SCIENCE GOES SOUTH: JOHN MILLINGTON, FREDERICK BARNARD, AND THE UNIVERSITY OF MISSISSIPPI, 1848 - 1861

by
Charlotte Webb

Thesis submitted to the Faculty of the
Virginia Polytechnic Institute and State University
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE
in
Science and Technology Studies

APPROVED:

Albert Moyer, Chairman

Ann La Berge

Mordechai Feigold

April 15, 1993
Blacksburg, Virginia

SCIENCE GOES SOUTH: JOHN MILLINGTON, FREDERICK BARNARD, AND THE UNIVERSITY OF MISSISSIPPI, 1848-1861.

by
Charlotte Webb

Committee Chairman: Albert Moyer
Science and Technology Studies

(ABSTRACT)

Traditional explanations for the lack of scientific activity in the ante-bellum South are not sufficiently inclusive. Past accounts generally consider religion, climate, lack of urbanization, and deficiency of intellectual activity as the major causative factors. I assert that scientific activity was proceeding along "normal" developmental lines; that is, it was following the national pattern established by the Northern universities whose proximity to urban centers provided the impetus for the earlier start of intellectual activities of various sorts. In this thesis I present as a case study the scientific program at the University of Mississippi developed by John Millington and Frederick Barnard - - with a central focus on Barnard's efforts - - from 1848 to 1861. The case study provides evidence of a Southern academic institution's ability to hire qualified and ambitious scientists, to promote a sophisticated curriculum in science, and to procure the instruments necessary to support a full-fledged scientific effort. An Appendix provides a detailed inventory of the ante-bellum instruments at the University of Mississippi.

ACKNOWLEDGMENTS

There are many people to whom I am most grateful for their assistance. I would like to thank my thesis committee, Professors Bert Moyer, Ann La Berge, and Moti Feingold for serving on my committee, taking an interest in my work, and providing me with intellectual motivation and support. A special thank you goes to my chair, Professor Bert Moyer, for tirelessly wading through drafts, constantly steering me in the right direction, and maintaining a sense of humor throughout this whole endeavor.

University Museum at the University of Mississippi, Oxford, has been incredibly helpful in allowing me access to their Barnard files, instrument collection, and xerox machine. Without their assistance, this thesis would not have been possible. I wish also to thank Jane Lowenthal at Wollman Library of Columbia University, the archivists at Swem Library, College of William and Mary, and Special Collections, Gorgas Library, University of Alalbama-Tuscaloosa. I am indebted to the Interlibrary Loan Department at Newman Library, Virginia Tech for finding me everything I needed in record time.

To all of my colleagues in STS, especially Stephen Gatlin and Doug Taylor, thanks for your support.

Thank you to Lawrence Craige.

Thank you to my parents, Jane and George Webb.

TABLE OF CONTENTS

INTRODUCTION

Traditional scholarship depicts the ante-bellum South as a cultural wasteland, sterile and barren, unable to yield intellectual fruit of any kind. Recent interpretations, however, offer much evidence to the contrary. Focusing on the scientific communities of the University of Alabama, University of Georgia, and University of South Carolina, historians of science are establishing a different conception of intellectual life in the South. In this thesis I use the University of Mississippi as a case study to demonstrate that science was alive in the ante-bellum South. As an understanding of both the state of science in the South and the various interpretations of scientific/ intellectual development in the South is beneficial when reading the thesis, I briefly summarize each before introducing the case study itself.

Ante-Bellum Science

Samuel Johnson's dictionary of 1775 gives evidence of the broad nature of the term "science" as it was commonly used in the eighteenth century. "Science," Johnson defines, is "1. Knowledge 2. Certainty grounded on demonstration 3. Art attained by precepts or built on principles 4. Any art or sphere of knowledge 5. One of the seven liberal arts."[1] Although Johnson's definition has

---

[1] Arnold Thackeray, "The Industrial Revolution and the Image of Science," in Arnold Thackeray and Everett Mendelsohn, eds., Science and Values: Patterns of Tradition and Change (New York: Humanities Press, 1974), 3.

the obvious drawback of both predating the ante-bellum era by several decades as well as referring to British science, it is, nevertheless, instructive, as it represents the continuing Enlightenment orientation of the majority of Americans in the early nineteenth century. The ardent Enlightenment belief in reason, natural law, and progress and their constant interaction, encouraged scientific inquiry into the natural world. In reflecting upon the life of his father, Benjamin Peirce, and that of his father's friends, Charles Peirce stated: "The word science was often in those mens' mouths, and . . . I am quite sure that they did not mean by it 'systematized knowledge', as former ages defined it but the well-considered life pursuit of knowledge; devotion to the truth . . . ."[2] Commenting on this quotation, Sally Kohlstedt writes: "Idealized though his reflection may be, Peirce was suggesting that the mid-century scientists did not see themselves as simply performing research but pursuing a truth whose implications were profound for the human experience."[3]

This search for "truth" was often practical and utilitarian as opposed to abstract and theoretical. "Science," in a strict sense, was thus an accurate reflection of the ideology of Jefferson: the process of finding useful knowledge with the intention of applying it to further the goals of society.[4] "Scientific knowledge" in the early nineteenth century took several forms: from broad generalizations in the biological sciences as well as "Baconian" and "Humboltian" fact-gathering. As new states joined the old and boundaries solidified, the desire

---

[2] Sally Gregory Kohlstedt, "Savants and Professionals: The AAAS 1848-1860," in Alexandra Oleson and Sanborn C. Brown, eds., The Pursuit of Knowledge in the Early American Republic: American Scientific and Learned Societies from Colonial Times to the Civil War (Baltimore: the Johns Hopkins University Press, 1976), 310.

[3] Kohlstedt in Oleson and Brown, eds., The Pursuit of Knowledge, 310.

[4] This is not an all-encompassing definition. There were those, such as Benjamin Peirce who went against this standard Jeffersonian and American Philosophical Society leaning, seeking, instead, knowledge for its own sake.

to survey and categorize the new environment expanded, lending credence to the inclusion in the professional arena of such areas of science as geology, taxonomic botany (including paleontology), and biology. There was a marked lack of interest in pure physics and chemistry, as applications for these two fields were perhaps more difficult to discern, as well as their requiring much technical training. Astronomy, from a practical, theoretical, and abstract level, was a growing area of interest, slowly gaining the reputation as "the model by which all self-respecting scientists of the day judged the state of their fields."[5] So encompassing was astronomy that Nathan Reingold has collectively labeled the field as "applied astronomy," in which he includes "practical astronomy, programs in the tides, meteorology, terrestrial magnetism, the temperatures within the surface of the earth, geodesy, earthquakes, and so on. . . ."[6] In Science and Culture, Susan Cannon develops the notion of "Humboldtian Science," a concept which though directed towards early nineteenth-century European science is applicable to ante-bellum America.[7] Alluding to the methods of scientist Alexander Humboldt, who explored from 1800 to 1840, "Humboldtian Science" represents "astronomy and the physics of the earth and the biology of the earth all viewed from a geographical standpoint, with the goal of discovering quantitative mathematical connections and interrelations or laws. . . although they may be charts or graphs."[8]

---

[5] Nathan Reingold, Science in Nineteenth Century America (London: Macmillan, 1966), 60-61.
[6] Susan Faye Cannon, Science in Culture (New York: Dawson and Science History Publications, 1978), 77.
[7] Cannon, Science in Culture ,77. Cannon is quick to point out, however, that historianWilliam Goetzmann in Army Exploration in the American West had already considered the idea of a specific Humboldtian influence, although he spelled it "Humboldean."
[8] Cannon, Science in Culture , 77.

To update Johnson's definition, "science," at the turn of the nineteenth century, was an activity, "like literature and politics," dominated by amateurs. Entering the English vocabulary in the eighteenth century, "amateur" was initially defined as "one who loves;" by the arrival of the nineteenth century, "one who loves" had evolved into "one who cultivates an activity as a pastime."[9] In analyzing the ante-bellum community which practiced science, whether amateur or not, Reingold uses a three-pronged approach, classifying the participants as "Cultivators," "Practitioners," and "Researchers." "Cultivators" are defined as those who actively participated in science yet whose welfare and livelihood were not dependent upon science. People demonstrating high competence in science yet for whom an advanced level of research was not necessarily evident, Reingold stamps "Practitioners." Finally, "Researchers" were those for whom the advancement and diffusion of science were of paramount importance.[10] By the middle of the nineteenth century, cultivators, practitioners, and researchers were no longer the appropriate distinctions, as science was increasingly becoming a profession and establishing more stringent boundaries.

Until 1840, when William Whewell decried the lack of a label for "students of the knowledge of the material world" and proceeded to dub them "scientific men" or "scientists," practitioners of science were regarded as "philosophers" or "natural philosophers."[11] A "Philosopher," wrote Samuel Johnson, is a "man deep

---

9 Elizabeth Keeney, The Botanizers (Chapel Hill: The University of North Carolina Press, 1992), 4. Keeney also points out that traditional studies see amateurs from the perspective of a professional and in so doing, they ignore the fact that amateurs and professionals pursue science for different reasons.

10 Nathan Reingold, "Definitions and Specializations: The Professionalization of Science in America in the Nineteenth Century," in Alexandra Oleson and Sanborne C. Brown, eds. The Pursuit of Knowledge, 38.

11 John Heilbron offers a slightly different perspective on the term "scientist" in the nineteenth century: " 'Scientists' also is a word of the 19th century , coined in the 1830s to designate the type of people who attended the meetings of the newly established British Association for the

in knowledge, either moral or natural."[12] Specialization was not inherent in the intellectual professions, so the "philosopher" was not confined to one area of study. By the time of the Civil War and the popularization of the term "scientist," however, the notion of specialization had been introduced, and an increasing number of scientists could lay claim to a particular area of study. Daniel Zochart regards this period as the juncture in which "the gentleman philosopher able to combine leisure with the pursuit of science (and often with considerable literary grace) was being superseded by a more disciplined class of "scientists" with distinct claims to professionalism."[13] By the mid-1840s, the atmosphere of collegiality which had so characterized the "scientific" community, began to change, as the distinction between amateurs and professionals became increasingly obvious.

As the community of scientists evolved, so too did the role of science in education, becoming increasingly important for the scientists themselves - - more, perhaps, for them than for their students. Egalitarian sentiments dominated the ante-bellum era; no longer, then, was science the concern merely of the learned and cultivated few.[14] By the middle of the nineteenth century, an increasing number of scientists, trained, for the most part, in European institutions, had returned to the States, securing "employment that required the

---

Advancement of Science. The name did not catch on: It sounded too much like "dentist." The preferred term continued to be "men of science" or "scientific men" until well after the First World War." Physics Today, 45 no. 11, (November 1992): 42-47; for further discussion on the derivation of "scientist," see Sydney Ross, "Scientist: The Story of A Word," Annals of Science 18, no. 2 (1962): 65-85.

12 Thackray in Thackray and Mendelsohn, Science and Values, 3.

13 Donald Zochart, "Science and the Common Man in Ante-Bellum America," in Nathan Reingold, ed., Science in America Since 1820 (New York: Science History Publications, 1976), 7.

14 While egalitarian sentiments marked the age, these sentiments did not halt the growing distinction between amateurs and professionals. These sentiments merely made science available for study and popularized it.

use of their specialized knowledge" either in the form of professorships, positions with groups such as the United States Coastal Survey or on the "various state geological surveys."[15] When the Civil War erupted in the spring of 1861, American scientists had matured from a scattered group of amateurs into an increasingly specialized community, well on its way to professionalization.[16]

This move toward professionalization manifested itself in three ways: an increase in the coverage of science in colleges, most obvious in new texts, apparatus, and teaching methods; the formation of scientific institutions and societies; and the establishment of scientific journals. This movement indicates a realization on the part of the scientists that in order to ensure the growth of science, thereby establishing a legitimate social position for the scientist, the perceptions of the American public as well as the international scientific community had to change. The public at large needed to conceive of science as both vital to itself and the advancement of society. Scientists worked hard in their appeals to these two groups. To the American public, this clearly was evident in the rhetoric the scientists adopted, which they took to the public lecture circuit, emphasizing the "moral dimensions of science in defining the social order."[17] In the eyes of the international community, the scientific community fought to change the reputation that they merely repeated "experiments made abroad," thus developing no original research.[18]

---

15 Nancy Smith Midgette, To Foster the Spirit of Professionalism: Southern Societies and State Academies of Science (Tuscaloosa: The University of Alabama Press, 1991), 2.

16 For a short discussion on professionalization, see George H. Daniels, "The Process of Professionalization in American Science: The Emergent Period, 1820-1860, " Isis 58 (1967): 151-166; see also, Jay Harrison Abrams, "Professionalism in Public Organizations: The Case of the Research Scientist," (Ph. D. diss., New York: State University of New York at Albany, 1975).

17 Hyman Kuritz, "The Popularization of Science in Nineteenth Century America," History of Education Quarterly, 21 (1981): 261.

18 Kuritz, "The Popularization," 261.

Instrumental in changing this conception of American science was the development of viable scientific institutions.

Much precedent had been set, both on the Continent as well as in Great Britain, indicating the importance of secure institutional foundations. With its roots in sixteenth-century Renaissance Italy and the first scientific academy, this organizational movement was well under way by the seventeenth century, as many notable academies of science were firmly established. Among the most prestigious were the Accademia dei Linceii at Rome (1603), the Academia Naturae Curiosum at Leipzeig (1651), the Accademia del Cimento in Florence (1657), the Académie des Sciences at Paris (1666), the Accademia delle Scienze at Bologna (1690), the Royal Society of London (1660), and the Societas Regia Scientiarum at Berlin (1700).[19] In studying these institutions as well as those established in the eighteenth century, such as the Royal Institution in London (1799), the importance of the scientific institution as that of "the major symbol for the advancement of learning of the enlightened" was clear to the American scientists.[20] Large numbers of the scientists living in America who either were British or European or who had received their education abroad, recognized the power of the scientific institution in lending credence to a profession, and they fought for similar institutions in the United States. The establishment of standards, regularizing relationships both among colleagues as well as between colleagues and outsiders - - be they from the general community or from another institution - - securing funding, providing laboratory space all occur within an institutional. Without solid institutional support, the widespread legitimation

---

[19] Ralph S. Bates, Scientific Societies in the United States, 3rd ed., (Cambridge, Massachusetts: M.I.T. Press, 1965), 1.

[20] Roger Hahn, The Anatomy of A Scientific Insitution: The Paris Academy of Sciences, 1666-1803 (California: University of California Press, 1971), 1.

and recognition of ideas is virtually impossible, not to mention the difficulties encountered in attempts at original scientific work. A strong institutional base has the added bonus of providing a platform from which the scientist can address a wide range of topics, from social and political issues to experiments in science, all of which serve to further increase the social standing of the scientific community.

Not only did the rise of the scientific institution and the practice of science within the universities serve to legitimate science and move it into a role of intellectual prominence, but it also popularized the societies and the associations. The earliest known scientific society in America was the Boston Philosophical Society, whose existence has been recorded by Increase Mather: "In 1683 I promoted a design for a private philosophical society in Boston, which I hope may have laid the foundation for that which will be for future edification."[21] Among the most successful of the early American societies was Benjamin Franklin's American Philosophical Society (A.P.S.). Chartered in 1743, the A.P.S. legitimated itself by citing the need for the promotion and expansion of useful knowledge among the British Plantations of America. The establishment in Cambridge, Massachusetts, of the Academy of Arts and Sciences (1780) soon provided the A.P.S. with a rival academy. The ante-bellum years witnessed the massive proliferation of societies and organizations: from the Boston Society of Natural History (1830), the National Institution for the Promotion of Science (1840), the Smithsonian Institution (1846), to the American Association for the Advancement of Science (1848) [hereafter referred to as the AAAS], to name just a few. Each state supported smaller, municipal societies, such as Charleston

---

21 Hahn, The Anatomy , 3, citing Increase Mather, Autobiography, MS: in the possession of the American Antiquarian Society.

South Carolina's Elliott Society of Natural History (1853) and Louisiana's New Orleans Academy of Science (1853), whose purpose was to stimulate the growth of science within the state. Reflecting the democratic spirit of their age, these organizations initially placed no restrictions on membership, in contrast to their European counterparts. People from every "walk and station of life who sought admission to the ranks of those who banded together in the name of science" were welcomed to the new disciplinary organizations.[22] For the most part, the leaders of the organizations held positions in science, the government, or in teaching. In adopting this "open-door" policy, the societies created a system which mimicked in some ways that of the church; strength was attained through the presence of many diverse interests.[23] This strength was further supported by the development and dissemination of journals of the various associations, serving to complete the rudiments of the "information network."[24]

Just as there was widespread recognition of the necessity for strong institutional and societal foundations, so there was also an understanding of the importance of the scientific journal. Aware of the power of print in legitimating oneself to the international profession, quite a few Americans already made contributions to the Philosophical Transactions, the journal of the Royal Society of London.[25] The twin effects of mass printing and the developing system of transportation permitted the American journals to have a similar effect to that of the institutions and societies. The number of domestic journals in scientific fields rose from twelve to forty between 1800 and 1810, to just under 100 in 1825, and

---

22 Hahn, The Anatomy, 84.

23 As the fields of science became increasingly specialized, however, membership inevitably became more selective, eventually causing the demise of this "open-door policy."

24 A. Hunter Dupree, "The National Pattern of American Learned Societies, 1769-1863," in Alexandra Oleson and Sanborne C. Brown, eds., The Pursuit of Knowledge, 21-22.

25 Bates, Scientific Societies, 3.

from then on numbers rose exponentially. Of these, the first dedicated to the diffusion of scientific knowledge was Benjamin Silliman Sr.'s American Journal of Science and the Arts. Established in 1818, the journal concentrated on chemistry and geology throughout the 1820s, adding zoology in the 1830s, and botany and mineralogy in the 1840s.[26] It was not until 1849, however, with the briefly lived Astronomical Journal, that a magazine existed solely for the advancement of science as opposed to the diffusion of science.[27] Like the institutions and societies themselves, the appearance of journals ushered in a more complex system of communication, allowing for the establishment of peer communities. Both signified the viability of science as an "organization" in the United States, offering the potential for coordinated scientific inquiry.

Ante-Bellum Southern Intellectual Development

This robust scientific development, particularly the growth of institutions, journals, and rapidly growing communities of scholars, was far more characteristic of the Northeast than of the South. The Southern states, in general, were much slower to fall in line with the northeastern trend, although there were, of course, places where intellectual development with an emphasis on science could hold its own with the rest of the country. These exceptional locations are more often than not ignored in the historical scholarship, for there is

---

[26] The importance of this journal cannot be underestimated: "Of the services of this Journal to American science, it is not too much to say that more than any other similar publication, it has aided and stimulated our countrymen in their scientific labors, and had made their names and works familiar to men of science abroad while through the variety and weight of its contributions it has not only won a high reputation among contemporary journals but has vindicated for our country an honorable place among the communities in which science is most promoted and esteemed. . . . " American Academy of Sciences, Proceedings, VI (1865), 512;, citing Bates, 36.

[27] Unfortunately, publication of the The Astronomical Journal ceased by 1861, resulting more from the Civil War, however, then from the complete lack of readership and interest.

an overriding perception among scholars and the general public alike that there exists a certain distinctiveness inherent in Southern culture which sets it apart from its Northern and Midwestern counterparts. Not only do Southerners avow that their regional culture has an underlying component strongly distinguishing it from other regions, but also people in the rest of the United States concur with the Southerners' claim. Historian Wilbur Cash notes: "The peculiar history of the South has so greatly modified it from the American norm that when viewed as a whole, it decisively justifies the notion that the country is - - not quite a nation within a nation, but the next thing to it."[28] Perhaps no other person put it so succinctly as William Faulkner in the following exchange in Absalom, Absalom!:

> "Tell me about the South. What's it like? What do they do there?"
> "You can't understand it. You would have to be born there."[29]

One may perhaps take issue with Faulkner as to what extent birth is required for an understanding of Southern distinctiveness. Nevertheless, there has been "the axiomatic acceptance [by Southern historians] of the belief that there was, in fact, an American South and it possessed clearly defined traits which set it apart from the rest of the nation."[30] In fact, it can be argued that by the end of the eighteenth century, the Southern mentality and character had already been formed.[31]

---

28 Wilbur J. Cash, The Mind of the Old South (New York: Vintage Books, 1941), viii. Cited in James Breeden, "Disease as a Factor in Southern Disinctiveness" in Todd L. Savitt and James Harvey Young, eds. , Disease and Distinctiveness in the American South (Knoxville: The University of Tennessee Press, 1988), 2.

29 William Faulkner, Absalom, Absalom! , introduction by Harvey Breit (New York: Modern Library, 1951),

30 Breeden, "Disease as a Factor in Southern Disinctiveness," 2. Breeden's article offers an excellent overview of the varying interpretations of "southern distinctiveness."

31 Breeden, "Disease as a Factor in Southern Distinctiveness," 3-4

Historically, many scholars have offered comparisons and contrasts between the North and the South, thereby further substantiating the South's claim to distinctiveness. One of the first Southerners to comment upon the Southern versus the Northern mentality was Thomas Jefferson. In a letter he wrote to the Marquis de Chatelleux in 1775, Jefferson characterized the Northern peoples as being cool, sober, and laborious, persevering and independent, and finally, jealous of their own liberties and sensitive to the claims to liberty of others. Southerners, on the other hand, were immediately recognizable by their fiery, indolent, unsteady, and independent attitudes, their zealousness for their own liberties and their ability to trample on those of others, as well as their generousness, candidness and their "lack of pretensions to any religion but to that of the heart."[32]

In addition to broad generalizations such as those made by Jefferson, many historians concentrate on the perceived "intellectual" differences between the North and the South.[33] "Southern intellectual culture has become a window upon which broader patterns and values, popular expressions of belief have gained attention and importance as keys to the ever-elusive southern mentality."[34] Traditionally, the majority of these comparative "studies of the intellect" follow the line of Henry Adams in his pronouncement that: Strictly speaking, the Southerner had no mind; he had temperament; he could not

---

32 Breeden, "Disease as a Factor in Southern Distinctiveness," 3-4

33 In this discussion of the "intellectual," I need to make clear that I place "scientists" under the heading of "intellectual." Therefore, when I speak, for example, of the "lack of intellectuals" in the South, I am referring at the same time to the "lack of scientists."

