“A Host of Experienced Microscopists”: The Establishment of Histology in Nineteenth-Century Edinburgh

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SUMMARY: Edinburgh was the foremost center in Britain for the introduction of microscopic anatomy into medical training. It therefore offers an instructive case study of the way in which what was initially an obscure and exotic technology eventually became a regular part of medical education. The paper explores the process by which skills that were originally the preserve of a small number of pioneers in histology came to be transmitted to a wider population. It focuses, in particular, on the transition from an authoritarian style of pedagogy, best exemplified by the histological teaching of John Hughes Bennett, to the more collegial styles of interaction between microscopists that came to be embodied in the Edinburgh Physiological Society.

KEYWORDS: microscope, histology, pedagogy, medical education, Edinburgh

Introduction

The topic of this paper is the emergence of a medical microscopical community in nineteenth-century Edinburgh. It therefore deals with the generation and transmission of forms of expertise peculiar to a particular form of scientific activity. These skills included the manipulation of the microscope itself; the acquisition and preparation of the specimens to be viewed under this instrument; and the ability to give valid verbal accounts and pictorial representations of microscopic phenomena. Pedagogic techniques for the transmission of such aptitudes from initiates to neophytes were prerequisite to the creation of a body of workers competent in these techniques. Although the individual was the focus of all these processes, microscopic skill could be acquired and exercised only in forms of society. The history of medical microscopy in this and in other settings is thus the history of the creation and maintenance of a scientific way of life.[1]

The 1830s are generally acknowledged as marking a turning point in microscopy. Around this time new kinds of microscope, free from the optical defects of spherical and chromatic aberration that had afflicted earlier instruments, became available.[2] Investigators took advantage of these achromatic glasses to launch numerous and sustained inquiries into the minute structure of the living body. The outstanding outcome of these researches was the 1838 promulgation by Theodor Schwann of the cell theory.[3]

The new microscopy was initially prosecuted with greatest vigor in continental Europe. However, students from Britain who had traveled to centers of microscopic expertise in France and Germany sought, on returning to their native land, to create their own schools of histologic enquiry. Many of these British pioneers had begun their medical studies in Edinburgh. Although the Edinburgh medical school was no longer the premier international center it had been in the eighteenth century, it remained an important center for medical education.[4] In particular, the existence of an extramural as well as the university medical school encouraged pedagogic flexibility and innovation. Moreover, institutions

1. I use the term "way of life" in Steven Shapin and Simon Schaffer's sense as a "pattern of activity": *Leviathan and the Air-Pump: Hobbes, Boyle, and the Experimental Life* (Princeton: Princeton University Press, 1985), pp. 14–15.

2. On the history of the microscope and related technologies, see Reginald S. Clay, *The History of the Microscope: Compiled from Original Instruments and Documents, up to the Introduction of the Achromatic Microscope* (London: Holland Press, 1932); Savile Bradbury, *The Microscope: Past and Present* (Oxford: Pergamon Press, 1968); Savile Bradbury and Gerard L'Estrange Turner, *Historical Aspects of Microscopy* (Cambridge: W. Heffer, 1967); Brian Bracegirdle, *A History of Microtechnique: The Evolution of the Microtome and the Development of Tissue Preparation,* 2d ed. (Lincolnwood, Ill.: Science Heritage, 1986).

3. For general discussions of the cell theory, see J. R. Baker, "The Cell Theory: A Restatement, History and Critique," *Quart. J. Microsc. Sci.,* 1948, *89:* 103–23; William Coleman, *Biology in the Nineteenth Century: Problems of Form, Function, and Transformation* (Cambridge: Cambridge University Press, 1977), chap. 2. For discussions of the cell theory in Britain, see L. S. Jacyna, "John Goodsir and the Making of Cellular Reality," *J. Hist. Biol.,* 1983, *16:* 75–99; idem, "The Romantic Programme and the Reception of Cell Theory in Britain," ibid., 1984, *17:* 13–48.

4. There is no full history of the Edinburgh medical school in the nineteenth century, but see Alexander Grant, *The Story of the University of Edinburgh during Its First Three Hundred Years,* 2 vols. (Edinburgh: Longmans, 1884); D. B. Horn, *A Short History of the University of Edinburgh, 1556–1889* (Edinburgh: Edinburgh University Press, 1967); Lisa Rosner, *Medical Education in the Age of Improvement: Edinburgh Students and Apprentices, 1760–1826* (Edinburgh: Edinburgh University Press, 1991); L. S. Jacyna, *Philosophic Whigs: Medicine, Science, and Citizenship in Edinburgh, 1789–1848* (London: Routledge, 1994).

such as the Royal Medical Society encouraged scientific enterprise among the student community; this was a culture that prompted even junior members of the medical school to seek means to advance knowledge, rather than being mere passive receptors of learning.

At or toward the end of their professional education some of these students chose to travel to the Continent in order to acquire additional aptitudes. In the early decades of the nineteenth century, Paris was a favored destination; by 1830 some were also visiting the German and Austrian universities.[5] The motives for such expeditions varied, as did the kinds of skills and experience that were cultivated. A significant group of these travelers, however, aimed to fit themselves to take on a particular persona when they returned to Britain: that of medical teacher. The existence of extramural teaching encouraged pedagogic entrepreneurship. Once a lecturer had proved his worth in this competitive environment he could, moreover, hope for promotion to the university medical faculty. Microscopy was introduced into British medical teaching through the agency of individuals following this career trajectory.

Teaching usually formed only a part of a lecturer's professional activity: most also engaged in medical practice. A reputation as a successful teacher might help establish a young physician's name. Once he had a sufficient clinical income, lecturing might be discarded as superfluous. But for others the academic role remained central to their professional identity throughout their career. They also drew upon other repertoires in formulating their professional identity. Perhaps inspired by such Continental exemplars as Johannes Müller,[6] they assumed the obligation, not only to promulgate existing knowledge, but also to advance science through original research.

Edinburgh's Pioneers

Four individuals were of special importance in bringing microscopy to Edinburgh: Allen Thomson (1809–84), William Sharpey (1802–80), John Goodsir (1814–67), and John Hughes Bennett (1812–75). Three of these conformed to the pattern outlined above. Thomson received his M.D. at Edinburgh in 1830; in his last year as a student he was president of the

5. Russell C. Maulitz, *Morbid Appearances: The Anatomy of Pathology in the Early Nineteenth Century* (Cambridge: Cambridge University Press, 1987); Thomas Neville Bonner, *Becoming a Physician: Medical Education in Great Britain, France, Germany, and the United States, 1750–1945* (New York: Oxford University Press, 1995).

6. [Allen Thomson], "[Address to] Medical Society of the University [of Glasgow]," MS Gen. 1476, box 7, Glasgow University Library, Glasgow, Scotland (hereafter GUL).

Royal Medical Society. He had already determined to become a physiology lecturer and, with this object in mind, set off for the Continent. While there, he pursued a variety of goals, including seeking additional clinical instruction and collecting anatomical specimens for use in teaching. But he also sought insights into and materials for his own favored area of research, embryology. It is likely that it was in pursuing these studies that he first became acquainted with microscopy.[7] On returning to Edinburgh, Thomson set up as a teacher of anatomy and physiology in partnership with Sharpey, who had also spent time in France and Germany. Sharpey had begun to use the microscope as a student: a contemporary recalled "him being much occupied with histology—& using with pride the same Microscope wh Dr John Thomson employed for his observations" (this was the compound microscope belonging to the Royal Medical Society).[8] Such shared use of an instrument is an indication of the scarcity of microscopes in Edinburgh before 1830. As well as teaching in concert, Sharpey and Thomson undertook joint microscopic investigations.[9] Sharpey's special interest was the motion of the vibratile cilia lining certain membranes.[10]

Bennett, too, was president of the Royal Medical Society as a student; in later life he remained a fervent supporter of its activity in shaping the student mind. His obituarist recalled that Bennett regarded the RMS as "one of the most valuable adjuncts to medical education and culture in Edinburgh, and a session rarely passed without the Society having the benefit of his powerful advocacy from the professorial chair."[11] This quotation also hints at another important function that the Society performed within the Edinburgh medical community, that of maintaining close links between junior and senior members of the school. After

7. The chief biographical source for Thomson is W. Aitken, "Obituary of Allen Thomson," *Proc. Roy. Soc. London,* 1887, *42:* xi–xxviii. See also L. S. Jacyna, ed., *A Tale of Three Cities: The Correspondence of William Sharpey and Allen Thomson* (London: Wellcome Institute for the History of Medicine, 1989), pp. xii–xiv; idem, *Philosophic Whigs* (n. 4), chap. 5.

