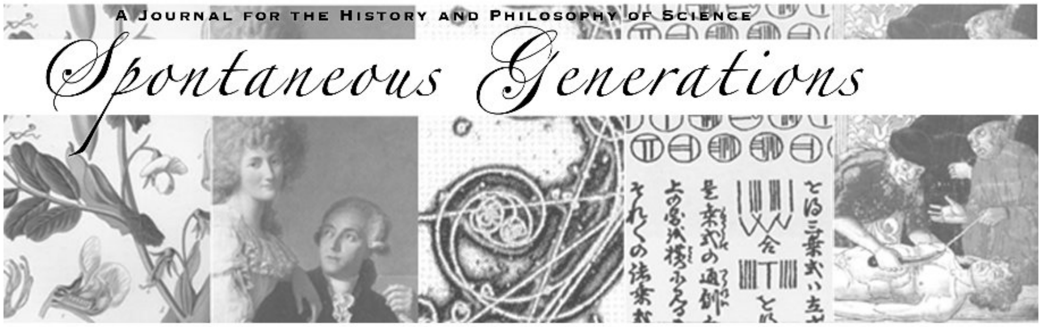

"I Hold Every Properly Qualified Navigator to be a Philosopher": The Making of the U.S. Naval Observatory's Global Laboratory

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"I Hold Every Properly Qualified Navigator to be a Philosopher"

The Making of the U.S. Naval Observatory's Global Laboratory*

Aaron Sidney Wright†

This paper presents the data gathering of Matthew Fontine Maury at the U.S. Naval Observatory as pushing an epistemic boundary outside traditional laboratory walls. Maury's use and control of civilian navigators explicates the development of an astronomic epistemology deeply embedded in nineteenth century American society. In conclusion, following the movement of epistemic boundaries is offered as a guide to crucial moments in the development of a multifaceted modernity.

> "PHI-LOS/O-PHER, n. 1. A person versed in philosophy, or in the principles of nature and morality; one who devotes himself to the study of physics or of moral or intellectual science. –2. In a *general* sense, one who is profoundly versed in any science."
>
> (Webster 1838, 608)

This paper engages with many facets of our understanding of epistemic boundaries.[1] While these boundaries have no settled definition, in this discussion I draw on the impacts that discipline (Thompson 1967; Foucault 1969; Schaffer 1988), virtue (Daston and Galison 2007), common practices (Fleck 1979; Daston 2004), and ethics (Weber 1905 [2002]; Shapin 2008) have on our understanding of what shapes and supports historical actor's epistemologies. I hope to sketch a story of the pushing of an epistemic boundary out from its traditional frame–the observatory–and into the socio-cultural space of nineteenth century Americans. Building on an accomplished history of the U.S. Naval Observatory (Dick 2003), this

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story starts with Superintendant Matthew Fontaine Maury’s (1806-1873) attempts to regulate the observations of his officers. Maury’s interests spread far beyond astronomy, and as a pioneer of meteorology he spent the majority of his time labouring on charts representing the sea. This project led him to extend his network of observers from the Observatory outwards into the community of American navigators who recorded information in the course of their regular voyages. If we can extend the idea of a laboratory (Gooday 2008) to the oceans, we can follow an epistemic boundary moving with it. This extension is further grounded in Bruno Latour’s insistence that a laboratory is a “place where scientists *work*” (1987, 64). Maury and his charts would find a place in the lives of navigators and their surrounding economic and literary spheres. This manifestly shifted the epistemological standpoint of these navigators. This standpoint was entrenched by Maury’s extension of an Astronomer’s discipline to his extended network. Carefully printed accounting sheets guided their observations, and the charts Maury exchanged for their labour were close at hand. This discipline was accompanied not by subjection but by elevation: Maury considered his navigators to be philosophers. If epistemic cultures are established by practice, Maury transformed his maritime observers into “scientific men.” The consequences of this are briefly explored, and I conclude with a discussion of the utility of following the path of epistemic boundaries for historians as another clue to where to look for the fraught development of modernity.