34 Drew Gilpin Faust "The Peculiar South Revisited: White Society, Culture, and Politics in the Antebellum Period, 1800-1860" in John B. Boles and Evelyn Thomas Nolen, eds., Interpreting Southern History (Baton Rouge: Louisiana state University Press, 1987), 99.

analyze an idea and he could not conceive of admitting two."[35] While in more recent years there has been an increasing body of literature supporting the growth of intellectual life and learning in the South, most of the historical theories and descriptions indicate only modest growth. The undesirable and inhospitable climate common to the South; the lack of urbanization and the predominance of a rural/plantation economy; the strong aristocratic bent which encouraged a rigid classical educational curriculum; a religious conservatism often at odds with those principles espoused by the intellectuals in the rest of the country; and the stifling presence of slavery, the "peculiar institution" - - all of these have been suggested as reasons for the alleged Southern disinterest in matters intellectual.

Most explanations for the modesty of intellectual growth in the South invoke the economic and social dependence of the ante-bellum Southern population on the plantation and its associated hierarchical class structure - - from aristocratic white males, to women, to black slaves. The plantation created the framework for the South's enduring social patterns: from the plantation the ideals of Southern culture developed, and because of it, they were maintained. As early as the 1920s, historians asserted that the plantation not only formulated the standards upon which the entire region based its livelihood, but it also ushered in the ideals of Romanticism.[36] These ideals infiltrated the South so strongly that when the Age of Romanticism had virtually left other regions, it still held sway in the South.

---

[35] Henry Adams, The Education of Henry Adams, with an introduction by Marion L. Starkey (New York: Time Inc., 1964).
[36] See, for example, the works of Ulrich Bonnell Phillips.

Southern historian William Scarborough addresses the formative role of the plantation in establishing the Old South as a cultural and intellectual desert. Although his primary interest is the lack of willingness of the plantation owners to apply new scientific approaches to agriculture, Scarborough's arguments have components which may be extended further: specifically, they are instructive in explaining the reluctance of plantation owners to embrace science and new ideas. One contributing factor, he suggests, might have been the romanticized ideal of the "agrarian, English, country-gentleman." The natural propensity of the plantation elite was to place a high value on hospitality, "gracious living," and the "out-of-doors" lifestyle rather than to prize the development of the "intellectual," and this tendency was supported by the manner in which the plantation owners lived. Despite the many romantic legends of the South, plantation owners did not have the time or the opportunity for serious study. Separated from one another by the large tracts of land over which they ruled and subject themselves to the demands put on them by nature's seasonal timetable, these people were hardly able to enter into the intellectual community that was beginning to emerge in the North. When there was time or opportunity, law and politics were the two routes away from the land that these "gentlemen" usually followed. As one critic puts it: "Public life in its broadest sense seems to have co-opted them. [However], in the modern world, intellectuals are known as critics of society, as outsiders. In the ante-bellum South, intellectuals were concerned with the support and the defense of the South and its institutions, not the criticisms of it."[37] In garnering support for their native region, these politicians and lawyers

---

[37] Cooper, William J. and Terrill, Thomas E., The American South: A History (New York: Alfred A. Knopf, 1990), 245.

often defended the institution of slavery, as it was an essential and formative part of the entire regional culture and world view.[38]

Debate over the extent to which slavery influenced Southern intellectual activity is many-faceted. Alexis de Tocqueville in his classic 1835 book, Democracy in America, specifically addresses the question of slavery, when he writes that the presence of the servant and slave class permitted the upper classes to have the time for leisure and to pursue their amateur interests - - time without which the feasibility of scientific/intellectual activities would be doubtful.[39] Historian Robert Bruce, however, advocates a different perspective, maintaining that this leisure permitted the Southerners to "succumb to both mental and physical self-indulgence."[40] In trying to weigh these points of view against each other, it is interesting that Mississippi and South Carolina - - the two states with the largest black populations - - enjoyed, at some time or another during the ante-bellum years, a fruitful intellectual life often equal to or surpassing that of other Southern states.[41]

Scholars who have concentrated on analyzing the orthodox pro-slavery ideology and its consequences make a variety of assertions. Among the more popular is that slavery required the rejecting of any logic, as it simultaneously embraced the Biblical doctrine that "blacks and whites alike belonged to the family of man, the Jeffersonian doctrine that all men had the right to liberty and

---

38 Eugene Genovese, "The Significance of the Slave Plantation for Southern Economic Development," Journal of Southern History, XXVII (1962): 422-37.

39 Alexis de Tocqueville, Democracy in America, translated by Henry Reeve, with an introduction by Henry Steele Commager (London: Oxford University Press. 1946).

40 Robert Bruce, The Launching of Modern American Science (New York: Cornell Univerisity Press, 1987), 62.

41 Private conversation 23 September 1992 with Dr. Peter Wallenstein, Virginia Polytechinic Institute and State University.

the Calhoun doctrine that blacks had no right."[42] The absence of a "logical" pattern of thinking, precluded intellectual growth on a par with the North. As an important counterpoint to this historical tradition, Ronald and Janet Numbers claim that "the failure of the Old South to keep pace with the Northeast resulted more from demographic and environmental factors --particularly the absence of a strong urban culture-- than from slavery itself;" furthermore they contend that, if anything, Southerners "increased their commitment to science in the decades immediately preceding the Civil War."[43] Although the by-products of a slave owning society may influence in idiosyncratic ways the intellectual or the scientist, it is difficult to argue that slavery and its consequences were solely responsible for such a paucity of interest in matters intellectual.

Eugene Genovese addresses the demographic/economic issues, writing that slavery "saddled the region with an overwhelmingly rural agricultural economy."[44] This economy is one of the greatest reasons that the South lagged behind the North in the various agencies of intellectual life. The institution of slavery sustained this rural economy, and also inhibited the rapid urbanization that characterized the North in the ante-bellum nineteenth century. The lack of urban culture prevented the quick dissemination of ideas through educational facilities, libraries, and forms of print, hampered the growth of professional societies and the formation of intellectual networks, and increased the difficulty of funding many of the intellectual ventures. Donald Beaver, using an historical/statistical method of analysis, reveals that American scientists are

---

42 Bruce, The Launching, 62.

43 Ronald L. Numbers and Janet L. Numbers, "Science in the Old South: A Reappraisal," Journal of Southern History, XLVIII (1982):184.

44 Eugene Genovese, "The Significance of the Slave Plantation for Southern Economic Development," Journal of Southern History, XXVIII (1962): 422-23, 437.

characteristically born in urban rather than rural areas. Although the populations of the North and South were roughly equivalent during this period, a close examination of birthplaces reveals that the Northeast produced 91 percent of the scientists, the South a mere 8.1 percent.[45]

A common point of departure among historians of science and of the South is the role of religion and its impact on the intellectual and scientific character of the times. The Great Revival of the early years of the nineteenth century did have a measurable effect on religion in Southern society, giving rise to a dramatic increase in the numbers of people who not only professed Christianity but also who attended church and participated in religious activities. By the time of the Civil War, the "proportion of church members had more than doubled and twice that many more--fully forty percent of Southern whites--actively participated in organized churches."[46] Although many scholars, such as Clement Eaton, consider both the stringency of the church doctrines in vogue at the time to be intellectually prohibitive within the clergy and outside, others endorse alternative views.[47] E. Brooks Holifield remarks on the enormous enthusiasm of the Southern clergy for natural science, unparalleled save for that of the physicians and scientists. [48] One explanation for this enthusiasm might have been the ability of the scientific and religious values to mesh, allowing for

---

45 Donald de B. Beaver, The American Scientific Community, 1800-1860: A Statistical-Historical Study (New York: Arno Press, 1980), 155-156.

46 Cooper and Terrill, The American South: A History, 263.

47 Clement Eaton, The Freedom of Thought Struggle in the Old South (New York: Duke University Press, 1940).

48 E. Brooks Holifield, "Science and Theology in the Old South" in Ronald L. Numbers and Todd L. Savitt , eds, Disease and Distinctiveness,131. Holifield further states that three-fourths of the Southern churchgoers in 1860 were Methodists and Baptists.

the easy and free transition of the American people from one realm to another.[49] Moreover, in the tradition of natural theology, many scientists believed that it was the purpose of their work to demonstrate the role of God and his handiwork in the design of nature.

Robert Merton, in his now-classic Science and Technology in Seventeenth Century England, developed what is universally referred to as the "Merton Thesis."[50] Puritanism and aesthetic Protestantism emerged as a coherent set of beliefs in which a direct interest in science was inevitable. Diligence, a high value on utility and a responsibility to society, a respect for and emphasis on education - - these values impressed upon society by religion were translated into the open and fruitful production of science and technology. Science and religion, then, were potentially mutually reinforcing. Theodore Bozeman proposes a similar argument, in that he cites the prevalence of the scientific methods of Bacon conjoined with Scottish Realist Philosophy as establishing for clergy of the ante-bellum America a vision of science that was in no way inimical to their religious doctrines.[51] Briefly, Baconian philosophy emphasizes strict observation and empiricism as well as exact adherence to the taxonomic laws of classification. A Baconian, "whether scientist or not-- was someone captivated by the ongoing spectacle of scientific advance."[52] Scottish Realist philosophy postulates intuitions of the mind to be direct, immediate perceptions of a real

---

49 Charles E. Rosenberg," Science and Social Values in Nineteenth Century America: A Case Study in the Growth of Scientific Institutions" in Arnold Thackray and Everett Mendelsohn, eds. Science and Values, 24.

50 Robert Merton, Science and Technology in Seventeenth Century England (New Jersey: Humanities Press: 1978, 1970c).

51 Theodore Dwight Bozeman, Protestants in the Age of Science (Chapel Hill: The University of North Carolina Press, 1977), 3-31; see also George H. Daniels, American Science, 63-75 for a succinct discussion of Baconianism and empiricism as it relates to American science.

52 Bozeman, "Introduction," Protestants in the Age of Science , xviii.

objective order.[53] Common to both schools of thought is the emphasis on a narrow and restricted planning of research, an absolute trust in the senses, and "scrupulous empiricism." Southerners, Bozeman contends, imparted a special meaning to both natural and social science. Southern Christians' invocation of Baconian inductive principles was intended at once to make the region a legitimate participant in the modern scientific enterprise, while at the same time to protect the South from the theological dangers inherent in abstract "deductive" thought.[54] Following Bozeman, one can argue that the emphasis on religion in the Southern culture is not likely to have been as major a contributor to the stunting of the intellectual growth as one might have expected.

The complicated relationships among the various factors affecting intellectual life in the South make it difficult to precisely define the extent of the influence of religion, or culture, or geography, or any of the myriad causes that might be responsible for the South's lagging behind the rest of the American nation. It is, therefore, useful to examine a case study of an institution that was, if not on equal footing with other colleges and universities in the North, certainly well on its way toward creating the kind of environment that would eventually have brought about a forceful scientific presence. Such an institution is the University of Mississippi at Oxford where a scientific community, under the guidance of two dynamic educators and scientists, slowly emerged.

The British scientist John Millington and American scientist Frederick Barnard dominated the University of Mississippi campus from 1848 to 1861. Although their Mississippi tenures did not cross, they shared the same commitment and orientation to science education and practice. Schooled in the

---

[53] Bozeman, Protestants in the Age of Science, 30-31.
[54] B ozeman, Protestants in the Age of Science, 30-31.

upper-class British tradition and later a lecturer at the Royal Institution, Millington brought to the University in 1848 a firsthand knowledge of the educational and experimental practices of a venerated scientific institution. In addition, with his sizable collection of scientific instruments, knowledge through demonstration and practice became a cornerstone of the Mississippi program. In so doing, Millington, in 1857, cleared the path for the arrival of the innovative and ambitious Frederick Barnard. Trained at Yale under the tutelage of Professors Dennison Olmsted and Benjamin Silliman, he brought to the University of Mississippi Yankee ideals of higher education, most notably those associated with the Yale Report of 1827: the classical core curriculum and an emphasis on scientific demonstrations and experimentation. Not only was Barnard schooled in a first-rate scientific institution, but he was also regarded as a fine scientist. His presence at the University of Mississippi, therefore, proffered a degree of legitimacy upon the nascent program

The most convincing evidence of "science gone south" at the University of Mississippi is the Collection of scientific instruments amassed by Barnard and, to a lesser extent, Millington. On view at University Museum of the University of Mississippi, these instruments, many of which were designed and constructed by reputable firms and are of the highest quality, stand as compelling testimony to the existence of a developing scientific community.

It seems odd that Mississippi, a byword even today for backwardness in matters of intellect in nearly every area except literature, could have ever been a state where a scientifically focused university reached a highly promising condition; yet that is the case. In the next three chapters, I examine the events and people that brought the University of Mississippi to such position.

CHAPTER ONE:

Preparing the way for Frederick Barnard - - Mississippi, the University of Mississippi, and John Millington

Mississippi

Geography, more than any other factor, dictated the historical development of Mississippi. With the Mississippi River running through the west to the smaller rivers in north, south, and east, the inhabitants' lives are shaped by the existence and the behavior of the rivers. Both the topography of the state and the quality of its soil are highly variable, and this, coupled with the dominance of water, encouraged a sectionalism and a divergence of social, economic, and political interests that still exists today. In describing his native state, William Faulkner writes: "To the west along the big river is the alluvial swamp threaded by the black almost motionless bayous. . . impenetrable with cane and buck vine and cypress and oak and gum."[55] Further Southwest, lies the Delta, "the richest land this side of the Nile," deriving its nutrients from the annual springtime floods of the Mississippi River.[56] Within the Delta lies the Yazoo countryside, an area covered by thick, black, stagnant pools of water, their color derived from the roots of indigenous trees. Completely south are the flatlands, composed of "pine

---

55 William Faulkner, "Mississippi" in James Meriwether , ed. , Essays, Speeches, and Public Lec tures (New York: Random House, 1965), 11.

56 Tennessee Williams, Cat on a Hot Tin Roof (New York: Penguin Books, 1955), 65.

barrens and moss, heavy live oaks. . . grassy marshes."[57] In the north are the highlands, full of red clay hills, the highest rising eight-hundred feet.

Not until 1798 did the United States, following France, Great Britain, and Spain, gain formal control over the territory of Mississippi. As early as the eighteenth-century, people conceived of the territory as part of the greater American frontier. Indeed, the majority of inhabitants had Anglo-American origins, not French or Spanish. Few foreigners or northerners immigrated to the territory; rather, the settlers came from the older southern states. By December of 1817, Mississippi gained recognition as the nation's twentieth state. In 1830, the Chocktaw and Chickasaw Indian tribes of the northern Mississippi territory ceded their lands to the federal government, allowing Mississippi to triple in size as these two million acres became the northern two-thirds of the state.[58] The land was cheap, providing the perfect opportunity for settlers, and between 1830 to 1860, the state witnessed a population explosion from 136,621 to 791,305 inhabitants.[59]

It is ironic that this new land instead of encouraging the growth of new cities prevented their development. Cheap land was easy to acquire, enabling the people to disperse across Mississippi. The effect of this scattering across wide areas of the state did not foster the development of great urban centers.[60] Even today, Jackson remains the only genuine urban area; Natchez, Vicksburg, and Hattiesburg are large towns. The small towns and villages tended to be single purpose entities, frequently serving as points of debarkment and embarkment for

---

57 Faulkner, "Mississippi," 11.
58 This is, of course, the traditional white person's view.
59 John Ray Skates, Mississippi (New York: W.W. Norton & Company, Inc. , 1979).
60 Skates, Mississippi , 86-87.

the trading boats as well as the railroads. Oxford itself, home of the University of Mississippi, had no viable economic base save for the University.

Mississippi did have an economy based on slavery. Introduced by the French in the eighteenth century, the roots of slavery were well established by 1817. With the addition of the new land in 1830, the slave population jumped from 66,178 blacks to 196,577, and by the end of the decade, the population of Mississippi was 52 percent black to 48 percent white.[61] Cotton and other forms of agriculture that were once limited to the Natchez region swept northward. As William Scarborough remarks: "Cotton, slavery, and the plantation system - - these were the dominant elements in Mississippi's agricultural economy. . . ."[62] Contrary to a widely-held belief, only about twenty percent of the farm operators were wealthy planters: the rest were farmers. Of these farmers in 1860, only half owned slaves. During the latter half of the ante-bellum years, Mississippi diverged from mainstream America; as discontent among other states over the slavery question rose, the number of slaves in Mississippi increased; as the nation grew more industrially based, Mississippi became more agriculturally based.[63]

Mississippi, for the most part, reflected the religious patterns and practices of the rest of the nation, especially the southern states. In 1817 when Mississippi gained statehood, only one in twenty persons professed allegiance to any religious denomination. By the end of the ante-bellum period, however, this was to change, as one in three adult whites practiced some form of religion.[64]

---

61 Skates, Mississippi, 87.
62 William A. Scarborough, "Heartland of the Cotton Kingdom" in Richard Aubrey Mclemore, ed., A History of Mississippi (Hattiesburg: University & College Press of Mississippi, 1973), 310.
63 Skates, Mississippi, 87.
64 Margaret Deschamps Moore, "Religion in Mississippi in 1860," Journal of Mississippi History XXII: 224-225.

Strong Baptist and Methodist constituencies carried the state; the Presbyterians had more influence then their numbers indicated, while the Episcopalians were not popular. Relations among the denominations varied: "a state of affairs not surprising since most of the Americans in the nineteenth-century displayed an ambivalent attitude toward the principles of religious pluralism."[65]

Mississippi was characterized by internal divisions within the political structure of the State. By and large, Mississippians supported Jacksonian politics, though to what degree depended upon the particular locale. The wealthiest merchants and planters stood to lose heavily from secession and war as many of them had substantial investments in the Northern railroads and banks. Furthermore, many planters and entrepreneurs had immigrated from the North, and they still had familial ties with the North. The smaller, interior farmers, unable or unwilling to exchange with the North, felt otherwise: "their destinies were linked to the preservation and expansion of slavery."[66]

University of Mississippi

Long before the famous 1862 Morrill Act which inaugurated the land grant university system as such, the federal government had proposed support for institutions of higher learning.[67] For example, funding for these institutions or "seminaries of learning," including a University of Mississippi, was included in the federal government's "budget" as early as 1815, a full two years before the territory gained statehood. Moneys were to be raised from the sale and the lease

---

65 James Pilar, "Religious and Cultural Life, 1817-1860" in, Richard Aubrey Mclemore , ed. , A History of Mississippi (Hattiesburg:University & College Press of Mississippi, 1973), 399.
66 Skates, Mississippi , 100.
67 The Morrill Land Grant Act, developed by Lincoln, provided state aid to colleges of "agriculture and mechanic arts."

of lands given to Mississippi by the government and placed into an endowment called "the seminary fund."[68] However, the insularity of specific regions, uncertain political circumstances, and the relative "newness" of the state contributed to an environment in which agreement was not feasible; hence, a coherent public education system, both in secondary and university levels, was not established for over a decade. It was common, then, for the more affluent to send their daughters and sons to the North, either to finishing schools or to universities. As wealthy planter Sir William Darby explained in a letter to a friend, his reason for sending his fourteen year old son to school in Philadelphia was that he "has not enjoyed those advantages of education in this country which he ought to possess at his years."[69] By 1833, however, the State Legislature reached a consensus over which lands should be leased and which should be sold. An initial sum of 8,328 dollars was raised from leasing the land. This sum, in addition to the 227,332 dollar profit from the sale of the remaining land, was invested in the stock of the Planter's Bank of Mississippi.[70] This trust, or "seminary fund" could be drawn upon for educational facilities, salaries, and equipment. Most significantly, the state had accepted the fund as a trust, and, as such, the constitution provided that the principal capital should never be diminished.[71]

Once funding had been established, the legislature remained in a gridlock, unable to agree upon the best location for the new University. Finally, on

---

68 Aubrey K. Lucas, "Education in Mississippi from Statehood to the Civil War" in Richard Aubrey Mclemore, ed., 364.
69 Lucas, "Education in Mississippi," 353.
70 Lucas, "Education in Mississippi," 364.
71 Frederick Barnard, Memoirs (Columbia University, New York, New York: Microfilm). I will discuss the importance of this seminary fund to the establishment of the University of Mississippi later in the text.

February 20, 1840, the legislature announced that, by one vote, the small town of Oxford had been elected as the site of the University of Mississippi. A day's travel (in the ante-bellum era) from Memphis, Tennessee, and several more from Jackson City, Oxford is located in the northern part of Mississippi, surrounded by the red-clay hills. An "interior" town, it was remote from any of the major thoroughfares, and, thus, was completely dependent upon water and wagon travel. By 1844 the University was incorporated with the Board of Trustees being appointed shortly thereafter. In 1846, the by-laws were voted upon: the Board was to have control over all academic matters with the noticeable exception of funding, which was to be handled by the State Commissioner.[72]

Between 1846 and 1848, the University took form; not only did the buildings and grounds take shape, but also as the Board underwent the arduous task of hiring faculty, its "vision" for the University slowly emerged. The former is evident in the five buildings constructed: the Lyceum, two three-storey dormitories, and two faculty housing areas. The "vision" of the Board, however, is more difficult to discern, becoming apparent only after one examines the professorial appointees. When the University opened its doors on November 6, 1848, it had a faculty of four, including a President. George Frederick Holmes, Distinguished Professor of History, Political Economy, and International Law at the College of William and Mary, was named the first President of the University as well as Professor of Moral and Mental Philosophy. Albert Taylor Bledsoe - - graduate of West Point, founding editor of the Southern Review, and a lawyer in the Supreme Court of Illinois - - joined the University as its Professor of Mathematics and Astronomy. Professor John Newton Waddel, an original

---

72 General information on the University of Mississippi taken from Jim Lloyd, The University of Mississippi: the Formative Years (Mississipppi: University of Mississippi, 1979).

member of the Board, was appointed Professor of Ancient and Modern Languages. As Professor of Natural Science, the Board elected John Millington, instructing him to involve the students in "chemistry, geology, mineralogy, botany, and natural philosophy (physics)."[73] These appointees, all of whom possess high scholarly credentials, indicate a commitment on the part of the Board to establishing a first-rate academic institution.