8. Allen Thomson, [Life of William Sharpey], GUL, MS Gen. 1476, box 16, p. 3. John Thomson was Allen's father; the "observations" in question were presumably those he incorporated into his monograph on inflammation: John Thomson, *Lectures on Inflammation, Exhibiting a View of the General Doctrines, Pathological and Practical, of Medical Surgery* (Edinburgh: W. Blackwood, 1813).

9. In Thomson's chronology of Sharpey's life (n. 8), he noted that "I returned from Paris &c. in July 1829. And found Dr. S. in lodgings in Castle St and we then became very intimate and constantly together—in observations &c" ("1829" entry).

10. William Sharpey, "On a Peculiar Motion Excited in Fluids by the Surfaces of Certain Animals," *Edinburgh Med. & Surg. J.,* 1830, *34:* 113–22.

11. [Obituary], "John Hughes Bennett, M.D., F.R.S.E.," *Brit. Med. J.,* 1875, *2:* 473–78, on p. 473.

graduation Bennett visited Paris where, inter alia, he undertook microscopic studies. Goodsir, on the other hand, does not seem to have traveled to the Continent; it is unclear where or how he acquired his skill as a microscopist.

After beginning their careers as extramural teachers, three of these four individuals obtained chairs in the Edinburgh medical faculty. Thomson became professor of the Institutes of Medicine in 1842; when in 1848 he moved to Glasgow he was replaced by Bennett. Goodsir held the chair of anatomy from 1846 to his death in 1867. Sharpey had left Edinburgh in 1836 to pursue an academic career in London. Both as extramural and as university teachers, the members of this group sought to transmit their skills as microscopists to rising generations of students. Each made his microscopic competence central to his identity as pedagogue, and this competence was crucial to the demands they made on the attention of the rising generation of medical men.

In adopting this strategy the advocates of microscopy had to confront considerable skepticism—if not outright hostility—from their colleagues. The reliability of microscopic observations had been put in doubt by the downfall of globulism; such eminent anatomists as Xavier Bichat had made no secret of their disdain for the instrument. A common complaint was that each observer saw what he wished through the microscope. In 1862 Sharpey recalled: "five-and-twenty years ago, I was one among the very few medical teachers in this country who exhibited objects to students with the microscope. Indeed at that time, we had to meet and answer objections to its employment; whereas now it has become almost a household instrument."[12] A polemical rebuttal of such doubts was incumbent on those who sought to promote their careers through microscopic discovery and instruction.

They first of all insisted upon the power and importance of The Microscope. The emergence of this prodigious entity in a form shorn of its previous optical defects had, in effect, transformed the world with which medical men had to deal. In his *Outlines of Physiology for the Use of Medical Students,* Thomson provided a long list of bodily processes accessible only through this means: "these are a series of facts and views due to microscopic research, which could not have been ascertained without it, and which all now acknowledge to be essential to the scientific character, practical utility, and further progress of Physiology."[13] The microscope

12. William Sharpey, "The Address in Physiology," *Brit. Med. J.,* 1862, *2:* 162–71, on p. 164.

13. Allen Thomson, *Outlines of Physiology; for the Use of Students. Part I* (Edinburgh: Maclachlan, Stewart, 1848), p. 84.

had opened up a new reality, and there was now an obligation upon at least the intelligent portion of the profession to take the opportunity to explore this virgin domain: "the systematic study," Thomson declared, "of the anatomical and physiological information which [the microscope] affords, is imperative on all those who desire to attain to professional excellence."[14]

The microscope became, in effect, an emblem of medical modernity. In a typical remark, one commentator maintained that there had occurred "a complete revolution in Physiology, Pathology, and Practical Medicine": speculation and hypothesis had been banished; only "rigid demonstrative accuracy" was valued by the new medicine, and the microscope was foremost among the "more modern modes of investigation."[15] Medical science had been "entirely transformed and rebuilt by the every where increasing and prevailing modern use of the Microscope."[16] In this new era, histology was "the true foundation of Physiology and Pathology."[17]

Those who failed to recognize that medical science had thus been "revolutionized" were suitable subjects for condescension and contempt. Thus in a review of a "new" edition of a textbook on pathological anatomy by an author who failed to acknowledge the profound influence the microscope had exerted on the subject, Bennett observed:

> It would be amusing enough to follow [David Craigie] in his quotations from the books of the last and commencement of the present century, with the contents of which no one can be more familiar, and then to contrast him hesitating, floundering, and gravely talking about corpuscles, nuclei, and cells, of which he knows no more than did Willis, Vieussens, Morgagni, or the rest of his favourite writers.[18]

In other words, Craigie's writing was to be discounted because he had no direct experience of the microscopic realm. For this reason, he was not *competent* to give an account of "the modern doctrine of pathology"; his book was merely an epitome of the science's "past history."[19] Given the sharp separation between past and present inherent in this rhetoric, to consign a work to history was equivalent to denying it any real value.

It was of particular importance that medical students, who embodied

14. Ibid.

15. John Hughes Bennett, *Testimonials in Favour of John Hughes Bennett, M.D., F.R.S.E.* (Edinburgh: Murray and Gibb, 1855), p. 85.

16. Ibid., p. 106.

17. Ibid., p. 58.

18. [John Hughes Bennett], "Review of David Craigie, *Elements of General and Pathological Anatomy*," *Monthly J. Med. Sci.*, 1848, *8:* 617–18, on p. 618.

19. Ibid.

the future of the profession, should subscribe to this rhetoric. Those attending Bennett's 1847–48 class in pathological histology were clearly converted; they declared that "through the medium of your instructions, we have been inspired with an interest altogether new to us in the progress of scientific medicine."[20]

Whereas the old medicine had regarded the evidence available to the investigator's unaided senses as a sufficient basis for clinical and scientific judgments, the new order was characterized by an insistence on the need to employ artificial aids to supplement these innate resources. It was, Bennett declared, "unnecessary to enter into a lengthened argument to prove that the science and art of medicine are greatly indebted, in modern times, to the invention and proper application of ingenious instruments."[21] The converse of the powerful, perceptive microscope was the feeble human eye. The inadequacy of unaided vision as an aid to scientific understanding and professional competence became a constant refrain. Thus Bennett declared: "I have lately had many opportunities of satisfying myself [by means of the microscope] that death may be occasioned by structural changes in the brain, which are altogether imperceptible to ordinary sight, and which have escaped the careful scrutiny of the first morbid anatomist in this city."[22]

We have here an instance of the nineteenth-century reorganization of vision that Jonathan Crary has described. Concomitant with a novel recognition of the physiological component to perception there was a new understanding of the relation of instrumental aids to the naked eye. It was a reordering, moreover, that made the observer the subject of new forms of knowledge *and* new techniques of power. Vision in general, and scientific vision in particular, had lost its immediacy and innocence. Seeing had become a matter of contrivance.[23]

Thus the proponents of the new science of microscopy repeatedly insisted that learning histology did not depend merely on the acquisition of manual skills: it demanded a training of the *eye*. To give just one typical quotation, again from Bennett: "the sense of sight as applied to the microscope, must undergo a new education, and our ideas of organized structure be completely changed, before it is possible to arrive at

20. Bennett, *Testimonials* (n. 15), p. 61.

21. John Hughes Bennett, *Clinical Lectures on the Principles and Practice of Medicine,* 2d ed. (Edinburgh: Adam and Charles Black, 1858), p. 61.

22. John Hughes Bennett, "Of the Doctrine of Life and of the Tissues which manifest it. Section 1—Histology of the Tissues," MS Gen. 2007, folders 1–4, p. 1, Edinburgh University Library, Edinburgh, Scotland (hereafter EUL).