In the 1850s the Naval (or Washington) Observatory’s “scientific men” (Gilliss 1845, 67) were subsumed in the epistemic virtues of a particularly American style of nineteenth century astronomy. They would measure the transit times of stars by observing the passage of the image of an astronomical object projected trough a telescope onto a small screen. A series of parallel wires ran between the screen and the observer’s eyepiece. The time to cross the wires was marked by the audible clicks of a chronometer. To properly record these times–ranging from 30 seconds to 23 hours–Officers had to maintain the “needful requisites of *good* habits” of observation. “[B]eginners” were required to read and record of astronomically irrelevant quantities from barometers and thermometers as a means of “inducting attentive habits of observation and remark.” Constantly shifting personnel leading up to the publication of the Observatory’s 1846 *Observations* prevented “the establishment of a *personal* equation between the observers” to quantify the systematic errors of individual observers. However, Maury thought that “the errors that arise from the bodily, nay, I may add the *mental* condition of the observer,” cannot be entirely controlled, but can be restrained “with untiring patience and watchful diligence” (Maury 1846, vi, xlix, lix). This follows in analogy with European observatories (Schaffer 1988). However, at the USNO the observational labour was not divided into assistants, calculators, and observatory managers. In fact, Maury writes that "each observer computes the corrections and prepares his own observations for printing," and their initial is published next to each result (Maury 1863, xxii). Each observer was individually responsible for his work, and accountable not to a manager, but to the American astronomical laity. This audience consisted of Naval and merchant navigators, amateur astronomers, and readers of the substantial sections of the *Observations* published in the popular press, of which more below. This discipline, individual and enforced by public scrutiny, is indicative of an American sense of the virtues of science.

Maury's time at the observatory would be cut short by his defection to the Confederacy at the outbreak of the Civil War, but while at the Observatory he further extended the reach of the Observatory into American society. Maury's prime interest was not astronomy, but hydrography, and during his tenure at the Observatory he directed a good portion of its resources and manpower to distilling the collected knowledge of the Navy's navigators–from pre-distributed "Abstract Log" books–of the winds and currents of the sea. Maury produced detailed charts that greatly reduced the sailing time between important ports for American sailors. The charts were published individually from 1847 and became more specialized in the 1850s. The initial "Track Charts" were followed by trade-wind charts (1851), storm and rain charts (1853) and whale charts (1852). These were combined with Maury's theories on the rules of nature responsible for these observations in his 1855 *Physical Geography of the Sea.* The Pilot Charts, Maury explains, are the result of hundreds of thousands of observations of ships at sea.

> For this purpose the ocean is divided into convenient sections, usually five degrees of latitude by five degrees of longitude. These parallelograms are then subdivided into a system of engraved squares [. . .]. As the wind is reported by a vessel that passes through any part of the parallelogram, so it is assumed to have been at that time all over the parallelogram. (Maury 1855, 425)

Thus, each sea chart's precision rested on the ability to accurately report a ships position. Navigators compiling their Log books had to write with confidence their longitude alongside observations of wind, rain, atmospheric pressure, or all three. That is, Maury's sea charts required the unproblematic use of a chronometer. Maury was well aware of how chronometers worked and when they did not. The nascent Observatory was born of the Depot of Charts and Instruments, which was created to control their use and upkeep (Goldsborough 1830; Dick 2003). As the need for accuracy grew, Maury needed the observations of sailors outside the Observatory’s influence. However, if he were to demand that each ship’s chronometer be tested at Washington before he included its data in his Logs, they could never have been compiled. The sea charts relied on the chronometer simply working, letting all the building, distributing, maintaining, and “rating” remain in darkness, inside its box.

In order to support his “beautiful system of investigations,” (Maury 1851) across the globe, Maury needed more data than the navy could supply. He went deep into the lives of mariners to get it. He did this by “translating” (Latour 1987) his interests so that they matched more closely non-naval and foreign, commercial navigators. The whaling charts were of less obvious interest to the navy than to merchants, and were clearly outside the purview of the Observatory. However, merchants found the wind and current charts the most useful (Dick 2003, 96). Maury’s “beautiful system” relied on taking commercial concerns as seriously as scientific ones. This put the Observatory in the commercial sphere, creating a firm alliance with common sailors and merchant ship masters (Dupree 1957). Suddenly, thousands of men were enlisted, with the aid of standardized log books, as data gatherers in Maury’s network. Plate I of *Physical Geography* is a “Diagram of the Winds” spread across a globe. Maury wrote that “[t]his plate combines in its construction the results of 1,159,353 separate observations on the force and direction of the wind, and a little upward of 100,000 observations of the height of the barometer at sea” (1855, [424], [434]). *Putnam’s Monthly Magazine* put the Charts’ circulation at 30,000 copies (1853). Benjamin Franklin had had success convincing navigators to assist him with his researches in the past (Chaplin 2008). But as Captain McKenzie, writing to Maury, explained: It was not a charismatic figure that overcame sailors reticence to share their knowledge but the “practical utility of [their] researches” (McKenzie 1851, quoted in Maury 1855, 310). Navigators and Maury were able to pass information back and forth happily, and to see the value intrinsic in it.