John Millington

A brief glance at Millington's life shows a man dedicated to the pursuit of science. Born in England on May 11, 1779, Millington followed the traditional elite British schooling pattern, culminating in his acceptance to Oxford University. For the next three years he studied at Oxford, finally being forced, as a result of financial constraints, to withdraw without taking his degree. Millington turned his attention to the study of law, gaining admittance to the Bar in 1803. Somehow, Millington also acquired the degree of M.D.[74] Millington ended his student career, thus, with an education in law, engineering and medicine. His steadfast dedication to science is exemplified in his various intellectual and academic pursuits: in 1820 he became a charter member of the Royal Astronomical Society; from 1821 to 1829, he was an officer in the Royal Society of Arts; and between 1823 and 1829 he was an active member in both the Mechanics' Institution and the Linnean Society of London. In addition, Millington was elected to the first faculty of London University. His most

---

[73] Sanford Charles Gladden A History of the Department of Physics and Astronomy at the University of Mississippi, 1848-1932 (University of Mississippi: 1933), 11.

[74] The early details of Millington's life are not easy to recount with any precision; when the federal troops burned his house in LaGrange, Tennessee, in the early months of the Civil War, the burned all of his personal belongings and effects.

prestigious honor, however, was his appointment as lecturer at the Royal Institution in 1817, where he served without salary until his resignation in 1829. While in England, Millington maintained close contact with many eminent scientists: Sir Michael Faraday, Sir David Brewster, Sir John Frederick William Herschel, and Sir Humphrey Davy, and, quite a few of their diaries record his presence at experiments and demonstrations.[75] Millington also conducted his own experiments, many with his personal collection of scientific apparatus. By the time of his arrival in the United States in 1830, he had already published the Epitome of the Elementary Principles of Mechanical Philosophy.[76]

In 1830 Millington went to Mexico under the joint appointment of Chief Engineer of Mines and Superintendent of the Mint for an English silver mining company.[77] While in Mexico, Millington suffered the tragic and untimely death of his wife and this, coupled with his own deteriorating health, caused him to remain in the United States after finishing his term in Mexico. Eventually settling in Philadelphia in 1832, Millington opened a scientific supply shop, quite an anomaly, as "science and experimentation had not yet had a great impact upon America."[78] His shop offered a wide variety of goods: "All the various machines, instruments, apparatus, and materials, required for mechanical, philosophical, mathematical, optical, and chemical purposes" in the areas of "mechanics, pneumatics, meteorology, hydrostatics, hydraulics, chemistry

---

75 Sanford Charles Gladden, "John Millington," William and Mary Quarterly (July, 1933): 3-4.
76 Gladden, "John Millington," 6.
77 Incidentally, the designaion of "Superintendent of the Mint" was a position traditionally awarded to prominent scientists. For many years after Millington's Mexican visit, one could find his initials on the Mexican dollars.
78 Gladden, "John Millington," 7.

electricity, magnetism, galvanism, electromagnetism, optics, astronomy, mineralogy, and geology" could be purchased.[79]

In 1836 the College of William and Mary contacted Millington, offering him the Chair of Chemistry, Natural Philosophy, and Engineering: an appointment about which Michael Faraday wrote in a letter to Millington: "And I know so much of your love for science as to be sure that in your new appointment you will find a continual source of the highest enjoyment."[80] Millington found the experience at William and Mary to be rewarding; not only did he construct many of the apparatus in his extensive instrument collection, but he also found the time in which to publish an engineering text, the first of its kind for the United States. By 1847 and 1848, internal dissension within the Board of Governors of the College forced Millington, along with several of his colleagues (one of them being George Frederick Holmes), to seek employment elsewhere. In a May 30, 1848, letter to scientist Joseph Henry, Millington wrote:

> I have no wish or inclination to leave the state, yet an advertisement has appeared requiring an entire faculty in a new University about to open for the first time at Oxford in Mississippi in November next - - some of our [William and Mary] professors have offered themselves for election and have induced me to do the same thing from a wish that four of our faculty (myself included) will be candidates for chairs in this new concern. Applications were to be made to the Honorable Jac Thompson Mem Congress in Washington who is one of the Trustees - - I have made my application to him and have taken the liberty of telling him that he might call on you, or on my friend Alexer. Dallas Bache to inquire as to my character and qualifications. [81]

From 1848 until 1853, then, Millington served the University of Mississippi.

---

79 Gladden, "John Millington," 5.

80 Michael Faraday to John Millington, transcript in the hand of Special Collections, College of William and Mary, Williamsburg, Virginia

81 John Millington to Joseph Henry, 30 May 1848, cited in University Museum Millington Files Oxford, Mississippi.

It was with careful calculation that the Board of the University of Mississippi elected sixty-nine year old John Millington as professor of natural sciences from among a pool of thirty applicants,[82] and it is this specific appointment which best demonstrates one important component of the Board's early "vision:" a commitment to science. Millington arrived at the University with an excellent reputation as a scientist and with an extensive collection of scientific instruments, of which the Board was well aware. This awareness is illustrated in the 1848 Minutes of the Board of Trustees in which a resolution was passed allowing that "the executive committee be authorized to draw for the amount of freight and charges incurred upon the chemical and philosophical apparatus."[83] As Frederick Barnard was to write of Millington in an 1895 letter: "He was advanced in life when elected and was preferred to his competitors chiefly, I think, because of his possession of an excellent collection of apparatus which he proposed to put at the service of the University."[84] By 1851, the Board had purchased the instrument collection from Millington. Although the exact amount of the transaction is not known, it is certain that at one point Millington valued his collection, including his library, at 10,000 dollars.[85]

Millington's instruments were simple and functional, the majority of which he himself constructed. Lacking textbooks his first year, he taught the students by "demonstration experiments," so that from the outset, the science program was built around apparatus. His collection was varied and shows a familiarity with the current state of science. In a 1979 lecture, Dr. Arthur B.

---

82 Gladden, "John Millington," 6.
83 Universiy Museum Millington files, University of Mississippi, Oxford.
84 F.A.P. Barnard to Dr. J. W. Johnson cited in Sanford Charles Gladden, A History of the Department of Physics and Astronomy, 5, 6.
85 Universiy Museum Millington files, University of Mississippi, Oxford.

Lewis of the University of Mississippi remarks on Millington and his instruments:

> . . . . this magnet over here is a Chinese copy of the electromagnet that Joseph Henry used. I know that's so because I've seen Joseph Henry's magnet in the National Academy of Sciences in Washington. The only difference is that Joseph Henry's magnet is insulated with red silk from his wife's petticoat. What she thought about that I don't know. But Millington even painted his red. What the significance of that is I don't know. . . . There is also a very old and interesting sextant which is somewhere about; I believe it is over there, and if we look at it you should be sure to read the maker's advertisement on the cover leaf . . . . The collection is rather impressive when you put it all together. So that the nub of it is that from the very beginning the University of Mississippi had a real and intense interest in the physical sciences.
>
> . . . . in those days the only source of electricity was electrostatic machine, a machine which compares with rubbing a cat's back and getting a spark from it; or batteries, chemical batteries, the ancestors of our dry-cells. The Royal Institution had an enormous 2,000 volt chemical battery. Each cell of the battery generates about 1.4 volts, so it was an enormous thing. Dr. Millington brought it with him to this country and the Museum has their battery, which is either a section from that battery with which Michael Faraday made the experiment which discovered how to induce electricity or it is the Chinese copy of it.[86]

Millington signed the instruments which he made, either with his full name or with the classical letters, I.M.[87]

Millington left the University of Mississippi to join the newly established Memphis Medical College as Professor of Chemistry and Toxicology. The importance of Millington's stay at the University cannot be overestimated. His professorial and pedagogical impact was two-fold. First, he was a well-known

---

86 Dr. Arthur B. Lewis, "The Millington - Barnard Collection of Scientific Apparatus," audiotape of lecture presented at University Museum, University of Mississippi, Oxford, March 27, 1979 (Oxford: University Museum Collection 1979).

87 In the classical alphabet, there was no letter for our letter "J."

scientist who had been engaged with scientists of the highest repute. Thus, he brought with him the professional strength that comes from not having to validate oneself: his scientific status was secure. In addition, Millington had both attended and taught science at schools and institutions of international reputation. He was familiar with the experimental and pedagogical techniques of these schools and he had actively engaged in them. It is logical to assume, then, that in the time in which he was employed by the University of Mississippi, he taught in this same manner. Second, and most important for the scientific program at the University of Mississippi, Millington's instrument collection provided the framework for the interactive study of science, and, in this sense, established the general orientation of the program as one in which both recitation and experimentation had pedagogical value. The combination of reputation and action that Millington brought to Oxford set a tone for science education at the University of Mississippi in which scientific instruments and experiment were stressed. Millington's successor was fortunate to be heir to this legacy, for it was on the basis of Millington's accomplishments that Frederick Augustus Porter Barnard was able to create a group with scientific potential at the University of Mississippi.

CHAPTER TWO:

Frederick Barnard: The man and his mission

Frederick Barnard

Frederick Barnard joined the University of Mississippi faculty in 1856, two years after Millington's departure. By the time of his arrival in Mississippi, Barnard had already experienced a rich career in the sciences, and his reputation preceded him. Like Millington, Barnard was not a Southerner. Rather, he was from the North, born in 1809 in Sheffield, Massachusetts. Barnard's family was highly educated; his father as well as uncle graduated from Yale. Aware of the value of a good education to their son's development, Barnard's parents sent him at an early age to the Saratoga Academy and then to live with his grandfather in Connecticut, where he attended the Hartford Grammar Academy. Having demonstrated a proclivity for mathematics and the sciences, Barnard was accepted by Yale in 1824, where he was soon winning his way to the head of his class in mathematics and the exact sciences.[88] Several professors at Yale took an interest in Barnard, among them Professor Denison Olmsted and Professor Benjamin Silliman, Junior. These two men were instrumental in changing the science curriculum at Yale, directing the courses from a strict recitation format to one in which scientific apparatus and experiments played a role in the actual classroom; this method of teaching was to have a profound effect upon Barnard's

---

88 Chute, Damn Yankee, 21-23.

view of the instruction of science in the classroom and the place of experiment in the practice of science.[89]

Barnard graduated from Yale in 1828 and spent the following year teaching at his alma mater, the Hartford Grammar Academy. In 1829, he began to study law under the tutelage of a private, prominent law firm. Barnard's aspirations to a career in law came to a screeching halt when, in 1830, he slowly began to lose his hearing. Barnard had otosclerosis, a hereditary disease in which the cartilage slowly grows over the ear, sealing it off, and making all hearing impossible. Immediately, he resigned himself to choosing another profession, accepting a position as a mathematics tutor at Yale. Barnard's high standing as a tutor at Yale is amply testified to by the support given to him by Professor Olmsted. When in 1832 he once again began to perceive the growing impairment of his hearing, Barnard informed the Professor of his intention to leave Yale and go to work for the New York State Institution for the Deaf and Dumb. Olmsted, aware of Barnard's considerable gifts, had another proposition for the younger scientist. He suggested that Barnard consider remaining at Yale working under him, and that Olmsted himself would be responsible for amassing the funds for a Chair in Mathematics to which Barnard would eventually be appointed. It is easy to speculate that Barnard must have been tempted by this proposal, but the steady decline of his hearing caused him to turn down Olmsted's generous offer and move to New York.[90]

---

[89] In the early nineteenth century, Silliman strove to create a much more active learning environment, combining "showmanship and a skill at popularization and a deep religious faith in his approach to teaching, along with realizing the necessity of textbooks in such subjects as chemistry and geology." Extending Silliman's novel approach in the classroom, Professor Olmsted was the first at Yale to depart from the text and dirtect the class around instruments and actual experimental demonstrations. Chute, Damn Yankee, 20-23.

[90] Chute, Damn Yankee, 40-41.

While in New York, Barnard's interest in science continued. Unexpectedly, his hearing loss abated, enabling him to once again consider an academic career. An 1837 publication "On the Aurora Borealis," in the American Journal of the Art and Sciences, "was considered one of the most scholarly and scientific of the day," and, as such , played a key role in causing the faculty of the University of Alabama to express an interest in him.[91] Their initial interest along with letters of recommendation from Professors Silliman, Olmsted, and J.W. Gibbs of Yale were instrumental in securing Barnard the position of Professor of Mathematics and Natural Philosophy at the University of Alabama.[92] Barnard's must have had many reasons to move to the South. One compelling reason might have been that he felt there was a better chance of professional progression in the newly-developing South than in the North. Illustrating this claim is his letter to his friend Edward C. Herrick at Yale in which he advises: "You will grow in the South much faster than in the North."[93]

From 1838 to 1848 Barnard taught mathematics and natural philosophy, or physics, at the University of Alabama before assuming the chair of chemistry and natural history as well, a position he held until 1854. Under Barnard's influence, the University of Alabama developed a vital science program. An examination of the course catalogues of the University of Alabama from 1833 to 1861 reveals the steady evolution of the science curriculum from one in which only the basic tenets of science were taught to one in which instruments of high quality, current texts, and a wide range of scientific subjects were prevalent. By 1843 the catalogue boasted that its philosophical apparatus was: "Constructed by

---

91 University Museum Barnard Files, University of Mississippi, Oxford.
92 Chute , Damn Yankee, 74.
93 F.A.P. Barnard to E.C. Herrick, February 27, 1838, cited in Chute, Damn Yankee, 76.

European artists after the most recent and approved models, is extensive and complete; and affords it is believed, great advantages for the study of natural philosophy and chemistry, as are afforded by any similar institution in the United States."[94]

In addition to revising and extending the science curriculum, Barnard managed to acquire enough funds from the Alabama Board to construct an astronomical observatory and a magnetic observatory. As the 1843 course catalogue states:

> An astronomical observatory is to be immediately erected, which will probably be completed before the autumn session of the current year. The building will be 54 feet in length, by 22 in breadth, in the centre; and will be furnished with instruments superior in power and accuracy to any hitherto introduce in the United States. A transit circle has already been constructed by Simms of London, having a telescope of five feet focus, and four inches clear aperture; the diameter of the limb being three feet. an astronomical clock with mercurial composition, by Molyneux, of London, has also been provided. It is proposed, as soon as possible, to complete the apparatus of the observatory, by the purchase of an equatorial telescope, of about 8 inches in aperture and 14 feet focus.
>
> For the observing, upon terrestrial magnetism, a separate structure of stone will be erected, with every precaution to guard against local attraction. The University has already imported a declination instrument, a dipping needle constructed by Gimbey of Paris, in the most superior style of finish and accuracy.[95]

In conjunction with the construction of the observatory, the State of Alabama appointed Barnard as its official astronomer and surveyor. Both the observatory and this new position brought him into contact with numerous scientists,

---

94 Course Catalogue, University of Alabama, Tuscaloosa (M.D.J. Slade: 1843).
95 Course Catalogue, University of Alabama, Tuscaloosa (M.D.J. Slade: 1843).

including Alexander Dallas Bache, superintendent of the United States Coastal Survey and Benjamin Peirce, the first mathematics professor at Harvard.[96]

Contact with these reputable scientists, Barnard's positive experience at Yale, and the growing astronomy center at the University made him a logical point of reference for those interested in scientific activity in the South. For instance, when Dr. John Collins Ware, a Boston surgeon and anatomical surgery professor at Harvard, needed to know the extent to which the southern universities would support the establishment of the AAAS, he wrote to Barnard. Barnard, as a representative of the University of Alabama, responded:

> Sir: I am instructed by the faculty of the University to acknowledge on their behalf, the receipt of the circular letter recently issued by the committee of correspondence appointed at the meeting held in Boston to consider the expediency of establishing an "institution for the cultivation of the Sciences," and to affirm that the plan therein proposed appears to the faculty of this institution to be well-adopted to promote the interests of science in the country and that it meets with their cordial approbation. So far as it may be in their power they will be happy to cooperate with other friends of science in the United States in support of the project. I have the honor to be, your most obedient servant.[97]

Significantly, at age forty-five, Barnard appears to have had no desire to make a job change. In 1854, he accompanied a friend of his, the Reverend Mr. Johnson, to the University of Mississippi, as the Reverend wished to apply for the vacant chair of chemistry. When they reached Oxford, it soon became apparent that the Reverend was not being courted for the position; rather, the Board displayed greater interest in Barnard, perceiving him as a man of "extensive

---

96 It should be noted that at this time Barnard also developed a working friendship with James Dwight Dana, due to Barnard's work with photography and the daguerrotype.

97 Chute, Damn Yankee, 106.

scientific learning, increasing fame, incredible Yankee energy."[98] Over the course of the days during which the Reverend and Professor Barnard remained in Oxford, the conversations clearly became increasingly intense, as the Board attempted to persuade Barnard to join the University of Mississippi faculty. Barnard finally said that it was possible he would accept the chair of mathematics, but not of chemistry. This remark, however, was intended to turn the attention back to Johnson and the chemistry chair, since when offered the chair of mathematics, physics, and civil engineering, Barnard announced to the clerk that it was not possible for him to accept the position. As Barnard recounts the tale: "The clerk had already made that I could not accept the chair. The clerk withdrew and after an interval of about half an hour he returned to say that the Board had elected me professor of mathematics, physics, and civil engineering."[99] Thus it was that Barnard, regarding himself as a "man of honor" and "feeling himself pledged to accept this appointment," joined the faculty at the University of Mississippi. On Barnard and Johnson's return to Tuscaloosa, a hotel clerk remarked: "Your friend seems to be unwell. I feel he has been unsuccessful at Oxford." "No madam," said Johnson, "he is sick because he has succeeded."[100] The efforts of the Board to obtain Barnard indicate their commitment to a strong faculty, particularly in science.

Barnard held the chair of mathematics and physics from 1854 to 1856, retaining it after he had become President and Chancellor of the University in 1856. During his tenure at the University, he initiated a series of changes that concurrently restructured the entire curriculum and brought external recognition

---

98 University of Mississippi files, University of Mississippi, Oxford.

99 Barnard, "Autobiographical Sketch of Dr. F.A.P. Barnard," Publications of the Mississippi Historical Society, 12 (1912): 108.

100 Chute, Damn Yankee, 153.

to the University's science program. It appears as if Barnard's method involved three steps. First, he endeavored to secure funding for new buildings as well as new scientific equipment that was on a par with or superior to scientific equipment at the more prestigious institutions. Second, he changed the University curriculum: experimentation and recitation held equal weight; the traditional "closed system" of classical education was replaced by the "double system" of instruction culminating in either a bachelor of arts or a bachelor of science degree; and the establishment of graduate programs was proposed.[101] Third, he maintained close contact with the scientific establishment outside of the University, realizing the need to position the University within the established scientific network.

Barnard's duties during his first year went beyond that of mathematics, civil engineering, and physics: the chemistry courses were also added to his teaching load. "I gave, therefore, during my first year, a full course of experimental lectures in chemistry, while teaching at the same time the higher mathematics, physics, astronomy, and the elements of civil engineering."[102] The school year went from November to July, with a Christmas break. Students had prayer at sunrise, studied until breakfast, had classes and obligatory recitations from 8 a.m. to noon, 3 p.m. until 6 p.m., and sunset until 9 p.m. Those not in the recitations were expected to be "enduring study hours."[103] From the outset, however, Barnard did not allow this teaching load to interfere with his other

---

101 University Museum Barnard Files, University of Mississippi, Oxford.
102 Barnard, "Memoirs."
103 James B. Lloyd, The University of Mississippi: The Formative Years, 1848-1906 (University of Mississippi: 1979).

duties, as he continued his commitment - - begun during his tenure at the University of Alabama - - to restructure the university's educational system.[104]

It is not surprising that one of Barnard's initial moves was to inquire into means of obtaining appropriations to improve his laboratory. While Millington's apparati provided a good base, they were not sufficient, both in scope as well as in overall quality, and were, by this time, outdated. Barnard, having spent time at the University of Alabama, another "land-grant" institution, recalled Mississippi's 'Seminary Fund:'[105]

> In the winter of 1854- '55 the trustees met, as they were accustomed to do during the session of the legislature at Jackson. I had, immediately after my connection with the university began, raised a question, what had become of the university endowment, or the so-called "Seminary Fund" obtained from the sale of lands granted by the congress to the state at the time of its admission in 1817.[106]

Barnard was informed that only eighty-thousand dollars remained in the fund, and he was confident that there should be much more in accordance with the land-grant agreement.

Barnard set himself a difficult task. As his biographer William Chute points out, there were thirty or so years during which the University made no real attempt to establish an institution of learning in accordance with the "land grant."[107] During this period, the State Legislature had administered the capital

---

104 While at the University of Alalbama, Barnard delivered several papers on the subject of educational reform. For example, by 1855, he had already published his letters on college government and education; in August of that year Barnard had delivered a paper before the American Association for the Advancement of Education on "Improvements Practicable in American Colleges." See Chute, Damn Yankee, for further infomation on Barnard's educational reform work at Alabama.

105 This reference to "land grant" is not the same as the Morrill Land Grants. Barnard just uses the same terminology in his writing.

