Introduction

The Odyssey of Indigo

Indigo was the quintessential blue dye in the era when dyes were extracted from plants and minerals. The world, it seemed, had been extracting dye from the indigo plant forever. Knowledge of indigo as a source of blue dye would have been widespread wherever the plant grew. After all, the leaves of indigo yielded the color in small quantities on mere pressing or squeezing. In those times deep in history when the knowledge of indigo culture had not become specialized or attached to large-scale production for commerce, indigo dye's prevalence to a large extent was determined by climate. Indigo was fundamentally a plant of the Tropics that could not be grown in temperate climates. Europeans mostly drew their supply of blue dye from another plant of a related family, woad. A good amount of indigo was also obtained from the Orient even though the difficulty of transportation over long, land-based routes drove up its price and curbed its full-scale use in the West. It is known that Oriental indigo was available in ancient Egypt and in the Greco-Roman world going back to the second millennium B.C. The oldest global networks of indigo production had significant ties to the Indian subcontinent even though it is hard to specify those connections precisely.[1] The use of indigo rose in

[1] The Indian subcontinent was central to the early history of indigo. Scholars have commonly inferred that indigo was in use in India in the protohistoric city of Mohenjodaro in the second millennium B.C. Etymological evidence connects indigo's deep history with India. Jenny Balfour-Paul has given an account of indigo's history in the ancient and medieval periods. She wrote, "The last two millennia of indigo's economic history are neatly encapsulated in its names." The word "indigo" derives from the Greek *indikon* or Latinized *indicum*, which meant a substance from India. In addition, the Sanskrit word *nila*, or deep blue, spread from India to both Southeast Asia and the Near East and from the latter through Arab Muslim merchants to northern Africa and Spain and Portugal and lies at

the medieval period though monarchical states in Europe enforced a ban on its import in an attempt to shore up the local woad industry, and the centrality of Asia and the Indian subcontinent as a source of the blue dye continued.[2] The European blockade of indigo ended at the cusp of the modern era. The new Europe in the age of commercial revolution began to procure indigo from Asia in vast quantities as the emerging trading companies improved the connectivity of Europe with Asia and brought down the price of imported indigo. As a consequence, plant indigo was able to defeat woad on its own terrain in the West and emerged as the universal blue colorant of the modern world.[3]

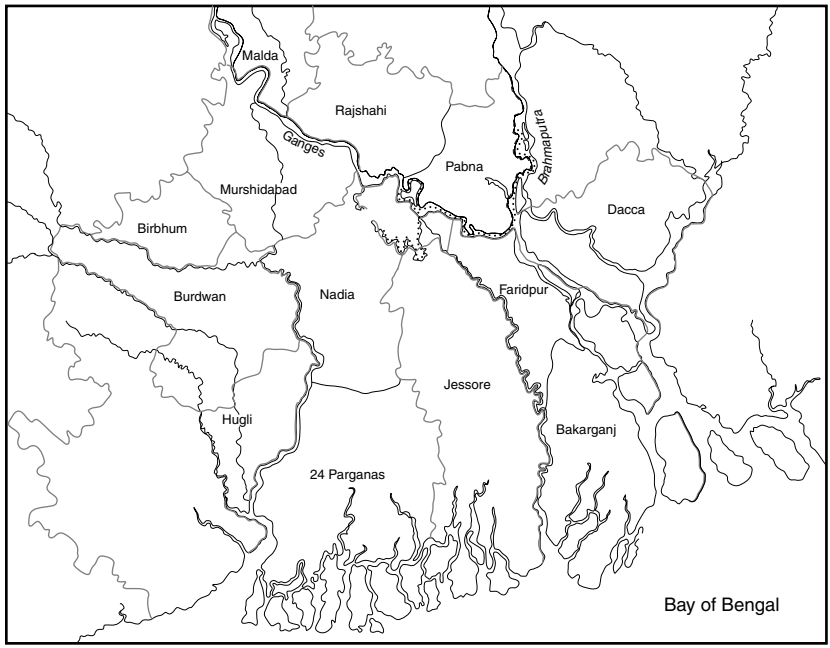
The history of indigo entered a new phase with the emergence of plantations in the seventeenth century. The plantations involved large-scale cultivation of indigo, managerial supervision by European planters, and the use of servile labor in various forms. The plantation life of indigo started in the Caribbean, South and Central America, and the American South, where modernizing trends in its production were apace before their appearance in South Asia. From the mid- to the late seventeenth century, the West Indian colonies, both English and French, and the Spanish controlled parts of Central America came to be the major suppliers of indigo to Europe. As English colonies in the Caribbean moved to the cultivation of other products, British imperial trade interests ensured the onset of indigo cultivation elsewhere within the empire. Indigo plantations first arose in South Carolina in the last three decades of the seventeenth century. But Carolina indigo could not meet the needs of the home market in Britain. It was also of an inferior quality compared to varieties emerging from Spanish Guatemala or the French Saint Domingue. A century later, the English East India Company officials based at Surat and Cambay were still trying to introduce indigo manufacturing in the presidencies of Madras and Bombay. But such efforts proved to be nonstarters.[4] Similar efforts, however, to shepherd the birth of indigo plantations in Bengal

the root of the Iberian word *anil* for indigo. Jenny Balfour-Paul, *Indigo,* London: British Museum Press, 1998; see chapters 2 and 3, pp. 11–88, quote on p. 11.

[2] Jenny Balfour-Paul, *Indigo,* London: British Museum Press, 1998.

[3] For the contest between woad and indigo in seventeenth-century Europe, see, Gosta Sandberg, *Indigo Textiles: Technique and History,* Asheville, N.C.: Lark Books, 1989, pp. 24–43.

[4] As Ghulam Nadri has recently pointed out, English officials made concerted efforts to poach on the surviving techniques of indigo culture in Gujarat, still an important manufacturer region, in order to start indigo production elsewhere on the subcontinent. Ghulam Nadri, *Eighteenth-Century Gujarat: The Dynamics of Its Political Economy, 1750–1800,* Leiden and Boston: Brill, 2009, p. 133; also see, notes 23 and 24.



MAP 1. Indigo manufacturing districts in Bengal in the early nineteenth century

by company officials in the last quarter of the eighteenth century proved magnificently successful. European planters, speculators, bankers, and traders responded positively to the encouragement given by the colonial state. After initial fits and starts, the plantations in Bengal began to expand at a feverish pace. At the beginning of the nineteenth century, Bengal had emerged as the predominant supplier of indigo to the world. The indigo plantations were mainly concentrated in the Lower Bengal districts as shown in Map 1.

