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JOHN HUGHES BENNETT: A CATALOGUE OF SOME SURVIVING ARTEFACTS

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A number of items connected with John Hughes Bennett have been preserved in his old department within the University of Edinburgh, now the Department of Physiology. In 1981, through the initiative of Professor William E. Watson, these were transferred into the care of the National Museums of Scotland, where they have been on display in the 'Instruments of Science' gallery. Some of the more important material, together with a number of items which help to provide a context for Bennett's work, were gathered together to form a display at the Royal College of Physicians of Edinburgh to coincide with the John Hughes Bennett anniversary meeting in September 1995, organized by the Leukaemia Research Fund.

John Hughes Bennett (1812-1875) became a medical student at the University of Edinburgh in 1833. After a brilliant undergraduate career he obtained his MD in 1837 and spent the next four years on the mainland of Europe in postgraduate study. At this time, British medical teaching was still conservative and in many respects perhaps lagged behind continental practice. Whilst in Paris he attended Alfred Donné's pioneering course on medical microscopy, which encouraged Bennett to start a similar lecture series on his return to Edinburgh in 1841, the first course on the systematic use of the microscope for medical students of any British university. The advertisement (Catalogue No. 1) (Fig 1) survives from his second term of extra-mural instruction. Bennett believed that every medical practitioner should possess a microscope, including students, and his writings promoted those instruments made for the student market by prominent continental makers such as Georges Oberhaeuser of Paris (Catalogue No. 2), which were sturdy and relatively inexpensive. He stressed the instrument's value in clinical diagnosis. His own discovery and description of a disease of the blood in 1845, now known as leukaemia, was based on careful microscopy.

Bennett especially recommended a portable microscope (Catalogue No. 3) (Fig 2) which he found 'exceedingly convenient in visiting patients', in the *London and Edinburgh Monthly Journal of Medical Science*, a periodical he both owned and edited. This microscope was Bennett's own, designed by a French doctor friend of his, and made by the Parisian optician Johann Brunner. In his influential textbooks and lectures, Bennett recommended the portability and optical superiority of the microscopes made by continental instrument makers against the weight and expense of those made by English opticians. However, in 1848, the year he became professor of the Institutes of Medicine at Edinburgh, he ordered a microscope from the pre-eminent London maker Andrew Ross, for which the bill survives (Catalogue No. 4) (Fig 3) , although the instrument itself (Catalogue No.5) (Fig 4) is now incomplete.

A slightly later microscope, made by Nachet of Paris, shows Bennett's concern with student appreciation of microscopy (Catalogue No.6) (Fig 5): an instructor and two students can view the same specimen simultaneously. By the end of Bennett's teaching career in 1874 he had overcome much of his earlier hostility to English-made microscopes: the class certificate (Catalogue No.7) (Fig 6) shows two

continental instruments in the background, while the *putti* concentrate their attention on a microscope made by James Smith of London.

Bennett's interest in the medical use of the saccharimeter provides a good example of his approach to new instrumentation of the mid-nineteenth century: this instrument is a form of polarimeter used to examine sugars in solution using optical polarization effects. In the earliest forms of the polarimeter, developed from Etienne Malus' discovery of polarization by reflection in 1808, the polarizer was usually a single sheet of black glass, and the analyzer a similar glass plate or a simple rhomb of Iceland spar. This later example (Catalogue No.8) by Deleuil of Paris uses a polarizer of this type. The Scotsman Sir David Brewster and the Frenchman Jean Baptist Biot both continued work in this area. Brewster discovered the law, which bears his name, in investigations which laid the basis for the science of optical crystallography, while Biot discovered that several naturally-occurring compounds, such as sugar, can rotate the plane of polarized light.

The instrumentation which developed from this work on both sides of the Channel was greatly helped by the invention of the Nicol prism in 1827, by William Nicol, an Edinburgh teacher and amateur geologist (Catalogue No.9). Both the saccharimeter (Catalogue No.10) and the polarimeter (Catalogue No.11) were developed into more useful and versatile instruments, which could operate with white light rather than being restricted to monochromatic light sources. The saccharimeter's widest use was in breweries for process and quality control and also in the food industry, to check for adulteration and to regulate the duty levied on sugar. In medicine, the instrument was used in the analysis of sugar levels in diabetic urine, then known as one of the principal indicators of diabetes. John Hughes Bennett suffered from this disease himself from about 1865. Two examples of saccharimeters (Catalogue Nos.12 and 13) (Fig 7) from Bennett's Edinburgh department survive. They were made by the Parisian firm of Duboscq-Soleil-Pellin, dating from the late nineteenth century, and it seems likely that Bennett would have used the earlier of these. The modern physical explanation of rotary polarization by organic molecules had to await the work undertaken during the second decade of the twentieth century.