106 Barnard, "Autobiographical Sketch," 111.

107 Chute, Damn Yankee, 151.

funds derived from the sale of these public lands through a series of trust funds deposited in several state banks. The Mississippi banking system, specifically Union Bank of Mississippi, collapsed with the other banks as a consequence of the disastrous banking policies of Andrew Jackson in his last presidential term. Supposedly, the seminary fund had "dissipated." However, as Barnard claimed:

> The State had, in fact, accepted the fund as a trust, and the constitution provided that the capital should never be diminished. As a trustee, the state was liable for the whole amount. . . . When the buildings were erected at Oxford about $200,000 had been expended; allowing for this expenditure, it was found, by severe application of the rules of law, that there remained a balance due to the University of nearly a million dollars.[108]

Rather than ask for the money directly from the Legislature, Barnard proposed an alternate solution: "I had resolved to recommend to the trustees to present a 'memorial' to the legislature, asking an increase in funds to the university, not on the ground of legal claim, but as a matter of public policy."[109] Rather than presenting Barnard's "memorial" themselves, the Trustees sent Barnard himself to the Legislature, where he delivered a speech outlining its contents. Barnard remembers:

> I represented that the university was the essential motive power of the entire educational system of the State; that we could not have any secondary or primary schools without teachers, and that the university was necessary to provide for the secondary schools and the secondary for the primary; yet that the university could never thrive unless it were enabled to offer the same advantages which were possessed by similar institutions in other States. And I pointed out the large deficiencies of the university in regard to apparatus and library. And I held that it would be a wise policy to

---

108 Barnard, "Autobiographical Sketch," 112.
109 Barnard, "Autobiographical Sketch," 112.

> make direct appropriations from the treasury in support of it, as was annually done in the Carolinas and Virginia.[110]

The result of Barnard's efforts was satisfactory. On March 6, 1856, the Legislature passed an act in response to Barnard's request:

> [T]hat to enable the trustees of the State university to provide suitable buildings to accommodate the increasing number of students at the said institution, to supply deficiencies in the library and apparatus, and to meet other pressing wants of the institution, the sum of $20,000 be, and the same is hereby, appropriated, to be paid out of the State Treasury annually, for the period of five years, to be paid in full on the order of the president of said trustees.[111]

This act was popularly known as "the annual $20,000 law." On July 18, 1856, the Board of Trustees appropriated $10,000 "for the erection of a Philosophical and Astronomical building," $10,000 "for the purchase of philosophical and chemical apparatus," and $4,300 "for the first payment in the purchase of a Meridian Circle."[112] As Barnard commented at the time:

> In consequence of this the trustees authorized the purchase of all the apparatus which is now found in the physical department, and provided for the erection of an astronomical observatory, and also a small magnetic observatory . . . . I was permitted to direct these purchases very largely myself. . . .[113]

Barnard made plans to visit Europe, both to attend the annual British Association for the Advancement of Science meeting to be held in Glasgow, Scotland, and also to purchase apparatus for the University, as funding had been secured. Barnard's intention to procure still more instruments, in and of itself, is

---

110 Barnard, "Autobiographical Sketch," 111-113.
111 Chute, Damn Yankee, 153-154.
112 Barnard, "Autobiographical Sketch," 113.
113 Barnard, "Autobiographical Sketch," 113.

an indication of his high ambitions for the University of Mississippi as a scientific institution. Unfortunately, his trip was abruptly canceled. As Barnard recounts:

> However, as to my unlucky star - - all matters having reached this satisfactory adjustment, the President of the university, without a whisper of premonition, and without assigning a reason, resigned; and to all solicitations that he should withdraw the paper, or at least consent to serve a few months longer - - say Christmas - - remained obstinately inflexible in his request to listen. . .[114]

Without hesitation, the Board placed Barnard in temporary charge of the University, making his European trip an impossibility.

After Barnard had begun his acting presidency, the Board, in response to Barnard's obvious need to maintain his contacts with the larger scientific community did grant Barnard a leave of absence until October 1, 1856, in order that he might attend both the inauguration of the Dudley Observatory in Albany, New York, and the AAAS meeting. On the day of the inauguration in Albany, Barnard received news that on August 19th, he had been elected President of the University of Mississippi; "While there I received a telegram from Colonel Thompson, containing only the words,'"You are president; come home as soon as possible.'"[115] Unfortunately, the following years were not to be easy. Internal dissension between the Board and the faculty, Barnard and the Board, and a few of the faculty and Barnard caused him to declare: "The next five years or so were a very difficult period of my life, probably the most so of any I have known."[116]

An examination of the course catalogues that exist for the period of Millington's and Barnard's tenures, in addition to the evidence of the secondary

---

114 F.A.P. Barnard to Eugene Hilgard, July 19, 1856. Transcript in the hands of Wollman Library, Columbia University, New York.

115 F.A.P. Barnard to Eugene Hilgard. Transcript in the hands of Wollman Library, Columbia University, New York.

116 Barnard, "Memoirs."

literature, reveals the extent to which Barnard revised the curriculum. Prior to the session of 1856-57, there exists no detailed description of courses.[117] It is known, however, that until 1854-55 and the election of Barnard, the instruction in the natural philosophy and astronomy was restricted to the senior class. In the catalogue for the ninth session, 1856-57, there appears the first (available) detailed description of the work offered in physics and astronomy. In anticipation of new scientific equipment ordered by Barnard, the catalogue states:

> The instruction in natural philosophy commences at the beginning of the junior year.. . in addition to this there will be delivered experimental lectures two or three of each week, in which, by means of apparatus and large diagrams, the fullest illustration will be given of every important fact and principle embraced in the subject under consideration. For this purpose, apparatus has been provided on the most liberal scale the recent purchases having been impressing the facts and principles of science upon the mind through the eye; and all the instruments selected have been to the best of their class: the University in this respect, fairly entitled to claim superiority to most collegiate institutions in the United States [sic].[118]

In advocating instruction based on the fullest demonstration of "every important fact and principle embraced in the subject," Barnard's philosophy of education is made clear: active participation must play an integral role in the learning process. Learning by doing, or in what more modern times is known as laboratory experiment, in conjunction with traditional textbook memorization and recitation facilitates complete comprehension. Early in his career, while teaching at the Stockbridge Academy, Barnard was to formulate this philosophy

---

117 Sanford Charles Gladden, A History of the Department of Physics and Astronomy at the University of Mississippi, 1848-1932 (University of Mississippi: 1933).

118 Course Catologue for the ninth session, 1856-57, Special Collections, University of Mississippi, Oxford.

as he taught the children, and he was to modify it only slightly in his approach to higher education. He writes:

> It has always seemed to me the great, as it is the almost universal, educational mistake of our time, that children, instead of being introduced to subjects which address the perceptive faculties, and which are adapted to furnish them with a flood of novel and clearly comprehensible ideas, are usually condemned to the dreary study of unintelligible words, which impose a heavy burden on the memory. . . .[119]

Barnard himself wrote the University catalogue for the tenth session, 1857-58; in it are extensive lists and descriptions of both the instruments secured and the range of instruction in scientific methodology conceived by Barnard. Barnard's attention to both matters of recitation and laboratory experiment is shown clearly in passages of the curriculum text, clearly reflecting his philosophy of education. For example, this description deals with recitation:

> The course in astronomy will commence hereafter, if possible, in the latter part of the Junior Years, and the subjects will be taught in part by lecture and in part from a textbook. . . . .

while the following passage indicates the experimental emphasis:

> For the experimental illustration of these subjects (optics) the department is provided with a rich collection of apparatus in which are to be found mounted mirrors and lenses of large size and all kinds, including...solid prisms of various materials and forms, achromatic prisms, hollow prisms, and prisms of variable angle. . . The principle topics then treated of will be the figure and dimensions of the earth, the doctrine of the sphere parallax, atmospheric reflection, time, and the modes of determining it, the construction and use of astronomical instruments. . . .[120]

---

119 Barnard, "Memoirs."

120 Course Catologue for the tenth session, 1857-58, Special Collections, University of Mississippi, Oxford.

Barnard's unification of recitation and experimentation is seen throughout the course descriptions. These descriptions are important to understanding Barnard's approach to education, and they also offer a first-hand glimpse at the particular subjects of science taught at the University of Mississippi. For example, one section considers Mechanics:

> The subject which will first come under consideration will be Mechanics, embracing a theoretical and experimental demonstration and illustration of the laws of equilibrium and motion, of the doctrine of gravity and the laws of falling bodies, of inertia and the centre of inertia, of the phenomena of elasticity, of the mechanical powers and the application of mechanical principles to machinery . . . .[121]

Another section describes Meteorology:

> Much attention will be given in the lectures to the subject of the atmosphere in its meteorological relations, the fluctuations of its temperature and pressure, the law of diminished pressure above the earth's surface, and the theory of winds, clouds, dew, rain, and snow. The construction and the theory of the barometer in all its forms, will be explained and illustrated . . . . The application of the barometer to the measurement of heights will here be investigated, and students will be required to familiarize themselves with both the process and the theory.[122]

Special attention was given to the subject of Electricity:

> The subject of Electricity, which is next take up, is commenced with the early history of the science, and the discoveries and theories of the last century, together with a comparison of the views of Franklin and Du Fay. The laws of electrical attraction, repulsion, distribution and induction, the construction and use of electrical machines, and of the torsion balance, the theory of the Leyden jar

---

121 Course Catologue for the tenth session, 1857-58, Special Collections, University of Mississippi, Oxford.

122 Course Catologue for the tenth session, 1857-58, Special Collections, University of Mississippi, Oxford.

> and electrical battery, the mechanical, chemical, and physiological effects of electricity . . . . [123]

Descriptions of the other subjects covered - - Hydrostatics, Hydrodynamics, Pneumatics, Heat, Acoustics, Magnetism , and Electro-Magnetism - - provide the same attention to detail, permitting the reader to formulate a comprehensive picture of the curriculum.

In light of Barnard's attempt at a radical revision of the curriculum, it would be logical to assume that a clash between the President and the Board was likely and that, in fact, was the case. In 1858, Barnard made public his views on education and on the University's future direction in a "Letter to the Trustees," which he had published in the form of a pamphlet and distributed throughout the State. The Board was enraged at this 112-page treatise laying out the basic problems, according to Barnard, of the present educational system: first, the failure of the people to recognize the need for transformation and the restructuring within the University and second, the lack of adequate funding.[124] The first criticism was a reaction to the traditional classical education, popularized by the Yale Report. Barnard favored a more liberal approach to education, as might be expected from his emphasis on scientific apparatus and actual experimental practice. As the content of the Treatise makes clear, Barnard advocated the German system of education "exemplified by Heidelberg University and anticipating the program at Johns Hopkins University by twenty years."[125] This system advocated emphasizing the sciences, learning by

---

123 Course Catologue for the tenth session, 1857-58, Special Collections, University of Mississippi, Oxford.

124 Letter to the Board of Trustees, Journal of the Minutes of Faculty and Trustees of the University of Mississippi, University of Mississippi, Oxford.

125 University Museum Barnard Files, University Museum, Oxford.

inductive and deductive reasoning, and instruction through experimentation and demonstration. In his argument Barnard stated:

> It need hardly be called to your attention that the educational world has long been agitated by the question, whether the American college system has not failed to keep pace with the intellectual advancement of the age in which we live. So large have been the conquests of mind, especially in the field of physical science, during the present century, that a much more considerable amount of positive knowledge is now expected of a liberally educated man, than was the case when the system was originated....It is claimed that the necessity of the age requires of colleges, that they no longer teach merely with the view, through the exercise of the mind upon the subjects taught, to develop the intellectual powers; but that, besides this, they should make knowledge itself, for its uses, the end of their teaching, and should, therefore, teach more than was esteemed necessary....

Barnard continues to elaborate upon his views, analyzing the weaknesses of the University:

> But what is the University of today? What but a training school for immature minds--impaired, indeed, in its usefulness for this purpose by the attempt to accomplish along with it, other and entirely incompatible objects? If the people suppose that this is a place to make practical men, or learned men, or profoundly scientific men--if they suppose that it is within the reach of possibility for the University, under the existing system , to turn out accomplished engineers, or expert chemists, or proficient astronomers, or very profound philosophers, or even finished scholars--we know very well that they are deceived.[126]

In short, Barnard proposed an entire reorganization of the University, proclaiming:

> If the University stands high in a literary and scientific point of view, the inference is natural in that it cannot be other than an

---

126 Letter to the Board of Trustees.

> intelligent people whose educational training is subject to such a control. . . . The University must [stand as] a repository of universal truth, and a dispenser of universal knowledge.[127]

Such an elevation of University standards could only begin with a radical restructuring of the curriculum, beginning with the introduction of "two separate programs of instruction, one three year classical course leading to a B.A. and designed to instill mental discipline, and one two-year course leading to an M.A. and emphasizing the accumulation of pure and practical knowledge of the physical sciences."[128] In addition, Barnard proposed a pedagogical change, one that would include lectures and rely upon extensive laboratory exercises.[129] Historian John Fulton remarks that Barnard firmly believed that an educational institution could survive only if three things worked in tandem: the charisma of the teachers as well as their personal ability, the methods of instruction, and the apparatus available for imparting this instruction.[130]

Although much hostility greeted the "Letter," its presentation to the trustees was sufficiently compelling to bring about the "liberal appropriation among which that for the (continued) erection of the observatory building and for the purchase of what was then considered a large telescope and a good equipment for the department of physics and astronomy."[131] This appropriation, coupled with the initial one derived from the "seminary fund," enabled Barnard to purchase collections, such as shells and minerals, to facilitate the study of the life sciences.

---

127 Letter to the Board of Trustees.
128 LLoyd, The University of Mississippi, 28.
129 LLoyd, The University of Mississippi, 28.
130 John Fulton, Memoirs of Frederick A. P. Barnard (New York, 1896), 207, cited in University Museum Barnard Files, University of Mississippi, Oxford.
131 Barnard, "Autobiographical Sketch," 113.

Despite his ever-increasing instrument collection and expanding science program, Barnard maintained steady and viable ties with the larger scientific community. This constant contact served a twin purpose: as Barnard's reputation grew, so did that of the University of Mississippi. Several of Barnard's external scientific activities warrant attention. The federal government, in 1858, commissioned Barnard to inquire into and report on the status of the United States Coastal Survey, a highly irregular request (at this time) for the government to make of an employed academic. By November of 1858, Barnard published his report titled "Report of the History and Progress of the American Coastal Survey up to the Year 1858." Participation in the Coastal Survey on this level led to a close and fruitful friendship with Alexander Dallas Bache, the director of the Coastal Survey. Bache promptly invited Barnard to be a member of his 1860 sea expedition to Labrador, organized to observe an eclipse of the sun.[132] Barnard accepted Bache's offer. As Barnard wrote to Hilgard: "Bache insisted on my going and refused to 'count me out.'. . . I shall start to-morrow."[133]

Upon his return to the United States, Barnard discovered that he had been elected president of the AAAS. The following year, Barnard traveled to Nashville, Tennessee, where he gave his formal speech of acceptance at the annual meeting.[134] In March of 1858, Barnard was appointed by the President of the United States to the Mint Commission, an honor bestowed only upon those of the highest public rank.[135] In 1859, Barnard's alma mater, Yale University, conferred upon him the honorary degree of Doctor of Laws. Several universities,

---

132 Chute, Damn Yankee, 177.

133 Barnard to Hilgard, 22 June 1860, University of Mississippi.

134 The Civil War prevented Barnard from serving his term as president until 1866.

135 W.H. Green to F.A.P. Barnard, March 1, 1858. University Museum Barnard files, University of Mississippi, Oxford.

among them Saint John's in Annapolis, Maryland, and the University of South Carolina, offered Barnard the position of president of their institutions. Ill-health prevented Barnard from visiting the former, while the desire not to compete with an old colleague for the presidential position persuaded him against considering the latter.

The changes wrought by Barnard during his ambitious tenure at the University of Mississippi provided the framework for a scientific community. Securing funding, restructuring the curriculum, and, through maintaining steady contact with the external scientific establishment while slowly positioning the University within the established scientific network, brought science to the south. To keep science in the south Barnard recognized the need to have first rate instruments. In the next chapter I turn to examine the instrument collection.

CHAPTER THREE:

Keeping Science South: The University of Mississippi Barnard - Millington Instrument Collection

While Barnard accomplished much with his curriculum revisions and teaching philosophy in creating a scientific community at the University of Mississippi, his most profound and convincing legacy of science going South is the vast and innovative instrument collection he left behind. In realizing the educational value, the potential for novel research, and the recognition that would follow, Barnard secured the best instruments, positioning the University of Mississippi's science program on par with the top Northeastern universities. Not only is his collection relatively intact today and available for viewing at University Museum of the University of Mississippi, but there also exists a complete inventory (see Appendix) from the ante-bellum period of the scientific apparatus. Additionally, both the magnetic and the astronomical observatories remain. Compiled by Barnard immediately prior to his departure from the University in December, 1861, this inventory, in conjunction with the actual collection, offers an essential resource in constructing an outline of the ante-bellum science program at the University of Mississippi.[136]

---

136 Before the University reopened in September of 1865, Eugene Hilgard, acting as the official caretaker during the Civil War, updated Barnard's Inventory, placing his entries next to Barnard's. Since Hilgard's notations, the inventory has been updated twice,before being transcribed into its present form by Jeanne Wells, assistant curator, University Museum, Oxford in October of 1980. The Appendix contains her transcription.

Before discussing Barnard's collection, it is important to consider the quality of the instruments. The instrument makers were well known inside the science establishment, with certain firms carrying more prestige than others. Although not all of the instruments of this period bear the name of their maker, many do, as it was common among the makers and distributors to sign their apparatus. [137] The majority of the instruments used by American institutions were made abroad, and Barnard would follow that practice in the purchases he made on behalf of Mississippi. Not only did the older, foreign firms have the means to produce high-quality tools, but they also were popular with the large number of American scientists who had received their training in Europe or England. These men, prejudiced in favor of the instruments they had used in their own training, carried into the American scientific community the idea that the best apparatus came from Europe and England. [138] An educational institution or an experimental program that offered the use of instruments bearing the names of well-known and dependable makers, gained a reputation for the quality of the foundation for its experimental and educational programs. Thus, in purchasing high quality instruments for the University of Mississippi program, Barnard created a first-rate framework in which to establish a flourishing scientific community.

---

[137] Leland Brown points out, however, that this was not always true, especially among the earlier instruments: "A piece of apparatus sometimes bears the name of the instrument maker, very seldom the date of manufature, and the use can only be inferred from the appearance and the relation of the movable parts." Early Philosophical Apparatus at Tranylvania College (Lexington, Kentucky: Transylvania College Press, 1959), 5; For many years Professor Greenslade of Kenyon College has run intemittent notes in The Physics Teacher that describe old apparatus, the most recent in the December 1992 issue.

[138] This is, of course, more true of the early nineteenth century. As science evolved into a legitimate, recognizable enterprise, the market for quality American instruments grew, and this was to change. In fact, one can see this in the Barnard Collection, as the acquisitions increasingly bear the mark of American instrument-makers.

The Instruments

The instrument plays a decisive role in the education of future practitioners. Students, such as those Barnard's ambitious program would have attracted to Oxford, Mississippi, would undoubtedly have encountered for the first time in their lives instruments of high sophistication and craftsmanship. Not only the observations of demonstration but the rare opportunity to perform for themselves experiments in support of the conceptual models of the day would have given these young men a taste of the nature of scientific exploration that would, one might hope (as Barnard certainly did), encourage some of them to learn enough to join the ranks of practicing scientists in America.

Barnard was well-aware of the latest innovations in instruments as he made his first round of purchases with appropriations from the seminary fund. As historian Sanford Charles Gladden remarks:

> The equipment purchased by Dr. Barnard appears to have been the exact duplicate of the apparatus employed at the Ecole Polytechnique in Paris, as can easily be shown by checking the inventory list of Barnard with the items listed and illustrated in Jamin's Traité de Physique, which was the leading textbook on physics at that time, as well as the official text of the École Polytechnique.[139]

Among the purchases were a planetarium, a large electromagnet, a number of lenses, prisms, mirrors, a Norrenburg Polariscope, various oil paintings illustrating the phenomena of light, and a friction-type electrostatic madrine, all reflecting the latest in the field. [140] For instance, the oil paintings comprise a set

---

[139] Sanford Charles Gladden, "A History of the Department of Physics and Astronomy at the University of Mississippi 1848-1932" (University of Mississippi: 1933), cited in University Museum Barnard files, University of Mississippi, Oxford.

[140] Lloyd, The University of Mississippi, 3.

of eighty originals from the Atelier Clichy, Paris. Illustrating all of the important forms of diffraction and polarization, these paintings seem to be the originals from which were made the color plates found in the classic 1869 Les phénoménes de la physique par Amédée Guilemin .[141] Another important purchase in this set was described as "Pouillet's "Grand Appareil pour les expériences de diffraction as d'interférences," containing every piece described in Pouillet's Physique and illustrating all phenomena of diffraction."[142]

By the publication of the 1857-1858 course catalogue, Barnard could state confidently that:

> . . .apparatus has been provided on the most liberal scale; the recent purchases having been extended to embrace whatever could be practically useful in impressing the facts and principles of science upon the mind through the eye; and all the instruments selected have been the best of their class. The University is, in this respect, fairly entitled to claim superiority to most collegiate institutions in the United States.[143]

In this catalogue, Barnard presents detailed descriptions of the instruments to be used in the experimental illustration of the subjects taught. A brief annotated overview of the course catalogue in conjunction with the full inventory listed in Appendix provides an excellent idea of the kind of science practiced by the ante-bellum students.

Barnard amassed a fine array of optical instruments, many catering to theoretical aspects of optics. As he states in the catalogue description:

---

141 W.L. Kennon and Sanford Charles Gladden, "Historical Apparatus at the University of Mississippi," The American Physics Teacher, 6(February, 1938): 2-3.

142 Kennon and Gladden, "Historical Apparatus," 3. Interestingly, when Kennon and Gladden wrote this article in 1938, the University was still using this apparatus.