This book is a story of indigo based on a case study of plantations in colonial Bengal.[5] The Bengal plantations had a lineage extending back to

[5] The dominant period of indigo plantations lasted from roughly the mid-seventeenth century to the end of the nineteenth century. In this age, plant indigo ruled the world of dyes. The use of indigo for dyeing and printing in blue was practically universal in this period. While there were a few minor blue dyes made from other sources such as minerals the currency of such blues was minor. Augusti Nieto-Galan, *Colouring Textiles: A History of Natural Dyestuffs in Industrial Europe,* Boston: Kluwer Academic Publishers, 2001, pp. 17–19. Also, the color shellfish purple was obtained from shellfish in the Roman and Byzantine Empires. But no reference is found to its use after the mid-fifteenth century. *Cf.* Jenny Balfour-Paul, *Indigo,* London: British Museum Press, 1998, pp. 14–15.

the period of the early rise of indigo plantations in the Caribbean. For a century and a half Bengal indigo was the object of major efforts to give it a modern form driven by changes in the worlds of knowledge, science, and trade. The Bengal plantations also turned out to be the last major holdout against the expanding sway of synthetic indigo. They lasted long after all other indigo plantations had decayed in the face of competition from the synthetic substitute. In short, the indigo of Bengal was central to the history of indigo from the beginning to the end. Thus Bengal plantations offer a compelling case study for analyzing the early genealogy, nineteenth-century consolidation, and late nineteenth- and early twentieth-century crisis and demise of agricultural indigo.

This is also a history of Bengal indigo in a global dimension. The history of indigo was not constrained by developments in the colonial locality alone. Rather, at each stage, this history was imbricated with genealogies extending to the prior period on the subcontinent and, in parallel, to developments beyond the subcontinent. This bifurcated genealogy was apparent even at the moment of the launch of plantations in Bengal in the last quarter of the eighteenth century and has previously drawn the attention of historians. For example, the historian of indigo enterprise in Bengal, Blair B. Kling, tried to capture Bengal indigo's antecedents on the subcontinent, saying, "From the seventeenth to the twentieth centuries indigo was a fugitive among industries, wandering from Gujarat in western India to the West Indies and then back to Bengal in eastern India."[6] Indigo production evidently had a long history in India. The chroniclers of the sixteenth- and seventeenth-century Mughal court in India and travelers have attested to the high level of output of indigo on the Indian subcontinent. The early records of European trading companies also attest that a good part of India's indigo was shipped at first by Armenian merchants and then increasingly by the Portuguese, Dutch, and English traders to the West.[7] As Kling rightly implied, any history of Indian indigo that singularly focuses on the novelty of the indigo enterprise in colonial Bengal runs the risk of minimizing indigo's local lineages

[6] Blair B. Kling, *The Blue Mutiny: The Indigo Disturbances in Bengal, 1859–1862,* Philadelphia: University of Pennsylvania Press, 1966, p. 15.

[7] W. H. Moreland and P. Geyl (trans. and ed.), *Jahangir's India: The Remonstrantie of Francisco Pelsaert,* Delhi: Idarah-i-Adabiyat-i-Delli, 2009, pp. 10–18; Jean Baptiste Tavernier, *Travels in India by Jean-Baptiste Tavernier, Baron of Aubonne,* translated from the original French edition of 1676 by V. Ball, second edition, edited by William Crooke, 2 vols., London: Oxford University Press, 1925; see vol. 2, *Concerning Indigo*, on pp. 8–12.

on the subcontinent. Indigo was prevalent in many regions of India and may even have been cultivated, used, and imported into Bengal before Europeans launched their plantations.[8] This earlier system of indigo manufacturing on the subcontinent already contained the basic elements involved in the culture of indigo.[9] It is also possible to show lines of influence between the prior culture of indigo in India and the emergent modern plantations in the Western Hemisphere as well as in Bengal. But despite such continuity, the indigo in Bengal in the last quarter of the eighteenth century had clearly entered a new career. For one, it departed from all prior Indian indigo production systems in that colonial capital was its primary driver. Even more importantly, however – and this is critical in terms of the existing gaps in indigo historiography – any claims of continuity from premodern local roots on the Indian subcontinent overlook the major changes in techniques and knowledge of indigo culture that transpired in a transnational dimension over the seventeenth and the eighteenth century. It is in the knowledge dimension that the Bengal plantations make their best claim for novelty from the previous regimes of production.[10]

From the beginning of the nineteenth century colonial South Asia was the largest exporter of indigo and remained so for the rest of the century alongside Java in Southeast Asia, Guatemala in Central America, and a few other minor areas of production. One turning point occurred in the middle decades of the nineteenth century. A movement against

[8] See a discussion of this aspect in Indrajit Ray, *Bengal Industries and the British Industrial Revolution (1757–1857)*, London and New York: Routledge, 2010, p. 210.

[9] Iqtidar Alam Khan, "Pre-modern Indigo Vats of Bayana," *Journal of Islamic Environmental Design Research Center* (1986): 92–8; K. K. Tivedi, "Innovation and Change in Indigo Production in Bayana, Eastern Rajasthan," *Studies in History* 10 No. 1 n.s. (1994): 53–79, see, p. 68.

[10] The historiography of indigo production in colonial South Asia is rich. The violence of indigo manufacturing as a colonial enterprise and the exploitation of Bengal peasantry engaged in the cultivation of indigo have been well documented. But these studies typically do not examine the technical context of indigo plantations even as they participate in the critique that the colonial industry was based on "antiquated" technique and primarily geared to exploit the cheap labor of natives. Benoy Bhushan Chowdhury, *Growth of Commercial Agriculture in Bengal, 1757–1900*, Calcutta: India Studies, 1964, 80–124; especially see his summation on 123–4. A major critique of indigo manufacturing by Chowdhury is articulated around the fact that profits from the colonial enterprise were not plowed back into improving the industry and its workings, but rather repatriated to Britain. Jacques Pouchepadass, *Champaran and Gandhi: Planters, Peasants and Gandhian Politics*, Delhi: Oxford University Press, 1999; see, 49–58 for a description of manufacturing labor, 127–36 for his analysis of appropriation of surplus from the peasantry, and 65–6 for a summation of his critique of the primitive characteristic of cultivation and manufacturing.

planters between 1859 and 1862 wiped out the indigo industry from Lower Bengal, which was the geographical pivot of indigo manufacturing on the subcontinent. This movement, called "blue mutiny," reflected the anger of the indigo peasantry against the excesses of European planters. But the popular movement failed to banish the industry from Bengal. The center of gravity of the colonial indigo industry simply shifted elsewhere to north Bihar within the Bengal Presidency.