23. Jonathan Crary, *Techniques of the Observer: On Vision and Modernity in the Nineteenth Century* (Cambridge: MIT Press, 1990), chap. 3.

satisfactory results."[24] An emphasis upon the lack of self-evidence in the microscopic realm served, of course, to magnify the importance of those who claimed they were able to provide this indispensable ocular instruction. In the old days, Bennett claimed, it took the microscopic autodidact years to acquire a skilled eye, but he claimed that "things are infinitely changed . . . when a teacher stands by the student, and points out and explains the difficulties which fall in his way."[25] This depiction of a somewhat avuncular relationship between master and pupil is, as we will see, at odds with how Bennett's students recalled their pedagogic experience. The passage does hint, however, at something of the intimacy between instructor and student that this form of pedagogy involved.

A Species of Actual Demonstration

It appears that Allen Thomson was the first to introduce the microscope into medical teaching in Edinburgh. He introduced histology into the physiology lectures he gave in the 1830s in the extramural school, and he continued the practice after he was appointed professor of the Institutes of Medicine in 1842, offering a special course on "Microscopic Anatomy" in the summer of that year.[26] Early references to microscopy in his manuscript lecture notes combine efforts to tout the value of the microscope with an anxiety to rebut the imputations that had been made against the instrument.[27] Thus in one passage the microscope is described as "an instrument the uses of which in respect to Anatomy cannot be sufficiently extolled."[28] In the following year, however, Thomson felt it necessary, in the course of a discussion of the capillary circulation, to remark: "it forms one of the most delightful spectacles to the physiological observer. [It] makes the best answer to physiological doubters and to those who would not have us assist our imperfect organs of vision with a magnifying glass."[29]

24. John Hughes Bennett, *On the Employment of the Microscope in Medical Studies* (Edinburgh: Maclachlan, Stewart, 1841), p. 13.

25. John Hughes Bennett, "Introductory Address to a Course of Lectures on Histology, and the Use of the Microscope," *Lancet,* 1845, *1:* 517–22, on p. 520.

26. Aitken, "Obituary of Allen Thomson" (n. 7), p. xx.

27. In Edinburgh one source of such skepticism about the value of the microscope was the prominent extramural teacher Robert Knox, who "was satirizing the microscope, as he did most things" (ibid.).

28. Allen Thomson, "Lect. 1st Introductory. Edinburgh 1838. & Aberdeen 1839," GUL, MS Gen. 1476, box 7, p. [29].

29. Allen Thomson, "Lectures on Physiology," GUL, MS Gen. 170 (1–3), vol. 2, p. 4. The second sentence of this passage was at some later date heavily scored out.

Thomson stressed that histology would be disseminated throughout his course in the form of frequent references to minute anatomy when dealing with the various functions of the body. He also felt it necessary to give his students direct ocular access to microscopic reality: there are numerous allusions to microscopic "demonstrations" in the lecture notes. The form of these exercises is unclear, but they presumably assumed the form of the students' taking it in turns to view specimens that the professor had displayed under one or more microscopes.[30]

Goodsir's teaching practices provide an indication of the difficulties involved in such demonstrations, as well as of the strategies that were devised to overcome them. In a preliminary lecture delivered after he became professor of anatomy in the University, he rehearsed the familiar trope of the inadequacy of the naked eye and the scientific indispensability of the microscope: "As much of the most important structure of the Body is Microscopic," he declared, "and can therefore only unsatisfactorily be illustrated in a course of Public Lectures on Anatomy, by diagrams and models, I became early impressed with the necessity of organising a system by which microscopic structure might be *demonstrated* to a large class."[31] He held that it was relatively easy to demonstrate microscopic appearances to small groups; the challenge was to provide for the needs of the 250–300 students who formed his anatomy class. For many years he had been able to do no more than place a few microscopes in the dissecting room and encourage the students to acquire their own instruments. It was, however, deemed unsatisfactory that students should be left to their own devices when making their first forays into microscopic reality.

More recently, Goodsir had "succeeded in arranging a system which enables me to teach microscopic anatomy to my entire class as a part of our daily discipline."[32] He had prevailed upon the Town Council to set aside a small room in the College premises provided with a circular table around which thirty students could sit. The table was equipped with trolleys bearing a microscope, a shaded lamp to provide illumination, and instruments for the preparation of specimens. The object to be

30. Notes from the early and mid-1830s contain extensive instructions on demonstrating the blood corpuscles to Thomson's class. This exercise involved the use of a micrometer to estimate the size of these objects. See ibid., vol. 2, Lectures 28, 29, 30. One note reminds Thomson to "take over a frog and the Microscope to shew the Blood globules"—which would suggest that only one microscope was employed in these demonstrations (ibid., "28th Lect. Thursday 12 Decr [1832]").

31. John Goodsir, [Prelim. Lecture], EUL, MS 289–306 (290), pp. 9–10.

32. Ibid., pp. 11–12.

examined having been "illustrated by diagrams suspended on the wall, and points to be attended to in its examination indicated, it is adjusted under the instrument by the Demonstrator, the carriage passes on to the pupil on his left; who after examining it passes it on to the others."[33] While one microscope did the rounds, a second and a third might also be put in circulation. Through these means, Goodsir declared, "I am now enabled to accomplish satisfactorily what, so far as I know, has not yet been attempted in any anatomical establishment whatever—the demonstration of microscopic *Structure* to every individual of a large class."[34] This technology provided a template for later attempts to teach histology to sizable groups: Sharpey, for instance, adopted a similar regime when he commenced teaching in University College, London.[35]

This system of incorporating microscopy into a regular pedagogic "discipline" bears close scrutiny. It shows how, in practical terms, the innocent eye was trained to view the microscopic world under constraint. The role played by diagrams and illustrations in this disciplining of vision is especially noteworthy. Goodsir's circular table represented, moreover, an early attempt at a mechanized method of achieving results with numerous students that had previously been possible only by personal interaction between an instructor and at most a few individuals.

By such means it became practicable to attain the ideal of exposing *all* students to some direct vision of microscopic reality. For the majority, however, their acquaintance with this realm would be slight and superficial; they would be mere visitors to this territory who were expected to do no more than acquiesce in the truths presented to them by their teachers. But, for a few, such initial exposure was but the first step to a much deeper involvement in the microscopic way of life; they were themselves to become explorers of that land.

Professed Microscopic Observers

In an 1848 text Allen Thomson insisted that "it is proper for every student of Physiology to have seen the principal appearances presented by the minute parts of the textures in the microscope."[36] This was to make microscopy part of the training of all medical men. When, how-

33. Ibid., pp. 12–13.

34. Ibid., pp. 16–17.

35. For variations on this technology used by other London teachers, see Graeme Gooday, "'Nature' in the Laboratory: Domestication and Discipline with the Microscope in Victorian Life Science," *Brit. J. Hist. Sci.,* 1991, *24:* 307–41, on p. 328.

36. Thomson, *Outlines* (n. 13), p. 83.

ever, Thomson went on to assert that, because of the insights it afforded, a familiarity with the microscope was "imperative on all those who desire to attain to professional excellence,"[37] he hinted at distinctions between members of the profession. The microscope was identified as an emblem of those who aspired to constitute a true elite within the profession—an aristocracy based not on wealth and connection, but on scientific attainment. For those who aspired to occupy this station within the medical community, a cursory glimpse of microscopic reality would not suffice; they required to be instructed in the skills of hand and eye that would make them competent histologists.