143 Course Catalogue, University of Mississippi (Oxford, Mississippi: 1857-58).

> For the experimental illustration of these subjects, the department is provided with a rich collection of apparatus, in which are to be found mounted mirrors and lenses of large size and of all kinds, including Fresnel's compound burning lens two feet in diameter, solid prisms of various materials and forms, achromatic prisms, hollow prisms and prisms of variable angle, Silbermann's heliostat, Rochon's dispersion apparatus, Arago's, Norrenberg's and Biot's polarizing apparatus, photo-electric and solar polariscopes with numerous accompanying objects for exhibiting to classes the chromatics of polarization, Soleil's saccharimeter, Engel's ingenious models for the illustration of the wave theory and double refraction, Pouillet's diffraction apparatus; also optical instruments of various kinds, the camera lucida, the camera obscura, the refracting telescope, the Gregorian reflecting telescope, compound microscope by Spencer with objectives from 2 inches to 1/20 of an inch, binocular and double microscope by Grünow, the solar and photoelectric microscopes, the stereoscope, the magic lantern and the double lantern with polyrama, dissolving views and phantasmagoria. . . for the better demonstration of the laws of refraction, dispersion, diffraction, interference, luminous meteors, etc., use will be made of oil paintings exhibiting the phenomena largely magnified.[144]

Based on the quality and range of these instruments, Barnard's personal interest in optics is clear. In a January 1912 letter from Robert Fulton to William Keenen (both men whose association with the University of Mississippi put them in contact with Barnard's work), the former remarked that the theoretical side of optics seemed to interest him [Barnard] very much - - evidence of which could be seen in instruments such as the "diffraction banc, the oil paintings illustrating interference, and a large number of curves drawn on large sheets of paper. . . . This set [was] probably the first of [its kind brought to America."[145]

---

144 Course Catalogue, University of Mississippi (Oxford, Mississippi: 1857-58).

145 Robert Fulton to William Keenen letter, 12 January 1912, The Miller School, Virginia. Transcription in the hands of University Museum, University of Mississippi, Oxford; in addition, Sanford and Gladden write in their "History," 3, of "A unique portion of the collection is a set of 80 original oil paintings about two feet square from the Atelier Clichy, Paris, which represent the important cases of diffraction and polarization. These paintings appear to be the originals from

Acoustical instruments also comprised a large section of the collection. As the description reads:

> . . . the apparatus of the University is complete; embracing every important instrument in the catalog of Marloye of Paris, whose name has so long been associated with this specialty, and who, since his retirement, has been replaced in this manufacture by Secrétan, by whom the University has been supplied. The collection will therefore, be found to contain all the ingenious contrivances of Savart, as for example his monochord his large apparatus for illustrating the sympathetic vibration of a column of air with a bell, his toothed wheel and spring, his system of parallel bars, etc., with a great variety of tubes, embouchures, organ pipes plates, and membranes for producing acoustic figures, diaspasons of various pitch from CC upward, Wheatstone's arrangements for interference, the siren of Cagniard for registering vibrations . . . .[146]

The collection holds extensive apparatus for the study of electricity, electro-magnetics, and electro-dynamics:

> . . . . with the opening of the ensuing session (1857-58), the electrical apparatus of the University of Mississippi will be superior to any similar collection in the United States. The principal electrical machine, now in progress of construction, by Ritchie, has two glass plates, five and a-half feet, each, in diameter, and, in its dimensions, will probably surpass any in the world. It is presumed that the illustrations which it will furnish of electrical phenomena will be correspondingly splendid. Batteries of a magnitude proportional to the power of the machine will also be prepared by Mr. Ritchie to accompany it. . . .The collection will embrace, also, a large torsion balance by Secrétan, and a great variety of minor apparatus, such as condensers, electroscopes of different kinds, among which are those of Bohnenberger, Peclet (for atmospheric electricity) and Coulomb's hollow sphere, Biot's spheroid with movable envelopes, Kinnersley's electrical thermometer, electrical

---

which were made the beautiful color plates in Les Phenomenes de la Physique by Amedee Guellemin" (Paris, 1869).

146 Course Catalogue, University of Mississippi (Oxford, Mississippi: 1857-58).

> mortars and guns, model houses for firing or exploding by electricity, electrical rotations, dances, bells, etc., the electrophorus, Zamboni's dry piles, together with extensively varied and magnificent illustrations of electrical light. . . . The University has also ordered and will shortly receive, Armstrong's hydro-electric machine, for the generation of electricity by steam, by means of which electricity is developed in enormous quantities and with astonishing effects. . . . In passing to Electro-Magnetism, and the theory of electro-dynamics as originally proposed by Ampère will be stated and compared with the theory at present received. The subject will here be illustrated by the electrodynamic apparatus of Ampère, Pouillet, De La Rive, Faraday and others . . . . The more recently discovered phenomena of dia-magnetism, or the influence of magnets upon non-ferruginous bodies, will come next in order, and will be demonstrated by means of a powerful apparatus constructed for the University by Rühmkorff, of Paris. . . .The subject of electro-dynamics will conclude with the phenomena of thermo-electricity, which will be illustrated by the elegant apparatus of Melloni.[147]

Mechanics was illustrated by using working models of all the primary types of machines. For example, the stationary, locomotive, and marine versions of the steam engine were available. One instrument, known as the Atwood machine, stood as a model of physical reality that would demonstrate very precisely the Newtonian law of gravity for falling bodies. As Barnard describes the instruments:

> The apparatus employed for the illustration of mechanical principles embraces not only every article which is usually found in such collections, but those which are less common; especially models of machinery, and contrivances for exhibiting the various modifications and transformations of motion employed in mechanics. The machines of Atwood and Morin for demonstrating the laws of falling bodies, lately purchased in Paris, deserve especial mention, as being unsurpassed in finish and accuracy, and provided with all the more recent

147 Course Catalogue, University of Mississippi (Oxford, Mississippi: 1857-58).

> improvements. The convertibility of the centers of suspension and oscillation is illustrated by the reversible pendulum of Kater. The steam-engine, to the construction and theory of which particular attention is given, is illustrated by working models, or miniature engines, of various forms, embracing the stationary, locomotive, and marine engines; and by dissected models in strong cardboard, in which all the movable parts are visible, and may be put in motion by hand. Separate models of the valves, pistons, and other essential parts of the engine are also exhibited.[148]

The doctrines of hydrostatics and hydrodynamics, or the study of equilibrium and motion of fluids, were covered in Barnard's program, and these subjects were illustrated by a number of different instruments. For the "static" part of the subject, Barnard employed :

> . . . contrivances of Haldat, Mariotte, and others, the hydrostatic bellows, Bramah's hydrostatic press, Barker's mill, and by the various forms of hydrometer and aerometer. The hydrostatic balance is also here introduced, and all of the different modes of determining the specific gravity of solids and liquids are explained and experimentally exhibited. . .

while for demonstrating the dynamical laws :

> The large apparatus of Venturi will be employed for spouting liquids, and glass models of pumps of various forms, of the fire-engine, of the intermitting fountain, of the fountain of Heron, of the Archimedean screw, and other hydraulic contrivances, will be shown, and the models of canal locks and of water wheels of different descriptions. . . .[149]

Pneumatics, "embracing the laws and properties of elastic fluids," was considered, powerfully illustrated by two air pumps, constructed by Ritchie of Boston and Secrétan of Paris.[150] Minor apparatus demonstrating the various

---

148 Course Catalogue, University of Mississippi (Oxford, Mississippi: 1857-58).
149 Course Catalogue, University of Mississippi (Oxford, Mississippi: 1857-58).
150 Course Catalogue, University of Mississippi (Oxford, Mississippi: 1857-58).

pressures of the atmosphere, power of the air, weight of air as well as "condensing pumps, condensing chambers of copper and glass, the air-gun . . ." complemented the air pumps.[151]

The University of Mississippi not only constructed the Magnetic Observatory (to be discussed later in the chapter) in which meteorology could be studied, but also possessed an outstanding collection of meteorological apparatus:

> The construction and theory of the barometer in all its forms will be explained and illustrated; and the instrument, as made by Green, of New York, and adopted by the Smithsonian Institution, and also Newman's standard barometer, as constructed expressly for the Observatory of this University, will be exhibited together with the mountain barometer of Guy Lussac, the sympiesometer, the aneroid barometer, and the metallic barometer of Bourdon. . . . In the course of these expositions all the different forms of the thermometer will be exhibited, including the metallic thermometers of Rutherford, of Negretti and Zambra, and of Wülferdin. Also, Melloni's delicate thermo-multiplier, of which the theory belongs to a later period of the course.[152]

The life sciences, though not as dominant in the University's curriculum as the physical sciences, slowly grew in importance, reflecting a new interest in biology, zoology, marine biology, and geology. While elaborate instruments such as the Atwood machine or the Rühmkorff induction coil were not as common in the life sciences, the University possessed several microscopes through which direct observations could take place. In addition, Barnard acquired two cabinets, the Budd collection of shells and the Markee collection of shells for the price of four thousand dollars, to serve as points of reference for the

151 Course Catalogue, University of Mississippi (Oxford, Mississippi: 1857-58).
152 Course Catalogue, University of Mississippi (Oxford, Mississippi: 1857-58).

students.[153] Strongly committed to a universal and unified understanding of the sciences, Barnard seriously considered the construction of an aquarium on the campus. In a letter to Hilgard, he states:

> I have been writing to Budd, of New York - and through a friend to Riddell, of New Orleans, about getting an aquarium here, when, taking up a newspaper yesterday, I observed that you have one at the Smithsonian, in full progress of successful experiment.
> Now what I asked Budd was, whether he could avouch that a lot of marine animals and plants could be brought safely over the R.R. from Charleston vv Savannah here - two and a half days. There would be no difficulty from N. Y. to the Southern port. . . .
> What I want is an elegant aquarium in the conchological cabinet.[154]

In addition to acquiring an extensive collection of instruments, Barnard secured funds for the construction of two observatories - - magnetic and astronomical. In a sense these observatories were just large instruments in that their use was for experimentation, demonstration, and observation of the natural and physical world. The Magnetic Observatory, a small, one-storey, lead-lined brick building on the University campus was completed in 1860 for the study of terrestrial magnetism and meteorology. Importantly for the University, the Observatory was intended to house projects done in cooperation with the American Coastal Survey headed by Alexander Dallas Bache.

Much like the Magnetic Observatory, the Astronomical Observatory was designed to facilitate cross-regional comparisons. An encompassing map of the

---

153 I am unable to locate the origin of these two cabinets. I assume that the "Budd" refers to the Budd of New York of whom Barnard speaks to Hilgard in his letter of 11 February 1858, University of Mississippi. Transcription in the hands of Wollman Library, Columbia University, New York, New York.

154 F.A.P. Barnard to Eugene Hilgard, 11 February 1858, University of Mississippi. Transcription in the hands of Wollman Library, Columbia University, New York, New York.

stars and planets, more accurate charts of the weather patterns, and a place as the "astronomical capital of the South," and likely the United States, led Barnard to fight to secure funding for this "laboratory." As he stated: "So soon as the arrangements for systematic astronomical observation now in progress shall have been completed, all will be taught to observe; and those whose tastes lead them in that direction may, if they please, become observers."[155] The Observatory was completed in 1861, just prior to the outbreak of the Civil War. While the plans and details of its construction are sketchy, it is possible to outline the brief history of this building which, like many of the instruments already described, was based on a superior model. In the ante-bellum years, there was much contact between the various countries regarding the science of astronomy; one such gesture aptly illustrating the extent to which astronomy "extended the boundaries of the scientific community" occurred in 1834 when the American Academy of the Arts and Sciences invited the German-born astronomer, G. W. Struve, to be a member. Within that same year, Struve was instrumental in establishing the Russian Imperial Observatory in Pulkova near Saint Petersburg.[156] Struve commissioned the German opticians Merz and Mahler of Munich to construct a fifteen-inch objective, creating what was, at that time, the most powerful refracting telescope in the world. This fifteen-inch aperture, along with other instruments commissioned by Struve to furnish the Observatory, established Saint Petersburg as the capital of astronomy, serving as a model for other observatories.[157] By 1841, Harvard University approached

---

155 Course Catalogue, University of Mississippi (Oxford, Mississippi: 1857-58).
156 Eufrosina, Dvoichenko-Markov, "The Pulkova Observatory," Isis 192 (September): 243-246.
157 A.Brachner, "German Nineteenth - Century Scientific Instrument Makers," in P.R. de Clercq, ed., 119.

Merz and Mahler, securing for itself the same telescope. Known as the "twin telescopes," the two were the largest refractors in the world until 1861.

During his early tenure as Chancellor of the University, Barnard secured funds for both the erection of an observatory and the purchase of an equatorial refracting telescope. He commissioned Alvan Clarke & Sons of Massachusetts, the first optical firm in America, to construct the telescope. For the telescope lens, Barnard obtained a block of glass from Chance Brothers and Company of Birmingham, England. The object glasses were to have fifteen-inch diameter. However, when Clarke received the block of glass from Barnard, "he found that it could be used for eighteen and a half inch glasses and Barnard ordered the lenses of this size."[158] At the same time that Clarke & Sons were constructing the telescope, the construction of the Observatory began. Built in the shape of an "H" with the "legs of the of the "H" facing true north and south," the Observatory was much grander than the other campus buildings. The ceilings were thirty feet in height, each room leading to the other through arched corridors. The building consisted of three domes: the large central dome in the middle to house the telescope, and smaller domes on each side, one intended for a comet seeker and the other as a small residence for the chancellor.[159] Extending back, the middle sections were constructed for classrooms and laboratories.[160] Unfortunately, no known record exists of the design and actual construction of the Observatory.

By the time Alvan Clarke & Sons finished the telescope in 1861, the Civil War precluded the possibility of a delivery to the University of Mississippi. The

---

158 Fulton to Keenen; Information offered by the Dearborn Observatory at Northwestern University (where this telescope now resides) states that the blanks were cast by Chance & Company in Birmingham, England.

159 Incidentally, the Chanceller did live in this space until 1971.

160 Lloyd, 'The University of Mississippi," 28.

agreement between the University of Mississippi and Alvan Clarke & Sons collapsed, and the lens remained in Massachusetts. In 1863, however, the Chicago Astronomical Society and the University of Chicago purchased the telescope, putting down $1,500 of the total $18,187 price, and in 1864, they received the lens. By 1886, the Chicago Astronomical Society and the University of Chicago found themselves unable to continue payments; the telescope was purchased by and moved to Northwestern University, where it remains to this day in the Dearborn Observatory.[161]

Although the telescope never made it to Oxford, the Observatory still stands as ample testimony to Barnard's efforts to secure a niche for the University in astronomy. Interestingly, it also stands as a model of the great Pulkova Observatory, which, during the siege of Leningrad, was completely destroyed by German Artillery, along with all of the instruments. Dr. Otto Struve, the fourth generation of Struve astronomers and director of the Yerkes and MacDonald Observatory in America was asked to write an account of the Pulkova Observatory. While writing the article, he discovered, among his momentos, an old photograph of the original structure of the Pulkova Observatory and reproduced it with his article. W. L. Kennon, professor at the University of Mississippi, recognized the photograph as the University's Observatory: "The close similarities in so many unusual features instantly made it certain that our observatory building is a very nearly exact replica of the astronomical observatory of the world in 1850."[162] Kennon sent a photograph of the Mississippi building to Struve, who immediately replied that there was no

---

161 Pamphlet, "Dearborn Observatory" (Evanston: Northwestern University).
162 W. L. Kennon, "A Century of Astronomy at Ole Miss," Ole Miss Alumni Review 11, no. 3, (October, 1947).

doubt that the Mississippi Observatory was modeled after the Pulkova Observatory.[163] Despite the lack of records of the Mississippi Observatory's construction, it is fairly certain that Barnard, at some point, obtained the plans for the Pulkova Observatory, and ordered the Mississippi building to follow the Russian plans. The Observatory stands as a lasting testimony to not only Barnard's efforts but also the influence of the Pulkova Observatory.

The Civil War both prevented the delivery of the telescope and effectively destroyed nearly every trace of the program which Barnard had labored to build. While Barnard was in the process of establishing his scientific base for his own development and also for that of the region, the South as a whole was increasingly focused on the coming rift with the North. Although it is a cliché to say that passions were overrunning reason throughout the South, that was certainly the case in Mississippi, notably among the students. It is tempting to speculate that Barnard, although he obviously was aware of the temper of the times, was attempting to deny the inevitability of the oncoming War. Support for this speculation is given by the fact that Barnard scheduled a series of lectures at the Smithsonian Institution during the time in which the Mississippi State Convention was expected to render a decision on secession. Despite the ever-mounting tensions, Barnard left for the Smithsonian on schedule, January 9, 1861; that same day Mississippi joined her sister states in seceding from the Union.

Barnard's sympathies were clear to all. In one letter of April 6, 1861, he writes: "We, who in the South still love the Union, had the right to look to Mr. Lincoln and his Cabinet for some indications of a policy that might strengthen

---

163 W. L. Kennon, "A Century of Astronomy," Ole Miss Alumni Review 11, no. 3, (October 1947). Among other things, Alvan Clarke & Sons built the 26 inch lenses used in the Naval Academy Observatory, the Leander McCormick Telescope, the Lowell telescope, which discovered Pluto, as well as the 46 inch Yerkes telescope.

our hands and aid us in restoring the integrity of the nation. . . ." His lack of influence over his own students, however, is clearly revealed when upon his return from Washington, he found that a large portion of the student body had mobilized themselves into a military organization called the "University Greys." Furthermore, the students already had demanded of the Governor, John J. Petus, that they be mustered into service in the Confederate Army. In spite of the protests of Barnard and other faculty members that the youth were too young to be sent to war, the Governor sent a recruiting officer to Oxford. On April 26, 1861, the University Greys were mustered into service. By May 4th, the University Greys, under the command of Colonel William A. Moore, became Company A of the 11th Mississippi Regiment, and were sent to the Virginia front. Of the students and graduates of the University of Mississippi, approximately ninety percent fought in the War. Over half either were killed or died from wounds and disease.[164]

In the spring of 1861, the Board of Trustees voted to close the University until September. When September came, however, the arrival of only four students prompted the Board, by October 1, 1861, to officially suspend University functions. Barnard's thoughts turned to the preservation of the Magnetic Observatory, the Astronomical Observatory, and the instruments, since it was clear that having expressed his Union sympathies and being from the North, he could not remain in Mississippi himself. The job of guarding the instruments fell to Barnard's close friend, Eugene Hilgard, then the state

---

164 Charles F. Thwing, A History of Higher Education in America (New York: D. Appleton & Co., 1906), 369; see also Alfred Hume, John Millington (1779-1868) (Princeton University Press for the Newcomen Society: 1950)16, in which Hume states: "It is probable that four-fifths of all the young men whose names appear on the rolls as students of the University from its organization up to the beginnnings of the Civil War enlisted in the Confederate service."

geologist and resident of the University. Once he had done all that he could for the tangible remains of his efforts at Mississippi, Barnard and his wife left Oxford, not to return.

Barnard's arrangements to protect the buildings and instruments were, in part, successful. Hilgard was an excellent choice as caretaker. Worried that the arrival of General Grant and his army would result in mass destruction of the University, Hilgard wrote a letter to the General, pleading for his protection, while at the same time gently reminding Grant of a common relative. When Grant's army arrived in Oxford, the General set up his camp directly in front of the Astronomical Observatory, saving it from harm. It was not to be the General's army, however, that caused the most damage but a radical group of Union sympathizers, the Kansas Jaywalkers. As one resident of Oxford reported: on hearing the news that General Grant's army was approaching in November, the Kansas Jaywalkers came in. Immediately, they "bore down upon the Observatory, burst in the main doors, and spread themselves all over the building, breaking up apparatus and chemicals, and then rushing into the dwelling apartments."[165] Both Observatories were used in the war for peaceful, though unpleasant, activities. During the Battle of Shiloh, the Astronomical Observatory, with its classrooms and Barnard's ex-residence, was used as a Confederate hospital. Likewise, the Magnetic Observatory became the morgue.[166]

Barnard's presence and his active pursuit of progressive educational goals meant that by the outbreak of the Civil War, the University of Mississippi was

---

165 University Museum Barnard Files, University of Mississippi, Oxford.
166 Gladden, "A History," cited in University Museum Barnard files, University of Mississippi, Oxford.

poised to enter the front ranks of institutions of higher learning - - with a major focus not only on scientific experimentation as a teaching tool, but also on scientific knowledge as means of attracting scientists themselves. In other words, the practice of science on an educational level was on a par with the recognized institutions, with the development of a research program not far behind. Apparatus, curriculum, and people were in place for scientists to begin to consider the University of Mississippi as a place of scientific research. Throughout Mississippi and the rest of Confederacy, Barnard's accomplishments were understood and appreciated by the Southerners themselves. As the July 19, 1859, issue of the Natchez Free Trader boldly attested:

> The University is destined to rank first in the Union. It is the wealthiest in the United States. It has a income of $50,000 from the state independent of tuition and also at interest $850,OOO! There have been $100,000 expended there for the last year. The apparatus for chemistry, Philosophy, Science etc. is the best money can buy from Europe. The philosophical rooms have no equal in America. The telescope instrument to be purchased will surpass anything Hershel ever dreamed of.[167]

In comparison to this recognition, the obscurity of the University of Mississippi within the scientific community after the Civil War is as strong a testimony as one can find of the tragic end to which Barnard's efforts at Oxford came.

The University of Mississippi under the leadership of Barnard was positioning itself to begin the active practice of science in the years prior to the Civil War. Traditional source material such as manuscripts, correspondence, lecture notes of professors as well as students were destroyed during the War. While outside correspondence, partial course catalogues, Minutes of the Board and Mississippi Legislature, memoirs, and autobiographical sketches do provide

---

167 "Commencement at the University of Mississippi," Natchez Free Trader, 19 July 1859. Transcript in the hands of University Museum, University of Mississippi, Oxford.

insight into the science program at the University of Mississippi, they are insufficient. The Barnard - Millington Scientific Apparatus Collection, however, used as a primary source, offers important evidence to the University's ante-bellum scientific potential.

CONCLUDING SUGGESTIONS FOR FURTHER RESEARCH

This thesis, "Science Goes South," provides a case study tracing the efforts of two ante-bellum scientists and educators - - John Millington and Frederick Barnard - - in the development of a scientific community at the University of Mississippi. From 1848 to 1856, John Millington, by means of his instrument collection and his intense belief in learning by experimentation, provided the framework for the interactive study of science. In this sense, he established the general orientation of the program as one in which both recitation and experimentation had pedagogical value. On the basis of Millington's accomplishments, Frederick Barnard was able, from 1856 to 1861, to create a scientific program at the University of Mississippi with national potential. Through ambitiously securing funding for instruments and buildings, restructuring the curriculum, and maintaining vital contact with the scientific establishment, Barnard single-handedly positioned the University of Mississippi so that, prior to the Civil War, the practice of science on an educational level was on a par with the recognized institutions, with the development of a research program not far behind.