This attempt “to construct elaborate migratory charts of the sperm whale” entered the American consciousness through literature and as well as commerce. The preceding quote is from Chapter 44 of *Moby-Dick*: “The Chart.” In a note to the sentence quoted above, Herman Melville wrote that “since the above was written, the statement is happily borne out by an official circular, issued by Lieutenant Maury, of the National Observatory, Washington, April 16 1851” (2002, 164-68). Melville concludes the note with a quotation from Maury describing the charts’ five-degree structure. This suggests that the technical details of the production of these charts were significant for both mariners and Melville’s readers. Maury and his

314 THE WIND AND CURRENT CHARTS.

ABSTRACT LOG of the

Date.	Latitude at noon.	Longitude at noon.	Currents. (Knots per hour.)	Variation *observed.*	Bar.	THER. 9 A. M.		WINDS.	
						Air.	Water.	First Part.	Middle Part.

☞ Leave broad margin.

☞NOTE.—Frequent mention has been made and much stress laid in this work as to the peninsula of cold water, in the North Atlantic, and as to the probabilities of soundings far to the southward and eastward as well as to the northward and eastward of the Grand Banks.

The ship "Hudson," Capt. Simpson, is said to have got soundings in 35 fathoms—mud—about Lat. 45° N., Long. 43° W.

Capt. M. D. Ricker, of the "Antarctic," on a voyage last June from New Orleans to Liverpool, reports a most remarkable change both in temperature and color of the water—the former may possibly have been caused by an iceberg, still it is very desirable to have more temperatures and soundings near the same place. This phenomenon occurred between his position, Lat. 39° 38′ N., Long. 63° 6′ W., at noon June 24th, and his position the next day at noon, viz. 39° 44′ N., 61° 2′ W.

I quote from the very excellent and valuable abstract that he has returned to this office.

Sea Account, June 24, 1851.

"At 1 P. M. observed the water to be much changed from a blue to a very light green, caught up the thermometer and hove it over, and looking at it I was very much surprised to see that it had fallen 11 degrees since 9 A. M., which was then 77, and I judged within the influence of the Gulf. One hour after, it had fallen to 54°, and in 25 minutes after, to 52; the color of the water a very light green, the ship going about 4 knots to the eastward with a light breeze from the West. At 3 P. M. a fog-bank was approaching the ship from the N. N. W. and N., which soon enveloped the ship in a cold mist, and changing the wind to that quarter, and bringing with it some considerable swell. Observed great quantities of chips, rockweed and some few sprigs of gulf-weed. Luffed the ship up in the wind and tried for soundings with the patent lead, but in the hurry did not get down but about 80 fathoms—no bottom—4 P. M. water 56°, and at 8 do. 66°, and at 12, 70°, wind W. by S.

I notice on the chart there is a bank or shoal laid down in this neighborhood, called Anne Bank, and in the "Memoir Atlantic Ocean" it is called ———— Reef, the position of which has not been very accurately determined. It is mentioned as being in about Lat. 39° N. and 64° 20′ W. Our Lat. by observation, one hour before I tried the water or at noon, was 39° 38′ and Long. by a good chronometer 63° 06′—[2, in fact, very good ones.]

I think if there was any bottom there, we had probably got past it before I sounded. During the following 24 hours we have had very little if any gulf current."

Figure 1: Maury's "Abstract Log" (1851, 314). Source: Making of America, University of Michigan Library, http://name.umdl.umich.edu/AAN1092.0001.001.

Charts were also featured in the rapidly growing American magazine market. Maury's *Sailing Directions* was reviewed in the *American Whig Review* (1850) and discussed in "A Philosophical Survey of the Ocean" in the *New Englander and Yale Review* (1855). The virtues of the Observatory were expounded by *Scientific American* (1866) and *The North American Review* (1867), and Maury's speeches and writings featured regularly in the *American Journal of Science* for their "curious and interesting facts" (1848, 400). This literary technology penetrated the astronomical community, out from the navy to port and sailing communities and into the lives of Americans "particularly eager to probe the special meaning technology might have for their lives" (Kasson 1979 [1999], 24).