One token of an aspiration to this status was readiness to make a financial commitment. It was no longer deemed sufficient to use a shared instrument, such as the one owned by the Royal Medical Society, or to be content with "the privilege of a peep through Allen Thomson's and John Goodsir's on a Saturday."[38] The serious observer needed to purchase his own microscope together with the accessory equipment. Thomson therefore undertook to give his students "some plain directions with regard to the purchase of [microscopes]."[39] In addition to the instrument itself, the "professed microscopic observer" would require

> 1. A number of small boxes or draws, with grooved sides, for containing the slides; and a writing diamond, for marking the names of the objects upon them. 2. Watch-glasses, or glass cells of various depths, for examining live plants and animals; animalcule cages, and holders for extending the frog's foot, or other objects of a similar kind; and larger flat vessels, with wax or leaded cork bottoms. 4. [*sic*] A graduated compressor, for flattening soft objects, or bursting minute vesicles, under examination. 5. Fine scalpels, steel and silver needles, and forceps, for dissection.[40]

Thomson advised his students to begin with relatively simple subjects, such as vegetable tissue, followed by the epithelia, cartilage, and bone of cold-blooded animals. After acquiring "a general knowledge of these objects and dexterity in the use of his instrument, the observer may take up any special branch of inquiry that presents itself."[41]

Thomson seemed to suggest that such knowledge and dexterity could be gained by the individual in isolation. Bennett, on the other hand, to a great extent built his reputation in Edinburgh on the claim that such

37. Ibid., p. 84.
38. Aitken, "Obituary of Allen Thomson" (n. 7), p. xx.
39. Allen Thomson, "Micros. Lect. 16. 42/44," GUL, MS Gen. 1476, box 8, p. 1.
40. Thomson, *Outlines* (n. 13), p. 88.
41. Ibid., p. 90.

skills could and should be *taught*.[42] The histological teaching that he instituted in Edinburgh had two aspects. He taught the *science* of histology, defined as "the Minute Structure of Organised Tissues, with reference to Anatomy, Physiology, Pathology, and the Diagnosis of Disease."[43] But he also provided a set of *techniques*—practical skills necessary to manipulate the microscope so as to gain access to the phenomenal world it revealed; Bennett's proud boast was that in the course of his teaching "every pupil has made observations for himself, microscope in hand."[44] While imparting the former kind of knowledge required the pedagogic methods traditional to medical teaching (lecture and precept), the latter demanded a different style of instruction. Something more akin to an apprenticeship system than a university education was needed to teach students how to use the microscope, how to prepare specimens for microscopic examination—and how to *see* through the microscope.

In addition to the lecture course he delivered at Surgeon's Square (the customary site for extramural teaching in Edinburgh), Bennett therefore undertook to give

> private courses on the practical Manipulation of the Microscope. Each class is limited to *six*. . . . The lectures embrace the optical and mechanical arrangements of microscopes, illumination, mensuration, optical illusions, mode of displaying objects, and every information necessary for the medical inquirer, in his examination of the animal textures in a state of health and disease.[45]

In short, Bennett was "not content with merely communicating certain facts to the student, but he showed him how to observe and record facts for himself."[46]

According to John Gray M'Kendrick, whom Bennett later employed as a teaching assistant, there were reasons behind this stress upon inculcating skills rather than merely expounding principles. Even at the outset of his career, M'Kendrick maintained, Bennett appeared "to have held the opinion that every medical man should be skilful in the manipulation of the microscope, and more especially that the microscope should be employed in the examination of diseased organs."[47] The creation of a body of skilled microscopic workers was therefore integral both to

42. S. Jacyna, "John Hughes Bennett and the Origins of Medical Microscopy in Edinburgh," *Proc. Roy. Coll. Physicians Edinburgh,* 1997, *27:* 12–21.

43. Bennett, *Testimonials* (n. 15), p. iii.

44. Ibid.

45. Ibid.

46. "John Hughes Bennett" (n. 11), p. 475. This remark is directed specifically at Bennett's clinical teaching; it applies, however, to other aspects of his pedagogy.

47. Ibid., p. 473.

Bennett's conception of the proper basis of rational clinical practice and to his projected trajectory of medical progress. When assessing the various kinds of microscope available, he distinguished between the "perfect" but expensive instruments made by London manufacturers and the "cheap & convenient" ones available in France.[48] The former, "notwithstanding the splendour of the screws, the glittering of the brass, and the fine workmanship," were "very clumsy affairs"[49]—whereas the latter, though less imposing, were better adapted to Bennett's program of promoting a wide dissemination of microscopic competence.[50] These instruments embodied the values of mass production rather than celebrating artisanal workmanship.

Bennett incidentally hinted at a collateral set of prior skills that must preexist if such satisfactory results were to be attained—namely, those required to teach the new science. "The art of demonstrating under the microscope," he insisted, "is only to be acquired by long practice, and, like everything requiring practical skill, cannot be learnt from books or systematic lectures."[51] He emphasized the "immense difficulties which oppose every attempt to demonstrate minute structure to a class, [which] has hitherto prevented a public course from being given on this subject," and remarked that previous attempts at histology teaching, such as those of Alfred Donné in Paris, had foundered on these obstacles.[52] He was thus obliged to devise a pedagogic technology adequate to the training of competent microscopists as well as intelligent histologists. The resources and devices Bennett brought to this task may be inferred from a passage in the pathological portion of his course. When speaking of the various changes that took place in the blood during disease, he advised his students that

> each of these subjects will be illustrated by means of a series of preparations and plates adapted to each, and the process of inflammation, tubercle, and

48. John Hughes Bennett, [Untitled Fragment], EUL, MS Gen. 2007, folder 1. For a discussion of Bennett's "French" microscopes, see A. D. Morrison-Low and R. H. Nuttall, "Science and Status: Chevalier Microscopes and the Edinburgh Medical School," *Bull. Sci. Instrum. Soc.,* 2000, *65:* 14–18.

49. Bennett, *Clinical Lectures* (n. 21), p. 65.

50. Thomas Laycock imputed baser motives for Bennett's attempt to guide his students' choice of microscope: he alleged that when Bennett became a professor, he "sold microscopes to his class, at a profit, and got them passed the custom-house free of duty as being for his own private use" (Michael Barfoot, ed., *"To Ask the Suffrages of the Patrons": Thomas Laycock and the Edinburgh Chair of Medicine, 1855* [London: Wellcome Institute for the History of Medicine, 1995], p. 104).

51. Bennett, *Clinical Lectures* (n. 21), p. 71.

52. Bennett, *On the Employment* (n. 24), p. 5.

> the ultimate structure of all the morbid products, will be demonstrated under a series of microscopes, previously arranged, for which purpose the construction of this classroom is particularly well-fitted.[53]

When he came to apply for a university position, Bennett and those who supported his candidacy laid great emphasis upon the material resources he had accumulated as a pioneer in the teaching of practical histology. The invention of this technology was portrayed as an important aspect of his achievement. Douglas Maclagan, for instance, saw it as a token of Bennett's "zeal" that he had collected "with much trouble, and at no small expense, a rich museum, and a choice series of valuable microscopes by the best makers; . . . he has thus furnished himself with one of the most efficient means of rendering his courses of lectures both instructive and attractive to his pupils."[54] By appointing Bennett, the university would therefore be securing not only the services of the man, but also those of the formidable array of pedagogic tools at his command.

The Bennett who sought to impose himself upon the Edinburgh medical school was thus a compound entity; microscopy was central to the establishment of that character. His persona was tightly bound up with the material requisites of a histology course: a set of preparations to put before students; a stock of microscopes on which to display them;[55] and a physical space suitable for the deployment of these assets. He was, moreover, endowed with a *disciplinary* technology to enforce a particular way of seeing upon the student. Describing the fully developed version of Bennett's system of pedagogy, W. W. Johnston in 1899 stressed how this form of instruction inculcated discipline in every sense of the word. In teaching histology Bennett "drilled his class in the use of the microscope until every man knew his instrument as a trained soldier knows his rifle, and until in the handling of it he was as perfect as the veteran in the manual of arms."[56]

Johnston's choice of simile is reminiscent of Michel Foucault's discussion in *Discipline and Punish* of military drill as a type of the disciplining of bodies to interact with an instrument, creating "a body-weapon, body-tool, body-machine complex."[57] In this instance the assemblage is that of

53. J. H. Bennett, "Diseases of the Blood," EUL, MS Gen. 2007, folder 4, pp. 3–4.

54. Bennett, *Testimonials* (n. 15), p. 50.

55. Bennett possessed "ten excellent achromatic microscopes" for teaching purposes ([Concluding Lecture to Course on Microscopical Anatomy], EUL, MS Gen. 2007, folders 1–4, p. 1.

56. W. W. Johnston, "John Hughes Bennett—His Services to Medicine," Address to the Medical and Chirurgical Society of Maryland, 1899, British Library, BL 10600.ff.9 (3), p. 5.

