The Colonial Machine

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The Colonial Machine: French Science and Colonization in the Ancien Régime

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BEGINNING IN THE SEVENTEENTH CENTURY, FRANCE CARVED out small settlement and exploitation colonies in wild, peripheral sites in the Americas (Quebec, Louisiana, the West Indies, and Guyana); along the slave coasts of Africa; and in the Indian Ocean (Ile de France, Ile Bourbon—today's Mauritius and Réunion—Madagascar, and trading posts on the subcontinent). With its fantastically productive sugar islands—notably Saint Domingue (Haiti)—eighteenth-century France rivaled England as the world's most economically potent colonial power.[1]

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[1] On French colonialism in this period, see Pierre Pluchon, *Histoire de la colonisation française,* vol. 1, *Le Premier empire colonial* (Paris: Fayard, 1991).

Concurrently, French science was institutionally and intellectually the strongest of any nation.

To say that France during the ancien régime offers a preeminent case for exploring connections between science and colonization, or even that contemporary French science provided knowledge useful in establishing and maintaining overseas colonies, merely states the obvious. What is not obvious—and what this essay examines—is that from the time of Louis XIV, the royal administration created and supported an elaborate scientific and technical infrastructure that was not merely tapped on occasion to aid colonization, but which quickly became integral to the process. This scientifico-colonial machine, so to speak, was highly bureaucratized and centralized and, although composed of diverse parts, it functioned in a coordinated way to advance the colonial, national, and dynastic interests of France and the Bourbon monarchy. It was not a static mechanism: the colonial machine existed only in action, and its existence and efficacy derived from the capacity of the administration to mobilize, organize, centralize, and unify material and intellectual resources in France and in the colonies. The lack of a comparable colonial science bureaucracy in contemporary Britain underscores the main point of this paper.[2]

IN SICKNESS AND IN HEALTH

French physicians and the instrumentalities of French medicine came with the first wave of formal colonization in the early seventeenth century. In addition to the church, the army, and the navy, medicine was instrumental in establishing and maintaining overseas colonies.[3] The Marine Royale, headed by the Ministère de la Marine et des Colonies, provided the primary institutional basis for colonial medicine, as for so much else of the scientifico-technical arm of French colonialism. Etienne Taillemite has labeled the contemporary French naval bureaucracy "a prodigious research laboratory."[4] In any event, the Marine Royale had many sick and injured to deal with both in France and in the colonies. As depicted in Figure 1, naval hospitals in Rochefort, Brest, and Toulon—all with origins in the seventeenth century—were the initial institutional manifestations of a colonial medical bureaucracy. The navy needed trained physicians and surgeons, and in the early decades of the eighteenth century, the Ministère de la Marine created naval medical schools in these three cities.[5] These were teaching centers with upwards of two hundred students. A short-

[2] John Gascoigne documents the gradual appearance of analogous structures in Britain, but only after the 1780s. See his *Science in the Service of Empire: Joseph Banks, the British State and the Uses of Science in the Age of Revolution* (Cambridge: Cambridge Univ. Press, 1998).

[3] On colonial medicine, see James E. McClellan III, *Colonialism and Science: Saint Domingue in the Old Regime* (Baltimore and London: The Johns Hopkins Univ. Press, 1992), chap. 8; Pierre Pluchon, ed., *Histoire des médecins et pharmaciens de marine et des colonies* (Toulouse: Privat, 1985); Caroline Hannaway, "Distinctive or Derivative? The French Colonial Medical Experience, 1740–1790," in *Mundialización de la ciencia y cultura nacional*, eds. Antonio Lafuente, Alberto Elena, and Mariá Luisa Ortega (Madrid: Doce Calles, 1993), pp. 505–10.

[4] Etienne Taillemite, *Les Archives de la Marine conservées aux Archives Nationales,* 2nd ed., updated by Philippe Henrat (Vincennes: Service Historique de la Marine, 1991), p. 123.

[5] See A. Lefèvre, *Histoire du Service de Santé de la Marine Militaire et des écoles de médecine navale en France, depuis le règne de Louis XIV jusqu'à nos jours, 1666–1876* (Paris: J. B. Gaillière et fils, 1867). The naval medical schools had periods of greater or lesser vitality and were subject to occasional reform; their full story remains to be told. On the Ecole de Chirurgie de la Marine, see

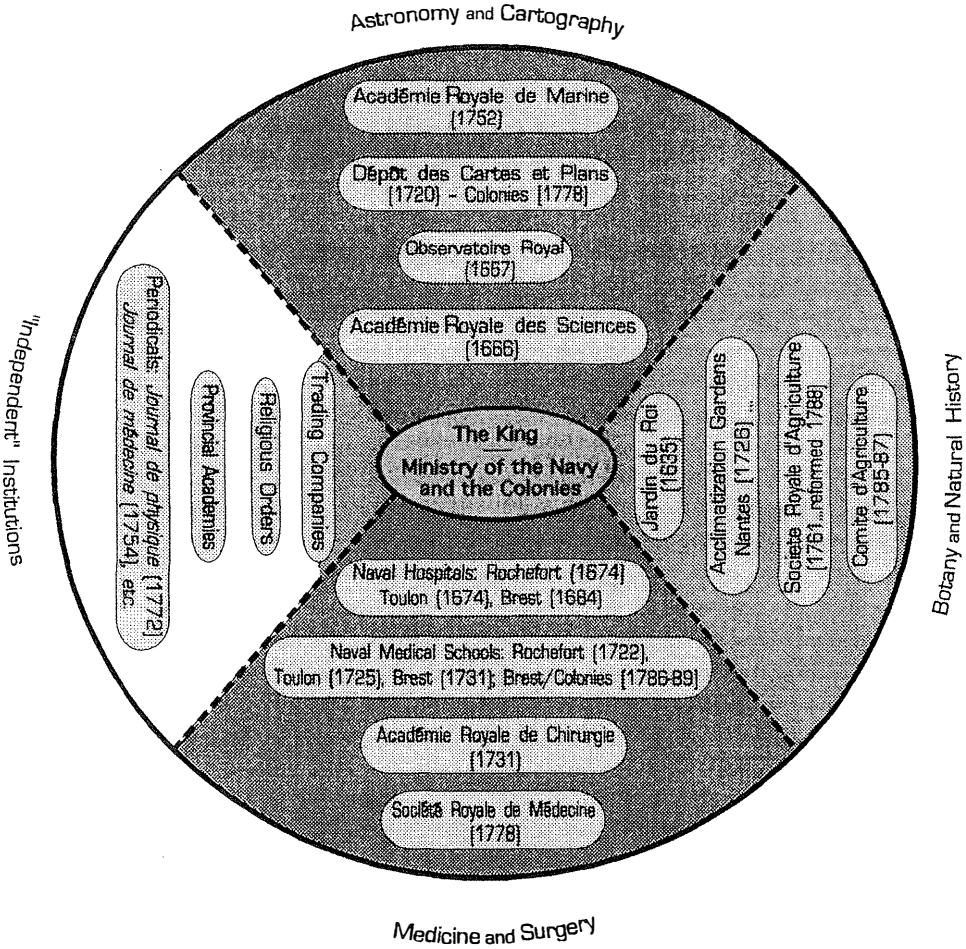

Figure 1. *The metropolitan apparatus.*

lived Ecole Pratique de Médecine, founded in Brest in 1783, capped this educational structure with an institution specifically designed to introduce recent graduates of medical faculties to diseases particular to the colonies and port cities.[6] The bureaucratization of naval medicine culminated in 1763 with the creation of the powerful posts of *inspecteur et directeur général de la médecine de la marine et des colonies*. Pierre-Issac Poissonnier, a major figure in this story, held these positions until 1791, and nominally received reports from all royal physicians—*médecins du roi*—posted in the colonies.[7]

Chartered in 1778, the Parisian Société Royale de Médecine was a well-known,

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Dr. Hamet, "L'Ecole de Chirurgie de la Marine à Brest (1740–1798)," *Archives de Médecine et de Pharmacie Navale*, 1923, *114:*165–99, 245–59, 321–39, 385–404.

[6] E.-L. Boudet, "Le Corps de Santé de la Marine et le service médical aux colonies au XVII[e] et au XVIII[e] siècle (1625–1815)," *La Géographie: Terre—Air—Mer*, March–August 1934, 34–6; Hamet, "L'Ecole de Chirurgie," (cit. n. 5), pp. 329–30.