Meanwhile rumblings of a deeper change in the world of dyes that were slowly coming to the surface would determine the future of Bengal indigo. The plant-derived dye began to face the new reality of market competition from synthetic dyes that were extracted industrially from coal tar–based hydrocarbons. The synthetic dye industry had its birth in England and France in the middle decades of the nineteenth century. But as the century progressed, Germany took the lead in the industrial production of synthetic dyes. Most critical advances in dye science based on organic chemistry and innovations in dye manufacturing took place in Germany, which cornered much of the world's trade in synthetic dyes in the last quarter of the nineteenth century. Synthetic dyes were pure and generally cheaper than natural dyes. Many variants of synthetic dyes, the anilines and alizarins in particular, were made available to the users of natural indigo. But by and large these alternates only supplemented the supply of blue and in the context of increasing use of indigo worldwide never really displaced natural indigo from the market. The plant-derived indigo held its position against the early synthetic blues.[11]

The challenge from synthetics intensified, however, with the launching of synthetic indigo by the German company, Badische Anilin and Soda Fabrik (BASF), in 1897. Synthetic indigo progressively ate into natural indigo's erstwhile markets in the West as additional German companies and their subsidiaries also started producing the synthetic substitute. The planters in Bengal were now called upon to take measures to produce cheaper and purer agricultural dye in order to compete with synthetic

[11] There exist many histories of the rise of the synthetic dye industry based on the archives of synthetic dye companies in the West. These studies have predictably not focused on the longevity of natural dyes and the resistance offered by them. A singular focus on synthetic dyes in the histories of transition tends to "naturalize" the death of agricultural dyes and furnishes a somewhat triumphalist understanding of the rise of synthetic dyes. John J. Beer, *The Emergence of the German Dye Industry,* Urbana: University of Illinois Press, 1959; Anthony S. Travis, *The Rainbow Makers: The Origins of the Synthetic Dyestuffs Industry in Western Europe,* Bethlehem, Pa.: Lehigh University Press, 1993; Carsten Reinhardt and Anthony Travis, *Heinrich Caro and the Creation of Modern Chemical Industry,* Dordrecht: Kluwer, 2000.

indigo in the international market. The effort to improve natural indigo after the introduction of synthetic indigo was largely determined by the nature of competition from a consistent and cheaper industrial product. The planters embraced modern laboratory science in an effort to make the natural dye purer and to lower its cost of production. This program of improvement in the colony continued for more than two decades. It was finally stopped when trade losses produced a sense of hopelessness with regard to the prospect of revival of indigo plantations. By the closing years of the First World War synthetic indigo seemed to have won unequivocally in the market, and, as a result, scientific efforts to improve natural indigo in the colony ceased in 1920.

Analyzing the Knowledge of Indigo Culture: Historiographical Constraints

In following the odyssey of plant indigo this book's fundamental project lies in uncovering the various knowledge forms surrounding indigo. This knowledge existed in multiple forms, such as textual knowledge describing ideal methods of cultivation and processing, information passed along continents and circulating among indigo manufacturers, the awareness of optimal agricultural and environmental conditions, the epistemic component of techniques of indigo manufacturing in use, and the knowledge attached to the practice of indigo culture. At its functional end, this knowledge was geared toward improvement[12] of the indigo plant and the processes involved in indigo culture. Improvement from the planter's perspective meant increasing the yield of the crop in the field and growing better plants with a higher content of color. On the manufacturing side, improvement meant reducing the price of the commodity either by

[12] Slightly different studies of "improvement" as a societal goal or imperial project have appeared elsewhere. Joyce Chaplin, *An Anxious Pursuit: Agricultural Innovation and Modernity in the Lower South, 1730–1815,* Chapel Hill and London: University of North Carolina Press, 1993; see particularly pp. 23–65; David Arnold, *The Tropics and the Traveling Gaze,* Delhi: Permanent Black, 2005; see the stating of his position on improvement on p. 6; Richard Drayton, *Nature's Government: Science, Imperial Britain, and the "Improvement" of the World,* New Haven, Conn., and London: Yale University Press, 2000. The construct of improvement as a colonial project for changing Indian society appears frequently in South Asian historiography: "[Quite early on,] by the end of Lord Cornwallis's years as governor-general (1786–93), the British had put together a fundamental set of governing principles. For the most part these were drawn from their own society, and included the security of private property, the rule of law, and the idea of 'improvement.'" Thomas Metcalf, *The New Cambridge History of India: Ideologies of the Raj,* Cambridge: Cambridge University Press, 1995, p. 17.

cutting labor costs on factory processes or by making extraction efficient. The claims regarding knowledge of improvement had to be validated in the marketplace. The market players placed value on the dye produced in certain ways. The users accepted or rejected the claims of improvement. The knowledge of indigo culture was evidently created in different locations and spaces and validated in laboratories and far-off markets.

The methods of knowledge production evolved during the long history of indigo plantations. Flow and exchange of information across the planters' diasporas in the Atlantic system of the seventeenth and eighteenth centuries and the honing of skills and craft practices at the hands of planters and peasants laid the foundation of the indigo knowledge system. Useful information on indigo cultivation and manufacturing was committed to and codified in a few foundational texts, which were then translated and disseminated widely. Some of these important indigo texts found their way to Bengal on the Indian subcontinent and influenced planters' craft even as they were modified in a local context of application. Indigo itself had to adjust to local landscapes in Bengal – both physical and social. Local climate put a limit as to what type of knowledge could be actually put into practice in the cultivation and processing of indigo.

The rise of empiricist trends in modern science over the nineteenth century altered how the knowledge of indigo culture was generated. These changes undergirded the transformation of indigo knowledge from its earlier moorings in natural history and craft practices into the shape of a more formal, discipline-based, and laboratory-edified science in the second half of the nineteenth century. Toward the close of the nineteenth century these methods underwent further transformation as planters and the colonial state established laboratories and agricultural stations to alter plant indigo. The establishment of these institutions transpired in the shadow of the rise of agricultural stations as the predominant institution for applying principles of agricultural science to the practical task of improving productivity.[13]

[13] The more specific form of "experiment stations" rose in mid-nineteenth-century Germany and then later spread to other nations and continents. Margaret W. Rossiter, *The Emergence of Agricultural Science: Justus Liebig and the Americans, 1840–1880*, New Haven, Conn.: Yale University Press, 1975; it has been argued that England's premier agricultural research station at Rothamsted itself underwent reorganization in the model of continental experiment stations in the early twentieth century. For England's longer-term tradition of agricultural research, see, E. J. Russell, *A History of Agricultural Science in Great Britain, 1620–1954*, London: George Allen & Unwin, 1946.

This is a social history that focuses on the nature and circumstances of production of indigo knowledge. Seen one way, indigo knowledge was a body of information associated with a technical process. Seen another way, indigo knowledge was also "colonial knowledge" as variously interpreted in the existing social histories of South Asia, that is, a social form embedded within colonial relations. The tracks followed by the history of science and South Asian history are both indispensable for generating a complete understanding of the knowledge of indigo culture. The former helps uncover the constructed nature of the technical aspects of indigo culture. But a full recovery of the social dimension of indigo culture requires analysis of the larger context of colonial relations as studied in area study approaches in South Asian history. Indeed the book contends that the study of indigo knowledge requires a simultaneous consideration of textual knowledge, natural history, modern scientific practice, institutional dynamics, colonial relations, and the political economy of colonialism.

But the study of science in South Asian historiography has so far evolved along two parallel tracks – works that cover colonial science and works that cover the social history of science in colonial South Asia. Their respective philosophical orientations and theoretical borrowings have led them in different directions, and they have built their own respective momentums in isolation from one another. Thus South Asia historians who study "science" fall into one group or the other. The partiality in favor of analysis in one or the other framework also accounts for the apparent chasm that separates the study of science so far. This mutual obliviousness is unfortunate because each field has much to contribute to the other and even more so because, as this study argues, the gap between the two fields is not unbridgeable.