57. Michel Foucault, *Discipline and Punish: The Birth of the Prison,* trans. Alan Sheridan (London: Harmondsworth, 1977), p. 153.

body-microscope, a coupling essential to the operations of histological work. It is noteworthy that despite the new medicine's emphasis on the importance of instruments, greater importance was placed on perfecting the human component of this duplet. Bennett was

> anxious to impress upon you [his students] that we should regard the Microscope only as a means to an end—That in itself it is nothing, and can no more confer the power of observing, reflecting or advancing knowledge, than a Stethoscope can enable a Physician to distinguish disease, or a cutting instrument give the judgment & skill necessary for performing a great operation—Astronomy in the present day could scarcely be said to exist without Telescopes, any more than Histology without Microscopes, yet we should learn to distinguish between the mechanical means necessary for arriving at scientific truths, and those mental processes which enable us to organise, compare & arrange the truths themselves.[58]

The main purpose of pedagogy was to inculcate and regulate those "mental processes." More precisely, it was to normalize the overt representation of those supposed processes in the realm of public science. Histology was not a conjectural art; it was "a science which admits of considerable exactitude."[59] There was, however, a constant danger that the beginner would fail to achieve this level of precision.

When deviant representations evaded this disciplinary surveillance, it was more likely to be the fault of the man than of the microscope. The achromatic microscope had "enabled histologists to arrive at greater uniformity in their results, whilst the systematic instruction in the subject given to advanced pupils by many able anatomists, is gradually raising up a host of experienced microscopists—It is much to be feared however . . . that a few inexperienced investigators may still publish their erroneous observations."[60] An insistence that it was the human side of the microscope/observer couple that was more prone to error was a familiar refrain in the utterances of the early histologists. After remarking that the performance of microscopes was something that could safely be left to the "optician to execute," Thomson asserted: "It is more difficult for us to perform that part which is ours viz to observe"; while fallacies of an "optical kind" did occur, errors were "most frequently those of judgement."[61] As proof that it was the quality of the observing eye, rather than that of the instrument, that was crucial to success, Thomson cited the fact that "Leeuwenhoeck saw as much or more with his single lenses as

58. John Hughes Bennett, [Untitled Lecture], EUL, MS Gen. 2007, folder 1, p. 1.

59. Ibid.

60. John Hughes Bennett, [Untitled Fragment], EUL, MS Gen. 2007, folder 1.

61. Thomson, "Micros. Lect. 16. 42/44" (n. 39), pp. 7–8.

modern improved microscopes can establish."[62] In a similar vein, Bennett urged his students to aim at "increasing your powers of observation and of reasoning correctly on the facts presented to you, than waste time in improving the optical and mechanical parts of an instrument—which however useful is after all only of secondary importance."[63]

What occurred in each individual sensorium was, of course, a private matter, which could not be policed. Pedagogy, and other disciplinary devices, intervened when those perceptions were transmuted into public representations. Jonathan Crary has remarked upon the analogies between the mode of seeing embodied in the camera obscura and the notion of "a privatized subject confined in a quasi-domestic space, cut off from a public exterior world."[64] One aspect of the reorganization of vision that occurred in the nineteenth century was the erosion of the sovereign rights of this subject, who now became answerable for what he saw to a supraindividual entity.

The goal of pedagogy was thus to inculcate skills that overtly enhanced the student's practical and perceptual capacities. But at the same time, the individual was to be assimilated into a collective and his energies directed toward the shared goals of that larger entity. The acquisition of technical competences was the precondition for participation in a shared morality. The individual was an active body that made its own sections and observations, but also a *docile* body inasmuch as strict control was exercised over what counted as a competent microscopic performance and what constituted a true observation.[65] In Bennett's stern words, "The art of observation is at all times difficult, but is especially so with a microscope. . . . Rigid and exact observation, therefore, should be methodically cultivated from the first."[66]

Individual liberty succumbed to collective surveillance at the point when observations were translated into language. Bennett's system, Johnston recalled, "was to let every man make every section for himself, see for himself the object prepared, and describe it in his own words; these words must be carefully chosen so as to give a correct picture of the cell, tissue or organ seen."[67] This description of the training process

62. Ibid., p. 13.

63. John Hughes Bennett, [Fragments on Microscopy], EUL, MS Gen. 2007, folders 1–4, p. 2.

64. Crary, *Techniques* (n. 23), p. 39.

65. On the notion of "docile bodies" within disciplinary regimes, see Foucault, *Discipline and Punish* (n. 57), part 3, chap. 1.

66. Bennett, *Clinical Lectures* (n. 21), p. 72.

67. Johnston, "John Hughes Bennett" (n. 56), p. 6.

stresses the autonomy of the student body. But when the student attempted to verbalize his private observations, to give them credit in the public domain, the *dirigiste* voice of pedagogic authority intervened:

> Nothing but accuracy would suit [Bennett's] exacting demand, and woe to the unhappy pupil who attempted to describe what he did not see, or whose words were ill-chosen or inappropriate. . . . The student soon learned a lesson in the art of observation and in the meaning of words in the English language that he was not likely to forget. A system like this developed in the student the art of seeing, of letting nothing escape the eye, and of transforming these sense objects into accurate and appropriate language.[68]

In short, "Precision was what he inculcated."[69]

One crucial point at which discipline was applied was therefore the regulation of linguistic performances. Only certain verbal representations of microscopic reality were deemed acceptable, and the student was drilled until his spoken and, by extension, written utterances conformed to this pre-text. In an era when the basic grammar and vocabulary of histological discourse were still being negotiated, such strict regulation of what it was permissible to say about one's perceptions had obvious importance. One mark of histological competence was the ability to use the right words at the appropriate time.

Histological discourse, however, depended as much, if not more, upon a nonverbal visual code. The importance of illustrations in teaching was well recognized in Edinburgh by the 1840s; Bennett, in particular, showed a strong sense of their rhetorical power. In an account of the pedagogical use of illustrations by John Thomson, a teacher of an earlier generation, he recalled how the lecturer "rose from his chair, and, rod in hand, walked up and down the lecture room, pointing out the exact likeness of this or that person . . . and thus forced conviction on the auditors by a species of actual demonstration."[70] Bennett in part repaid the debt by introducing the elderly Thomson to the wonders of the microscopic universe. Goodsir's use of histological illustrations in his teaching has already been noted. Allen Thomson likewise maintained the family tradition by making use of a large number of "beautiful diagrams" in his lectures.[71]

68. Ibid.

69. "John Hughes Bennett" (n. 11), p. 475.

70. [John Hughes Bennett], "The Late Dr John Thomson," *Monthly J. Med. Sci.,* 1846, *7:* 397. On John Thomson's use of illustrations in his teaching, see Jacyna, *Philosophic Whigs* (n. 4), pp. 123–24.

71. Aitken, "Obituary of Allen Thomson" (n. 7), p. xx.

Pictorial representation was, moreover, central not only to pedagogy but also to histological practice itself. Bennett's "method of working" with the microscope was "to take careful notes of all interesting cases and post-mortem appearances which came before him in the hospital. These notes . . . were fully illustrated by numerous drawings made of microscopical preparations."[72] In Bennett's notebooks the verbal account of a case was complemented by a drawing "neatly executed on the opposite page."[73] Those who aspired to be competent microscopists were expected to emulate this example. The student

> should early learn to draw the various objects he sees, before and after the action of re-agents, not only because such copies constitute the best notes he can keep, but because drawing necessitates a more careful and accurate examination of the objects themselves. A note-book and pencil for the purpose should be the invariable accompaniments of every microscope.[74]

Thomson added to this basic list of requisites a camera lucida as an aid to the student in making microscopic drawings.[75]

His emphasis on the importance of correct language notwithstanding, Bennett asserted that histology's pictorial codes were even more important in establishing and perpetuating the discipline. He expressed the conviction that "in the existing state of our knowledge, no mere verbal description of ultimate tissues is sufficient to communicate correct impressions of them to others."[76] For this reason he took special care over the production of the illustrations to his published works on histology; by promulgating these representations of microscopic reality, he hoped to influence the perceptions of others.