[7] See, for example, the royal warrant of J.-B. Roux (dated 5 April 1766), where one reads that Roux was to "rendre régulièrement compte audit sieur Poissonnier des maladies qu'il aura traitées, de leurs différentes natures, & de la manière dont il les aurat traités des découvertes qu'il pourra

progressive institution that organized physicians and medical science on a national basis. Less well recognized today was its strongly colonial and naval side. The Société elected a number of navy physicians and correspondents from ports and from the colonies. It received regular reports of disease outbreaks in the colonies, published colonial meteorological data in its *Mémoires*, and seriously concerned itself with the health of sailors and conditions in port hospitals. For example, it sponsored prize questions on scurvy, proper rations for sailors, and maintaining troops in hot climates. Along with the Académie Royale de Marine at Brest (1752), the Société became involved in experiments with Parmentier's sea-biscuits, baking bread with sea water, and preserving fresh water at sea. The Société Royale de Médecine also received a steady flow of reports about colonial products and their medical applications, such as cinchona from Saint Domingue, seeds from Sainte Lucie (a.k.a. Saint Lucia), torpedoes (to treat gout), lizards (eaten alive to treat skin diseases) from Guyana, and tisanes from Madagascar. Elephantiasis was such a threat that the *ministre de la marine* himself asked the Société to investigate, which it did in characteristic fashion by preparing a questionnaire and, through official administrative channels, surveying physicians posted in the colonies.[8]

The colonial-medical dimension of the earlier Académie Royale de Chirurgie (1731) was less spectacular.[9] It elected some colonial correspondents and received many reports from the colonies. The Académie Royale Marine at Brest likewise dealt with health issues affecting its personnel. The Académie Royale des Sciences (1666) possessed its colonial-medical side, too, for example, through the election in 1738 of Jean-Baptiste-René Pouppée-Desportes, chief royal physician in Saint Domingue and author of a three-volume *Histoire des maladies de S. Domingue* (1770).[10]

A complementary set of medical structures arose in the colonies themselves, most notably royal hospitals staffed by state-appointed *médecins du roi*. These royal physicians served as local agents for the construction of colonial knowledge, conducting research on the spot. In the most developed case of Saint Domingue, a full-fledged medical community established its independence from the structures of naval and colonial medicine per se, despite resistance from Poissonnier in his role as inspector of colonial medicine. This community included virtual guilds of physicians, surgeons, apothecaries, and veterinarians.[11]

Inoculation against smallpox began in the colonies in the 1740s, decades before

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faire tant dans la médecine, la pharmacie et la botanique que dans les objets relatifs à l'histoire naturelle." "Séance du Conseil Supérieur de la Martinique 5 mai 1767," Archives Départementales de la Martinique, Fort-de-France, B 12, fol. 47.

[8] See the Procès-Verbaux of the Société Royale de Médecine held in the library of the Académie Nationale de Médecine (hereafter cited as Acad. Nat. Méd. Lib.), Paris; see also Centre des Archives d'Outre-Mer, Aix-en-Provence (hereafter cited as Aix-en-Provence Archives), Colonies C10 C3, dossier 6 (1786).

[9] See Salem Yaqubi, "Contribution à l'histoire de l'Académie Royale de Chirurgie" (Thèse pour le doctorat en médecine [no. 624], Faculté Mixte de Médecine & de Pharmacie de Rennes, Rennes, 1967), and Yves Dordain, "La Chirurgie provinciale française au XVIII^{e} siècle: Son niveau technique d'après les membres non résidents de l'Académie Royale de Chirurgie" (Thèse pour le doctorat en médecine [no. 281], Faculté Mixte de Médecine & de Pharmacie de Rennes, Rennes, 1962).

[10] McClellan, *Colonialism and Science* (cit. n. 3), p. 137 and note.

[11] See *ibid.*, cit. n. 3, and Isabelle Homer, "Médecins et chirurgiens à Saint-Domingue au XVIII^{e} siècle," Thèse d'Ecole des Chartes, Paris, 1998.

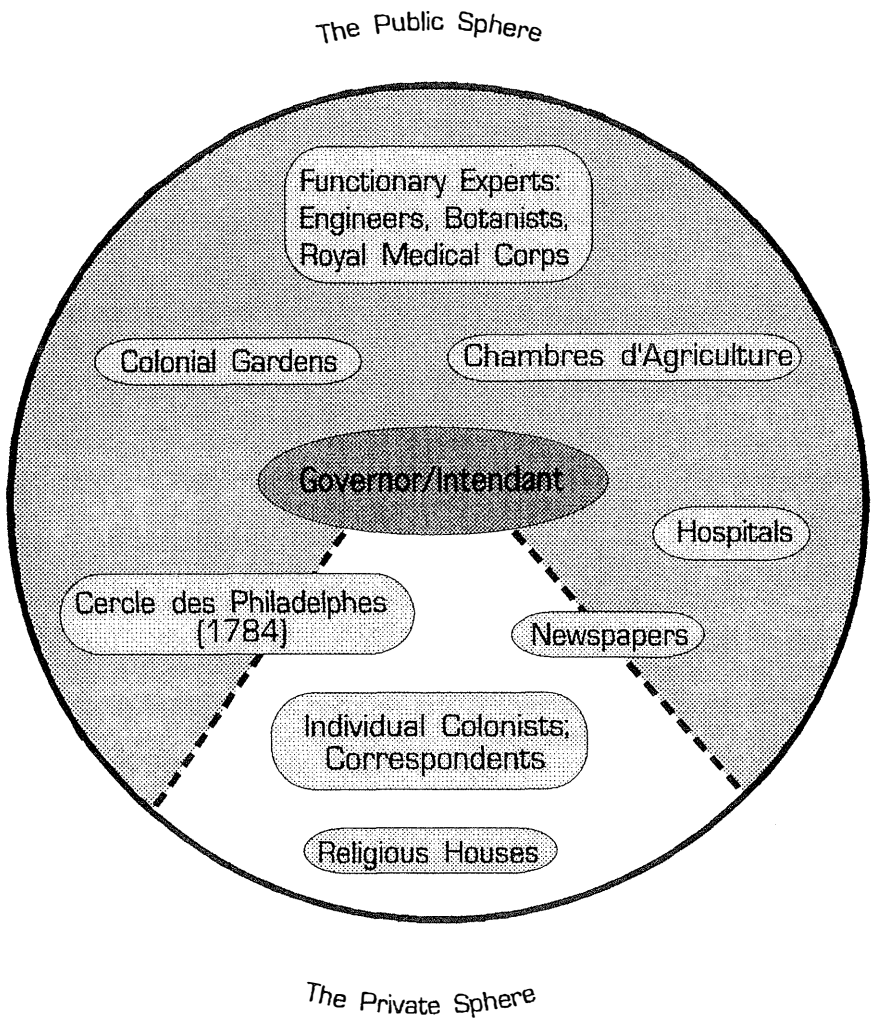

Figure 2. *The Colonial World*

the practice was accepted in France, and a notable subspecialty of eighteenth-century French medicine concerned itself with tropical diseases, their treatment, and related medical issues, such as acclimatizing colonials from France and Africa to local pathologies. A number of monographs published in the colonies and in the metropolis treated colonial medical topics. For example, in Saint Domingue the colonial scientific society, the Cercle des Philadelphes, produced volumes on tetanus and on veterinary medicine (See Figure 2). In France, Poissonnier's brother and deputy *inspecteur général* for colonial medicine, Poissonnier-Desperrières, published a *Fièvres de St. Domingue* (1763) and a *Traité des maladies des gens de mer* (1767). One of Poissonnier's agents, the physician J.-B. Dazille, was especially productive, publishing on illnesses affecting slaves (1776), on tropical diseases in general (1785), and on tetanus (1788).

Science piggy-backed on colonial medicine. Colonial authorities enlisted experts

of all sorts, and, as it happened, the medical and the scientific converged in the service of colonial France.

THE CONQUEST OF COLONIAL SPACE

Creating and maintaining colonies in the eighteenth century required a command of the seas. Like its rivals, the French state needed reliable knowledge of the position of its colonies, and mastery of colonial space was seen to depend upon mastery of astronomical space. The authorities turned to a constellation of sciences—astronomy, geodesy, cartography—and established a set of institutions to address, in part at least, this core issue. These included, notably, the Académie des Sciences, the Observatoire Royal (1667), and the Académie de Marine (1752).[12] From this point of view, much of the pure science of eighteenth-century astronomy emerged out of, and was inseparable from, practical problems faced by the colonial machine.

The Académie des Sciences established colonial links through its corresponding members.[13] Michel Sarrasin, a surgeon and royal physician stationed in Canada, was an early correspondent, elected in 1699.[14] In the 1730s, Réaumur in France and his correspondent on the Ile de France, Jean-François Charpentier de Cossigny, published a series of concurrent weather observations.[15] The Académie similarly elected correspondents from Cayenne in South America (e.g., Pierre Barrère in 1725), the West Indies (e.g., Jean-Antoine Peyssonnel in 1723), and the Indian Ocean (e.g., Jean-Baptiste-François Lanux in 1754). The Académie also recruited colonial officialdom, including the Marquis de La Galissonnière (*lieutenant général de la marine* and former *gouverneur-général* in Canada) and the Count de La Luzerne (*ministre de la marine* and former *gouverneur-général* in the Antilles). Resident academicians themselves held posts within the colonial system—Henri-Louis Duhamel du Monceau for many years was *inspecteur-général de la marine*. These connections seem typical of the ties established by the Académie des Sciences with the colonies and with centers of power in France.