The field of colonial science in South Asia, while invested in analyzing broader questions of colonialism and modernity, has maintained a separate identity because of the agenda that the field has defined for itself. With its broad moorings within the classical history of science in the West and imperialism studies, the field has dwelled in a collection of issues around transfer and movement of knowledge, science as a tool of empire, and the nature of engagement between Western and native knowledge systems.[14] It is within this larger agenda that the field of colonial science approaches the "social."

[14] The history of science field delved into sociology of knowledge with a corresponding focus on the social context in a separate trajectory of its own. As Jan Golinski has

On the other hand, the social study of science in South Asian historiography has emerged out of traditions of investigating knowledge as a social form, evolving on two parallel tracks. Among the earlier generation of historians, Bernard Cohn used the trope of knowledge to investigate the social history of colonial India. Cohn argued that the initiatives ranging from revenue measures to the creation of Orientalist scholarship on India or the collection of historical artifacts from the Indian past were not benign but rather represented an effort to understand, codify, and rule India. Thus, in this rendering, India's castes and tribes or its museums or brahmanical religion, all were alibis for or stood for colonial knowledge.[15] Another important moment in the expanding use of knowledge frameworks was reached with the publication of Edward Said's *Orientalism* in 1978. Said addressed the knowledge implicit in Western texts as European representations of non-Western peoples. South Asianists combined Said's analysis with the new understandings of knowledge from the fields of postcolonial theory and literary theory to focus on discursive formations and on language as sites of knowledge formation. In particular, Michel Foucault's notion of discursive formations made a major impact with ideology, science, and social science theory – all of the latter, as "domains of objectivity" – becoming open

illustrated, postwar accounts of history of science opened up to inputs from the growing field of sociology of knowledge. The time was opportune because history of science was gradually moving out of the older tracks of documenting progress and the discovery of a preordained "nature" toward a more historicist project of contextualizing. In this new intellectual environment historians were ready to embrace an understanding of historical development of knowledge marked by "discontinuities and transformations" rather than mere "forward movements." But Golinski also pointed out a subsequent countermovement in the consideration of the social in the research program of the history of science. He argued that the rise of the constructivist program from the 1970s has caused a reduction in the scale of the "social" that is analyzed by historians of science. The targeted focus on specific episodes, controversies, and ethnographic look-in at the laboratory has caused a "trend away from macrosocial explanations." Jan Golinski, *Making Natural Knowledge: Constructivism and the History of Science,* Cambridge: Cambridge University Press, 1998, pp. 2–4, 10–11.

[15] Bernard Cohn's writings appeared in various publications from the 1950s to the 1980s and are published as two major collections: Bernard Cohn, *An Anthropologist among the Historians and Other Essays,* Delhi: Oxford University Press, 1990; *Colonialism and Its Forms of Knowledge: The British in India,* Princeton, N.J.: Princeton University Press, 1996. These understandings of social forms and things as knowledge were the result of Cohn's ties with the historicist traditions within American anthropology in which culture was the "common frontier" of anthropology and historiography. See "Introduction" by Ranajit Guha in Bernard Cohn, *An Anthropologist among the Historians and Other Essays,* pp. vii–xxvi, and "Foreword" by Ronald Inden in Bernard Cohn, *Colonialism and Its Forms of Knowledge,* pp. ix–xvii.

to critique as knowledge or discourse.[16] Other South Asia historians dissent from such culturist interpretations of South Asian social history. These historians work in traditions that do not entirely depend upon the explanatory templates of discourse and representation but nonetheless cover subjects that would pass for knowledge in the postcolonial and cultural formulations.[17]

The different renderings of knowledge and the associated difference in perspective on colonial power, the resilience of the local society, and the place of native traditions have left their imprint on the studies of science, medicine, and disease within the historiography of South Asia. The existing studies of science and medicine reflect those broad differences. On the one end, Gyan Prakash has used postcolonial theories within a broad cultural history approach to study modern science *as* knowledge in the colony. Prakash's study focused on the cultural authority of science launched by the colonialists, which was subsequently embraced by elite

[16] "Whenever one can describe between a number of statements, such a system of dispersion, whenever, between objects, types of statement, concepts, or thematic choices, one can define a regularity (an order, correlations, positions and functionings, transformations), we will say, for the sake of convenience, that we are dealing with a *discursive formation* – thus avoiding words that are already overladen with conditions and consequence, and in any case inadequate to the task of designating such a dispersion, such as 'science', 'ideology', 'theory', or 'domain of objectivity.'" Michel Foucault, *The Archaeology of Knowledge and the Discourse on Language*, French edition, 1969, trans. A. M. Sheridan Smith, New York: Pantheon Books, 1972, p. 38; Homi Bhabha (ed.), *Nation and Narration,* London: Routledge, 1990; *The Location of Culture,* London: Routledge, 1994.

[17] Christopher Bayly's study of social communication in colonial India is an excellent representative example of the study of "information" as against knowledge in a social history tradition. C. A. Bayly, *Empire and Information: Intelligence Gathering and Social Communication in India, 1780–1870,* Cambridge: Cambridge University Press, 1996. There has been a raging critique of the analytical path of seeking and explaining discursive knowledge in South Asian history by those who follow the tracks of social history. Aside from several specific notes that have pointed out gaps in the postcolonial program built around Orientalism, representation, and discourse, others have spoken of the merit of social history. Sumit Sarkar has strongly argued the benefits of the tradition of evidence-based social history that attends to social, political, economic, and intellectual contexts in greater detail. In particular, he has spoken of the values of social history traditions exemplified in the works of E. P. Thompson. Sarkar's critique represented a broader response to the "cultural turn" represented by the subaltern school in Indian historiography. Sumit Sarkar, "Orientalism Revisited: Saidian Frameworks in the Writings of Modern Indian History," *Oxford Literary Review* 16 (1994): 205–24; *Writing Social History,* New York and Delhi: Oxford University Press, 1997. A number of other scholars have alluded to what is left out in the generalizations built around the study of discursive knowledge formations. See, for instance, Benita Parry, "Problems in Current Theories of Colonial Discourse," *Oxford Literary Review* 9 Issue 1–2 (1987): 27–58.

nationalism and still later by the postcolonial elites. The latter inscribed "difference" on this science in their counterhegemonic drive even as they pressed their own claim to modernity through science.[18] Other historians have applied the notion of discursive knowledge to varying extents. David Arnold has taken a somewhat middle-of-the-road approach between cultural history and social history. Arnold emphasized the power of colonial discourse but in addition to considering discursive formations, he focused on the social and political process with which colonial power was complicit. Thus his study of exclusions and pathologizing of natives in the colony was pivoted on the examination of institutions like the army, jails, and hospitals, and of elements of social control evident in state measures to fight back epidemic diseases.[19] On the other end of the spectrum, the social history approach was best epitomized in Christopher Bayly's study of astral and medical sciences.[20]

A case can be made that the separate fields of history of science and South Asian history share some common goals in the analysis of knowledge despite their distinct analytical paths. All of these approaches are seemingly engaged with the question of exchange of knowledge, either between the "West" and the "East" or between the colonizers and the colonized. Historians of colonial science in South Asia have drifted away from simplistic assumptions that modern science was of Western origins and that it gradually diffused to the rest of the world. They have increasingly focused on the local development of science in the colony.[21] Historians of South Asia have similarly engaged with the question of knowledge and its transformation in the colonial context. The subaltern

[18] Gyan Prakash, "Science Gone 'Native' in Colonial India," *Representations* 40 (Autumn 1992): 154–78; *Another Reason: Science and the Imagination of Modern India*, Princeton, N.J.: Princeton University Press, 1999.