Literature: Biographical information about Bennett from DNB IV (1885), McKendrick (1875a) and (1875b). For his circle, see Lonsdale (1868). For the background to histology, and microscopy in medicine, see Reiser (1978), 69-90 and Bracegirdle (1977) and (1978). For the history of the polarimeter in diagnostic medicine, see Davis and Merzbach (1994).

CATALOGUE OF THE ITEMS INCLUDED IN THE NATIONAL MUSEUMS OF SCOTLAND EXHIBITION AT THE ROYAL COLLEGE OF PHYSICIANS OF EDINBURGH, 27 SEPTEMBER 1995.

1. Handbill for Bennett's Second Course of Lectures on Histology, 1842

Bennett returned to Edinburgh from the Continent in 1841, and in November he began his pioneering lecture course on the use of the microscope in medical studies, of which the first lecture was published as a pamphlet that year. Subsequently an amended version appeared in the *Lancet*. This printed handbill, dated 2nd May 1842, is advertising Bennett's second course of lectures on histology at 16 Pitt Street, Edinburgh, and his private course on practical manipulation of the microscope. Bennett states that 'These lectures will be illustrated by numerous preparations, diagrams, and demonstrations under the microscope; the latter by means of twelve achromatic instruments of great power, manufactured by Chevalier of Paris expressly for this course.' Unfortunately, none of these instruments appear to have survived.

Source: Department of Physiology, University of Edinburgh: on loan to the National Museums of Scotland.
Literature: Bennett (1841); review of ibid., in Anon. (1841); Bennett (1845). Exhibited in Anderson and Simpson (1976), item 357. For Chevalier, see Brenni (1993).

2. Student microscope: G. Oberhaeuser et E. Hartnack, Paris, c. 1860
The Bavarian-born Parisian microscope maker Georges Oberhaeuser reintroduced a version of the drum microscope in 1835, which he patented in 1837. The pattern shown evolved from this, and using achromatic lenses, it became established amongst continental microscope makers for the rest of the century as a fairly cheap and simple type of instrument, well within the reach of the student pocket. As such, it was recommended by Bennett as 'an excellent microscope ... by Oberhaeuser, with two objectives ..., two eyepieces, ... a neat box with all the accessories necessary (with the exception of a micrometer, which had better be English) ... will cost in Edinburgh, after payment of carriage and duty, about seven guineas.' Oberhaeuser took his nephew Edmund Hartnack into business in 1857, and retired in 1860. That year, the total number of microscopes manufactured in Europe may have reached 2000.

Source: National Museums of Scotland, purchased.

Literature: Bennett (1858), 61-70; for Oberhaeuser, see Harting (1866), III, 148-156 and Otto (1970); for the development of the Continental microscope stand, see Nias (1893). Microscope production is discussed by Nuttall (1979), 55.

3. Pocket achromatic microscope: Brunner à Paris, c.1846
While in Paris, Bennett attended a private course of lectures on the use of the achromatic microscope with Dr David Gruby of Vienna. This pocket microscope, designed by Gruby, cost £6, and belonged to Bennett. He denigrated British-made microscopes as 'cumbrous machines' and 'a mass of brasswork and screws'. As Editor of the medical journal in which this instrument was first described in 1846, he commented: 'We have had one of those instruments in our possession upwards of a month, and have found it exceedingly convenient in visiting patients, and in making post-mortem examinations at private houses.'

Source: Department of Physiology, University of Edinburgh: on loan to the National Museums of Scotland.

Literature: Gruby (1846); Bennett (1858), 66-7; Harting (1866), III, 166-7; Guthrie (1963), p.220 and plate 9; exhibited, Anderson and Simpson (1976), item 358. For Brunner, see Payen (1985). Another example of this microscope is in the collection of the Royal Microscopical Society, London: see Turner (1989), 213.

