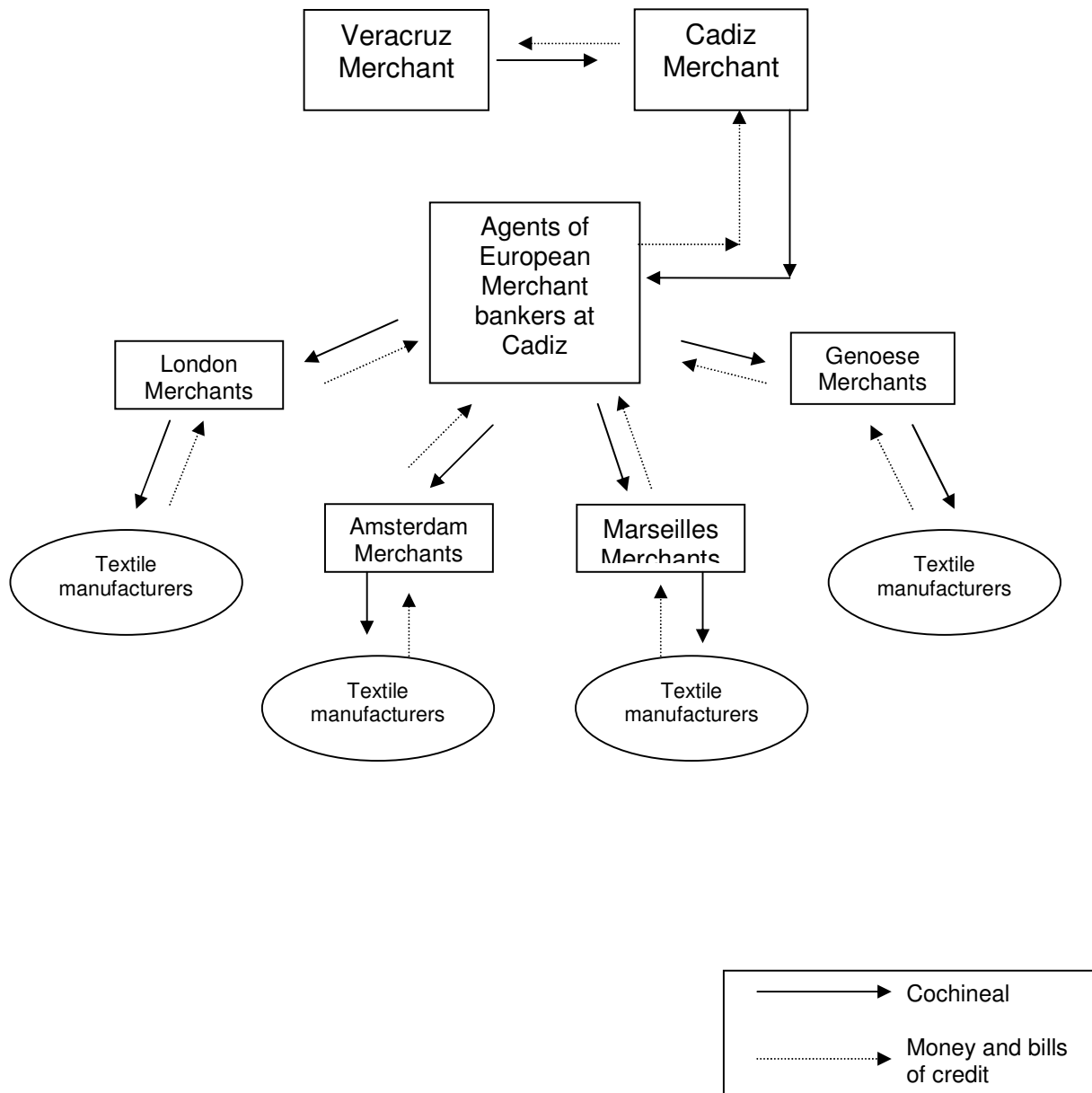
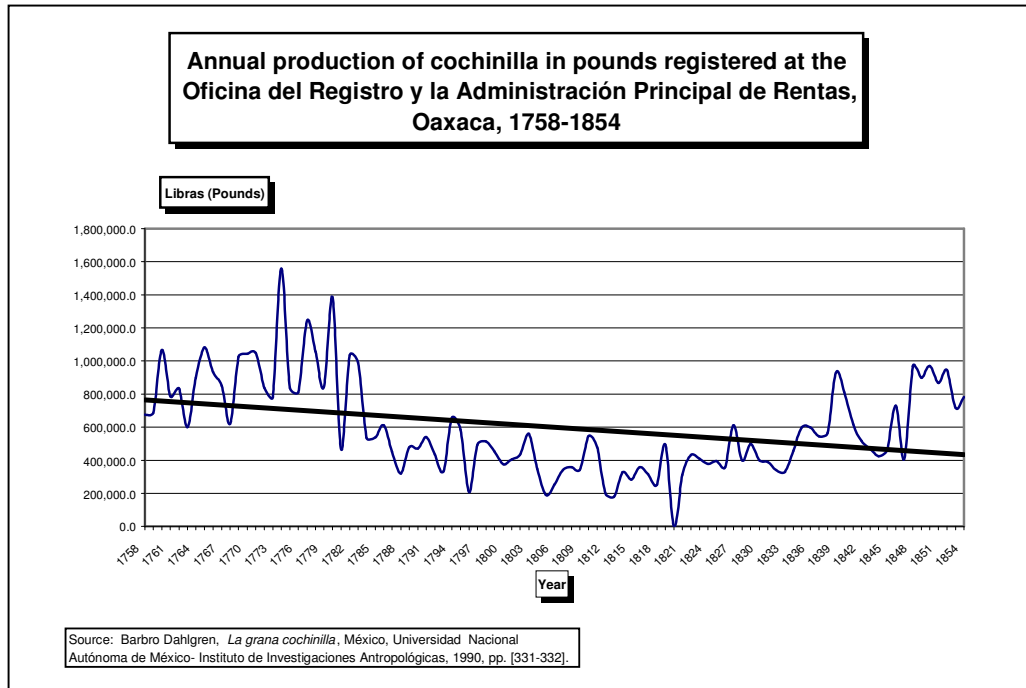