The question of what were acceptable forms in which to depict that reality was still a matter of some contention in the mid-nineteenth century. It was common for histologists to criticize the representations of others on various grounds, while presenting their own illustrations as faithful reflections of reality. Nonetheless, there was sufficient consensus among the Edinburgh teachers for them sometimes to accept each other's efforts as authoritative pictures of the microscopic world. Thus when lecturing on secretion, Allen Thomson undertook to "illustrate

72. John G. McKendrick, "Obituary: John Hughes Bennett," *Edinburgh Med. J.,* 1875–76, *21:* 466–74, on pp. 469–70.

73. Ibid., p. 470.

74. Bennett, *Clinical Lectures* (n. 21), p. 72.

75. Thomson, "Micros. Lect. 16. 42/44" (n. 39), p. 37.

76. John Hughes Bennett, *On Cancerous and Cancroid Growths* (Edinburgh: Sutherland & Knox, 1849), p. vi.

this by reference to Mr Goodsirs figures of the secreting cells of the liver."[77]

Such sharing of pictorial resources was a tacit acknowledgment of their credibility as representations of reality; this, in turn, implied a recognition of the authority of the eye and hand that had produced them. The provenance of an illustration was at least as significant as its style. A microscopic adept such as Bennett relied on his personal authority as sufficient warrant for the verisimilitude of his accounts and depictions of microscopic reality. In one of his papers he asserted that "a glance at the different figures given above, all of which were drawn as seen under the same magnifying power, must convince any one, that corpuscles possess distinct differences in their physical properties."[78] What (if anything) made the truthfulness of these figures so unquestionable, however, was that they were "drawn as seen" *by Bennett.* To question their reliability was therefore to cast doubt upon his observational and representational skills.

Bennett was wont to rely on his personal credibility to resolve controverted histological issues. He sought, for instance, to settle the issue of whether or not one kind of cell might develop from another by asserting: "I have carefully watched [cells] springing up between the mucous and muscular coats of the stomach, and in other situations, where no cells existed."[79] But such authority endured only so long as these claims to competence and expertise received general acceptance. The novelty of the microscope and the narrow distribution of the skills involved in its use meant that some of Bennett's peers were willing to defer to his judgment. Thus in the course of a public debate William Pulteney Alison, the professor of the practice of medicine, announced himself "willing to rely on Dr Bennett as to the existence of a sufficient distinction between purulent and other ordinary deposits,"[80] although in other respects he disagreed with him. Professional rivals knew how damaging it was to an adversary to cast doubt on his scientific reliability. In an attack on Bennett's character, Thomas Laycock alleged that "he had no grace of any kind—

77. Allen Thomson, "Function of Secretion & Nutrition," [1844–45], GUL, MS Gen. 1476, box 8, p. [5].

78. John Hughes Bennett, "Contributions to Pathology and Rational Medicine. Number 2," *Monthly J. Med. Sci.,* 1847, *7:* 93–101, on p. 96.

79. John Hughes Bennett, [Notes on Cellular Physiology], EUL, MS Gen. 2007, folders 1–4, quotation in folder 1, p. 94.

80. John Hughes Bennett, "On the Morbid Anatomy and Pathology of the Typhus Fever which has been Prevalent in Edinburgh during the Session 1846–7," *Monthly J. Med. Sci.,* 1847–48, *8:* 299–302, on p. 302.

religious, moral, aesthetic"; moreover, Bennett's "reasoning powers were defective, and it was not thought that his observing powers were accurate."[81]

Bennett invited such attacks because of the cult he evolved around himself within the Edinburgh medical school. Using typical rhetoric, he called on his students to support him in "the ensuing struggle between advancing science, and a routine practice," and asked them to rally around the cause of "rational investigation and sound argument."[82] These attributes were personified by Bennett himself. His pretensions provoked jealousy and hostility among some of his colleagues; this persona, however, also inspired admiration, if not adulation, within the student body. One enthusiast declared his devotion by scribbling on a library book: "Professor J. H. Bennett in my humble opinion is entitled to be ranked among the first men, of the age, to a student he is invaluable."[83]

The centrality of Bennett's status as a master of the microscope to the self-image that he promulgated is abundantly clear from the testimonials he collected in 1855 when he was a candidate for the chair of the practice of medicine. These return constantly to his reputation and success both as a practitioner and as a teacher of histology. In this branch of science, according to James Young Simpson, Bennett was "acknowledged by the whole profession as a master and leader."[84] Students who attended the extra class on pathological histology that Bennett offered in 1847–48 expressed their own sense of indebtedness to him: "Many of us," they declared, "who have attended the course of lectures alluded to, feel that, through the medium of your instructions, we have been inspired with an interest altogether new to us in the progress of scientific medicine."[85]

Such utterances suggest a vision of Bennett as a heroic figure, a genius who inspired those around him. The accounts of his histological teaching quoted above depict a didactic system of pedagogy in keeping with this Napoleonic model. Knowledge was unequivocally located in Bennett's person; he was the authoritative source of truth and of the skills requisite for its acquisition. He was, moreover, a model for all those in the student body who aspired to contribute to scientific medicine. Such concentration of power in the person of a single individual was appropriate to a particular, intermediary, stage in the process of creating a corps of competent and productive microscopists. Once this groundwork was

81. Barfoot, *"To Ask"* (n. 50), p. 70.

82. John Hughes Bennett, "Lectures on Cancer," EUL, MS Gen. 2007, folder 3, p. 10.

83. The note is scribbled on the fly-leaf of the EUL copy of Bennett's *Pathological and Histological Researches on Inflammation of the Nervous Centres* (1843).

84. Bennett, *Testimonials* (n. 15), p. 20.

85. Ibid., p. 61.

laid, however, this autocratic regime was complemented by forms of interaction in which disciplinary power was dispersed throughout the collective.

A Microscopic Republic

The rhetoric of the early proponents of microscopy in Edinburgh was permeated by a strong participatory ethos. If the new science was to progress, it was imperative that the number of microscopic observers should be multiplied; the cumulative results of the labors of this host would gradually contribute to the edification of histology. This program implied a particular notion of the nature of scientific discovery, one that placed less emphasis on spectacular advances achieved by a solitary genius and more on the accumulation of a multitude of small facts that together would constitute an impressive whole.

In order to recruit the workforce needed for this endeavor, the pioneers of histology sought to impress upon their students a responsibility to become active participants in the process of discovery. In an 1845 graduation address, Allen Thomson maintained that although "we may despair of the formation of a general theory applicable to the practice of medicine, it is nevertheless the duty of every one who takes an interest in the advancement of our science to contribute his share of the materials out of which that theory must ultimately be formed."[86] While few could aspire to the stature of a Müller or a Goodsir, all could by dint of assiduous labor contribute their mite to this noble endeavor.

Bennett preached a similar message. He told his students that the "next great advance to be made in Medical Science will be brought about by means of those who dedicate themselves to [histology's] cultivation"; despite the great advances of the recent past, "the field, gentlemen, is still open to those who will assiduously cultivate it. Aided by systematic instruction you may with diligence shortly place yourselves on a par with those at present engaged in clearing the soil."[87] Bennett undertook to provide the "systematic instruction" that was an essential prerequisite for involvement in this endeavor—but it was for the students themselves to determine to make best use of the skills they had thus obtained. What histology needed above all was "intelligent and laborious investigators . . . to render it highly productive. In this path every young man at the present day has the means of rendering himself early distinguished."[88]

86. Allen Thomson, "Graduation Address. Aug^{t} *1*st 1845," GUL, MS 1476, box 7, p. [26].

87. Bennett, "Doctrine of Life" (n. 22), p. 5.

88. John Hughes Bennett, [Fragment on Attitudes to Microscopy], EUL, MS Gen. 2007, folder 3.

The goal was therefore to multiply the number of microscopic observers: in the quest for new facts, more was better. But this strategy was also attended with dangers. Microscopic seeing was essentially a solitary activity; unless properly regulated, there was a risk that it would result in the creation of a myriad of solipsistic microscopic realms. “From the moment indeed that the combination of two or three lenses enabled man to contemplate things which were invisible to the naked eye,” Bennett warned, “the disposition towards the marvellous led them to exclaim—‘A new world is laid open before us’—and this world appeared to be regulated by new laws.”[89]

This was to take the view that in his natural state the microscopist was beset with a species of original sin: a tendency to error was inherent in his nature. This native vice could be extirpated only by means of discipline. Some of this discipline has already been described. Microscopy tyros were required to make their first ventures into the microscopic world in closely regulated pedagogic settings, and the verbal and pictorial reports they brought back from these early expeditions were subject to severe scrutiny. At this stage authority was vested in a single figure. The technologies of the classroom became inappropriate, however, when these observers ceased to be students and became colleagues in a shared scientific endeavor.