Maury notes two types of labour connected to the construction of the Sea Charts: that of compilers and that of his mariner-observers. Each encountered aspects of an astronomer's discipline. In order "to satisfy navigators as to the confidence which is due the results, [charts of the China Sea,]" Maury "explain[ed] the process" he used to generate them. He emphasizes the faithfulness of the "compiler" in Washington who "wades through Log book after Log book, and scores down column after column, and upon line after line, mark after mark[. . .]" of the navigators records. Importantly, Maury addresses the unreliability of mariner's measurements. "Instead of entering the wind in the Log as from the *point* of the compass from which it blows, many seaman were too much in the habit [. . .] to enter it by quadrants ["Sd. and Wd."]." Maury did not know what to do with these observations, however, he knew how to discipline habits. Additional measurements "remedied the defect [. . .] by entering the winds for the first, middle and latter part–3 times a day–as from the point of the compass from which it most prevailed" (Maury 1851, 17). This demonstrates Maury's attempt to extend the astronomer's disciplined inscription aboard ship. However, it represents a more symmetrical exchange of information than other naval researchers practiced (Schaffer 2007).

The Abstract Log's regimented tables (see Figures 1 and 2, pages 86 and 88) were physical objects that carried the framework for a disciplined observer from Washington to the China sea. The Logs can be considered "epistemic engines": their "epistemic quality lies in the way they focus [the compiler and navigator's] activities" (Carroll-Burke 2001, 602).[2] Beginning as "border objects" between "scientific men" and navigators, the Logs-as-engines worked to diminish the border they sat on. As the Charts proliferated, navigators would have at hand both Abstract Logs and the Charts themselves. There is another border crossing between navigator and astronomer in the relationship between observer

[2] I would like to thank an anonymous reviewer for bringing my attention to this point.

FORM OF ABSTRACT LOG. 315

Commander, bound from to 18

WINDS.	REMARKS.
Latter Part.	

Enter under this head, force of wind, kind of weather, state of barometer just before, during, and after gales of wind. The changes and the time of changes of the wind during gales; sudden changes in temperature or color of the water, and the time when such changes are first and last noticed.

Discolorations of water, tide rips, sea-weed and drift. Flocks of birds. Whales, stating whether they be sperm or right, in shoals, pairs or single.

Always mention thunder, lightning, fogs, rain, snow, dew and hail, meteors and auroras, &c., pumice stones found floating at sea; fall of dust, &c.

When falls of dust or red fogs are encountered, collect and send specimens; and note all atmospherical or other phenomena of interest to navigation.

And when any of the routes herein recommended are tried, state whether you have had a longer or shorter passage than vessels sailing about the same time *without* the " Wind and Current Chart" on board, or without having tried these routes.

It is very desirable to know the temperature of the water, even for a few feet below the surface. Therefore, those vessels that are provided with the means of letting water into the hold, would render a valuable service, by drawing a bucket of water through the cock daily, and recording its temperature. Let the water so drawn run a little while first, so that it may be of the natural temperature. State the depth of the cock below the water.

☞Keep your Abstracts on paper of this size, and leave a *large* margin in the middle for binding.

☞Leave broad margin.

ERRATA.—Page 68—line 4—for "73°" read 72°.
" Page 179—line 21—for " Plate IV " read Plate IX.

79

Figure 2: Maury's "Abstract Log" (1851, 315). Source: Making of America, University of Michigan Library, http://name.umdl.umich.edu/AAN1092.0001.001.

and public. Maury's permanent officers in Washington were responsible to their reading public for the accuracy of their recorded transit times. Each navigator, holding both Chart and Log book, saw that the quality of his measurements would affect the entire community of chart readers. In this symmetric exchange–giving completed Log books and receiving Charts–the navigators could satisfy themselves "as to the confidence which is due" their Charts in their thrice daily ritual of observation.