The central problem for the seagoing powers was the determination of longitude at sea, and the solution emerged in the 1760s with John Harrison's marine chronometer. In the decades prior, the Académie des Sciences had played a leading role in

[12] On these institutions, see Charles C. Gillispie, *Science and Polity in France at the End of the Old Regime* (Princeton: Princeton Univ. Press, 1980). On the Académie de Marine at Brest, see Alfred Doneaud du Plan, *Histoire de l'Académie de Marine*, 6 vols. (Paris: Bergot-Levrault, 1878–1882); Josef W. Konvitz, *Cartography in France, 1660–1848: Science, Engineering and Statecraft* (Chicago: The Univ. of Chicago Press, 1987), pp. 75–7. The Brest Académie needs a new historical study.

[13] Alfred Lacroix's biographical studies from the 1930s are the most explicit treatments of the colonial face of the Académie des Sciences; see *L'Académie des Sciences et l'étude de la France d'outre-mer de la fin du XVII^e siècle au début du XIX^e siècle (Figures des Savants, vols. 3–4)* (Paris: Gauthier-Villars, 1938).

[14] On Sarrasin (or Sarrazin) and his successor, Jean-François Gaultier, see Luc Chartrand, Raymond Duchesne, and Yves Gingras, *Histoire des sciences au Québec* (Montreal: Boréal, 1987), pp. 46–53, 56–8. For Sarrasin, see also *Mémoires de l'Académie Royale des Sciences (hereafter cited as Mém. l'Acad. Roy. Sci.)*, 1704, 48–65; for Gaultier, see also *Mém. l'Acad. Roy. Sci.*, 1747, 466–88 and 1750, 309–10.

[15] On these individuals, see Institut de France, Académie des Sciences, *Index biographique de l'Académie Royale des Sciences* (Paris: Gauthier Villars, 1979). For Cossigny's and Réaumur's papers, see *Mém. l'Acad. Roy. Sci.*, 1733, 417–37; *Mém. l'Acad. Roy. Sci.*, 1734, 553–63; *Mém. l'Acad. Roy. Sci.*, 1735, 545–76; *Mém. l'Acad. Roy. Sci.*, 1738, 387–403.

longitude research by administering a fund of 125,000 *livres* (bequeathed in 1714 by the parlementarian Rouillé de Meslay) for two prizes.[16] The first prize, on motion, has attracted comparatively more attention from historians. The second, to determine "longitude at sea and discoveries useful to navigation and long-distance voyages," is less well studied. The Académie made the first navigation award—a substantial 2000 *livres*—in 1720, and it continued to pose research questions and award the Meslay prize into the 1780s.

As the Académie *Histoire* remarked proudly in 1745, "Points of longitude determined astronomically are to Geography what medals and monuments are to History."[17] Before the chronometer, practical men at sea and in the colonies (who were variously sponsored by the Académie des Sciences, the Académie de Marine, the Observatoire, the Marine Royale, and the Compagnie des Indes) used astronomical techniques to determine the geographical location of French overseas territories. Using simultaneous observations of Jupiter's satellites, eclipses, or occultations of stars, observers in Paris and in a colonial locale could determine the difference in time, and hence the longitudinal separation, between the two stations. For example, in 1685 Jean-Dominique Cassini and Philippe de la Hire determined the longitude of Quebec by observing a lunar eclipse in Paris while Jean Deshayes watched it in Canada.[18] In 1703 and 1704, coordinating with Louis Feuillée, a Minim priest sent to the West Indies for this purpose, Jacques Cassini II used simultaneous observations of the satellites of Jupiter to establish the longitude of Martinique.[19] To the end of the century a steady stream of papers appeared in the *Mémoires* and the *Savants Etrangers* of the Académie des Sciences on colonial longitudes and related matters.

The French expended considerable effort determining the location of their Indian Ocean possessions and developing related navigational aides. The merest, remote specks in that great body of water—Ile de France, Ile Bourbon, and their dependency, Ile Rodrigue—were the key transit stations for French mercantile voyages to and from India and China. In the middle decades of the eighteenth century, J.-B.-N. Denis d'Après de Mannevillette led efforts to chart the region. D'Après rose to become inspector general for the Compagnie des Indes, and was a member of the Académie de Marine and a correspondent of the Académie des Sciences. Sailing in the Indian Ocean in 1740, he worked with the academician Pierre-Charles Le Monnier to determine the longitude of Ile Bourbon. In 1745, with the approbation of the Académie des Sciences, he published his *Neptune oriental* and a navigator's manual (*Routier*) for the Indian Ocean.[20] In 1750–1753, d'Après returned to the region on

[16] See Ernest Maindron, *Les Fondations de prix à l'Académie des Sciences: Les Lauréats de l'Académie, 1714–1880* (Paris: Gauthier-Villars, 1881), pp. 14–22, 44, 46, 48–9. A skilled worker at the end of the ancien régime earned on the order of five hundred *livres* a year; the value of $5–10 U.S. to the *livre* is a helpful rule of thumb.

[17] *Histoire de l'Académie Royale des Sciences* (hereafter cited as *Hist. l'Acad. Roy. Sci.*), 1745, 77.

[18] See Chartrand, Duchesne, and Gingras, *Histoire des sciences au Québec* (cit. n. 14), pp. 25–7; Joseph-Nicolas Delisle reports this observation and further work with Joseph-Bernard de Chabert in 1750 to confirm Quebec's longitude in *Mém. l'Acad. Roy. Sci.*, 1751, 36–9.

[19] Jacques Cassini, *Mém. l'Acad. Roy. Sci.*, 1704, 338–44.

[20] Pierre-Charles Le Monnier, *Mém. l'Acad. Roy. Sci.*, 1742, 347–53; J.-B.-N. Denis d'Après de Mannevillette, *Savants Etrangers*, 1768, *5*:90–232; also Andrew Cook, "An Exchange of Letters Between Two Hydrographers; Alexander Dalrymple and Jean-Baptiste d'Après de Mannevillette," in *Les Flottes des Compagnies des Indes 1600–1857*, ed. Philippe Haudrère (Vincennes: Service Historique de la Marine, 1996), pp. 173–82, see p. 174.

the orders of the *ministre de la marine*, the Académie des Sciences, and the Compagnie des Indes with the goal of producing a new set of maps for the area.[21]

Another part of d'Après's assignment in 1750 was to transport the *associé astronome* of the Académie des Sciences, the abbé Nicolas-Louis de Lacaille, to the Cape of Good Hope. With ministerial approval and the material support of the Compagnie des Indes (which Lacaille praised for its "zeal for Navigation which in large measure depends on Astronomy"), Lacaille went to Africa primarily to map the stars of the southern hemisphere.[22] In 1753 the *ministre de la marine* ordered Lacaille to the Iles de France and Bourbon to fix the islands' "exact geographical location." Lacaille had seen d'Après's recent data and thought them satisfactory, but used his time well, reporting longitude and other astronomical observations, performing declination and pendulum experiments, and drawing maps. His meteorological observations included an annotated list of monsoons for the period 1733 to 1754.[23]

The observation of the transit of Venus in 1761 on the Ile Rodrigue by Alexandre-Guy Pingré, an *associé libre* of the Académie, represented the next step in continuing French efforts to chart the Indian Ocean.[24] But it was the 1760–1771 odyssey of Guillaume Legentil de la Galaisière that capped French scientific navigation in the East Indies in the eighteenth century. An *astronome adjoint* of the Académie des Sciences, Legentil went to observe the 1761 Venus transit at Pondicherry, but the entrepôt had fallen to the English. He remained in the Indies for the transit of 1769, returning to France only in 1771.[25] Legentil sailed on the ships of the Compagnie des Indes, sent reports back to the Académie des Sciences from Ile de France, Ile Bourbon, Ile Rodrigue, Pondicherry, Madagascar, and Manilla, and returned to publish his two-volume *Voyage dans les mers d'Inde* in France in 1779–1781.[26] By that point the French had mastered longitudes and techniques for getting to and from the Indian Ocean.

In conducting research in distant locales, investigators did not limit themselves to longitude observations. Informally, they reported various astronomical, cartographical, meteorological, geological, botanical, natural historical, economic, anthropological, and other scientific findings. For example, following Jean Richer's discovery in Cayenne in 1672 that a standard pendulum beats more slowly towards the equator, it became customary to perform pendulum experiments on every expedition, even after the "shape of the world" controversy had been settled. Observations of magnetic variations from true north deserve particular mention because some savants in

[21] See J.-B.-N. Denis d'Après de Mannevillette, *Savants Etrangers*, 1763, *4:*399–457; and Pierre-Charles Le Monnier, *Mém. l'Acad. Roy. Sci.*, 1751, 270–2.

[22] Nicolas-Louis de Lacaille, *Mém. l'Acad. Roy. Sci.*, 1751, 519–36.