[19] David Arnold, *Colonizing the Body: State Medicine and Epidemic Disease in Nineteenth Century India*, Berkeley: University of California Press, 1986; a somewhat similar position is taken on the cultural-social axis in the study of public health by Biswamoy Pati and Mark Harrison. *Cf.* Biswamoy Pati and Mark Harrison, *Health, Medicine and Empire: Perspectives on Colonial India*, New Delhi: Orient Longman, 2001.

[20] C. A. Bayly, *Empire and Information: Intelligence Gathering and Social Communication in India, 1780–1870*, Cambridge: Cambridge University Press, 1996, pp. 247–83.

[21] The model of diffusion of Western science to the rest of the world finds best representation in: George Basalla, "The Spread of Western Science," *Science* 156 (May 5, 1967): 611–22. For counterperspectives to Basalla's assertions in the works of historians of science in South Asia, as two representative studies, see, Deepak Kumar, *Science and the Raj, 1857–1905*, Delhi: Oxford University Press, 1995, and Kapil Raj, *Relocating Modern Science: Circulation and the Construction of Knowledge in South Asia and Europe, 1650–1900*, Basingstoke: Palgrave, 2007.

school has exposed the untenable claims of universality of Enlightenment knowledge that was launched in South Asia during colonial rule. They attacked knowledge claims that were seemingly held up to the natives to justify colonial rule, giving a call instead to "provincialize" European thought in developing an understanding of Indian history and society on terms true to Indians. They argued that a particular knowledge system on which Europe held a monopoly did not exhaust all potential sources of positive social change in Indian history. Thus scholars have critiqued nationalism as a derivative discourse and directed attention toward the task of uncovering native visions.[22] Others have sought out imposition, mutual adaptation, and dialectic between Western and Indian institutions and ideologies in the "encounter." They argue that the colonialists could not and did not completely displace Indian systems of thought, and therefore historians must locate the emerging Indian modernity in the outcome of collisions and contestations between European and Indian knowledge in a local context and ultimately in the resilience of the Indian society.

These perspectives are also inhering in elements that limit the possibility of writing a global history of indigo knowledge. All assume that "modernity" was born in the West and subsequently engaged with other knowledges in the non-West. In parallel, others in the subaltern school search for "another reason" in local, native spaces in the colony that if anything is remarkable for its lack of correlation with the Western thought.[23] In different degrees, then, historians in South Asia focus on the analysis of social in the "locality" – ranging from the social space of engagement between colonialists and Indians to the social space of autonomous Indian institutions and imagination. The latter argument is sometimes extended to claim legitimacy for indigenous knowledge in the colony by conceptualizing the existence of alternative modernities and emphasizing the plurality of modern existence. These positions are unhelpful to the task of writing the history of indigo. Indigo knowledge developed simultaneously at several sites. Indigo appeared as a different plant type on numerous continents, and its physiology was shaped distinctly in keeping with local climatic variations. Its universal utility as a

[22] Dipesh Chakrabarty, *Provincializing Europe: Postcolonial Thought and Historical Difference,* Princeton, N.J.: Princeton University Press, 2007. See, also, Partha Chatterjee, *Nationalist Thought and the Colonial World: A Derivative Discourse,* London: Zed Books, 1986.

[23] The phrase appears in the title of Gyan Prakash's book. Gyan Prakash, *Another Reason: Science and the Imagination of Modern India,* Princeton, N.J.: Princeton University Press, 1999.

dye plant was realized in different ways by multiple societies. These people put the dye to use for separate purposes on small and large scale. Thus the knowledge of indigo culture was a variable one reflecting the numerous circumstances of its production and use in the world. The knowledge zones and the people possessing them were at the same time also connected with each other at the level of sharing of information and trade relations. This aspect of multisited development of indigo knowledge remained true in the era of passage from the premodern to the modern. It is this aspect of simultaneity of emergence of modern indigo knowledge that is overlooked in the current studies. Rather, the model of a global history that is open to the suggestion that modernity developed at multiple sites simultaneously is more suitable to writing the history of indigo culture.

Indigo Plantations: South Asia and the World

This book seeks out the fundamental connections between the historical space of South Asia and the wider world. It considers whether the emergence of South Asia as a region, a colony, and a nationalist territorial and imaginary space – the dominant focus of historiography so far – was also invaded by impulses from various points in the world that were imbued with additional meanings and possibilities. The history of developing indigo knowledge in Bengal suggests that the Indian subcontinent was influenced by external forces of multiple origin and nature, not only those enabled by British imperialism. Cosmopolitan knowledge of multiple lineage, global trade, and the movement and flows of peoples, ideas, and institutions contributed to the making of knowledge of indigo culture during the colonial times. The imperial framework and colonial relations were never irrelevant to this history. In fact, if anything, they were foundational. The needs of the British Empire led to the launching of Bengal indigo plantations. The profit-seeking motives of the European entrepreneurs who immigrated to the colony, the facilitation by the institutional space of the colonial state, and the remittance requirements of the East India Company sustained the colonial indigo industry. But none of these delimited the frontiers of knowledge determinants for indigo culture. As the indigo industry ebbed and flowed from the last quarter of the eighteenth century, it drew on information from both varied external sources and local traditions, developed its own methods in the local context of the colony, embraced new institutions of knowledge making, and adjusted to the demands of knowledge sanctified by consumers in diverse

markets of the world. The categories of Western, foreign, imperial, colonial, and local only go so far to explain the situatedness of this body of knowledge without accounting for all of the contributing factors. A focus on the composite nature of this process of knowledge making clarifies that the colony was a space interconnected with multiple other spaces in the world and that colonial Bengal was a participant in a historical process unfolding on a scale that was not confined within the territorial limits of the Raj or even the formal margins of the larger British Empire.