Maury considered his mobile observers to be deserving of astronomical work, and believed that the ethos of the astronomer was not at odds with the "qualities and habits necessary for command at sea." In response to such a suggestion "from one in high office," Maury expounded:

> There is no calling of men that has done more for philosophy than the mariner, and any one who will take the trouble to examine plate 1, which is made up entirely of observations by this much abused class, will find it abounding with philosophical truths, principles and instruction. More than any other class, the sailor is accustomed to observe upon the great deep the workings of nature, and he, to be fit for his calling, must be a philosopher in the truest sense of the term. (Maury 1851, 19)

(See Figure 3, page 90) Using language reminiscent of Genesis, Maury equated studying the heavens with observing the "great deep." This was Maury's investment in his observers; the extension of his epistemic virtue to their lives.

Maury's words are far more than might be needed to bolster a reader's confidence in his results. Comparing the Observatory's work to the U.S. Coast Survey's, we find lesser praise and no faith in the virtue of non-officers. In a speech to the American Association for the Advancement of Science, A.D. Bache engages in a discussion of the Survey's methodology in studying the temperature of coastal waters. His rhetorical positions and his fidelity to class divisions contrast starkly with Maury. Confronted with similar challenges in reading thermometers as Maury had with chronometers, Bache rejected using non-Naval Officers as partners in his work. "Keeping them ["Six self-registering thermometers"] in order requires the skill of an experimenter, rather than that of an observer, and hence they do not satisfactorily fulfil the conditions of the problem" (1860, 3). After 16 years of recording observations on the Gulf Stream, Bache commends six observers (two of whom are Bache's brothers) for their work, and lists their names:

> Too much credit cannot be assigned to those who have succeeded in this laborious and perilous work, and their names