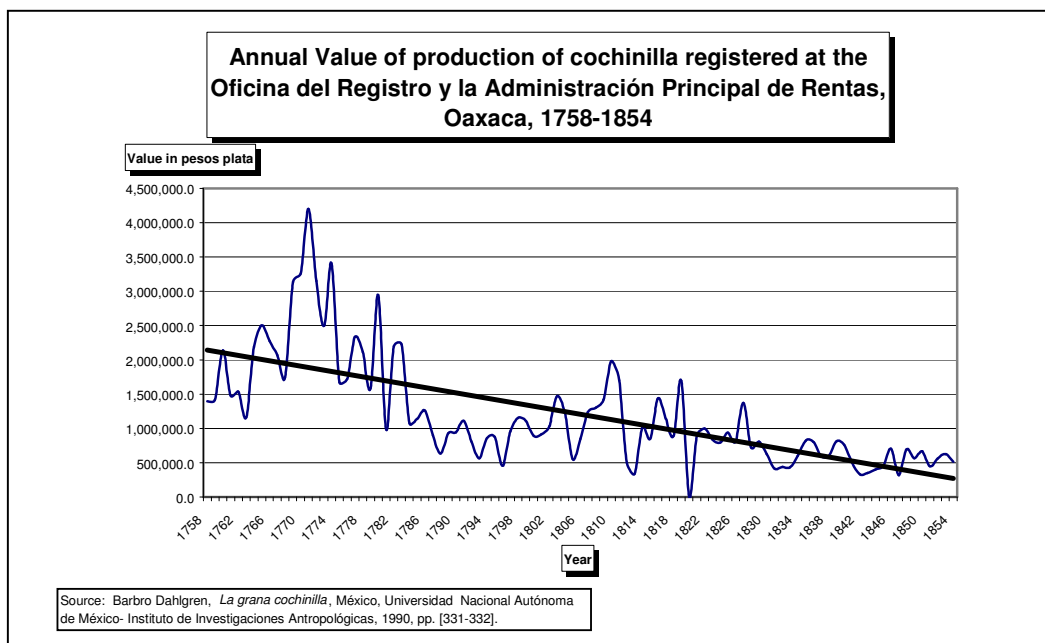
Chart 2
The commodity chain of cochineal from Veracruz to Europe, circa 1780