My studies of Barnard's efforts convince me that there is a need for other such analyses in which the traditional accounts, which dismiss the potential for scientific education and research in the South, are challenged. While Frederick

Barnard was a man of talent and ambition who possessed an obvious drive and love towards science, it is difficult to believe that careful study of other institutions in the South would not uncover other such men of learning who were in the process of sowing the seeds that ultimately would have blossomed had not the Civil War intervened.

War is generally portrayed as encouraging the growth of science and technology. This case, however, provides an important counterexample, as one result of the Civil War was complete destruction of the ability of the University of Mississippi to move forward along the road of scientific development. With Barnard's move North, the high casualty rate among the young men who might have enrolled at the University of Mississippi, and the economic devastation resulting not only from the War, but also from the harsh politics of reconstruction, any reasonable hope for the development of science at Mississippi completely disappeared.

Unfortunately, in the case of Mississippi, much primary source material was burned; a precise and documented account of the University's scientific program is, therefore, difficult to formulate. As discussed in "Chapter Three," however, an outstanding collection of scientific instruments and their original inventory is available for study. Alternative approaches to the study of these instruments might lend further insights into Barnard's science program. One way of placing this collection in a different interpretive context would be to look at the means by which historians, philosophers, and sociologists of science - - science studies practitioners - - have recently begun to conceptualize the role of instruments.

Instruments support and promote science - - whether used in educational settings as demonstrational apparatus or in research programs to generate knowledge - - and therefore are worthy of study in and of themselves. In a research setting, they measure, provoke, and create phenomena. While in the classroom, they validate scientific concepts. Integral components in new knowledge generation, instruments play an epistemic role in discovery. "Scientific effects," writes Gaston Bachelard, "are [only] realized through active instrumental work, rather than recovered immediately by a passive observer from an all-powerful nature."[168] Without the experimental apparatus that is designed specifically for the anticipated functions, the results that ultimately lead to novelty could not take place. Enough of the phenomena must be observed and developed before the instrument designs can be created, so that there exists a dialectical exchange between the instrument and knowledge. The instrument, then, is designed to elicit a certain response, although the anticipated response is not always the one that generates the new knowledge. When contemplating the history of an instrument, both its changing use and construction are evident, reflecting the growth and the scope of science. Thus, the claim can be made that instruments accurately indicate the state of experimental science at a specific point.

The formative role instruments play manifests itself throughout the experimental process, as well as in the preparation for and the conclusions of the actual experiment. Many an experiment, thwarted by instruments that were too

---

168 Gaston Bachelard, Les nouvelle esprit scientifique, 1st edition(Paris: P.P.V.F., 1934); cited in Teresa Castelao-Lawless, "Chapter One" in "Scientific Phenomenology and Science Studies: Gaston Bachelard and the Concept of Phenomenotechnique" (Ph.D. diss: Virginia Tech, 1993).

rudimentary, fails to lead to anticipated discoveries.[169] Likewise, novel instruments and procedures sometimes lead directly to unexpected discoveries. Thus, as historian William Hackmann maintains, the exchange among apparatus, experiment, and discoveries, flows in several directions: advances in instruments lead to new discoveries, which in turn directly affect instrument design. As such, instruments reveal the conceptual framework of the day, both in their design and in their predicted results.

These predicted results lead to new knowledge. In its ability to make claims for new knowledge legitimate, the scientific instrument holds considerable status. Once an instrument is "accepted as a means of producing or observing or measuring certain phenomena" and agreement is reached among its potential users as to how it should be used, then the instrument and its associated knowledge claims have achieved legitimation.[170] Standardization is achieved; at this point, the instrument itself is the legitimater: its presence proffers credibility. Additionally, instruments are vital in maintaining a focus for the scientist: they assure that throughout a group or community the same knowledge claim or "scientific fact" is the subject of inquiry. In this sense, they are controlling. J. Bennett maintains that once the data have been accepted, however, the instruments lose their position as legitimaters of *new* knowledge, slowly fading out of the active research picture;[171] however, the instruments

---

169 R. Taton, Reason and Change in Scientific Discovery, translated A. J. Pomerans (New York: Philiosophical Library, 1957), 42.

170 Jan Golinski, "Experiment in Scientific Practice," History of Science XXVIII(1990): 207.

171 Some claim that instruments, even when eased out of the position as legitimaters, remain, at base, essentially the same. The real changes result from shifts in "intellectual frameworks," caused by "radical changes" which take place in the purpose and function of the instruments: J. A. Bennett, "A Viol of Water or a Wedge of Glass," in David Gooding, Trevor Pinch, and Simon Schaffer, The Uses of Experiment: Studies in Natural Science (Cambridge: Cambridge University Press, 1989), 105-107.

continue as legitimaters of *accepted* knowledge and practice as teaching resources in schools. Barnard, in the purchases he made on behalf of the University of Mississippi, appears to have been aware of both functions of the instrument. A large part of the apparatus he bought would support accepted knowledge claims, while others, such as the telescope and magnetic observatory, would be employed in the generation of new knowledge.

In both supporting accepted knowledge claims and generating new knowledge, instruments must help to decide what is to be "regarded as evidence and proof." They are the arbiters in theory and they have an important role in establishing what counts as a scientific fact.[172] "A fact," maintain Shapin and Schaffer, "is a constitutively social category: It is an item of public knowledge."[173] Because of their ability to "recreate" phenomena and repeatedly demonstrate "scientific" facts, instruments transform what would generally be a "private sensory experience. . . into a publicly witnessed and agreed fact of nature." In line with common terminology, Shapin and Schaffer call this "replication," and they maintain that it is characteristic to all fact-production in experimental science. "Replication," they assert, "is the set of technologies which transforms what counts as belief into what counts as knowledge."[174] Instruments permit replication to take place, for once the instrument has been accepted as legitimate, so too has the scientific fact.[175] Educational institutions, as the University of Mississippi indicates, depend heavily on replication - - involving classroom

---

172 Steven Shapin and Simon Schaffer, Leviathan and the Air Pump: Hobbes, Boyle, and the Experimental Life (Princeton: Princeton University Press, 1985), 255.
173 Shapin and Schaffer, 225.
174 Shapin and Schaffer, Leviathan, 225.
175 Golinski, "Experiment in Scientific Practice," 207.

laboratory experiments and demonstrations - - in support of curricula designed to teach the current state of a given discipline.

Institutions also look upon instruments as powerful tools of persuasion, both within the research and educational community and to the public at large. Science and scientists strive for an elite status, and one of the ways this perception is perpetuated is the constant generation of new knowledge through the use of precise instruments. Scientists use discoveries, validated by instruments, to "promote an air of infallibility" which has the dual purpose of drawing more people to the field as well as generating additional social support. The instrument is, in a sense, a rhetorical tool: the "authors" (in this case, scientists) are attempting to persuade their audiences of the reality of the effects they have observed and of their significance.[176] The discourse of this persuasion has, as its main referent, the scientific instrument.

Given the lack of documents which normally would guide the researcher in fully assaying Barnard's instrument-based program, the methodologies I have briefly summarized provide an opportunity for further analysis of the program. Such an analysis could be extended, I believe, by combining the science studies methodologies with a comparison of the uses of instruments at other universities, where professors with backgrounds similar to Barnard's were in charge of the curriculum. This mode of inquiry would provide, at the very least, additional evidence of the kind of science and the level of science taught and practiced in Barnard's science program. Very likely, this evidence would support the finding of this thesis: that the University of Mississippi was developing a framework for scientific research and pedagogy in line with the norms of the wider professional

---

176 Golinski, "Experiment in Scientific Practice," 207.

community. In other words, prior to the outbreak of the Civil War, science was going South.

APPENDIX[177]

The Barnard Inventory

The Barnard Inventory: Inventory of Scientific Apparatus at University of Mississippi
Inventoried 1861-- 1881
Written by F.A.P. Barnard, Chancellor, December 1861
Addended by Eugene W. Hilgard, Agt. in Charge, July 1865
Addended by L.C.Garland, Professor of Natural Philosophy and Astronomy, May 1867
Addended by R.B. Fulton, Professor of Physics and Astronomy, June 1881

In October 1979 Lisa Howarth, Assistant Curator, University Museums, stated that the whereabouts of the original inventory was uncertain.
On December 20, 1979, Dr. Henry E. Bass, Professor of Physics, gave Lisa Howarth the original inventory, which had been found.
In October 1980 Jeanne Wells Assistant Curator, University Museums, transcribed the inventory.

List of Articles of
Philosophical Apparatus
in this Collection, 1861.

The Apparatus in this list came under the care of L.C. Garland on March 7. 1867 - - Much of it was found in an injured state. Apart from breakage, which has effectually destroyed several piece; the principal injuries seem to have resulted from the leakage of the Building. Until this source of mischief is cut off, it will be impossible to preserve many of the instruments from further damage.

As the Professor in charge has had occasion examine [sic] and to use each piece of Apparatus, he has recorded the condition in which he found it by the following symbols written in red ink to its name in the list.

A. Indicates that the apparatus is in good order.

---

177 I have followed the same format as the actual inventory in my transcription.

B. " " " " bad order, but can be put into working order by the Professor.
R. Apparatus requiring repaired repairs by an Instrument Maker, or some skillful workman in metal.
W. Apparatus that is worthless--& not worthy of being repaired.

L. C. Garland
Professor Nat. Phi. & Astronomy
University of Mississippi May 1867

[1 verso]

In July 1875 R.B. Fulton was elected professor, and placed in charge of the apparatus, his term of service beginning Oct. 1 - - following. He had previously handled all of the pieces while acting as assistant to Dr. Garland. many pieces had then been overhauled & repaired, and some pieces put together which had been overlooked by the former professor. The annotations signed "F" are made by

R. B. Fulton
Professor Physics and
Astronomy

June 1881.

[2]
See addenda, 20 pages from the end[178]

List of Articles,
Philosophical Apparatus
in the Collection
of the
University of Mississippi;
1861

With a minute of the
Apparatus
in the
Magnetic Observatory:
December 1861.

178 This entry was written by Fulton.

See addenda 20 pages from end[179]

[3]

Optics:-- Lenses & Microscopes.

A Convex Lenses, mounted on foot.

A Concave " " "

A Meniscus " " "

A Large Fresnel, annular lens.

A Coddington Lens--(microscope.) (?)[180]

B+ Large Spencer, Compound Microscope.

B* Binocular and Double Microscope, by Grunow.

B Porte Luniere [sic] Universel of Lerébours accompanied by Solar Microscope, Polariscope, and Diffraction apparatus: Also telescope for throwing [sun's] images on screen.[181]

B+- Case of microscopic objects.[182]

* Box in pieces--Instrument itself rusted, and two object lenses wanting. This has been put in working order with the pieces remaining.

\+ Several of the appendages are wanting--particularly several object lenses. The parts of remaining have been put in working order.

+_ Many of the objects are totally ruined--some from fracture but most from dampness-

[4]

Optics.
Prisms & Refraction Apparatus

A Common prism, not mounted

A Prism of crown glass, mounted.

---

179 Ibid.

180 "(?)" was entered in pencil.

181 Lerebours et Secretan, 1853, lists the apparatus as Porte Lumiere.

182 This entry was made in pencil probably by Fulton.

A " " flint glass, "

A " " " " with achromatic lens.

A " " rock crystal.

A " " Iceland spar.

A Conical prism, for circular spectrum.

A Pyramidal prism, giving four spectra.

A Cylindrical prism. (or lens)[183]

A Polyprism--1 different species of glass.

A Rochin's Diasporametre, for determining dispersion.

A Prism of variable angle, for water, [etc.]

B Hollow prism with numerous compartments, open.[184]

A Hollow prism with stoppers, for volatile liquids.

A Compound prism for theory of achromatism.--two pieces.

A " " " " " " " --three do.

A Seven small mirrors, mounted on stand, for recomposition of light.

A Oscillating prism, for recomposition of light.

compartments not water tight[185]

cracked F.

[5]

---

183 "(Or lens)" was added probably by Fulton.

184 "B" was written in pencil over the red "A."

185 This entry was made in pencil, probably by Garland.

Optics.

Physiological Optics

A Artificial eye--large dimensions--by Dr. Auzoux.

B Plateau's Phenakisticope.[186]

B Newton's rotating [disk][187]

B Brewster's Stereoscope, with photographic objects.[188]

not found Two small glasses of complementary colors mounted in horn.[189]

[6]

Optics.

Reflection

A Plane round mirror, mounted.[190]

A Convex " " "

A Concave " " "

B 2 Cylindrical Mirror, for anamorphoses, with objects.[191]

B Conical " " " " " " " [192]

B Silbermann's Heliostat.

W Brewster's Kaleidoscope--two.

---

186 "B" was entered in pencil.
187 "A" was entered in pencil and subsequently crossed out in pen.
188 "A" was entered in pencil.
189 "Not Found" was entered in pencil possibly by Garland. It has been underlined in pen.
190 "A" was entered in pencil.
191 "B" and "2" were in pencil but not necessarily by the same person.
192 "B" was entered in pencil.

B Apparatus for determining angles of reflection and of refraction--divided circle with movable arms.

A Babinet's Gonioscope.

B Fantasmagoria Lantern, double,--for lamps or lime lights.

B+ Collection of paintings on glass, for same.

A Common Sheet-Iron Lantern.

A Collection of Astronomical sliders for the same.

A Cosmorama--with collection of pictures.

+ These fine paintings, are becoming discolored, probably from dampness-

[7]

Optics

Double Refraction, and Polarization.

Rhomb of Iceland Spar polished on its natural faces, and truncated on the axis.

Rhomb unpolished and second one bought by R.B.F.

B W Collection of Selenite Figures.

A Specimen of Iceland spar, for rings.

A " " Quartz " "

A " " Arragonite " "

A Various specimens of unannealed glass.[193]

A Pinces a tourmaline

A Apparatus for heating glass for examination in the polariscope.[194]

---

193 "B" was entered but has been crossed out.
194 Ibid.

B " for compressing " "

B " " for stretching " " (glass broken)[195]

B " " for bending " "

A Arago's Scopeloscope [a simple tube with tourmaline eye-piece.]

A Soleil's Saccharimeter.

A Arago's Polariscope.

A Malus's Polariscope.

A Norremburg's Polariscope.

A Fresnel's Rhombs --a pair--for circ. pol.[196]
Biot's Polariscope.

[8]

Optics.
Paintings in oil.

A Oil paintings, illustrating optical and meteorological phenomena, and optical theory--undulation, interference, diffraction, dispersion, etc. etc. in number of which a list is to be found in the case on the north side of the depot of apparatus, containing the optical apparatus.
Perforated cards, and colored sheets, to illustrate Chevreul's principles.

B & R Telescope--objective 4.6 inch.--mounted paralactically. Munich make.
[One of the directing rods detached when the instrument was purchased--connection broken.][197]

A Camera Obscura, for the use of the draftsman[198]

---

195 "(Glass broken)" was entered probably by Hilgard.

196 "Not found" appearing in the left margin was written but has been crossd out in pencil.

197 It is difficult to determine the writer of this entry. The handwriting is unlike Barnard's as it appears throughout this inventory; yet, the consistency and color of the ink is very similar to Barnard's ink.

198 "(Not there)" was entered in the left margin possibly by Hilgard, but it has been marked out.

A Light portable sketching table, on tripod
Tabouret for draftsman, in form of a cane

A Wheatstone's Photometer.

A System of Lenses showing Newton's Rings.

[8 verso]

Two large Glass Mirrors (black) for polarization.

A One small Black screen frame, for opt. dem.[199]

[9]

Optics.

Diffraction

B& Pouillet's, "Grand Appareil pour les experiences de diffraction et d'interférences: "--containing every piece described in Pouillet's Physique, and illustrating all the phenomena of diffraction.[200]

A Two plane glasses mounted with Lycoperdon [spans] (?)
between for illustrating halves, etc. [small][201]

A Set of Large Diagrams drawn on paper, to illustrate Theory of Optics.
Purchased and presented by F.A.P. Barnard.

[10]

Acoustics

A Soufflerie [Organ bellows & wind-chest.]

A Mouth-pieces--Trumpet, horn, hautbois, bason, clarinet.
Universal Mouth-piece (so called.)

A Mouth piece of organ-pipe, with movable lip.

199 "A" was entered in pencil. "One . . . dem." was entered probably by Hilgard.

200 "R" written in red beside "B &" has been crossed out.

201 "Lycopodium. . . (?)" written in pencil by Garland or Fulton, replaces "Lycopodium" written by Barnard. "[Small]" was written probably by Hilgard.

A Long and slender tube formed of several short ones, screwed together, each the wave-length.

A Long glass tube with piston marked at the nodes.

A Two glass tubes mounted on stand, capable of being filled to different heights with water.

A Tubes (in a box) cut at the nodes and ventres.

A Set of three tubes of equal (inner) measurement: two of wood of different thickness and one of card board. [There are two sets of these.]

? Two brass tubes--lengths as 1:2--without mouth-pieces.

A Two cubic tubes--octaves.

A Two--rectangular parallel [tripods]--do.

A Set of four tubes, in which the product of length by depth is the same--one of them embouched on the end.

A Brass tube of large diameter, with piston.

A Three tubes of equal length--one with square base--the other two with base equal to half the square.

[12]

A Three equal tubes, of brass, wood and card.

A Large tube with one side of glass, to make the vibration of an introduced membrane visible.

A Two tubes giving the fundamental and the fourth. A third gives the resultant of the two sounding simultaneously.

A Two very large tubes, to illustrate beats.

A Three tubes, with a support which will hold two of them--to illustrate the effect of distance or proximity upon loudness.

A Branched tube

A Branched tube with square membrane connected.

A Tube with parallel & movable branches.

[13]

Harmonics. Four flute tubes, illustrating the common chord.

Four stopped flute stop tubes--do. do.

Four with circular embouchures, --do. do.

Four hautbois stop do. do.

One tube with chimneyed stopper.

Tubes for illustrating the mode of tuning organ pipes, by appendages at the embouchure, or at the open end of the tube.

One tube with movable lip.

Two trapezohedric tubes.

One broken steam whistle. [There are two which blow with unequal facility.][202]

? Bird call whistle.

A Speaking trumpet. [Two of these.]

A Humming Top.

B Reed tubes--free reed in glass chamber--pyramidal tubes to match.

A Beating reed--in similar chamber, with pyramidal tubes also.

[14]

202 Fulton's entry was written in pencil.

B Membranes, square, triangular and circular, for showing acoustic figures with sand. (much injured by moths)[203]

B Membrane of variable tension.

A Vibrating plates, of brass--square, triangular, and circular, for sound figures.[204]

2 Sandboxes for same.[205]

Vibrating bars, of steel--four [for sound figures][206]

" " of brass--" "

" " of wood--" " more than four[207]

A Rude musical instrument, formed of suspended bars of wood--"claque-bois".

[There are two of these.]

giving diatonic & chromatic scales.[208]

[15]

A Diaspon ut- --mounted on a sounding box. [Two of these]

A Three other diasons, mounted, giving with the first the common chord.

Sounding box with a support for a tumbler of water, or vessel of mercury. Showing vibration of liquids etc.[209]

---

203 The "W" written in red pen to the left of "B" has been crossed out. "(Much . . . moths)" was written probably by Hilgard.

204 "For . . . figures" was added by Hilgard.

205 This entry was written in pencil probably by Hilgard.

206 The following note regards three entries for the vibrating bars: in the left margin "Lost" was written, marked out, and then replaced with "found F." all of which are written in pencil. Hilgard probably originally entered "Lost."

207 "More . . . four" was probably entered in pencil by Fulton.

208 This addition was probably entered in pencil by Fulton.

209 Ibid.

A Sonometer, with weights for tension.[210]

Instrument similar to the Sonometer (longitudinal vibrations) transversal vibrations, showing nodes & loops of strings.[211]

A Savart's large monochord.[212]

A Three steel rods, and one steel plate, for longitudinal vibration.

B Instrument of music "Marloye's Harp," formed of wooden rods, for longitudinal vibration.[213]

[16]

A Savart's system of five horizontal bars on common support.

B Savart's plate of wood and string.

B Savart's circular wooden disk and string.[214]

A Bog's buzz--horsehair [&] parchment.

A Watchman's rattle.

A " " " with a valve, changing the pitch.

R Savart's large apparatus for experiment with toothed wheels and revolving bars.

A Cagniard's Siren.[215]

Common block bell (Broken)[216]

---

210 "A" replaced by "B" written in red ink and crossed out.

211 "Transversal . . . loops," probably penned by Fulton, was inserted between the lines of Barnard's description.

212 "A" was written over the original red "B."

213 "Marloye's Harp" was inserted probably by Fulton.

214 In the left margin "not found" was written in pencil possibly by Garland, but has been crossed out.

215 "A" was written in pencil.

216 In the left margin the red "A" has been crossed out. "(Broken)" was written probably by Hilgard.

A Elliptic Bell.

B Rows for sounding the vibrating plates and strings (three.)

A Sand-box, for dusting the plates and membranes.

[16 verso]

This large machine was set up by Dr. Barnard in 1861 & did not work satisfactorily, --the electricity not being under control. It was then placed in an elevated glass case & calcium chloride used to dry the air in the case. Success unknown. I have overhauled it & attempted twice to use it but have not been successful. I think the glass contains excess of soda & is hygroscopic; & the atmosphere is seldom dry enough in the room for the satisfactory working of any elec. machine. The mechanical parts & the silk jackets are badly out of order. R.B. Fulton

[17]

Electricity

W Ritchie's Great Electrical Machine

A " Prime Conductor for Same

W " Great Electric Battery.

A Chain (brass) for communications.

? Metallic cord, for same use.

A Glass friction cylinder--unpolished at one end.

B Red wax cylinder.

B Gum lac cylinder.

B Brass cylinder with glass Handle.

B 2 Electrophorus--large & small.[217]

2 Cat Skins.--(moth eaten) [rotten][218]

A Gold Leaf Electroscope.

" " " (not received)[219]

W Bohnenberger's dry pile Electroscope[220]

(Broken in transit.)

[17 verso]

W Dry Pile Perpetuum Mobile (stopped)[221]

[18]

Electricity.

? Peltier's Electroscope for Atmospheric Electricity.

Large Condensor.

A Leyden Jars

A Diamond Leyden jars--white--yellow and red

A Discharging Rods--Two. one broken[222]

A Coulomb's Hollow Sphere--insulated.