[23] *Hist. l'Acad. Roy. Sci.*, 1754, 110–16; Lacaille's memoirs, *Mém. l'Acad. Roy. Sci.*, 1754, 44–56; *Mém. l'Acad. Roy. Sci.*, 1754, 94–130; see also his log book, Bibliothèque de l'Observatoire (Paris), MS C 3, 26.

[24] See *Hist. l'Acad. Roy. Sci.*, 1761, 107–111; Alexandre-Guy Pingré, *Mém. l'Acad. Roy. Sci.*, 1761, 413–86. According to Pingré, even the *latitudes* of the Indian Ocean possessions were still not known with sufficient accuracy. Harry Woolf, *The Transits of Venus: A Study of Eighteenth-Century Science* (Princeton: Princeton Univ. Press, 1959) remains the definitive treatment of the transits of Venus.

[25] See entry on Guillaume Legentil by Seymour L. Chapin, *Dictionary of Scientific Biography*, ed. Charles C. Gillispie, vol. 8, pp. 143–5.

[26] See Guillaume Legentil papers, *Mém. l'Acad. Roy. Sci.*, 1768, 237–47; *Mém. l'Acad. Roy. Sci.*, 1771, 247–80.

the 1750s believed that *variations* in the magnetic needle held the possibility of solving the longitude problem.[27] J.-D. Cassini wrote an early series of papers on the subject, and so-called declination data repeatedly show up in the research.[28] Other researchers contributed memoirs to the Académie des Sciences, the Société Royale de Médecine, and other organizations on such practical subjects as gauging the tonnage of ships, ventilating ships' holds, preserving drinking water at sea, rendering fresh water from sea water, and arming ships with lightning rods.[29]

In the long run, the success of France's colonial endeavor depended on the strength of French cartography.[30] Like other European seagoing powers, the French centralized their cartographical and hydrographical efforts, creating a formal Dépôt des Cartes et Plans—a great "calculating" center—within the Navy Ministry in 1720 to collect and consolidate cartographical information.[31] In 1776, the library and collections of D'Après de Mannevillette became a subsidiary Dépôt des Cartes, Plans et Journaux de la Marine in Lorient. A separate Dépôt des Cartes des Colonies was created in 1778, indicating the importance of the colonies in the eyes of officialdom.[32]

The colonies themselves required mapping and surveying. Local surveyors did some of this work for private plantations, and the army and the navy each had an engineering corps charged with building bridges, roads, fortifications, and port installations for colonial defense. In addition, engineer-geographers (*ingénieurs-géographes*), "supersurveyors" in royal service, were deployed in the colonies to draw up local maps.[33]

[27] Pierre-Louis Maupertuis, for example, in his *Lettre sur le progrès des sciences* (1752) proposes this solution. See this *Lettre* appended to the Diderot Editeur edition of *La Vénus physique* (Paris: Diderot Multimedia, 1997), pp. 124–6.

[28] See Jean-Dominique Cassini's papers, *Mém. l'Acad. Roy. Sci.*, 1705, 8–13; *Mém. l'Acad. Roy. Sci.*, 1705, 80–2; *Mém. l'Acad. Roy. Sci.*, 1708, 292–6. See also paper by Guillaume Legentil explicitly devoted to declination in the Indian Ocean, *Mém. l'Acad. Roy. Sci.*, 1777, 401–19.

[29] See Dortous de Mairan, "Remarques sur le jaugeage des navires," *Mém. l'Acad. Roy. Sci.*, 1721, 76–107 and his "Instruction abrégée, & methode pour le jaugeage des navires," *Mém. l'Acad. Roy. Sci.*, 1724, 227–41; see also articles by Sébastien-François Bigot de Morogues, "Mémoire sur la corruption de l'air dans les Vaisseaux," *Savants Etrangers*, 1750, *1:*394–410; Jean-François Charpentier de Cossigny, "Expériences réitérées pour s'assurer si les filtrations de l'eau de la mer aux travers des pores du verre sont possibles," *Savants Etrangers*, 1760, *3:*1–18 and his "Essai de la manière de conserver à la mer l'eau potable, dans les voyages de long cours," *Savants Etrangers*, 1774, *6:*94–109; Gabriel de Bory, "Mémoire sur les moyens de purifier l'air dans les vaisseaux," *Mém. l'Acad. Roy. Sci.*, 1781, 111–19; Jean-Baptiste Le Roy, "Mémoire sur un voyage fait dans les ports de guerre de l'océan, pour y établir des paratonnères, et en faire placer sur les vaisseaux," *Mém. l'Acad. Roy. Sci.*, 1790, 472–84.

[30] On the background of contemporary French cartography, see Konvitz, *Cartography in France* (cit. n. 12) and Mary Sponberg Pedley, *Bel et Utile: The Work of the Robert de Vaugondy Family of Mapmakers* (Tring, Herts., England: Map Collector Publications, 1992); Monique Pelletier, *La carte de Cassini: L'extraordinaire aventure de la carte de France* (Paris: Presses de l'Ecole Nationale des Ponts et Chaussées, 1990).

[31] See Bernard Le Guisquet, "Le Dépôt des Cartes, Plans et Journaux de la Marine sous l'Ancien Régime," *Neptunia*, 1999, *214:*3–21; Olivier Chapuis, "Charles-François Beautemps-Beaupré (1766–1854) et la naissance de l'hydrographie moderne" (Thèse de doctorat, Université Paris IV-Sorbonne, 1997) pp. 1391–2; also, Bruno Latour, *Science in Action* (Cambridge, Mass.: Harvard Univ. Press, 1987), pp. 232–47.

[32] Cook, "An Exchange of Letters" (cit. n. 20), p. 180; Taillemite, *Les Archives de la Marine* (cit. n. 4), p. 5.

[33] See Comité des Travaux Historiques et Scientifiques, *La Martinique de Moreau du Temple: La Carte des ingénieurs géographes* (Paris: Comité des Travaux Historiques et Scientifiques, 1998);

While astronomical techniques for determining longitude worked on terra firma, the solution to the problem at sea lay elsewhere. John Harrison solved this more narrow concern.[34] It is less well known that the French, notably the royal clockmaker Ferdinand Berthoud, followed not far behind the English in developing comparable clocks. In the French case, although the chronometric solution emerged from the world of technology, it took astronomers and the Marine Royale to test and certify its utility. Of several French sea trials, two ventured to Saint Domingue in 1769 and 1771.[35] The results of these tests demonstrated the value of chronometers and thereafter French navigators regularly employed them.[36]

The chronometer also became a precision instrument for cartography. Earlier in the century, cartographers usually worked from offices in Paris or Versailles, and even the leading mapmakers, such as Jacques-Nicolas Bellin, came under heavy criticism for imprecision. The chronometer allowed more accurate work to be done in the field, and in 1784–1785 French authorities sent Antoine-Hyacinthe-Anne de Chastenet, Count Puységur to Saint Domingue to take data for a new set of maps of the colony and its waters.[37] Puységur returned to France in 1785, and in 1787 the government published his highly accurate *Pilote de l'Isle Saint-Domingue* and his *Détail sur la navigation aux côtes de Saint-Domingue.*

CULTIVATING NEW EDENS

The colonies were a long way from France and, especially in the early years, were exotic places waiting to be explored and studied. Colonial authorities and the scientific establishment took a keen interest in botany and natural history, and investigating colonial flora and fauna was a defining element of the French colonial enterprise.[38]

Missionaries, especially Dominicans, wrote the first descriptions of tropical nature in the French colonies.[39] Raymond Breton, for example, published a *Dic-*

Jean-Louis Glénisson, "La Cartographie de Saint-Domingue dans la seconde moitié du XVIII[e] siècle (de 1763 à la Révolution)" (Thèse d'Ecole des Chartes, 1986); Chartrand, Duchesne, and Gingras, *Histoire des sciences au Québec* (cit. n. 14), pp. 21–8.

[34] See, in particular, the recent collaboration by Dava Sobel and William J. H. Andrewes, *The Illustrated Longitude* (New York: Walker, 1998). For an entrée into the French side of the story, see Catherine Cardinal, *Ferdinand Berthoud (1727–1807), Horologer mécanicien du roi et de la marine* (La Chaux-de-Fonds, Switzerland: Musée International d'Horlogerie, 1984). Note that at roughly the same time Tobias Mayer and others developed an alternative astronomical solution to the problem of longitude that used lunar tables.

[35] McClellan, *Colonialism and Science* (cit. n. 3), pp. 122–3.

[36] The evident end of the longitude story, as least as far as the French were concerned, is plain in papers by Alexandre-Guy Pingré (*Mém. l'Acad. Roy. Sci.*, 1770, 487–513) and the Marquis de Chabert (*Mém. l'Acad. Roy. Sci.*, 1783, 49–66).

[37] François Regourd, "L'Expédition hydrographique de Chastenet de Puységur à Saint-Domingue (1784–1785)," in *Mélanges Paul Butel*, ed. S. Marzagalli (in press). Regarding longitude work in the Indian Ocean, see Philippe Buache, "Observations géographiques sur les Isles de France et de Bourbon, comparées l'une avec l'autre," *Mém. l'Acad. Roy. Sci.*, 1764, 1–6.