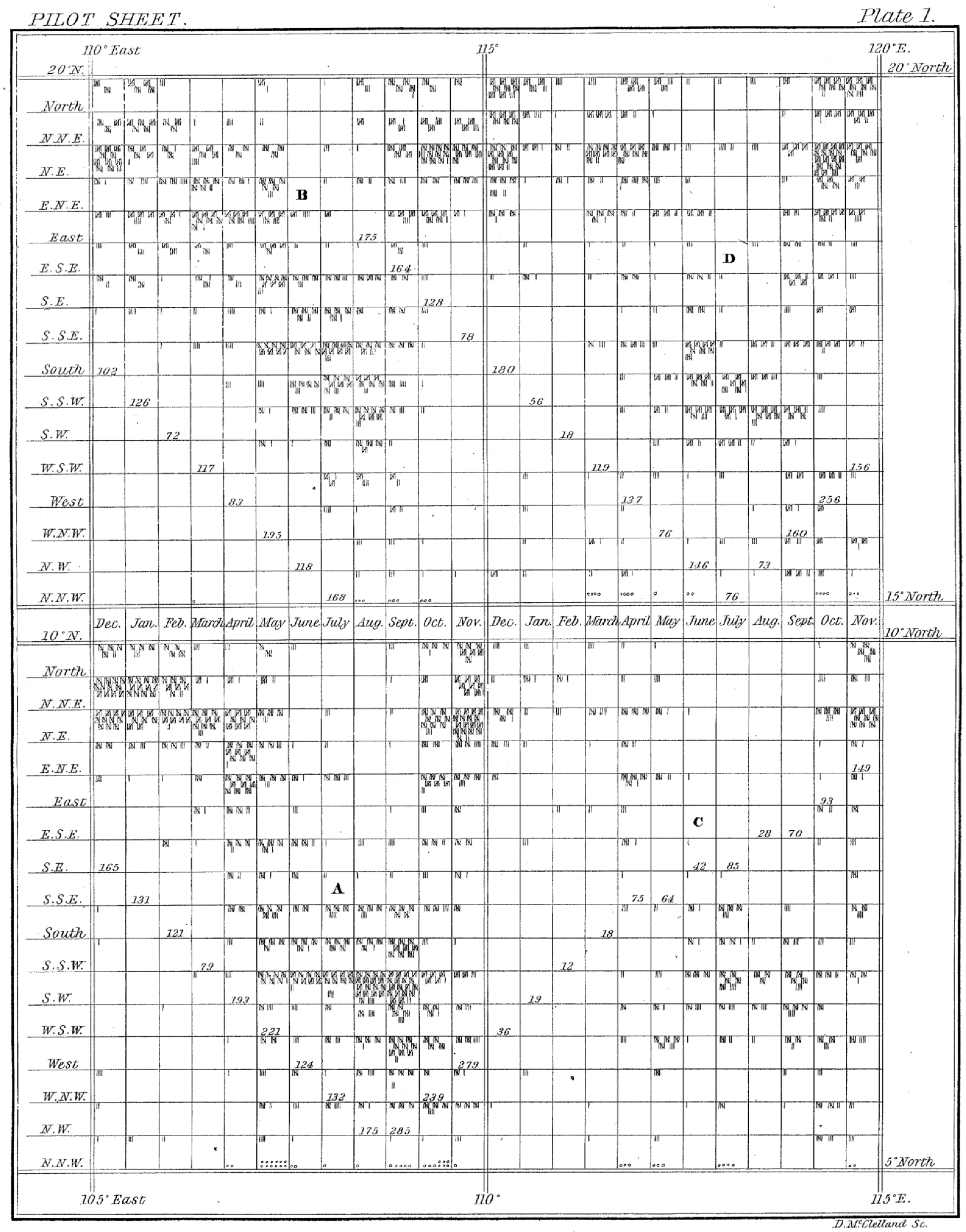

Figure 3: Plate 1 of *Explanations and Sailing Directions* (1851, [316]). Source: Making of America, University of Michigan Library, http://name.umdl.umich.edu/AAN1092.0001.001.

> have been kept in close connection with their results, whenever and wherever brought before the public, and they have been carefully preserved in the archives of the Survey. (1860, 6)

Bache does not insist his observers are philosophers; he need only assign credit to observers already comfortable in an Officer's authority. In fact, Bache explicitly contrasts his findings to "Navigators [who][. . .] have been greatly embarrassed" by the Survey's competing conclusions about the Gulf Stream (1860, 10).

Maury's work belongs to the nineteenth century trend of "Humboldtian Science";[3] "an enterprise which could establish and track natural equilibria[,] [. . .] an organized network of observers [. . .] dispersed over large expanses of the earth's surface, using comparable instruments and standard protocols" (Dettelbach 1996, 298-99). However, his approach to observation sets him apart from his peers. This shift away from science in laboratories and parlours to widely varied field work required a concomitant change in observation. For Europeans, this meant that networks of naturalists had to become adept at manipulating instruments and making judgments outside a controlled environment. No longer solely concerned with classifying nature, the *botaniste nomenclateur* ceded to "the 'higher, philosophical aims' of the *botaniste physicien*" (Dettelbach 1996, 289). The champion of Humboldtian science in the United States was A.D. Bache at the Coast Survey, and he courted the European scientific elite. Bache, too, enforced discipline with his observers, instilling in them "Whiggish cultural values, including paternalism, discipline, and moral absolutism" (Slotten 1996, 154; Cawood 1977). In order to secure support for the Survey, Bache worked to actively raise boundaries between professional men of science and amateurs (Slotten 1996; Gieryn 1983). Maury used his Charts and Logs differently. These epistemic engines did not create boundaries, or even mediate between two distinct epistemic communities. As engines, these objects were erasing the boundary they sat on. For Maury, the move from *botaniste nomenclature* to *botaniste physicien* was extended to *navigateur physicien*: Maury crossed class–alongside epistemic–boundaries. As a mostly self-educated man, Maury adduced a finer balance between the warring American values of republican authority and individual liberty.

Earlier in this essay I leaned on Bruno Latour to support extending our conception of the laboratory space on to the decks of ships scattered across the globe. But Latour's proposition that a laboratory is a "place where scientists *work*" (1987, 64) is playing some semantic sleight of hand. He pins the idea of the lab to the identification of the people that work

[3] I thank an anonymous reviewer for pointing this out.

there; and this identification is far from given in micro-analyses and far from constant in *longue durée* histories. The question "What is a laboratory?" is displaced into "Who is a scientist?" Also at question is who is doing the identification. Maury differentiated his "centre of calculation" (Latour 1987) from those examined as part of continental imperial networks (Aubin 2003; Spary 2000; McClellan and Regourd 2000). He elevated, rather than subjected, his scientific workers to his own epistemological standpoint. These questions of identification are crucial for understanding epistemic boundaries.

In Robert Kohler's evocative phrase, laboratories can be seen "as fractals of whole societies" (2008, 767), a microcosm that can be reliably "scaled up" to understand society as a whole. Here, the extension of epistemic boundaries from inside traditional laboratory environments out in to society allows us to read social change out of science's form of life. Following mobile epistemic boundaries allows us to identify places where scientific virtue merged with civic virtue. Just as Maury extended his researches across the world, following epistemic boundaries can help us understand our episteme.

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