The use of the category of "world" in this study is precisely meant to emphasize the aspect of wide dispersal of points of influence on Bengal indigo's history. It does not imply that the history of indigo was marked by any sort of universal homogeneity or commonality in patterns.[24] As with "global," "transnational," or "international," the use of "world" as a framework fundamentally represents a common historiographical stand that urges shifting of attention away from the "national."[25] The "nation" has defined the project of history writing in spatial terms for a long time. This could not be truer for South Asian historiography.[26] Regardless of the fact that some historical studies have focused on international trade, religion, and ocean, for instance, whose ambits exceed national frontiers, historians have by and large continued to pivot their attention on the nation as the predominant space of origination or impact. This book seeks to move analysis beyond the current understandings in the historiography that imply that the history of indigo was delimited by influences that could be best categorized as imperial and colonial or native and national. Instead, this study highlights the multiple loci of the history of Bengal indigo.

A gesture forward toward two specific moments in the history of indigo puts the basis of this book's contention in broad relief. One was the global dispersal of an early indigo text authored by Jean Baptise

[24] A. G. Hopkins, "Introduction," In A. G. Hopkins (ed.), *Global History: Interactions between the Universal and the Local,* London: Palgrave Macmillan, 2006, pp. 1–38.

[25] "AHR Conversation: On Transnational History," participated in by C. A. Bayly, Sven Beckert, Matthew Connelly, Isabel Hofmeyr, Wendy Kozol, and Patricia Seed, *American Historical Review* III No. 5 (December 2006): 1140–64.

[26] The rise of the subaltern school in the 1980s was based on a critique of the nationalist historiography in South Asia. The subalterns critiqued "nation" as a derivative form and sought to recover other subjectivities by working outside the framework of Western teleologies. As a methodological strategy the subalterns often directed research away from the larger structures ordained by colonialism and toward the autonomous, the individual, and the episodic – "the fragment." In effect such trends minimized the treatment of histories on a large spatial scale.

Labat, the famous seventeenth-century French naturalist. This text was composed at the beginning of the era of indigo plantations. It became an important medium in the global movement of indigo manufacturing knowledge from the Caribbean, in particular from the indigo-growing regions of the French Empire to those of the British Empire. The seamless passage of Labat's work through historical times reveals the openness of political formations, territories, and knowledge systems to information contained in the indigo treatise. A second case in point was the birth of synthetic indigo in 1897, which ultimately caused the demise of plant indigo and brought the end of indigo plantations. A product of the German dye industry, synthetic indigo was an "externality" to the nineteenth century's varied imperial systems. It was rather a product of German industrial history, and its expansion was riveted on capturing major textile markets of Germany's imperial rivals like Britain and other Western textile manufacturing nations.[27] Its ultimate victim was agricultural indigo, which was produced by the major colonial systems of the world. It was thus able to interrupt the arrangement in which European colonies in Asia, Africa, and America produced the indigo dye, and dyers and printers in the West consumed it. It inaugurated a new division in production and consumption. Synthetic indigo captured not only the erstwhile markets of agricultural indigo, but also the new emerging markets for the blue dye, in particular those developing in the Far East. Thus the putative imperial motifs do not explain the birth and expansion of German indigo. The history of its origin in Germany and global expansion – of which the death of agricultural indigo was but a counterpart – requires an analytical ambit beyond those involving imperial systems and local colonialisms alone. It equally requires consideration of dynamics of global scaling.

First, let us turn attention to Jean Baptiste Labat.[28] Labat was born in Paris in 1663 and joined the Dominican order. Although he was a Catholic theologian, preaching was not his only vocation. He was a man respected for his learning and would go on to travel overseas and earn a

[27] Even though Anthony Travis has suggested that the monopoly by English traders and merchants on the world's supply of plant indigo might have motivated the search by the Germans for a synthetic substitute, the fact remains that the birth of synthetic indigo followed its own trajectory of industrial history and innovation in the national state context of Germany. Anthony S. Travis. *The Rainbow Makers: The Origins of the Synthetic Dyestuffs Industry in Western Europe,* Bethlehem, Pa.: Lehigh University Press, 1993.

[28] Lafcadio Hearn, *Two Years in the French West Indies,* New York: Harper and Brothers, 1890, pp. 157–83; Robert Bracey, "Jean Baptiste Labat," *New Blackfriars* 5 Issue 151 (June 1924): pp. 136–43.

reputation as a preacher, as a successful colonialist, and later as a writer of travelogues and compendia. He had his calling after he heard that the French colonies in the Antilles were short of preachers on account of the ravages of yellow fever. He applied for permission to go to the Antilles and, permission in hand, arranged for passage to the Caribbean. He reached Martinique in 1693. This marked the beginning of a long sojourn of twelve years in the Caribbean.

It is Labat's first of its kind account of detailed cultivation and manufacturing of indigo that we are concerned with here.[29] Labat was quite versatile in his pursuits in the Caribbean. He helped turn the Dominicans' Martinique sugar plantation into a profit-making unit, assisted a French governor of another island in building defensive fortifications against attacks from the English, and even participated in combat against the English and the Spaniards. He also spent a lot of time traveling, observing local plantations and manufactories. His handbook on sugar manufacturing was considered an indispensable aid by generations of manufacturers. But it was his key composition on indigo manufacturing in the French colony that won him a reputation far beyond the lands of the French Empire. By the late seventeenth century the French colonies had raced ahead of the English colonies in the Antilles in indigo manufacturing. Martinique was indeed a leading center for indigo plantations. Labat based his treatise on the art of indigo manufacturing on what he observed in the Macouba parish of Martinique. This was published in 1722, several years after his return to France, as part of an account of his travels through the Caribbean.

Labat's account of indigo manufacturing spread afar in a way he would never have imagined. Although written primarily with an audience composed of French countrymen and colonialists in mind, the text readily found its way into the imagination and thought of literati and practitioners in the wider world immediately after its publication in Paris. Perhaps the timing was right. The work found relevance at a time when indigo production was expanding worldwide. It was quickly translated into major European languages. A previous combatant against the English, Labat likely may not have fancied its reaching the English. Regardless, an English translation of the section on indigo appeared in London in

[29] Labat was preceded by another French Catholic humanist, Jean Baptiste Du Tertre, who traveled to the Antilles in 1640. Du Tertre also provided an account of indigo that was published in France in 1671. The distribution of Du Tertre's text was somewhat limited at that time, although it became popular among the French colonialists and in the French metropolis.

1731 as part of Phillip Miller's *Gardener's Dictionary*. The latter text and its rendition by other planters in local journals in the American South formed the basis of information as South Carolinians embraced indigo in the 1740s.[30]

Two points are worth emphasizing. First, the description of indigo culture by Labat floated in competing European imperial networks and their colonies. Second, and this is more specifically relevant for the South Asian story, as the Indian subcontinent started opening to immigrant planters from the last quarter of the eighteenth century, those from the British Empire extending into South Carolina could have gained access to the English translations of Labat. Other planters entering India with prior experience in other European colonies – and there were many in the early phase – had also been likely in a position to draw on textual knowledge of indigo culture of the type represented in Labat's account. Knowledge, it would seem, did not follow the bounds of political frontiers imposed by several imperial and colonial systems. The migration of textual knowledge ascribable to Labat was not the exception but the rule, as this study will show. Other French expositions on indigo by writers and planters like Elias Monnereau of Saint Domingue and De Cossigny de Palma of Mauritius, to mention two other prominent cases, similarly made it to the wider world including colonial South Asia. It is the contention of the present study that the history of indigo manufacturing in colonial South Asia cannot be complete without a consideration of these larger, if amorphous, knowledge networks.