Other disciplinary forms were required to obviate the danger of microscopic solipsism among qualified members of the histology community. Prototypes for such forms of interaction existed, some of which were spontaneous and informal. Particular observers had on occasion chosen to work in concert; thereby a mutual check was maintained on individual reports of microscopic reality. Thus, Allen Thomson reported that when he returned to Edinburgh in 1829 after his tour of the Continent he began to associate with Sharpey, “and we then became very intimate and constantly together—in observations &c.”[90] Bennett urged upon his students the value of such mutually beneficial interaction: “To protect yourselves,” he held, “both in observing and reasoning nothing is so good as continually conversing with others both as regards facts and theories.”[91]

89. Bennett, [Fragments on Microscopy] (n. 63), pp. 1–2.

90. Thomson, [Life of William Sharpey] (n. 8), “1829” entry.

91. Bennett, “Doctrine of Life” (n. 22), p. 4. On the conversational mode as a means of maintaining solidarity about matters of fact, see Steven Shapin, *A Social History of Truth: Civility and Science in Seventeenth-Century England* (Chicago: Chicago University Press, 1994), esp. pp. 119–25. Shapin notes that conversation was incompatible with any one individual’s claiming exclusive authority.

There were also more formal settings that fostered scientific sociability. In an 1859 address to the Glasgow Medical Society, Thomson extolled the virtues of such institutions. He remarked that they brought together the "best students" united in "the love of knowledge and improvement"; within such societies, "the best and most lasting friendships" were formed; and above all, "the minds of the Members undergo a discipline of culture not to be obtained by solitary study or by attendance on Lectures."[92] As a model of what might be achieved through such socialization, Thomson cited the example of Johannes Müller, whose career had been "an uninterrupted succession of observations & experimental investigation": Müller had honed his scientific skills by becoming a "Member and Secretary of a students Society of naturalists in the proceedings of which he took the deepest interest."[93]

The most obvious exemplar of such a society for the early Edinburgh histologists was the Royal Medical Society. As students they all took an active part in its proceedings, and in their subsequent careers they continued to lend the RMS their support. The RMS served to inculcate investigatory practices at the outset of a medical career. There was, however, a perceived need for a mechanism to maintain and regulate that way of life among more senior members of the profession. On 4 June 1851, therefore, "a meeting of several gentlemen, interested in the progress of physiological science, was held . . . when it was resolved that a society should be instituted, having for its object the investigation of the structure and functions of all organised beings in their healthy and diseased conditions."[94]

Bennett was appointed president of the new Physiological Society of Edinburgh, and its proceedings were reported in his publication, the *Monthly Journal of Medical Science.* The avowed goal of the Society was to unify the diverse branches of organic science; its program was based on the conviction that, "instead of there being a science of Botany, a science of Zoology, a science of Physiology, and a science of Pathology, there is in truth but one science, the laws of which embrace the facts of all of these."[95] Such a broad-based biological approach was made possible by the recent discovery that "the growth of a plant and of an animal is brought about by like histological changes; physiological and pathological

92. [Allen Thomson], "[Address to] Medical Society of the University [of Glasgow]" (n. 6), p. 1.

93. Ibid., pp. 8–9.

94. "Physiological Society of Edinburgh," *Monthly J. Med. Sci.,* 1851, *13:* 90–93, on p. 90.

95. Ibid.

changes are fundamentally the same."[96] The activity of the Society was by no means confined to further histological investigation; microscopy was, however, a prominent item on its agenda.

Although Bennett presided over the Society's proceedings, and other senior figures such as Goodsir occasionally attended its meetings, the majority of its active members were drawn from the more junior ranks of the Edinburgh medical community. The prospectus of the Society declared: "at no period in the history of this school has a larger number of original investigators existed among its youthful members."[97] Many of these individuals had matriculated at the university in the early 1840s, and thus had concluded their formal studies and were in the early years of their professional lives. The goal of the Society was, however, to be inclusive: it sought "to assemble such of the students as distinguish themselves in investigation, the teachers of the Medical School, and the professors of the Faculty, to occupy ourselves with the confirmation of demonstrative facts, and a rigid criticism of the theories derived from them."[98] The criterion for admission was simple: "All who are actual labourers in the field of science may readily qualify themselves for admission by forwarding to us an original observation, which henceforth shall be the only recommendation demanded."[99]

The constitution of the Edinburgh Philosophical Society was thus republican in form. All members were endowed with equal rights; the sole qualification for citizenship was proof of scientific capacity. Bennett, who in his classroom was an autocrat, was here a first among equals. On occasion he made a point of deferring to the judgment of the collective, inviting "the members of the Society to express their views" as to the nature of a particular microscopic appearance.[100] Power was exercised within this republic; it was, however, diffused throughout the membership rather than being concentrated in the person of any one individual.

The printed proceedings of the Society give some indication of how these disciplinary mechanisms worked. But Bennett himself drew attention to the inadequacy of these reports as accounts of what occurred at the meetings: the published record conveyed "a very imperfect notion of the benefit which we derive from meeting together; considering also that demonstration of facts and a careful confirmation of new discoveries, determined by high magnifying powers, occupies our attention to no

96. Ibid.
97. Ibid.
98. Ibid.
99. Ibid., p. 91.
100. Ibid., p. 190.

small extent, it must be remembered that much that passes here is not communicable"; the true value of the Society's proceedings was not to be found in its written records, but in "the instruction obtained by each member from the co-operation of his fellows."[101] The Society thus provided an extended and more organized form of the "conversation" between observers that Bennett had held essential to counteracting the tendency to solipsism inherent in the microscopy endeavor.

One way in which the Society served to obviate this danger was by means of the collective witnessing of microscopic phenomena: individuals would present specimens for the other members of the group to view. The proceedings note that on one occasion three microscopes were employed to enable members to view tissue from a melanotic growth.[102] Seeing correctly had to be complemented by saying: after they had viewed the specimen, the members engaged in a lengthy discussion of the proper denotation of the term *melanosis*.[103] The Edinburgh Physiological Society thus performed a dual function: it provided a space in which individual judgment and utterance could be regulated—in this respect, it was *open*; on the other hand, entry into this space was strictly regulated, thus limiting the tolerated degree of disagreement about matters of fact.[104]

Members would often also submit pictorial representations of histological reality to the scrutiny of their colleagues. Thus, as part of an account of "a peculiar appearance in the blood of leucocythemia," William Tennant Gairdner "exhibited many drawings, which he had at different times made of these bodies in all their relations."[105] Such illustrations made possible a form of virtual witnessing of the fruits of Gairdner's researches by the other members of the Society. But this witnessing also ensured that his pictorial idiom took a form recognizable by his fellows; the drawings' worth as credible reports from the microscopic realm would be diminished if they failed to conform to established norms. He sought to establish a lineage for his drawings by pointing out that some of the structures he had represented had first been figured by Bennett some years before.

In conjunction, these practices tended to homogenize the range of what might be seen, described, and depicted in the microscopic realm. When these criteria were satisfied, a microscopic fact could be declared.

101. "Meeting XVII, July 13 1852," *Monthly J. Med. Sci.,* 1852, *15:* 509–12, on p. 511.
102. "Meeting III, June 21 1851," *Monthly J. Med. Sci.,* 1851, *13:* 188–94, on p. 190.
103. Ibid., pp. 191–92.
104. Cf. Shapin and Schaffer, *Leviathan* (n. 1), p. 336.
105. "Meeting VIII, July 26 1851," *Monthly J. Med. Sci.,* 1851, *13:* 491–92, on p. 492.