W Electric Magic Plate [words, "University of Mississippi"][223]

---

217 "Large & small" was added probably by Hilgard.

218 "(Moth eaten)" was written probably by Hilgard; "[rotten]" was written in pencil probably by Fulton.

219 "[Peclet's]," which appears to the left of the ditto mark, and "with Condensor," which appears to the right of the ditto mark, have been marked out.

220 "W" was written in pencil.

221 All but "W" appear to be Hilgard's handwriting.

222 All but "W" appear to be in Hilgard's handwriting.

223 "[. . . }" was written possibly by Hilgard.

" " " " metallic leaf cover.[224]

A Electric Mortar and ball, of ivory.

A " " " wooden.

A 2 Electric Chimes.

A Kinnersley's Electrical Air Thermometer.

A Electric Thunder House.

B Pith Balls--variety.

[19]

W Pith-Ball Figures for dancing.

A Plates for Dancing figures.

B Electric Fliers (Rotating Points.)

B Electric Sportsman and Birds.

A Basin with long handle, for firing Alcohol or Ether

A Ingenhouz's apparatus for burning steel in oxygen by the Electric spark.

A Spiral Tubes--simple spiral,, and tortuous spiral: -- two tubes.

B Electric Egg.[225]

A Tube for Vacuum experiment.

A Colored tube, for the same.

A Electric Windmill.

---

224 "B" in the left margin has been marked out.
225 "B" replaces the "A" which was marked out.

Magnetism,

Electro-Magnetism

and

Magneto Electricity

B Three Large Bunsen Elements.

W Six Sulfate of Copper cells:--constant Bat.

W Zamboni's Dry Piles--with revolving figures (Injured in transit.)

[21]

Magnetism

A Specimen[s] of natural magnet--rude.

A Large armed natural magnet, with support and scale-pan.

Weights for the same.

A Pair of bar magnets

A Pair of Compound Bar magnets--large.

A Horse-shoe Magnet--Compound.

A Horse shoe Magnet--long and narrow, for 2 wheel armatures and likewise.[226]

3 Armatures of various shapes.

A 3 Magnetic Needles, on pivots.[227]

Small Dipping Needle.

? Ampere's Astatic Needle.

---

226 This entry was added possibly by Hilgard.
227 "3" was entered in pencil.

Horseshoe armatures, with rings. [228]

[22 has been torn out.]

[23] Magnetism

Wurderman's [sic] Dipping Needle for accurate observation

o Wurdermann's Theodolite Magnetometer[229]

NB. Elements of the Inertia Ring of Magnetometer:

Outside diameter		2.001 inches
Inside	do.	1.596 do.
Weight		483.840 grains.[230]

N.B. In 1880 this magnetometer was sent to Washington, overhauled by [Fauth] & Co. & tested by C.S. Schott at the U.S. Coast & Geodetic Survey office. It was returned in good order.[231]

[24]

Electro-Magnetism

Pouillet's Electro-Dynamic Apparatus. ?[232]

Pole-Charger, or Commutator

Ampere's Astatic Needle.

Mounted Helix.

Mounted Electro-Magnet

228 This entry was made possibly by Hilgard.
229 The small circle was written in pencil.
230 "NB. . . . grains." was entered by Hilgard.
231 "N.B. . . . . order." was entered by Fulton.
232 The question mark wa written in pencil.

Small Electro-Magnet, revolving between the arms of Steel Magnet

Electric Magnetic Engine.

Arago's Needle rotating by induction from a revolving disk.

Disk with teeth revolving between the poles of steel magnet.

6 coils of insulated wire, asst'd.[233]

[25]

Farmer's Electric Repeater, or Relay Instrument.

Break-Circuit Instrument, for investigation of Electric Contacts.

Coated -wire--fine and course--in coils.

Telegraphic transmitting and receiving instruments--Wheatstone's

[pl].

[26]

Magneto Electricity.

Large Magneto Electric Machine

Induction Instrument, with separable Helices (Ruhmkorff's)
Ritchie's large Ruhmkorf-Coil.

Large colored Goblet, for Gassiot's Cascade.

Large white Glass Bowl for the Same.

Clarke's Magneto-Electric Machine.[234]

[27]

Dia-Magnetism

---

233 This entry was written in pencil probably by Hilgard.
234 This entry was written by Hilgard.

Ruhmkorff's Large Dia-Magnetic Electro-Magnet.

Objects for illustrating Dia Magnetic Force.

[28]

Electro-Chronometry.

Electro-Magnetic Clock: In three parts--Pendulum, Register, and Relay pendulum.[235]

The above clock is not completed

L. C. G. [236]

[29]

Pneumatics.

Large Air Pump, by Ritchie.

Bell-Glasses--an assortment.

Hand Glass.

Bladder Glass.

Guinea and feather tube.

Large tube and piston, one tripod, to show upward pressure.

Large copper Globe, to show weight of air,

Small " " " (with balance and counterpoise, ?) to show buoyancy of air.[237]

---

235 "Three" was written by Hilgard to replace Barnard's "two." Hilgard also added "and Relay pendulum."

236 Garland's entry was written in pencil.

237 The parentheses and question mark were added in pencil.

Long pear-shaped glass to show fountain in vacuo, by external atmospheric pressure.

Small glass, to show fountain in vacuo by expansion of confined air.

Fliers-Carved tubes revolving on the principle of Barker's mill--single and double.

Hero's fountain--large, glass globes, brass mount.[238]

Double windmill, to illustrate resistance of air.

Mercury Shower.

Heron's fountain, lacquered tin.[239]

[30] Pneumatics

Magdebourg Hemisphere's--2 pairs (one injured)[240]

? Magdebourg Glass [Planes]

Bell mounted to show that air is the vehicle of sound.

Large Bursting and [Crushing] Squares for demonstrating weight and t expansive force of air.

[31]

Pneumatics.

Compression of air.

Fire syringe, of Glass

Compression syringe.

---

238 The paretheses and question mark were added in pencil.

239 This entry was written probably by Hilgard. Cf. Intermittant fountain, "Hydrostatics & Hydrodynamics," [36].

240 The question mark was addded in pencil. "(One injured)" was added probably by Hilgard.

Glass Compression Chamber.

Crushing squares--small--for glass chamber.

Compression fountain--large metal vessel with syringe and various jets.

A Mariotte's tube, for illustrating law of compression.

[32]

Meteorology

Newman's large standard Barometer, with Mercury for filling it.[241]

Now set up. FULTON[242]

A Smithsonian Barometer, on the principle of Fortin. glass somewhat tarnished.[243]

A Aneroid Barometer.

A Bourdon's Metallic Barometer.

W Gay Lussac's Mountain Barometer, with Tripod for suspension.

[33]

Meteorology

A Newman's Standard Thermometer.

---

241 In the left margin "W" written in red ink has been marked out.

242 In the right margin "broken" was written in pencil and subsequently marked out and replaced with Fulton's addendum above it.

243 In the right margin "Broken" was entered in pencil probably by Hilgard and was crossed out in ink. Beside it "never set up" appears in ink probably written by Garland but is crossed out in pencil. The remaining assendum written in pencil, "glass somewhat tarnished," was written probably by Fulton.

W Maximum and Minimum Thermometer, -- scale on wood. Negretti & Z Zambra.

Maximum and Minimum Thermometers, -- scale on silvered brass Negr. & Zambra.

Maximum and Minimum Thermometers called "a bague"--divided on the tube. do.

Walferdin's Max. & Min. Thermometers, with standard for comparison --in case (one broken)[244]

W Straw hygrometer

Both imperfect when received.

W Horse hair hygrometer

one broken (F.) Wet and Dry Bulb Thermometers--a pair for Hydrometric Observation.[245]

A Regnault's Hygrometer, with Asperator[246]

A Daniell's hygrometer [sic]. [247]

[34]

Hydrostatics & Hydrodynamics

B Haldat's Apparatus, for pressure

A Apparatus to show the independent pressure of every column.

Do. to show upward pressure of liquids.

---

244 "(One broken)" was written in pencil possible by Hilgard.
245 Fulton's addition was written in pencil.
246 This entry was made by Hilgard.
247 This entry was added by Hilgard.

A Apparatus showing equilibrium between columns of various forms.

A Cup and weight to prove the Archimedean proposition.

B Hydrostatic Balance.

W Mariotte's Vase.

A Glass cylinders for holding liquids.

weights not found.

[35]

Hydrostatics and Hydrodynamics.

A Nicholson's Areometer.

A Fahrenheit's Areometer.

A Hydrometers of various kinds and for various purposes--an assortment.

Alcoometers, centesimal--in velvet case[248]

Volumetric Universelle, in " " "

Densimetre " " " " "

W Dutrochet's Endosometer.

B Glass plates hinged, to illustrate capillarity.[249]

broken F.[250]

[36]

Hydrostatics and Hydrodynamics.

---

248 In the left margin "A" was written in pen but was crossed out.
249 In the left margin "B" replaces "A" which was written in red ink and later crossed out.
250 Fulton's entry was written in pencil.

R Venturi's large apparatus for illustrating the efflux of liquids

A Intermittent fountain, in Glass.

Do. in tin lacquered, old.[251]

B Large model illustrating pumps of every description.

A Screw of Archimedes.

B Model of Fire Engine.

B Model of Hydraulic Press:--Glass.

W Tournequel hydraulique,--illustrating the principle of Barker's Mill.[252] (broken)[253]

R Model of Fourneyron's Turbine Wheel.[254]

R Model of Canal Lock. (Broken in transit rep. by E.W.H.)[255]

[37] Hydrostatics and Hydrodynamics

Pistons, a variety--

Valves--do

R Model of pump body, showing valve within.

Circulation fountain:--showing something resembling the circulation of blood.

[There is an obstruction at one point, within this tube.

---

251 "Do. . . old" was added by Hilgard. Cf. Heron's fountain, "Pneumatics," [29].
252 "Tounequel" was written for "tourniquet."
253 This entry was added possibly by Hilgard
254 "R" was written in pencil.
255 This entry was written in pencil.

The liquid has been withdrawn and an attempt made to remove the obstruction without success.]

Refilled & made to work satisfactorily by R. B. FULTON

W Porta's reservoir, or fountain siphon.

A Two Tantalus Glasses.

Magic [Tunnel].

[38]

Mechanics.

A Lever apparatus--

A Combination of three levers.

A Balance beam--to illustrate theory of Balance.

B Systems of pulleys, in frame.

A Inclined Plane--Glass--with car for weights.

B Wedge of variable angle, counter poised.[256]

A Illustration of analogy between inclined plane and Screw.

B Hunter's screw. (Repaired)[257]

Two wooden wedges.[258]

[39]

Mechanics

A Set of Ivory balls, for illustrating collision of Elastic Bodies.

---

256 This entry was made by Hilgard.
257 This addition was probably written by Fulton.
258 This entry was made by Hilgard.

A Atwood's Gravity Machine

(Pulley, Pendulum & Dial of old do)[259]

R Revolving Cylinder, to illustrate the path of a projectile.

(Morin's)[260]

Repaired by F.B.F.[261]

A Apparatus to show descent of a body in a cycloid.

A Apparatus to illustrate centrifugal force. Only flexible [rim][262]

Gyroscope--Lane's, in box.

Gyroscope--Ritchie's--2

Apparatus to show fall of body in a parabola.[263]

A Sliding frame to illustrate parallelogram [sic] of forces.[264]

repaired F.[265]

[39 verso]

B Stand with two pendulums, nearly equal in beat--and also a cycloidal pendulum.

[40]

Mechanics.

---

259 Ibid.
260 Ibid.
261 "Broken" appears immediately to the left of Fulton's
262 This addition was written possibly by Garland or Fulton.
263 This entry was made by Hilgard. Following the entry is "not found," possibly written by Garland but now marked out.
264 This entry was written by Hilgard.
265 Fulton's note replaces Garland's note which was written in red ink and was marked out. It read, " Very old and worthless."

A [Disk], Triangle and Square, to illustrate Centre of Gravity.

(Iron)[266]

Ellipse and Parallelogram, (Wood) for id.[267]

A Cylinder (or disk) ascending inclined plane

A Double cone, doing the same.

W Chinese Tumblers.[268]

A Kater's reversible pendulum, for theoretic explanations--

and for determining true length of simple pendulum.

A Regnier's Dynanometer.

A Leaning tower, to illustrate center of gravity[269]

Portion of Wall (wood, for id.[270]

[41]

Mechanics

Model in wood of Sheers.

A " " " Crane.

A " " " Capstan.

A " " " Wheel and Axle.

A " " " Differential Axle.

A " " " Ringing Pile Driver.

---

266 "(Iron)" was written by Hilgard.
267 This entry was added by Hilgard.
268 Following this entry is "not found," written in pencil probably by Garland. It has been marked out.
269 This entry was made by Hilgard.
270 Ibid.

A " " " Power Pete Driver.

A " of common Spur Gearing.

A " " bevel Gearing.

[42]

Mechanics.

R Model Table--showing all the modes of use in transforming Motion. [This table much injured in transit.] (Repaired by E. W. H.) But does not work. Very roughly made. F.

A Model of Steam Engine. (Low pressure)[271]

A Model of Slide Valve.

" of Piston with Metal Packing.

" Valve of Oscillating Engine.

B Small Model of Steam Engine, operating by a lamp. (High pressure)[272]

[43]

Leveling. Transferred to Math. Road

A Water level with tripod.[273]

Plain sight Level, with Tripod.

" Leveling Instrument, with Telescope, English Construction.[274]

---

271 "A " replaces "B" written in red and marked out. "(Low pressure" was added probably by Hilgard.)

272 "(High pressure)" was added probably by Hilgard.

273 n the left margin "Math. Room," penciled in probably Hilgard, has been marked out.

274 All ditto marks in the left margin of this page were written in pencil.

" Leveling Instrument, with Telescope, French Construction.

" Leveling Rods, --French and English

(NB. Several of the above articles are in the case in the Mathematical lecture room in the Main Building) [The balance out][275]

[43 verso]

B Elliptic Compass.[276]

A 10 Leaden Weights for holding down Drawing Paper.

F Set of Draughtsman's Curves.

In Mathematical Lecture Room there are:[277]

One Level with Telescope

One Engineers Transit

On Surveyors Compass

4 Surveyors chairs, with 2 sets of pins

3 " " divided rods.

2 " " flags

[44]

Surveying and Geodesy. Transferred to Math. Room

A X Wooden Measure, one Metre

M X Chain, one decametre in length.

---

275 This note was written in pencil by Hilgard.

276 "B" replaces "A" which has been marked out.

277 This line and the remainder on [43 verso] were written in pencil by Hilgard.

M	X	Chain--half English Chain.
M		Surveyor's Compass.
M	X	Pantometer--with telescope.
M	X	Engineer's Transit.
B		Groetaer's instrument for measuring distance of inaccessible objects.[278]
A		Reflection-Square, for laying off right angles on the ground.[279]
A		Large Doubly Repeating Theodolite.

x)Articles marked x are not in the Observatory but supposed to be among the articles in the case in the Mathematical Lecture room.[280]

[45]

Astronomy.

R	Equatorial Telescope--objective 4.6 in. Munich constructed.
A	Dent's Dipleidoscope, for meridian passages of the sun.
A	Transit-Instrument--portable, by Pike.
A	Sextant--(Blunt's)[281]
A*	Mercurial Artificial Horizon: with cover of plate glass. No mercury[282]

278 The "x" in the left margin has been marked out.
279 Ibid.
280 This entry was written in pencil by Hilgard.
281 "(Blunt's)" was added by Hilgard.
282 In the right margin appears "No Mercury," written in pencil probably by Garland.

[B] Pair of thirty six inch Globes.[283]

Terrestrial seriously damaged by long exposure in leaky room F.

B Barlow's Planetarium.

Old Sextant, in green case. worthless[284]

worthless on accounts stated in special Report to the Trustees

Afterwards repaired under L. C. G. & mounted R. B. F.

*without Mercury

[46] blank

[47] Except for Fulton's additions this page written by Hilgard.

Caloric

Two parabolic mirrors, mounted on stand; copper gilt.

Hollow cube, for hot water, with various surfaces, mounted

Ring & cylinder, for heating, on foot.

Triple metallic rod, for curvature

(Ruined by overheating F.)

Lever 7 pulley thermoscope, with manometer, thermometer, and exit pipe; on brass foot.

Sheet copper boiler (old) with quintuple lamp, safety valve, fliers, and thermometer (broken)

---

283 "B" appears to have been written over the existing red "A."

284 "Old. . . case." was written by Hilgard. "Worthless" was written in pencil by Garland.

App. for illustr. Conduction of Heat (Igenhaus')[285]

Thermometer

[48] blank

[49]

Magnetic Observatory

In this building are deposited, at present, the following Articles.

1 doz. 32 oz. bottles.

1 " " 12 oz. " ".

1 " " 8 OZ. " ".

Suite of eight funnels-glass. (only 3)[286]

One glass siphon

One filtering stand.

4 oz. pyrogallic acid.

5 lbs. hyposulfite of soda.

4 oz. Bromide Potas.
not extant.[287]
4 oz. Iodide do.

(Not extant) Bottle originally containing 8 oz. nitr. silver[288]

[The salt chiefly used by Prof. Boynton in General Laboratory.]

Transferred in part only to Prof. Thomp. much having disappeared

285 "App. . .. Heat" was written in pencil by Fulton.
286 "(Only 3)" was written probably by Hilgard.
287 "Not extant." was written probably by Hilgard.
288 Ibid.

previous to May '64.

E. W. HILGARD[289]

[50]

There are, also, in Magnetic Observatory--

One package parliamentary hinges, designed for external blinds of building yet to be put on.

One package brass butts.

One package large screws (brass) for the window blinds.

(All the above articles have disappeared between the time at which this list was made out, and May 1864, when I took charge of the apparatus whether appropriated by Federals or confederates, does not appear. A small Copper stove, constructed for the observing room, appropriated by a Federal officer, in Dec. 1862.

Eug. W. Hilgard

[51] through [54] are blank.

[55] This list was written by Hilgard.

List of tools in the workshop of the Observatory, 1864

One lathe with the following appurtenances:

Common rest, with two bits--long and short shoulder.

Slide-rest, double motion.

---

289 Hilgard's addition was written in pencil.

Slide-rest single do.

Adjustable support for long pieces.

Universal Chuck, double jaws, with 10 pairs of clamping bits.[290]

Universal Chuck, four jaws.

Gimlet Screw Chuck.

Screw clamp chuck, with 4 triads of clamp bits.

Three male screw chucks, asstd.

Three female do. do. do.

Plain cylindrical chuck.

Dog chuck, with three dogs and a double screw clamp.

4 asstd. flat chisels
for wood
4 do. gouge do

4 square chisels for metal, for hand

23 various do do , for slide rest

10 large drills, asst'd., with screw counterchuck

2 conical counterchucks; 1 do for small drills.

[55 verso] This page was written by Hilgard.

1 plane disk counterchuck

1 trident do ; 1 concentric do.

2 hexagonal wrenches

290 "10" was written in pencil.

1 triple wrench, for chucks & dogs

2 circular saws, with chuck

4 asst'd male & corresponding female screw tools.

with handles.

Brace of black wood, metal mounted (broken) with

15 asst'd centre bits

6 asst. plain gouge bits

9 " gouge bits with cutter

1 do. " gimlet screw

1 gouge reamer

1 octagonal reaner

1 square do.

1 semicylindr. do

4 screw-head reamers

1 plain screw driver; 1 double tongue screw driver.

1 flat drill bit.

1 Bow drill, with 12 asst. bits, & wedge for starting

2 reamers, [north] handles.

1 square, ditto. do.

[56] This page was written by Hilgard.

5 mortising chisels, asstd.

Two tenon saws.

Two wooden screw clamps (cabinet makers)

Common carpenters square

Large square mallet

One broad handaxe

Large bench vise

Small (watchmakers) vise

Handvise with sliding ring

Large nippers (18 inch)

Small cutting nippers

1 pr. round pliers

2 square pliers

1 small shears

1 large hand shears

1 shoemakers punch

1 do hammer & tongs

1 plain ribbed tongs or nippers

1 screw cutting tongs, (3 threads), with 6 taps

2 screw plates, with 10 taps[291]

1 punch with "Observatory."

---

291 "10" was written in pencil

Set of 3 round punches

do 3 rectangular punches

do 3 hollow do.

[56 verso] This page was written by Hilgard.

Large handsaw for metals

Small do (watch spring) with 8 spare blades.

6 half round (rasp) files, asstd.

6 flat files, course, asstd.

3 rat-tail files, asstd.

1 flat polishing file

2 " finishing files

1 biconvex file, fine

Sash tools, in handle

1 watchmakers small hammer

4 Screw drivers, asstd.

1 square anvil, on wooden pillar

1 monkey wrench (spring broken)

1 flat crow-bar, 24 inch; 1 forked do, 12 inch.

1 set stencils.

1 Arkansas whetstone.

NB. A number of tools from this shop, among them a small monkey wrench was impressed by hospital [sic] of Grant's army. Details

not recollected.

[57]

40 feet Rubber hose; with jet; will screw to lift & force pump in vestibule of workshop.[292]

I have never had charge of these tools. The Proctor keeps the key of the shop, & he and others have access to the shop as they please.

Ap. 1867

L.C.G.

When I took charge of the Dept. in 1875 there were very few tools left, except those belonging to the lathe & it had been seriously deranged by careless handling. Any one who wished had access, and the tools had disappeared. Since 1875, various simple tools have been added--enough for doing rough-repairs work.

1881

R.B.F.

[57 verso] Except for Garland's note, this page was written by Hilgard.

10 brass case locks, with keys & socket plates.

1 doz. 6 inch brass balls

---

292 This entry was written by Hilgard.

1 doz. 10 " " "

with socket plates

9 doz. 3 " "

4 brass sash rollers.

2 " mortise locks; one key wanting

6 bars lead

3 sheets brass

Parts of 6 packages asstd. Iron woodscrews

" " 1 brass do.

Lots of zinked Iron, & Copper nails

1 bunch tie wire

6 small rolls of asstd brass wire

A few sheets of sand & emory paper.