The second important global moment chosen for this early exposition was in 1897, the year the German synthetic dye company, BASF, launched its version of synthetic indigo on the market. The arrival of synthetic indigo created a new cast of adversaries on the side of synthetic and natural indigo, respectively, that cut across the familiar fault lines between imperial and colonial or between colonial and native interests, further illustrating the limitations of such categories for understanding the history of indigo. Until then the global market for the blue dye had been supplied by agricultural indigo. Three major imperial systems dominated that market with British India holding the top position as the biggest supplier of Bengal indigo, followed by the Dutch Java, and Central

[30] Miller reproduced Labat's account. See the entry "anil" under *AN* in the dictionary. Philip Miller, *The Gardener's Dictionary in Two Volumes*, London: printed by the author, 1743, no page number; David L Coon, "Eliza Lucas Pinckney and the Reintroduction of Indigo Culture in South Carolina," *Journal of Southern History* 42 No. 1 (February 1976): 61–76.

America. The German dye company BASF first interrupted this imperial social formation of the world. Others followed suit and soon several German companies and their subsidiaries in other European nations started to manufacture the synthetic substitute, which ate into natural indigo's share of the market. These forces caused the beginning of a slide in the fortunes of natural indigo that proved to be irreversible except for short phases, until the natural indigo industry was completely obliterated at the end of World War I.

The challenge posed by synthetic indigo to the natural dye was of a global nature that can scarcely be explained on the basis of the dialectics of colonial relations. There is little doubt that colonialism had led to the birth of the indigo plantations in Bengal. Colonial power secured the entry of indigo into South Asia, and the colonial state's land settlement policy, revenue policy, commercial policy, and laws relating to the use of native labor set the basic parameters within which indigo culture developed. But colonialism also tied the destiny of indigo with a worldwide spread of consumers. The fact that it was consumed by a dispersal of dyers and printers in the entire world, not only by those in the British home market, meant that global trends in dye consumption could make an impact on the colonial industry. Indeed in the late nineteenth century colonial indigo's future was caught up in the global process of transition from natural to synthetic dyes. Emerging outside the orbit of British imperialism synthetic indigo threatened the investments of British expatriate planters in India. But as dyers and printers made a switch to synthetic indigo – including those at home in Britain – the national government could do little to forbid them. Imperial Britain could do far less to stop the tide of a global trend. Thus neither an exclusive focus on imperial Britain nor one on local colonialism can adequately explain the history of struggle between the German synthetic indigo and the plant indigo of Bengal. This story, rather, needs explanation on the basis of a broad template that weaves the study of the imperial-colonial relationship along with that of the colony's connections with the world, and the transnational processes that touched the Indian subcontinent.

"A Product of Nature": Science-Nature Relationship

A good part of the book addresses the "science" of indigo culture in a correlation with cross-cutting movements of knowledge, the local context of peasant production, land structure in colonial Bengal, institutions that facilitated exchange such as market and trade networks, and the

contingencies introduced by the institutional and disciplinary framework of modern science. The focus of the study accordingly shifts among agriculture, colonial relations, market, and scientific institutions. But a running thread through the analysis is the focus on science as a tool in pushing at the limits of "improvement." What was the best indigo? What was humanly possible in terms of making the very best indigo? The answers to these questions were never a "given." As a matter of fact, a resolution of these complex issues was very much historically contingent. Philosophers countered each other in texts, market players asserted different viewpoints in an exchange context, and scientists disagreed with each other. They were all in one way or another engaged in the creation and validation of knowledge about indigo.

The task of improving indigo through science on the plantations drew upon the traditions of looking at nature in specific ways or even objectifying it. These traditions were implicit within the informal practical knowledge and the later formal goal-directed laboratory science as the plantations evolved from the early modern to the modern period. Later, scientific practice predetermined the conjuring of indigo as an "object" with its own characteristics as well as the understandings of what indigo was, how it could be enhanced, and to what extent. Other ideas of improvement emerged with the flow of craft practices, experiments, and trials. The growing understanding of the material artifact influenced the agenda of enhancement subsequently. And changing externalities of trade, exchange, and market impinged on the improvement process to affirm or challenge what constituted real improvement in the making of a commodity. Thus the developing indigo science depended on the multiple meanings of what constituted a valid scientific practice, object, nature, and commodity, meanings that were all historically contingent and open to definition by dominant forces.[31]

The last third of the book addresses the science-nature relationship by studying the imputing of "natural" attributes to agricultural indigo by forces around the plantations. For European planters and scientists in colonial Bengal, who were trying to improve the natural dye to defeat synthetic's competition, the agricultural indigo's claim to be a product of nature was elemental. It was often made part of a central rhetoric in its

[31] For a critical perspective on how objects become valid objects of scientific analysis and fade away, see, Lorraine Daston, "Introduction: The Coming into Being of Scientific Objects," in Lorraine Daston (ed.), *Biographies of Scientific Objects*, Chicago: University of Chicago Press, 2000, pp. 1–14.

defense in the market. Thus in 1907, one of the advocates of the industry, Keith MacDonald, said:

> Nothing made in a chemical laboratory will even come near what is created in the laboratory of nature. The incessant work going on in the cells of the plant – God's laboratory – can't be equalled by any human agency, which, at best, can only be an approximate imitation, without substance; the ghost and shadow of what has stood the test of … thousands of years. The dye which coloured the ribbons that bound the mummies deposited in the tombs of Egypt more than 2,000 years ago, that coloured the beautiful carpets of Achilles, 1,100 BC and has given luster to the magnificent colours of Oriental textile fabrics for countless generations, is not going to succumb ….[32]

Indigo, the blue dye, did not automatically ooze out of the plant. Rather planters used a streamlined manufacturing process that involved systematic processing of leaves in modern, large-scale establishments on the plantations – also called "factories" – to turn indigo into a dye. European planters in Bengal embraced mechanization, steam power, and the use of chemical substances through the course of the nineteenth century at a faster pace than ever before. All of the above meant a progressively more systematic, efficient, and intrusive – and hardly natural – method of extracting the dye. The apparent disdain for the "chemical laboratory" in MacDonald's verdict apparently did not reflect any disavowal of science. It was more a critique of the factory system of chemical dye manufacturing, which in this view seemed further removed from nature than the planters' layout of land, farming, and manufacture of the agricultural commodity.

What was at stake in these debates was the definition of "nature" as embodied in indigo. The indigo dye hardly seemed to be in any way "prior" to human intervention. The Bengal planters' production of the blue dye involved a clear human intervention with nature's scheme of things.[33] In the final leg of scientific experiments the dominant view in the

[32] Letter of Keith MacDonald to the editor, *Indian Planters' Gazette,* December 7, 1907, p. 704. The holdings of this journal are available at the National Agricultural Library, Beltsville, Maryland, USA.