Thus Charles Murchison presented an illustrated account of four cases of tumor to the Society with the express aim of prompting a discussion of "the propriety or non-propriety of separating *fibro-nucleated* tumours into a class distinct from that of *fibrous* tumours."[106] This was a distinction that Bennett had drawn in one of his works, but that Murchison suggested was otiose. Bennett concluded the discussion by declaring that

> in giving the name Fibro-nucleated to a certain class of tumours, he only intended to express an histological fact. Dr Murchison's excellent drawings, and his valuable cases, show that a structure composed of nuclei and fibres does exist; and the term fibro-nucleated applied to such structures, is therefore as appropriate as the names of fibrous, fatty, and epithelial are, as distinctive of certain other forms of growth.[107]

Such declarations have an ex cathedra quality that reflects Bennett's special position within the Society. He was a first-generation histologist, and many of the members were his past or current students. His published views on histology provided the starting point for many of the observations presented to the Society. But this should not obscure the fact that judgment was expressed collectively, and that Bennett's voice was only one among several in the debates that took place.[108]

This collective judgment was embodied in a number of mechanisms. A formal refereeing process was instituted at the establishment of the Society to evaluate the various putative matters of fact brought to its attention. Individuals or ad hoc committees were appointed to seek to corroborate observations, and then to communicate their findings back to the Society. Thus on 27 March 1852 one such committee reported: "We are satisfied of the correctness of Mr Drummond's statement, that the middle coat of the [foetal] arteries is composed of fibres arranged spirally, as found and demonstrated by him"; Drummond had repeated the observation in the presence of these judges, who had agreed with the verbal account he gave of them: "we conclude, that he is right in describing the middle coat to be composed of fibres, or bundles of fibres, arranged spirally."[109] The same committee adjudicated an application for membership, concluding that "Mr Adam's paper contains sufficient evidence of his ability as a writer and observer, and [we] have much pleasure in suggesting that he be admitted a member of the Physiological Soci-

106. "Meeting II, December 6 1851," *Monthly J. Med. Sci.,* 1852, *14:* 185–90, on p. 186.
107. Ibid.
108. On occasion, Bennett's views were contradicted: see "Meeting XVIII, July 27 1852," *Monthly J. Med. Sci.,* 1852, *15:* 510–12, on p. 511.
109. "Meeting X, March 27, 1852," *Monthly J. Med. Sci.,* 1852, *14:* 185–90, p. 574.

ety."[110] Again, representational skills were seen as integral to the applicant's claim to competence.

This scrupulous examination of the credentials of those who aspired to join the Society reflected a sense that its members constituted an elite. In a presidential address, Bennett distinguished between the "practical men [who] apply scientific discoveries for the good of mankind," and the "few patient and laborious investigators who make the discoveries themselves."[111] The Society was a means of accrediting the claims of particular individuals to belong to the latter group; it was "a fundamental rule with us to admit as members those only who are both willing and able to assist us."[112] By implication, those who failed to conform to the representational and procedural conventions demanded by the Society were excluded from the body of competent microscopic observers. They were, at best, relegated to the ranks of the medical proletariat.

Conclusion

In this paper I have explored some of the aspects of the creation of a histologic discipline in nineteenth-century Edinburgh. I have, in particular, focused upon the ways in which a new form of scientific vision was created and maintained during this period. It was generally agreed that the improved microscope opened up the possibility for the human eye to penetrate hitherto-unexplored recesses of creation. But concomitant with these opportunities was the danger that a cacophony of voices would issue from this exploration. Instead of sober reports and truthful delineations, fabulous narratives and imaginary designs would spread confusion and bring the microscopic enterprise into disrepute.

The power to instil order into this chaos was initially vested in the persons of a small number of individuals who embodied histological competence and credibility. Thomson, Goodsir, and Bennett were the outstanding examples of a pioneering group who at an early stage incorporated the microscope into their professional personas; their standing in the medical community was intimately connected with their mastery of the instrument. There was an entrepreneurial aspect to this move: in a free market for medical knowledge, whatever distinguished an individual from the rest gave him a competitive advantage. Calculation of self-interest aside, however, it is clear that these pioneers also wove a

110. Ibid.

111. "Session II. (Winter 1851–52)—Meeting I.—22d Nov 1851," ibid., pp. 180–85, on p. 181.

112. Ibid., p. 180.

romance about the microscope. Bennett, in particular, made it a metonym for a new medicine, one based not on "routine practice" but on laboratory science. Those in the vanguard of this movement thus took on a heroic aspect; they were engaged in a struggle against the obscurantism that characterized too many of their professional brethren.

To pursue this contest it was necessary to recruit an army, one equipped with both the skills and the moral qualities that the life of scientific medicine demanded. Once this corps began to form, novel disciplinary devices, such as the Edinburgh Physiological Society, were required to direct their labors. Surveillance was no longer maintained by a single individual; it was now pervasive within a community of investigators. As a condition of membership of this collective, each individual submitted the veracity of his own observations to the judgment of his peers. In his presidential address to the 1853–54 session, Bennett congratulated his fellow members on what they had achieved. He boasted that the Society's "objects were now well understood, and the principles on which it was founded had been adopted by similar institutions abroad": thus the Medical Society of London had "commenced a series of Physiological meetings, which indicated the desire generally expressed, if not always carried out, of founding the practice of medicine on a scientific basis."[113] He also cited similar societies in Paris and Würzburg dedicated to the same goals by comparable means. Whether or not Bennett's inference that such other societies had been founded in direct emulation of the EPS is correct, their inauguration does suggest that the pattern of discipline formation evident in Edinburgh was mirrored elsewhere.

An obvious direction for further study would be to conduct case studies of the origins of histology in other centers in order to determine how typical or otherwise the Edinburgh model was. For Britain, the most obvious point of comparison would be London, where—thanks to the efforts of workers like John Quekett, Robert Bentley Todd, and William Bowman—a comparable, if not rival, school of microscopy had emerged by the middle of the nineteenth century. Although some work has explored such developments as the origins of the Royal Microscopical Society,[114] more needs to be done to elucidate the creation of a histological school in the capital. Of particular interest is whether there was any clash of cultures when the native London tradition encountered Scottish immigrants such as Sharpey. Similarly, a study of Allen Thomson's activi-

113. "Session 1853–5. Meeting I, Nov 19 1853," *Monthly J. Med. Sci.,* 1854, *18:* 79–85, on p. 79.

114. Gerard L'Estrange Turner, *God Bless the Microscope! A History of the Royal Microscopical Society over 150 Years* (Oxford: Royal Microscopical Society, 1989).

ties as a teacher of histology after he moved to Glasgow in 1848 would illuminate how far the novel local conditions forced an adaptation of the Edinburgh methods of pedagogy. Existing studies reveal scope for comparable investigations within other national contexts: the medical schools of Philadelphia, Boston, and New York, for instance, all developed their own histological practices in the middle decades of the nineteenth century.[115]

Recent years have seen an admirable trend toward the writing of a "social history" of the microscope.[116] Instead of an exclusive emphasis on instruments, or on the bodies of knowledge that issued from their use, historians have begun to examine the contexts in which the microscope was deployed, the various constituencies that made use of it, and the cultural ramifications of these endeavors. The creation and dissemination of microscopic skill and competence was, however, also a social achievement, one that offers rich scope for future research.[117] While such studies require a finer focus than most social historians of microscopy have hitherto adopted, the links between local activities and the emergent ethos of scientific medicine, for which the microscope became so potent a symbol, should always be borne in mind.

115. Deborah Jean Warner, "The Campaign for Medical Microscopy in Antebellum America," *Bull. Hist. Med.,* 1995, *69:* 367–86.

116. Stella Butler, R. H. Nuttall, and Olivia Brown, *The Social History of the Microscope* (Cambridge: Whipple Museum of the History of Science, 1986); J. A. Bennett, "The Social History of the Microscope," *J. Microsc.,* 1989, *155:* 267–80; John Harley Warner, "'Exploring the Inner Labyrinths of Creation': Popular Microscopy in Nineteenth-Century America," *J. Hist. Med. & Allied Sci.,* 1982, *37:* 7–33.

117. For a rare attempt to combine a discussion of the rhetoric surrounding the microscope with a study of the mechanisms whereby technical competence was imparted, see Gooday, "'Nature' in the Laboratory" (n. 35).