[38] For in-depth treatments see McClellan, *Colonialism and Science*, (cit. n. 3), chap. 6; François Regourd, "Maîtriser la nature: Un Enjeu colonial: Botanique et agronomie en Guyane et aux Antilles (XVII[e]–XVIII[e] siècles)," *Revue Française d'Histoire d'Outre-Mer* (hereafter cited as *Rev. Fran. d'Hist. d'Outre-Mer*),1999, *86:*39–63. In the same number of this journal, on pp. 7–38, see also the important overview of this topic by Marie-Noëlle Bourget and Christophe Bonneuil, "De l'inventaire du monde à la mise en valeur du globe: Botanique et colonisation (Fin XVII[e] siècle-début XX[e] siècle)."

[39] See note 38 and P. Fournier, *Voyages et découvertes scientifiques des missionnaires naturalistes français à travers le monde, pendant cinq siècles* (Paris: Paul Lechevalier, 1932).

tionnaire caraïbe in the 1660s that was full of details about Amerindians and Caribbean plants. Jean-Baptiste Du Tertre published a four-volume *Histoire générale des Antilles* (1667–1671) after spending sixteen years in the French West Indies. Jean-Baptiste Labat sojourned in the Antilles for more than a decade, and his *Nouveau voyage aux Isles de l'Amérique* (first published in 1722) contained notable chapters on island botany, as did Du Tertre's. The role of missionaries qua researchers and colonial *rapporteurs* indicates that, to some extent, the emerging colonial machinery was able to co-opt monastic networks. For example, the Jesuit and *académicien honoraire* of the Académie des Sciences, Thomas Gouye (1650–1725), served as a key intermediary between his order and secular scientists, communicating to the Académie numerous reports originating in the Antilles and elsewhere.[40]

The key step from preparing catalogues to exploiting nature was initiated by Jean-Baptiste Colbert, Louis XIV's finance minister and, concurrently, *ministre de la marine*. Motivated by the economic potential of the colonies, in the 1660s and 1670s Colbert began the systematic collection of plants and animals.[41] To further the movement to catalogue and collect colonial flora (Latour's "mobilisation of resources"), Colbert and his successors relied on the Jardin du Roi (1635) and the Académie des Sciences.[42] Under the aegis of these royal scientific institutions, several notable botanists traveled to the colonies. The Minim monk Charles Plumier made three government-financed trips to the West Indies between 1689 and 1697, sending to the Jardin du Roi thousands of drawings and plants that were later used for his *Description des plantes de l'Amérique* (1693) and his eight-volume *Botanicon americanum* (1705).[43] Another Minim monk, Louis Feuillée, went to the West Indies primarily to do astronomy but pursued botany in his spare time, and published an interesting *Histoire des plantes médicales de l'Amérique* (1714).

The great botanists from the Jardin du Roi and the Académie des Sciences—like Antoine and Bernard de Jussieu—occasionally recommended their pupils for scientific appointments in the colonies. Pierre Barrère, for example, held the post of royal physician-botanist for four years in French Guyana, publishing his *Histoire naturelle de la France equinoxiale* (1741). Similarly, Jean-Baptiste-Christophe Fusée-Aublet was posted to the Ile de France in 1753 and then to Guyana in 1762 before publishing his great *Histoire des plantes de la Guiane française* in 1775. Michel Adanson, the talented pupil of Antoine and Bernard de Jussieu, was em-

[40] See Académie des Sciences, *Index biographique* (cit. n. 15) and Jacques-Phillippe Maraldi, *Mém. l'Acad. Roy. Sci.*, 1724, 365–79; *Hist. l'Acad. Roy. Sci.*, 1707, 113; *Hist. l'Acad. Roy. Sci.*, 1703, 57; *Hist. l'Acad. Roy. Sci.*, 1704, 42; etc.

[41] For example, on 21 June 1670, Colbert wrote to the director of the Compagnie des Indes Occidentales: "Je désire que vous examiniez bien toutes les fleurs, les fruits et même les bestiaux, s'il y en a de naturels du pays et que nous ne voyons point en Europe, et tout ce qu'il faut observer pour les faire venir. Il faudra m'en envoyer par tous les vaisseaux qui viendront afin que si l'un manque, l'autre puisse réussir; surtout envoyez-moy de l'ananas [for Louis XIV's table!], afin de tenter si l'on en pourra faire venir ici." Pierre Clément, ed., *Lettres, instructions et mémoires de Colbert*, 8 vols. in 10 (Paris, 1861–1882), vol. 3-2, p. 486.

[42] On the Jardin du Roi, see Gillispie, *Science and Polity* (cit. n. 12); Yves Laissus, "Le Jardin du Roi," in *Enseignement et diffusion des sciences en France au XVIII^e siècle*, ed. René Taton (Paris: Hermann, 1964; reprint 1986), pp. 287–341. The colonial dimension of the Jardin du Roi likewise is in need of systematic study. See also Latour, *Science in Action* (cit. n. 31), pp. 224–8.

[43] Jean Lescure, "L'epopée des voyageurs naturalistes aux Antilles et en Guyane," in *Voyage aux Iles d'Amérique*, exhibition catalogue, April–July 1992, l'Hôtel de Rohan (Paris: Archives Nationales, 1992), p. 61.

ployed in Africa by the Compagnie des Indes, published his *Voyage au Sénégal* in 1757, and ended up as a *pensionnaire* of the Académie des Sciences in Paris.

With the passing of time, a notable shift of emphasis occurred. As the colonies became better established, scientific and taxonomic botany increasingly gave way to economic botany and efforts to introduce economically useful plants into production. This step called for implanting institutions and personnel on site, and to this end the French state created official botanical gardens in the colonies and staffed them with salaried *botanistes du roi* and *médecins du roi*. Gardens were created in Saint Domingue, Guadeloupe, Cayenne, Ile de France, and Ile Bourbon. The Cercle des Philadelphes launched two, and other gardens were sponsored by individuals or connected with colonial hospitals. These colonial gardens functioned alongside a special naturalizing garden in Nantes, established at the beginning of the century to receive colonial specimens.

The advent of practical horticulture greatly affected the colonies. The rise of Ile Bourbon, for example, stemmed from the introduction of coffee trees and coffee cultivation in the 1730s. Coffee culture transformed the French West Indies and provided a model the French hoped to imitate with other commodities. The *modus operandi* of these botanical efforts matured in the 1750s. The crown agent and later colonial administrator Pierre Poivre successfully conducted three covert raids in the 1750s on the Dutch East Indies and the Philippines to collect (read: steal) stocks of plants for acclimatization and cultivation on Ile de France and Ile Bourbon. These included pepper, cinnamon, clove, and nutmeg.[44] Poivre returned to the Indian Ocean to direct two more such raids, one in 1769 and another in 1771–1772.

The notable point is that in the 1770s and 1780s, French authorities were mobilizing colonial botanical gardens, their staffs of *botanistes du roi*, and navy transport capabilities to link colonial gardens in the Indian Ocean with those in Cayenne and the West Indies.[45] Shipments of exotic plants from the Indian Ocean to the Caribbean included pepper, cinnamon, mango, mangosteen, and breadfruit trees. While this traffic proceeded on the periphery of the French colonial system, other connections linked the colonies with Paris. In particular, using government channels, the royal botanist in Saint Domingue, Hippolyte Nectoux, and other colonial agents exchanged seeds and specimens with André Thouin, chief gardener at the Jardin du Roi and associate member in botany at the Académie des Sciences.[46]

[44] See Madeleine Ly-Tio-Fane, *Mauritius and the Spice Trade: The Odyssey of Pierre Poivre* (Port-Louis, Mauritius: Mauritius Archives Publication Fund, 1958) and her *Mauritius and the Spice Trade: The Triumph of Jean Nicolas Céré and his Isle Bourbon Collaborators* (Paris-La Haye: Mouton, 1970). The coconut, thought to be an antidote for poisons, was also successfully introduced onto Ile de France; see Pierre Sonnerat, "Description du cocos de l'Ile Praslin," *Savants Etrangers*, 1776, *7:*263–6.

[45] For these details see Patrice Bret, "Le Réseau des jardins coloniaux: Hypolite Nectoux (1759–1836) et la botanique tropicale, de la mer des Caraibes aux bords du Nil," in *Les Naturalistes français en Amérique du Sud XVI^e^–XIX^e^ siècles*, ed. Yves Laissus (Paris: Comité des Travaux Historiques et Scientifiques, 1995), pp. 185–216; see also his "Des 'Indes' en Méditerranée? L'Utopie tropicale d'un jardinier des Lumières et la maîtrise agricole du territoire," *Rev. Franc. d'Hist. d'Outre-Mer*, 1999, *86:*65–89. See also Jean-Louis Fischer, *Le Jardin entre science et représentation* (Paris: Comité des Travaux Historiques et Scientifiques, 1999).