[33] The subject of human-nature interaction forms the cornerstone of environmental history. Nature in these studies frequently appears as "constructed" nature or socially "produced" nature. The concept of pristine, untouched nature at some point much deeper in history is not completely ignored, though. If anything, it appears as a constant referent in illustrating the impact of social action on nature. The pristine nature also has a conceptual presence for analytical purposes of highlighting that ecosystems, environments, or the natural world has a history of its own outside human influence. See Donald Worster's treatment of the "arcadian ideal" in ecological worldviews, whether in Gilbert White's

imperial-colonial world held that indigo dye had reached a "natural" limit to its improvement, thus harking back to the notion of "natural order" that was seen as standing in the way of introducing further changes to the natural dye. These views attributed agency to nature, which purportedly had set final limits on the human ability to act on nature. The multiply implied meanings of nature in the claims of indigo planters and dye scientists were relevant in validating a science for the natural dye and later caused its abandonment. The examination of these meanings of nature throws light on the historical question as to when and how the defenders of natural indigo quit the fight with synthetic indigo and let natural dye meet its final demise.

The study of conceptualizations of nature affords an opportunity to examine "society-nature" or "culture-nature" relationships, an important theme in environmental history and science and technology studies (STS). The study of this important relationship has received due attention by environmental historians and STS scholars, who have frequently discussed the extent to which nature could be taken to be a real, material actor or the end product of human actions and envisioning exclusively. "Nature" is treated in such discussions either in its physical form such as landscape, body, and else, or as natural knowledge. Environmental historians have importantly argued that nature was never a given and thus drawn our attention to the relationship between nature and the historical conceptions of nature.[34] STS scholars have clarified the ways scientists generated truth about the natural world, thus conjuring science as a representation of nature, not any

eighteenth-century history of Selborne, England, or Henry David Thoreau's depiction of the history of Concord, Massachusetts. Worster was motivated to study ecological sciences to understand nature at the level of human-nature interactions. In the preface to the new edition Worster acknowledges in an implied way his intellectual agenda of uncovering the autonomy of nature, referring to one of the fundamental questions of the times as "whether nature has an order, a pattern, that we humans are bound to understand and respect and preserve." Donald Worster, *Nature's Economy: A History of Ecological Ideas,* Cambridge: Cambridge University Press, 1988, first published in 1977, p. ix. See also William Cronon's distinction between "first" and "second" nature, in which he identified the former with some sort of a prehuman nature that was later changed through human interaction toward meeting the ends of society. William Cronon, *Nature's Metropolis: Chicago and the Great West,* New York: W. W. Norton, 1991, p. 56, and *passim.*

[34] The subject has a rich historiography and constitutes the very core of the program of environmental history. For a review of the theoretical stakes in this debate in light of very recent scholarship, see, Kristin Adal, "The Problematic Nature of Nature: The Post-Constructivist Challenge to Environmental History," *History and Theory, Theme Issue* 42 (December 2003): 60–74.

reflection of an ultimate reality.[35] Within the latter tradition a few have conceptualized the existence of "networks" within which, they insist, nature, culture, and science are so intimately lodged that it makes no sense to treat any one as the causative prior.[36]

In this *longue duree* study of developing indigo culture the following chapters analyze indigo's improvement in multiple contexts. Chapter 1 connects the origins of indigo plantations in colonial South Asia with the prior and parallel history of indigo in the Western Hemisphere. It demonstrates that the knowledge undergirding the indigo plantations in South Asia was of a composite nature and was also evolving, a knowledge whose genealogy extended to multiple pasts. The second chapter delves into the agricultural history of colonial Bengal to illustrate how the unique system of indigo manufacturing that took root on the Indian subcontinent involved indigo cultivation on peasant plots. The larger focus of the chapter lies in exploring the interaction between a transnational, modernizing agricultural science in the nineteenth century and local forces of landscape and land structure in colonial India. The third chapter connects the global history of transition toward synthetic dyes with the colonial history of agricultural indigo production in India. In doing so it makes the case that colonial developments had an external arena or context that cannot be adequately captured by reference to the imperial framework and its broader networks alone. Colonial trade in indigo had economically fused the Indian subcontinent with consumers in many national markets. Through focus on the British dye market as a national market it lays out the parameters on which natural indigo had to

[35] For historically grounded studies of science embedded in society and social relations, see, Steven Shapin and Simon Schaffer, *Leviathan and the Air Pump: Hobbes, Boyle, and the Experimental Life,* Princeton, N.J.: Princeton University Press, 1985; Steven Shapin, *A Social History of Truth: Civility and Science in Seventeenth Century England,* Chicago: University of Chicago Press, 1994. These and similar studies drew on the methodological contributions of sociologists of the Edinburgh school, who emphasized the symmetry that existed between truth and falsity in the way of creation of scientific "facts."

[36] Bruno Latour, and following him, Donna Haraway completely fuse society and nature in their analysis. Both maintain that society/nature dualism is a product of Enlightenment modernity. Latour lends agency to microbes alongside followers of Louis Pasteur, the bacteriologist, in his study of the pasteurization of French society in the last quarter of the nineteenth century. "There are not only 'social' relations, relations between man and man," Latour concluded, adding, "society is not just made up of men, for everywhere microbes intervene and act." Bruno Latour, *The Pasteurization of France,* translated by Alan Sheridan and John Law, Cambridge, Mass.: Harvard University Press, 1988, p. 35. Haraway blends society/nature in what she calls "hybrids." Donna Haraway, *Simians, Cyborgs and Women,* New York: Routledge, 1991; *Modest Witness @ Second Millennium,* New York: Routledge, 1997.

seek validation in the marketplace. Chapter 4 spotlights the entanglement of the developing indigo science with colonial agricultural institutions, which, in turn, were influenced by a program of colonial agricultural development and rising nationalism. Chapter 5 unravels the planters' questioning of specific aspects of reductionist science and a corresponding rationalization in the market in which the dominant criteria of purity and cheapness had sidelined natural indigo. At the same time it also shows the planters as eager apostles of another arm of the same reductionist science in embracing Mendelian selection. But in the end, nothing seemed to work for the planters and their agricultural indigo as consumers worldwide kept switching to synthetic indigo. Even as natural indigo was gasping for breath, the outbreak of the First World War provided a new lease on life to the plant indigo program. As supplies of German synthetic indigo dwindled, a new effort was made to revive the natural indigo industry. A corresponding science of natural indigo also arose that fundamentally tried to turn out natural indigo in a form similar to synthetic indigo. While these efforts were still under way, the end of the war saw all nations reembracing synthetic indigo and many starting the production of synthetic indigo for their national markets. The producers of natural indigo saw the writing on the wall and stopped all efforts to improve indigo scientifically. In that context the last chapter analyzes the standard of rationalization that was held up to the agricultural dye in settling a lasting meaning of "improvement."