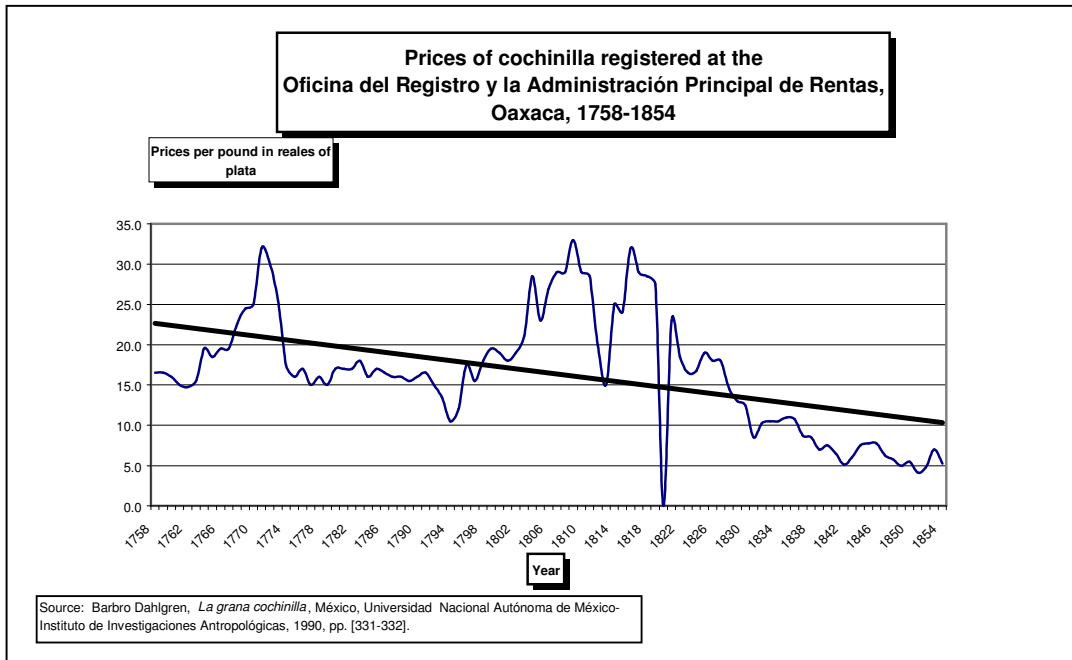
Graph 1



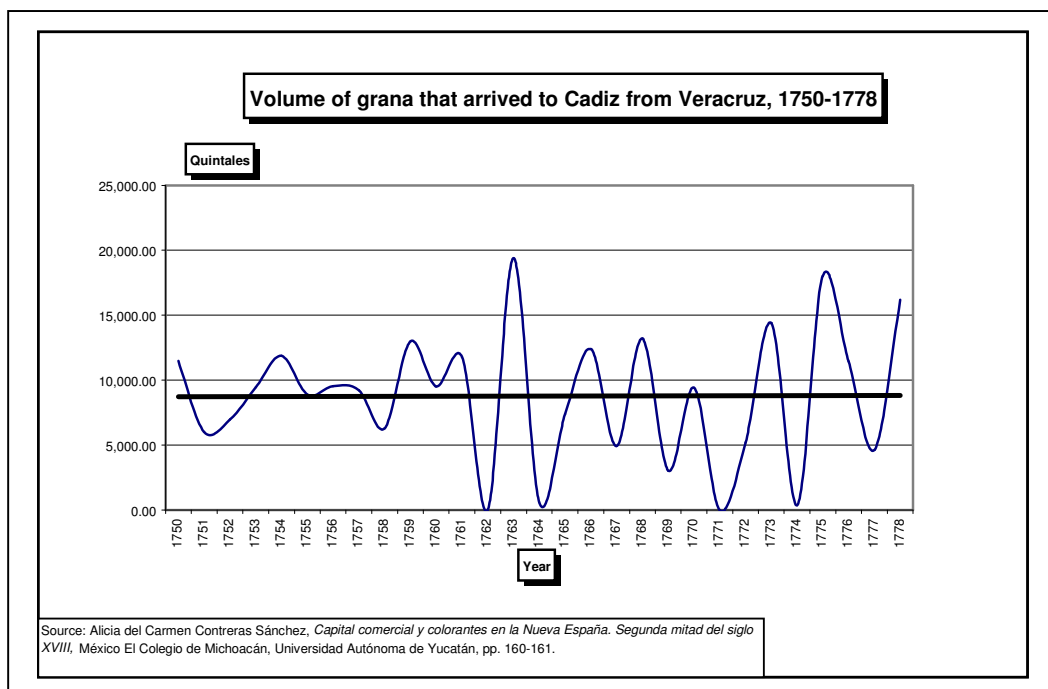
Graph 2



Graph 3



Graph 4



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