[46] See Yvonne Letouzey, *Le Jardin des Plantes à la croisée des chemins avec A. Thouin (1747–1824)* (Paris: Muséum National d'Histoire Naturelle, 1989), esp. pp. 174–97; Emma Spary, "Making the Natural Order: The Paris Jardin du Roi, 1750–1795," (Ph.D. diss., Univ. of Cambridge, 1993). See also the sizeable contemporary literature about shipping botanical specimens, including works by Académie members Duhamel du Monceau (whose *Avis pour le transport par mer des arbres* . . .

To stimulate colonial agronomy, the monarchy had established colonial Chambres d'Agriculture in Saint Domingue, Martinique, Guadeloupe, and Sainte-Lucie in 1763.[47] These organizations produced some minor dissertations on mills, cotton, and cochineal for their respective colonial administrators, but by and large their contributions were not significant.[48] Local officials sometimes organized competitions on subjects relevant to the development of colonial products. For example, in Sainte-Lucie in the 1780s, they offered prizes worth several thousand *livres* for the best processed sugar, the best rum, and the best cotton mill.[49] The idea of locally based research organized by the royal administration cropped up again at the very end of the ancien régime in a project that Dutrône La Couture defended before the Assemblée Nationale in 1791. In addition to a revitalized network of colonial botanical gardens, Dutrône La Couture proposed a new set of colonial agricultural societies that would mutually correspond under the authority of a renewed Société Royale d'Agriculture.[50]

In Paris, the Société Royale d'Agriculture was called on to play a role in the development of applied botany and agronomy in the colonies.[51] (Although founded in the 1760s, it assumed this role actively only after 1785.) Through its trimestral *Mémoires*, the Parisian agricultural society assured the diffusion of papers sent from the colonies (i.e., on West-Indian cotton, on rice from Ile Bourbon, on sugar cane from Guyana, and on colonial plant and seed transfers).[52] These texts were read in expert circles in France, thereby integrating colonial knowledge into French agronomy. The Société Royale d'Agriculture also encouraged its colonial correspondents by awarding gold medals; one went to Jean-Nicolas Céré and another to his colleague Joseph Martin for their horticultural efforts in the Indian Ocean and West Indian colonies.[53]

Official institutions occasionally recognized individual colonists and their private botanical-agricultural research. For example, A.-T. Broussonnet, secretary of the Société Royale d'Agriculture, recommended a colonial planter from Guadeloupe, one Badier, to the *ministre de la marine*. Badier studied chemistry and botany in Paris and after his return to Guadeloupe, received official encouragement for his experiments on cotton. Following a familar bureaucratic pattern, Broussonnet solicited the advice of the *inspecteurs généraux des manufactures* attached to the Bureau du Commerce before asking the *ministre de la marine* to underwrite Badier's expenses.[54]

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appeared in 1753) and the Abbé Tessier, whose "Mémoire sur l'importation et le progrès des arbres à l'épicerie dans les colonies françois" appeared in the Académie's *Mémoires* for 1789.

[47] McClellan, *Colonialism and Science* (cit. n. 3), pp. 44–5 ff.

[48] These memoirs are found in the Aix-en-Provence Archives (cit. n. 8), Colonies F3, pp. 124–26.

[49] *Ibid.*, Colonies C10 C3, parts 6 and 10.

[50] See Jacques-François Dutrône la Couture, *Extrait des mémoires que M. Dutrône a présentés à l'Assemblée Nationale au mois de janvier 1791, tiré du "Journal des Colonies"* (Paris: Imprimerie du Cercle social, n.d.), p. 2.

[51] François Regourd, "La Société Royale d'Agriculture de Paris face à l'espace colonial (1761–1793)," *Bulletin du Centre d'Histoire des Espaces Atlantiques* (Université Bordeaux-III), 1998, *8:*155–94; Emile Justin, *Les Sociétés Royales d'Agriculture au XVIII*[e] *siècle* (1757–1793) (Saint-Lô [publisher not indicated], 1935).

[52] Regourd, in "La Société Royale d'Agriculture" (cit. n. 51) gives a complete list of colonial memoirs published by the Société.

[53] See Société Royale d'Agriculture de Paris, *Mémoires*, Fall Trimester 1788, vi–vii; and Fall Trimester 1789, xiii.

[54] The Aix-en-Provence Archives (cit. n. 8), Colonies E 14, dossier Badier. These *inspecteurs généraux des manufactures* and their relations with scientific circles have been studied by Philippe Mi-

Further indicative of the agricultural concerns of the colonial machine, an ephemeral Comité Consultatif d'Agriculture met informally under the aegis of the *contrôleur général des finances*. Born after food shortages in the winter of 1784–1785, this Comité consisted of ten top-level scientists and physicians (Lavoisier, Poissonnier, and others) and met about seventy times between 1785 and 1787 before merging with the Société Royale d'Agriculture in 1788. The Comité Consultatif paid serious attention to such matters as Thiery de Menonville's introduction of cochineal in Saint Domingue, Duchemin de l'Etang's call for importing so-called Guinée grass (a fast-growing fodder), naturalizing insect-eating birds from Ile Bourbon and India, and founding a new naturalizing garden in the south of France.[55]

ON THE MARGINS

Thanks to the considerable institutional and human investment made by the monarchy, the scientific bureaucracy of the ancien régime successfully brought its expertise to bear on colonial development, and the world of science became thereby enlarged. Not every scientific act associated with the colonies was necessarily tied—wholly or in part—to overall institutional structures or was bound to submit to norms controlled by the colonial machine. The features that were complementary to "official" colonial science must be kept in perspective. They were relatively unimportant, but a closer examination of sources reveals other modes of circulation, publication, and elaboration of knowledge within the colonies, all of which call for nuancing the monolithic character of the scientifico-colonial machine that we have depicted thus far.

For example, the scientific model exported by the metropolis was not unconditionally accepted in the colonies. In the preface to his *Nouveau voyage aux isles de l'Amérique* (1722), Father Jean-Baptiste Labat proudly claimed the right not to classify plants and animals according to artificial taxonomies as "some persons of consideration" advised.[56] He objected to the "itinerant" science of botanists sent to the West Indies, proposing instead a "field science" born of careful observation and a modest description of nature. Labat repeatedly pointed out—with obvious satisfaction—the mistakes and lapses of Father Charles Plumier, the emissary of the Académie des Sciences.[57]

Similarly, much information transmitted by missionaries escaped the secular apparatus. The Jesuits at the College at Quebec, for example, held official positions as royal hydrographers, but what else did they do for science outside the purview of

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nard in *La Fortune du Colbertisme: Etat et industrie dans la France des Lumières* (Paris: Fayard, 1998), and in his "Les Savants et l'expertise manufacturière au XVIII[e] siècle," in *Histoire et mémoire de l'Académie des Sciences: Guide de recherches*, eds. Eric Brian and Christiane Demeulenaere-Douyère (Paris: Tec & Doc Lavoisier, 1996), pp. 311–18. In addition, Lavoisier was regularly consulted, for example on sugars or cloves; see *Œuvres de Lavoisier* (Paris, 1862–1893), vol. 4, p. 478, vol. 6, p. 74, and ff.

[55] The minutes of this *comité* have been published; see Alfred de Foville and Henri Pigeonneau, eds., *L'Administration de l'agriculture au contrôle général des finances (1785–1787): Procès-verbaux et rapports* (Paris, 1882).

[56] R. P. Jean-Baptiste Labat, *Nouveau voyage aux isles de l'Amérique*, 4 vols. (Martinique: Saint-Joseph, 1979), vol. 1, p. 17.

[57] *Ibid.*, p. 147, where he writes: "C'est à quoi s'exposent ceux qui veulent faire des Relations d'un pays qu'ils ne voyent qu'en passant et comme en courant."

the monarchy?[58] While only a careful examination of monastic records will reveal the knowledge collected and housed in monastic libraries, we do know that Father Mongin sent astronomical observations to his Jesuit superior at the end of the seventeenth century; that the missionary Philippe de Beaumont refers to shipping natural history samples to his order; and that the naturalist Father Nicolson left his important collection from Saint Domingue to his mother house in France (and *not* to the Jardin du Roi).[59]

Religious communities were not alone in doing science on the colonial periphery. Examples abound, particularly in the second half of the eighteenth century, of agricultural, physical, chemical, even electrical or aerostatic experiments conducted by individuals in private, unaffiliated colonial circles.[60] Manuscripts occasionally turn up that exemplify this activity: a compendium of plants from Saint Domingue illustrated with watercolors by an artillery captain; a flora of the West Indies with seventy colored drawings compiled around 1764 by an imprisoned army officer of Guadeloupean origin.[61]

The metropolitan scientific bureaucracy proved flexible in responding to the growing needs of the royal administration and to the increasing specialization of knowledge—while still attracting the goodwill of enlightened amateurs. But in the end the "machine" showed obvious limitations. The distant and elitist character of official institutions and difficulties in publishing through their official outlets presented obstacles for colonials. Similarly, because of the explosive growth of knowledge in the eighteenth century and the growing complexity of science's intellectual and material tools, the scientific effort originating in the colonies increasingly became diverted toward other, second-tier institutions in metropolitan France.