I have verified the foregoing list of Apparatus and tools in July 1865

Univ. of Miss. EUG. W. HILGARD

July 29, 1865. Apt. in charge.

BIBLIOGRAPHY

Primary sources - Archival Materials

"Autobiographical Sketch of Dr. F.A.P. Barnard." Mississippi Historical Society (21 September 1888): 107-121.

Barnard, F.A.P. letters to Eugene Hilgard, 1856-1861. Special Collections, Wollman Library of Barnard College, Columbia University, New York, New York.

Barnard, F.A.P. "Sermons," "Memoirs," and "Account of Trip from Oxford to Labrador." Special Collections, Wollman Library of Barnard College, Columbia University, New York, New York.

Barnard, F.A.P. to the Board of Trustees of the University of Mississippi. Special Collections, University of Mississippi, Oxford.

Course Catalogues of the University of Alabama, Tuscaloosa, 1833-1861. Special Collections, Gorgas Library, University of Alabama, Tuscaloosa.

Course Catalogues of the University of Mississippi. Special Collections, University of Mississippi, Oxford.

Faraday, Michael to John Millington, 12 November 1836. University Museum. University of Mississippi, Oxford; Millington Collection, Swem Library, College of William and Mary, Williamsburg, Virginia.

Fulton, R.L. to W.L. Keenen, 12 January 1912. University Museum. University of Mississippi, Oxford.

Millington, John to Col. R. McCandish, 15 August 1848. University Museum. University of Mississippi, Oxford.

"The Barnard Inventory." Transcript in the hand of Jeanne Wells. University Museum, University of Mississippi, Oxford.

Interviews

Bass, Henry. Interview by Jeanne Wells, 5 March 1981. Interview transcript. University Museum, University of Mississippi, Oxford.

Braybrooke, Valerie. Interview by Jeanne Wells, 3 January 1981. Interview transcript. University of Mississippi.

Hartline, Beverly K., Ph.D. , Scientific Assistant to the Director of the Continuous Electron Beam Accelerator. Interview by author, 11 December 1992, Newport News, Virginia.

Lewis, Arthur B. Presentation recorded by Elizabeth Scott Brenkert, 27 March 1979. Presentation transcript. University Museum. University of Mississippi, Oxford.

Unpublished Secondary Sources

Abrams, Jay Harrison. "Professionalization in Public Organizations: The Case of the Research Scientist." Ph.D. diss., State University of New York at Albany, 1975.

Barnard-Millington Symposium, University of Mississippi, Oxford. 1981.

Castelao-Lawless, Teresa. "Scientific Phenomenology and Science Studies: Gaston Bachelard and the Concept of Phenemenotechnique." Ph. D. diss., Virginia Polytechnic and State University, 1993

Chen, Xiang. "Theories, Experiments, and Human Agents: The Controversy between Emissionists and Undulationists in Britain, 1827-1859." Ph.D. diss., Virginia Tech, 1992.

"Docent Report," University Museum files, University of Mississippi, Oxford.

"F.A.P. Barnard at the University of Mississippi." University Museum files, University of Mississippi, Oxford.

Faust, Catherine Drew Gilpin. "A Sacred Circle: The Social Role of the Intellectual in the Old South, 1840-1860." Ph. D. diss. , University of Pennsylvania, 1947.

"John Millington, University of Mississippi, 1848-1853." University Museum files, University of Mississippi, Oxford.

Slotten, Hugh Richard. "Patronage, Politics, and Practice in Nineteenth-Century American Science: Alexander Dallas Bache and the United States Coastal Survey." Ph.D. diss: University of Wisconsin, Madison, 1991.

Secondary sources

Ackermann, John Robert. Data, Instruments, and Theory: A Dialectical Approach to Understanding Science. Princeton: Princeton University Press, 1985.

Adams, Henry. The Education of Henry Adams. New York: Time Inc., 1964.

Bachelard, Gaston. Le nouvel esprit scientifique. 1st edition. Paris: P.U.F., 1934.

Bates, Ralph A. Scientific Societies in the United States. 3rd edition. Cambridge: MIT Press, 1965.

Beaver, Donald de B. The American Scientific Community, 1800-1860: A Statistical-Historical Study. New York: Arno Press, 1980.

Bennett, J.A. "A Viol of Water or a Wedge of Glass." In The Uses of Experiment: Studies in Natural Science, ed. David Gooding, Trevor Pinch, and Simon Schaffer, 105-114. Cambridge: Cambridge University Press, 1989.

Bennett, J.A. "Science at the Great Exhibition." In Exhibition Catalogue of the Whipple Museum. Whipple Museum of the History of Science.

Bozeman, Theodore Dwight. Protestants in the Age of Science. Chapel Hill: University of North Carolina Press, 1977.

Brachner, A. "German Nineteenth-Century Scientific Instrument Makers." In Nineteenth-Century Scientific Instruments and their Makers, ed. P.R. de Clercq, 117-158. Leiden: Rodopi, 1985.

Breeden, James O. "Disease as a Factor in Southern Distinctiveness." In Disease and Distinctiveness in the American South, ed. Todd L. Savitt and James Harvey Young. Knoxville: The University of Tennessee Press, 1988.

Brown, Leland. Early Philosophical Apparatus at Transylvania College. Lexington, Kentucky: Transylvania College Press, 1959.

Bruce, Robert V. The Launching of Modern American Science, 1846-1876. New York: Cornell Press, 1987.

Cabaniss, James Allen. A History of the University of Mississippi. Birmingham: Birmingham Printing Company, 1949.

Cannon, Susan Faye. Science in Culture. New York: Dawson and Science History Publications, 1978.

Cash Wilbur J. The Mind of the Old South. New York: Vintage Books, 1941.

Chute, William. Damn Yankee! The First Career of Frederick A.P. Barnard. New York: Kennikat Press, 1978.

Cohen, I. Bernard. Some Early Tools of American Science. New York: Russell & Russell, 1950.

Collins, Harry and Trevor Pinch. Frames of Meaning: The Social Construction of Extraordinary Science. London: Routledge and Kegan Paul, 1982.

"Commencement at the University of Mississippi in 1859." Natchez Free Trader. 19 July 1859.

Cooper, William and Terrill, Thomas E. The American South: A History. New York: Alfred A. Knopf, 1990.

Curti, Merle. The Growth of American Thought. New York: Harper and Row Publishers, 1964.

Daniels, George H. American Science in the Age of Jackson. New York: Columbia University Press, 1968.

Daniels, George H. Science in American Society: A Social History. New York: Alfred A. Knopf, 1971.

Daniels, George H. "The Process of Professionalization in American Science: The Emergent Period, 1820-1860." Isis 58 (1967): 151-166.

Daniels, George H., ed. Nineteenth Century American Science: A Reappraisal. Evanston: Northwestern University Press, 1972.

Daniels, George. "The Process of Professionalization in American Science: the Emergent Period, 1820-1860." In Science in America Since 1820, ed. Nathan Reingold. New York: Science History Publications, 1976.

Daumas, Maurice. Scientific Instruments of the 17th & 18th Centuries, ed. and trans. by Mary Holbrook. New York: Praeger Publishers, 1953, 1972.

de Tocqueville, Alexis. Democracy in America. trans. Henry Reeve. London: Oxford University Press, 1946.

Dupree, A. Hunter. "The National Academy of Sciences." In The Organization of Knowledge in Modern America, 1860-1920, ed. Alexandra Oleson and John Voss, 342-363. Baltimore: Johns Hopkins University Press, 1979.

Dupree, Hunter. "The National Pattern of American Learned Societies 1769-1863." In The Pursuit of Knowledge in the Early American Republic: American Scientific and Learned Societies from Colonial Times to the Civil War, ed. Alexandra Oleson and Sanborne C. Brown. Baltimore: The Johns Hopkins University Press, 1976.

Dvoichenko-Markov. "The Pulkova Observatory and Some American Astronomers of the Mid-19th Century." Isis 43 (September, 1952): 243-246.

Dyer, Thomas. "Science in the Antebellum College: The University of Georgia, 1801-1860." In Science and Medicine in the Old South, ed. Ronald L. Numbers and Todd L. Savitt. Baton Rouge: Louisiana State

Eaton, Clement. The Freedom of Thought Struggle in the Old South. New York: Duke University Press, 1940.

Elliott, Clark. "Models of the American Scientist: A Look at Collective Biography." Isis 73 (1982): 77-102.

Elliott, Clark. "The American Scientist in Antebellum Society: A Quantitative View." Social Studies of Science 5 (1975): 93-108.

Faulkner William. Absalom, Absalom! New York: Modern Library, 1951.

Faulkner, William. "Mississippi." In Essays, Speeches, and Public Lectures, ed., James Meriwether. New York: Random House, 1965.

Faust, Drew Gilpin, "The Peculiar South Revisited: White Society, Culture and Politics in the Antebellum Period, 1800-1860." In Interpreting Southern History, ed. John B. Boles and Evelyn Thomas Nolen. Baton Rouge: Louisiana State University Press, 1987.

Flynt, Wayne. "Southern Higher Education and the Civil War." Civil War History 14, no. 3 (September 1968): 211-226.

Fulton, John F. "Science in the American University, 1636-1946." Bulletin of the History of Medicine 20 (1946).

Galison, Peter. How Experiments End. (London and Chicago: University of Chicago, 1989).

Genovese, Eugene. "The Significance of the Slave Plantation for the Southern Economic Development." Journal of Southern History. XXVIII (1962): 422-37.

Gladden, Sanford Charles. A History of the Department of Physics and Astronomy at the University of Mississippi, 1848-1932. Mississippi: University of Mississippi, 1933.

Gladden, Sanford Charles. "John Millington." William and Mary Quarterly. (July, 1933): 3-10.

Golinski, Jan. "Experiment in Scientific Practice." Review of The Uses of Experiment, by David Gooding, Trevor Pinch, and Simon Schaffer. In History of Science XXVIII (1990):203-209.

Gooding, David, Trevor Pinch, and Simon Schaffer, ed. The Uses of Experiment: Studies in Natural Science. Cambridge: Cambridge University Press, 1989.

Greene, John C. "Science, Learning, and Utility: Patterns of Organization in the Early American Republic." In The Pursuit of Knowledge in the

Early American Republic: American Scientific and Learned Societies from Colonial Times to the Civil War, ed. Alexandra Oleson and Sanborne C. Brown. Baltimore: The Johns Hopkins University Press, 1976.

Guralnick, Stanley M. Science and the Ante-Bellum American College. Philadelphia: American Philosophical Association, 1975.

Guralnick, Stanley. "Sources of Misconception on the Role of Science in the Nineteenth Century American College." Isis LXV (1974):352-66.

Guralnick, Stanley. "The American Scientist in Higher Education, 1820-1910." In The Sciences in the American Context: New Perspectives, ed. Nathan Reingold. Washington, D.C.: 1979.

Hacking, Ian. "Review: The Life of Instruments." Studies in the History and Philosophy of Science 20, no. 2 (1990):226.

Hacking, Ian. "The Self-Vindication of the Laboratory Science." In Science As Practice and Culture, ed. Andrew Pickering, 29-64. Chicago and London: The University of Chicago Press, 1992.

Hackmann, W.D. "Instrumentation in the Theory and Practice of Science: Scientific Instruments as Evidence and Aid to Discovery." Annals of Science 26(1979): 205-24.

Hackmann, W.D. "Scientific Instruments: Models of Brass and Aids to Discovery." In The Uses of Experiment: Studies in Natural Science, ed. David Gooding, Trevor Pinch, and Simon Schaffer, 31-66. Cambridge: Cambridge University Press, 1989.

Hahn, Roger. The Anatomy of a Scientific Institution: The Paris Academy of Sciences, 1666-1803 . California: University of California Press, 1971.

Heilbron, John. "Creativity and Big Science." Physics Today. 45, no. 11 (November, 1992): 42-47.

Higham, John. "The Matrix of Specialization." In The Organization of Knowledge in Modern America, 1860-1920, ed. Alexandra Oleson and John Voss, 3-18. Baltimore: Johns Hopkins University Press, 1979.

Hofstadter, Richard. Academic Freedom in the Age of the College. New York: University Press, 1955.

Holifield, E. Brooks. "Science and Theology in the Old South." In Disease and Distinctiveness in the American South, ed. Todd L. Savitt and James Harvey Young. Knoxville: The University of Tennessee Press, 1988.

Holmes, Larry. "Do We Understand Historically How Experimental Knowledge is Acquired?" History of Science XXX(1992): 120-36.

Hume, Alfred. Dr. John Millington (1779-1868). New Jersey: Princeton University Press, 1950.

Johnson, Thomas Cary. Scientific Interests in the Old South. New York: D. Appleton-Century Company, Incorporated, 1936.

Keeney, Elizabeth. The Botanizers. Chapel Hill: The University of North Carolina Press, 1992.

Kennon, W.L. "A Century of Astronomy at Ole Miss." Ole Miss Alumni Review 11, no. 3 (October, 1947).

Kennon, W.L. and Sanford C. Gladden. "Historical Apparatus at the University of Mississippi." The American Physics Teacher 6 (February 1938):1-7.

Knight, Edgar W. A Documentary History of Education in the South before 1860. North Carolina: Chapel Hill, 1952.

Kohlstedt, Sally Gregory. "Savants and Professionals: The AAAS 1848-1860." In The Pursuit of Knowledge in the Early American Republic: American Scientific and Learned Societies from Colonial Times to the Civil War, ed. Alexandra Oleson and Sanborne C. Brown. Baltimore: The Johns Hopkins University Press, 1976.

Kuritz, Hyman. "The Popularization of Science in Nineteenth-Century America." History of Education Quarterly 21(1981):259-79.

Lloyd, Jim. The University of Mississippi: the Formative Years. Mississippi: University of Mississippi, 1979.

Lucas, Aubrey K. "Education in Mississippi from Statehood to Civil War." In A History of Mississippi, ed., Richard Aubrey Mclemore. Hattiesburg: University & College Press of Mississippi, 1973.

Merton, Robert. Science and Technology in Seventeenth Century England. New Jersey: Humanities Press, 1978, 1970c.

Middleton, W.E. Knowles. Catalog of Meteorological Instruments in the Museum of History and Technology .Washington, D. C.: Smithsonian Institution Press, 1969.

Midgette, Nancy Smith. To Foster the Spirit of Professionalism: Southern Scientists and State Academies of Science. Tuscaloosa: The University of Alabama Press, 1991.

Moore, Margaret Deschamps, "Religion in Mississippi in 1860." Journal of Mississippi History. XXII: 224-225.

Morris, Philip. "Taking Barnard Back: After a Turbulent Past, Ole Miss Resurrects Its Classic Observatory." Southern Accents, 15, no. 8 (Nov. / Dec. , 1992).

Numbers, Ronald L. and Janet Numbers. "Science in the Old South: A Reappraisal." Journal of Southern History. XLVII (1982).

Oleson, Alexandra. "To Build A New Intellectual Order." In The Pursuit of Knowledge in the Early American Republic: American Scientific and Learned Societies from Colonial Times to the Civil War, ed. Alexandra Oleson and Sanborne C. Brown. Baltimore: The Johns Hopkins University Press, 1976.

Pickering, Andrew, ed. Science As Practice and Culture. Chicago: University of Chicago Press, 1992.

Pickering, Andrew, ed. Science as Practice and Culture . Chicago and London: The University of Chicago Press, 1992.

Pilar, James. "Religion and Cultural Life, 1817-1860." In A History of Mississippi, ed., Richard Aubrey Mclemore. Hattiesburg: University & College Press of Mississippi, 1973.

Potts, David B. "Curriculum and Enrollments: Some Thoughts on Assessing the Popularity of Antebellum Colleges." History of Higher Education Annual (1981).

Reingold, Nathan. "Definitions and Specializations: The Professionalization of Science in the Nineteenth Century." In The Pursuit of Knowledge

in the Early American Republic: American Scientific and Learned Societies from Colonial Times to the Civil War, ed. Alexandra Oleson and Sanborne C. Brown. Baltimore: The Johns Hopkins University Press, 1976.

Reingold, Nathan. Science in America Since 1820. New York: Science History Publications, 1976.

Reingold, Nathan. Science in Nineteenth Century America. London: Macmillan, 1966.

Rosenberg, Charles E. "Science and Social Values in Nineteenth Century America: A Case Study in the Growth of Scientific Institutions." In Science and Values: Patterns of Tradition and Change, ed. Arnold Thackray and Everett Mendelsohn. New York: Humanities Press, 1974.

Rossiter, Margaret. "The Organization of Agricultural Improvement in the United States, 1785-1865." In The Pursuit of Knowledge in the Early American Republic: American Scientific and Learned Societies from Colonial Times to the Civil War, ed. Alexandra Oleson and Sanborne C. Brown. Baltimore: The Johns Hopkins University Press, 1976.

Rudolph, Frederick. Curriculum: A History of the American Undergraduate Course of Study Since 1636. San Francisco: Jossey-Bass Publishers, 1977.

Russell, Colin A. Science and Social Change, 1700-1900. Hong Kong: The Macmillan Press Ltd., 1983.

Savitt, Todd L. and James Harvey Young, eds., Disease and Distinctiveness in the American South. Knoxville: The University of Tennessee Press, 1988.

Scarborough, William A. "Heartland of the Cotton Kingdom." In A History of Mississippi, ed., Richard Aubrey Mclemore. Hattiesburg: University & College Press of Mississippi, 1973.

Schaffer, Simon. "Glass Works: Newton's Prisms and the Uses of Experiments." In The Uses of Experiment: Studies in Natural Science, ed. David Gooding, Trevor Pinch, and Simon Schaffer, 67-104. Cambridge: Cambridge University Press, 1989.

Scott, Donald M. "The Profession that Vanished: Public Lecturing in Mid-Nineteenth Century America." In The Origin of Knowledge in Modern

America, 1860-1920, ed. Alexandra Oleson and John Voss. Baltimore: The Johns Hopkins University Press, 1979.

Shapin, Steven and Simon Schaffer. Leviathan and the Air Pump: Hobbes, Boyle, and the Experimental Life. Princeton: Princeton University Press, 1985.

Skates, John Ray. Mississippi. New York: W.W. Norton & Company, Inc., 1979.

Stevenson, Louise L. Scholarly Means to Evangelicism. Baltimore and London: The Johns Hopkins University Press, 1986.

Storr, Richard J. "Commentary: An Historian of Education Looks at the Newagen Study." The Pursuit of Knowledge in the Early American Republic: American Scientific and Learned Societies from Colonial Times to the Civil War, ed. Alexandra Oleson and Sanborne C. Brown. Baltimore: The Johns Hopkins University Press, 1976.

Taton, R. , Reason and Change in Scientific Discovery, trans. A. J. Pomerans. New York: Philosophical Library, 1957.

Thackeray, Arnold. "The Industrial Revolution and the Image of Science". In Science and Values: Patterns of Tradition and Change, ed. Arnold Thackeray and Everett Mendelsohn. New York: Humanities Press, 1974.

"The Dearborn Observatory." Pamphlet. Evanston: Northwestern University.

Thwing, Charles F. A History of Higher Education in America. New York: D. Appleton and Company, 1906.

Tindall, George Brown. America: A Narrative History. New York: W.W. Norton & Company, 1984.

Turner, G. L' E. Forward to Nineteenth-Century Scientific Instruments and their Makers, ed. by P.R. de Clercq. Leiden: Rodopi, 1985.

Turner, Gerard L'E. , ed. Scientific Instruments and Experimental Philosophy, 1550-1850. With a Preface by the editor. Great Britain: Variorum, 1990.

Turner, Gerard L'E. Nineteenth-Century Scientific Instruments. Berkeley: Sotheby Publications and University of California Press, 1983.

University Press, 1989.

Van Helden, A. "The Birth of the Modern Scientific Instrument 1500-1700." In The Uses of Science in the Age of Newton, ed. , J.G. Burke. Berkeley: University of California Press, 1983.

Voss, John. "The Learned Society in American Intellectual Life." In The Pursuit of Knowledge in the Early American Republic: American Scientific and Learned Societies from Colonial Times to the Civil War, ed. Alexandra Oleson and Sanborne C. Brown. Baltimore: The Johns Hopkins University Press, 1976.

Warner, Deborah Jean. Alvan Clark & Sons: Artists in Optics. National Museum Bulletin 272 (1968).

Wheatland, David. The Apparatus at Harvard, 1765-1800. Cambridge: Harvard University Press, 1968.

Williams, Tennessee. Cat on a Hot Tin Roof. New York: Penguin Books, 1955.

Zochart, Donald. "Science and the Common Man in Ante-Bellum America." In Science in America Since 1820, ed., Nathan Reingold. New York: Science History Publications, 1976.

CURRICULUM VITAE

CHARLOTTE WEBB
Center for the Study of Science in Society
Virginia Polytechnic Institute and State University
Blacksburg, Virginia 24061
(703) 231-7687

EDUCATION

M.S. , Science and Technology Studies, April 1993
Virginia Polytechnic Institute and State University
Blacksburg, Virginia

B.A. , Art History, May 1989
William and Mary
Williamsburg, Virginia

PRESENTATIONS

Blechschmidt, Lara and Charlotte Webb. "The Transmission of Scientific Information to the Public and the Resulting Perception of Risk." Presented at Annual Society for the Social Studies of Science Meeting, Cambridge, MA., November, 1991.

Webb, George, Jane Webb, and Charlotte Webb. " Scientific Discourse About Public Policy: A Case Study of the Japanese Oyster." Presented at Annual Virginia Academy of Science Meeting, Blacksburg, VA., May, 1992.

Webb, George, Jane Webb, and Charlotte Webb. "The Masks of Science: A Case Study in Scientific Discourse and Public Policy." Presented at Annual National Association for Science and Technology Meeting, Washington, D.C., November, 1992.

EMPLOYMENT

Virginia Academy of Science Grant, 1993-1994
Joseph Henry Biography, Research Assistant, Ssummer 1993
Teaching Assistant, Virginia Polytechnic Institute and State University, 1991-93

OTHER

Panel member, GEM sponsored television program. "Graduate School: Paying the Bill." October 1992.

PROFESSIONAL SOCIETIES
National Association for Science and Technology
Virginia Academy of Science
History of Science

Charlotte Webb