French provincial academies, for example, were more likely to acknowledge the merits of colonial authors—or at least to gratify their vanity. Indeed, many reports that can be called "colonial" are housed today in the archives of provincial academies. For instance, in the archives of the Académie des Sciences, Belles-Lettres et Arts in Bordeaux, one finds reports coming from Sainte-Lucie (by Jean-Baptiste Cassan), Guadeloupe (by Peyssonnel) and Guyana (by Pierre Barrère and Desrivierre-Gers).[62] Other colonial memoirs are waiting to be discovered in the archives of Marseilles, Rouen, and the big Atlantic ports.[63]

[58] Chartrand, Duchesne, and Gingras, *Histoire des sciences au Québec* (cit. n. 14), pp. 22–31.

[59] On these examples, see Bibliothèque Municipale de Carcassonne, MS 82, fol. 74–7; Gabriel Debien, "Un Missionnaire auxerrois des Caraïbes: Claude-André Leclerc de Château-du-Bois à la Dominique et à la Guadeloupe (XVII[e] siècle)," *Bulletin de la Société des Sciences Historiques et Naturelles de l'Yonne*, 1976, *108:*43; Fournier, *Voyages et découvertes* (cit. n. 39), p. 70.

[60] McClellan, *Colonialism and Science* (cit. n. 3), chap. 10 outlines these for the case of Saint Domingue; see also François Regourd, "Un Médecin des Lumières à Sainte-Lucie: Le Docteur Cassan," Comité des Travaux Historiques et Scientifiques Annual Congress (Fort-de-France, 1998), in press.

[61] For the compendium, see Bibliothèque Municipale de Besançon, MS 446. The flora is an uncatalogued MS in the Bibliothèque Mazarine (Paris), presented in Marcel Chatillon and Jean-Claude Nardin, *De la découverte à l'émancipation: Trois siècles et demi d'histoire antillaise à travers les collections du Docteur Chatillon et de la Bibliothèque Mazarine* (Catalogue of exhibit at the Bibliothèque Mazarine, 2 Nov. 1998 to 29 Jan. 1999) (Paris: Institut de France, 1998), entry 16.

[62] Bibliothèque Municipale de Bordeaux, Fonds Ancien, MS 828 (I–CVI).

[63] For a sense of these archival sources and of provincial academies generally, see the magisterial work by Daniel Roche, *Le Siècle des Lumières en Province: Académies et académiciens provinciaux, 1680–1789* (Paris-La Haye: Mouton, 1978).

Likewise, several free societies and *musées* created in France in the 1780s welcomed colonial correspondents. The Parisian Société d'Histoire Naturelle, for example, had eight colonial associates in 1791.[64] The Bordeaux Musée established contacts with the Cercle des Philadelphes and individuals in Saint Domingue.[65] And the Parisian Musée founded by Court de Gébelin had the famous Moreau de Saint-Méry for its president, a renowned figure in colonial science who was also permanent secretary of the Musée of Pilatre de Rozier.[66]

Metropolitan newspapers were willing to open their columns to contributions from the colonies. The *Journal de Physique*, the *Journal des Savants*, and even more specialized sheets like the *Feuille du Cultivateur* or the *Gazette de Santé* published numerous articles written in the tropics. Many of these articles were, in fact, passed on by distinguished members of the various royal academies, but in many other instances authors addressed editors directly, bypassing official channels. Newspapers published in the colonies were also vehicles for circulating agricultural information and other reports.[67] If some of these reports are attributable to local administrators, most of the planters' submissions were published on the initiative of editors (like the famous Charles Mozard, publisher of Saint Domingue's *Affiches Américaines*), who played a significant role in endowing local scientific statements with a degree of legitimacy.

Some of the activities conducted on the margins of the French colonial machine could be exploited by rival machines, notably England's. Peyssonnel, the Caribbean-based physician and botanist, actually turned to the rival machine and published in the *Philosophical Transactions* when his discovery of the nature of coral reefs as living organisms was rejected by Réaumur.[68] Such behaviors were common practice. Somebody like Cassan, for example, the royal physician in Sainte-Lucie in the late 1780s, was an active correspondent of the Ministère de la Marine, the Société Royale d'Agriculture, the Académie de Marine, and the Académie Royale de Bordeaux, but he did not hesitate to send his report on the Sainte-Lucie volcano to the Swedish *Vetenskapsakademie*.[69] The strictly national logic encouraged by the colonial machine (and by the *ministres de la marine* in particular) was not always upheld by the actors in the field. By the same token, in a spirit of fraternity following the American war, botanical exchanges began between and among British and French gardens in the Caribbean. Nectoux, the superintendent of the French royal garden in Saint

[64] On the Société d'Histoire Naturelle of Paris, see Pascal Duris, *Linné et la France* (Geneva: Droz, 1993), esp. pp. 69–96. For a list of colonial associates, see *Actes de la Société d'Histoire Naturelle de Paris*, 1792, *1:*131–32.

[65] McClellan, *Colonialism and Science* (cit. n. 3), pp. 267–8.

[66] Anthony Louis Elicona, *Un Colonial sous la Révolution en France et en Amérique: Moreau de Saint-Méry* (Paris: Jouve, 1934), pp. 19–20.

[67] McClellan, *Colonialism and Science* (cit. n. 3), pp. 97–101; Jean Sgard, ed., *Dictionnaire des journaux 1600–1789* (Paris: Universitas, 1991), passim. See also Jean Fouchard, *Plaisirs de Saint-Domingue: Notes sur la vie sociale, littéraire et artistique* (Port-au-Prince: Imprimerie de l'Etat, 1955; reissued 1988).

[68] For a list of Peyssonnel's papers appearing in the *Philosophical Transactions*, see Auguste Rampal, "Notes biographiques sur J.-A. Peyssonnel," *Bulletin de Géographie Historique et Descriptive*, 1907, *22:*32.

[69] Regourd, "Un Médecin des Lumières" (cit. n. 60); Jean-Baptiste Cassan, "Beskrifning om Vulcanen på Sainte-Lucie," in Kongliga svenska vetenskaps-academiens, *Nya Handlingar*, 3rd trimester 1790, pp. 161–78.

Domingue, twice traveled to Jamaica where he and his English counterpart, Dr. Thomas Clarke, exchanged interesting specimens from their gardens, including tea.

While on the geographical periphery of the French colonial empire, the Cercle des Philadelphes in Cap-François, Saint Domingue represented the fullest extension of ancien-régime colonial science, and at the same time evidenced some of the centrifugal forces discussed here. On the one hand, like provincial academies, it began by private initiative (in 1784), and its existence suggests the emergence of autonomous colonial scientific practices. It automatically became *the* regional scientific authority. It cultivated its own botanical garden outside the control of colonial administrators, and published a number of small scientific and medical works in the colony.

But the Cercle des Philadelphes began to receive government subsidies in 1787, and in May of 1789 it became the official Société Royale des Sciences et Arts du Cap François. Compared with the typical French provincial academy, the Cercle des Philadelphes was on a fast track to government recognition and support. Included in that support were gold and silver *jetons de présence*, just like those awarded by the big academies in Paris, and money for prizes. The Cercle des Philadelphes integrated itself within the metropolitan academic network by formalizing a virtually unprecedented association with the Académie Royale des Sciences. It also established links with the Société Royale de Médecine and a few provincial academies and *musées*, and it showed its subservience to the state by electing colonial *gouverneurs-généraux* and *intendants* as honorary members. By the same token, provincial academies in France were notoriously independent, and as a provincial, if tropical, academy, the Cercle des Philadelphes likewise exemplified the desire of colonials for scientific self-determination while maintaining friendly links with the rest of official science. In so doing, the Cercle des Philadelphes legitimated a voice for science originating in and aimed at the colonies.[70]

Finally, parallel forms of knowledge persisted on the periphery of the French colonial machine. We are not referring to the mature scientific traditions of India or China, which the envoys of the Académie des Sciences and the Jesuits identified and collected quickly enough.[71] We have in mind, rather, Amerindian knowledge of nature and that introduced and enriched by African populations brought as slaves to colonial plantations in the West Indies or the Mascareignes. References occur particularly in connection with cures effected by plants best known to Amerindians or slaves. The French colonial machine showed a keen scientific and political interest in this potentially valuable, yet also threatening, indigenous knowledge. Already in 1647, Father Raymond Breton wrote about West Indian natives: "They certainly have wide knowledge and they exploit the rare virtues of many things we have no name for in Europe."[72] A century later the French engineer Fresneau identified and

[70] On the Cercle des Philadelphes, see McClellan, *Colonialism and Science* (cit. n. 3), part III; Pierre Pluchon, "Le Cercle des Philadelphes du Cap Français à Saint-Domingue: Seule académie coloniale de l'Ancien Régime," *Mondes et Cultures*, 1985, *45:*157–85.

[71] See for example, Guillaume Legentil's "Remarques et observations sur l'astronomie des Indiens," *Mém. l'Acad. Roy. Sci.*, 1784, 482–501 and related papers in volumes for 1785 and 1788. See also the many reports from the Jesuits in China held in the archives of the Observatoire in Paris.

[72] Père Raymond Breton, *Relations de l'île de la Guadeloupe*, vol. 1 (Basse-Terre: Société d'Histoire de la Guadeloupe, 1978), p. 50. See also Chartrand, Duchesne, and Gingras, *Histoire des sciences au Quebéc* (cit. n. 14), pp. 65–8.

located the rubber tree, thanks to the aid and expertise of the Indians of Guyana.[73] The Société Royale de Médecine received a report about a plant well known in Guadeloupe and in Saint Domingue that was used by slaves supposedly to cure smallpox.[74] In another instance, the *ministre de la marine* queried the Société Royale de Médecine about certain ant nests used by blacks (but not Indians!) in Guyana to staunch hemorrhages.[75] Behind much of this concern loomed the threat of poisonings, which regularly terrorized white colonists. Moreau de Saint-Méry wrote about slaves with knowledge of poisons "giving classes on this repulsive weapon everywhere in the colony."[76] Nightly practices in Saint Domingue that blended *vaudon* rites with Mesmeric principles imported from France attracted the attention of colonial authorities and confirmed—if confirmation were needed—that such underground, badly understood, and possibly threatening knowledge existed and needed policing.[77]

As revealing as they are, secondary centers and modes of activity did not rival the functioning of the central institutions. The great and powerful French colonial machine possessed informants and an allure such that Paris would ultimately retrieve any useful information that appeared in its colonial networks.

CONCLUSION

From its seventeenth-century origins to the end of the ancien régime, the scientifico-technical dimension of French colonialism formed an integral element of a colonial mode of production superintended by the French government. Medicine, astronomy, cartography, botany, and the marine sciences were pressed in every way to produce useful outcomes. French colonial science was heavily institutionalized—witness the Académie Royale des Sciences, the Académie Royale de Marine, the Société Royale de Médecine, the Société Royale d'Agriculture, the Cercle des Philadelphes, botanical gardens, port hospitals, and other organizations. Centered around the Ministère de la Marine, these institutions came to function in a coordinated way, as part of a larger bureaucracy, normalized in the service of the state. Although not without interest, little scientific activity took place outside of this bureaucratized apparatus, and our story involves comparatively little pluralism.

Notable by their near-complete absence from this account are the conventional interests of French commerce. Traders in Nantes or Bordeaux who grew rich from the slave trade, and planters and others in the colonies and in France who profited from sugar and coffee production, expressed comparatively little interest in research

[73] Charles-Marie La Condamine, *Mém. l'Acad. Roy. Sci.*, 1751, 326–8.

[74] Acad. Nat. Méd. Lib. (cit. n. 8), Archives of the Société Royale de Médecine, "Manuscrits #7: Plumitif de la Société R. de Med: Depuis le 1 Xbre 1778 jusques au 30 9bre 1779," p. 141 [Meeting for Friday, 23 April 1779.]

[75] *Ibid.*, "Manuscrits #11: Plumitifs depuis le 10 mars 1786 jusqu'au 24 juillet 1789," fol. 31r [Meeting for 4 July 1786]; also, MS 132, dossier 49.

[76] Louis Médéric Moreau de Saint-Méry, *Description topographique, physique, civile, politique et historique de la partie française de l'isle de Saint-Domingue*, eds. Blanche Maurel and Etienne Taillemite (Paris: Société Française d'Histoire d'Outre Mer, 1984), p. 630. Pierre Pluchon, *Vaudou sorciers empoisonneurs de Saint-Domingue à Haiti* (Paris: Karthala, 1987) is the fundamental and pioneering work in this regard.

[77] See Pluchon, *Vaudou sorciers* (cit. n. 76); McClellan, *Colonialism and Science* (cit. n. 3), p. 146; and Gabriel Debien, "Assemblées nocturnes d'esclaves à Saint-Domingue (La Marmelade, 1786)," *Annales Historiques de la Révolution Française*, 1972, *44:*273–84.

science or in using the forces of knowledge to improve production. The economics of the contemporary colonial game simply did not reward long- or even medium-term investment.

French colonial science in the ancien régime is not completely congruent with French exploration in the eighteenth century. Voyages of discovery preceded formal colonization, but in the final analysis the better-known examples of scientific research expeditions undertaken by the French—the missions to Lapland and Peru in the 1730s, the Venus transit observations in the 1760s, and the voyages of Bougainville and La Pérouse later in the century—had little to do with colonization per se, even if the colonial enterprise ultimately benefited. These great expeditions may be said to have been driven by the internal demands of science and an Enlightenment program of measuring the world and documenting its contents.[78]

Why, then, did the monarchy go to such lengths to engage science and expertise in support of colonization? Answers are not hard to find. First, colonial commerce was crucial for the French economy in general and government finances in particular. The economic principles of mercantilism guided Bourbon policy in colonial matters. On the eve of the Revolution, one person in eight in France lived off of colonial commerce, and 60 percent of 632 million *livres* of French foreign trade involved colonial products, with taxes, tolls, and duties (totaling up to 50 percent) bringing millions into state coffers.[79] Second, the colonies served as treasured possessions in contemporary geopolitics, especially vis-à-vis England, and from the 1660s to the French Revolution a driving purpose of the scientifico-technical apparatus of France was to develop the colonies as part of the country's international presence. France's loss of much of its first colonial empire after 1763 and defeat in the Seven Years' War embittered many, especially in the Marine Royale, and gave a new impetus for reform and expansion of the Marine, especially by scientifically inclined officers.[80] Needless to say, this movement found vindication in the victory over the English in the American war. Finally, although arguably first, the sheer glory and magnificience of a great empire was enough of a *raison d'être* for the French state to underwrite costly colonial investments. What we think of as nationalism was only part of the story; the rest, foreign to us in the twenty-first century, concerned the majesty *Très Chrétienne* of the Bourbon kings, a majesty not to be taken lightly.

The revolutionary and Napoleonic periods destroyed the first French colonial empire and, with it, the distinctive ancien-régime style of French colonial science. The French lost Saint Domingue in 1804 to the rebellious slaves of the new country of

[78] On French scientific voyages, see especially the recent Ph.D. dissertation by Jordan Kellman, "Discovery and Enlightenment at Sea: Maritime Exploration and Observation in the 18th-Century French Scientific Community" (Princeton University, 1998). See also John Gascoigne, *Joseph Banks and the English Enlightenment: Useful Knowledge and Polite Culture* (Cambridge: Cambridge Univ. Press, 1994). Regarding the Enlightenment and colonialism, see David Wade Chambers, "Period and Process in Colonial and National Science," in *Scientific Colonialism: A Cross-Cultural Comparison*, eds. Nathan Reingold and Marc Rothenberg (Washington, D.C.: Smithsonian Institution Press, 1987), pp. 297–321, here pp. 299, 306–10; McClellan, *Colonialism and Science* (cit. n. 3), p. 293.

[79] See Jean Tarrade, *Le Commerce colonial de la France à la fin de l'Ancien Régime*, 2 vols. (Paris: Presses Universitaires de France, 1972), esp. chap. 19 and table 3, p. 739; Pluchon, *Histoire de la colonisation français* (cit. n. 1), pp. 687–79 and appendices, esp. p. 1018. See also McClellan, *Colonialism and Science* (cit. n. 3), chap. 4, esp. p. 63 and notes, and Paul Butel, *Européens et espaces maritimes (vers 1690–vers 1790)* (Bordeaux: Presses Universitaires de Bordeaux, 1997), chap. 4.

[80] This theme echoes through the volume edited by Ulane Bonnel, *Fleurieu et la Marine de son temps* (Paris: Economica, 1992).

Haiti, and after 1815 France was left with only crumbs of its former empire. The remaining *veilles colonies* declined in importance as France struggled to build a second colonial empire around new, more substantial holdings in Africa and in Southeast Asia.[81] European imperialism in the nineteenth century eclipsed in scale and importance earlier, mercantilist episodes of colonial development. The distinctive "civilizing mission" of the French Republic replaced the pursuit of Bourbon glory. But undoubtedly, as de Tocqueville might have it, the roots of French colonial science reach back to the ancien régime.

[81] On these developments see Denise Bouche, *Histoire de la colonisation française,* vol. II, *Flux et reflux (1815–1962)* (Paris: Fayard, 1991). On French science and colonization in the nineteenth and twentieth centuries, see Lewis Pyenson, *Civilizing Mission: Exact Sciences and French Overseas Expansion, 1830–1940* (Baltimore: The Johns Hopkins Univ. Press, 1993).