4. Invoice for an achromatic microscope by Andrew Ross, London, 1848
In spite of Bennett's stated preference for continental instruments for students and portable diagnostic use, he nonetheless acquired for his own use one of the best London-made instruments of its day. This invoice for 'A Complete Microscope', at a basic price of 18 guineas, together with numerous accessories, came to a total of £70 12s 6d, and is dated 20th October 1848, shortly after Bennett was 'unanimously elected to the chair of Institutes of Medicine in the University of Edinburgh'. In the second (1858) and subsequent editions of his textbook, *Principles and Practice of Medicine*, in which he devoted considerable space to 'The Use of the Microscope', he wrote:

> ... I consider that the London opticians are pre-eminent, for I am not aware that in any part of the world such perfect objectives have been manufactured as the eighth of an inch by Smith, the twelfth of an inch by Ross, and the sixteenth of an inch by Powell.

This invoice shows that Bennett paid 12 guineas for just such an objective made by Andrew Ross, although unfortunately it does not survive.

Source: Department of Physiology, University of Edinburgh: on loan to the National Museums of Scotland.

Literature: Bennett (1858), 67. For Andrew Ross, see Nuttall (1979b); Turner (1989), 154-70 and Simpson (1994). For microscope optics at this period, see Deiman (1992).

5. Achromatic microscope: Andrew Ross, London, 1848

This monocular achromatic microscope is signed on the foot 'A. ROSS, LONDON N° 510', although it is now sadly very incomplete: of the six original objectives, the twelfth of an inch is now missing. Ross first described his bar-limb instrument in 1843, and by 1846 had added two further versions - larger and smaller models of the 1843 microscope - to his repertoire. This one can be identified as the 18 guinea middle version, both from the surviving invoice, and from a trade catalogue of 1846. Although Bennett thought that the optics of London-made microscopes were pre-eminent, he had reservations:

> ... when we come down to the one-fourth of an inch, which is by far the most useful objective for anatomical and medical purposes, the superiority of the London opticians is very slight, if any ... I cannot employ Ross's fourth of an inch for fifteen minutes without feeling intense headache.

But he reserved his most severe criticism for the mechanical aspects of the large instruments manufactured in London, emphasising his continued preference for Continental instruments for portable use:

> The large London instruments require an equipage or a porter to transport them from place to place; even the putting them in and out of the large boxes or cabinets that are built around them, is a matter of labour. In short, notwithstanding the splendour of the screws, the glittering of the brass, and the fine workmanship, there can be little doubt that, on the whole, they are clumsy affairs.

Source: Department of Physiology, University of Edinburgh: on loan to the National Museums of Scotland.

Literature: Ross (1843); Bennett (1858), 64-70; for Ross's microscopes, see Nelson (1900); Nuttall (1979a), 46; Nuttall (1979b); Morrison-Low and Nuttall (1982); Turner (1989), 154-70 and Simpson (1994); for the optics, see Deiman (1992), especially pp.139-142 and appendix 8.

6. Triple demonstration microscope: Nachet et Fils, Paris, c.1860

A preparation made by one person can be watched by two passive observers, using this instrument. The Parisian firm of Nachet et Fils of Paris offered such instruments for sale between 1856 and 1872. This example was purchased by the University of Edinburgh for use in the department during Bennett's professorship. Camille Nachet was one of the most prominent Parisian opticians, who had learned his trade in the workshops of Charles Chevalier, starting up on his own account in 1839. He became famous as an exporter of inexpensive dividing objectives, many of which found their way to the British market. His first instruments were based on Oberhaeuser's pattern, but gradually his microscopes became influenced by the better London models. His incorporation of a prism to allow more than one observer to view a preparation, was advertised as his 'microscope à trois corps'. For the period before photomicrography, this was considered the best method of student instruction.

Source: Department of Physiology, University of Edinburgh: on loan to the National Museums of Scotland.

Literature: For Nachet's microscopes, see Harting (1866), III, 247 and Turner (1979).

7. Class certificate: University of Edinburgh, Practical Physiology, 1871
This certificate, signed by Bennett, acknowledges the attendance of an undergraduate named Franklyn S. Fraser at his summer course of practical physiology in 1871: this course had been first offered in 1862. Decorative class cards were issued by professors to students to demonstrate that they had fulfilled University attendance requirements. This example shows Bennett's enthusiasm for the practical use of scientific instruments in diagnosis in the cartouche at the top. On the shelf, two Continental microscopes can be identified: at left, a 'Universal' instrument by Charles Chevalier, with Oberhaeuser's student model in the centre. The two *putti* are using a London-made instrument by the pre-eminent maker James Smith, dating from about 1840. The 'roll of honour' upon which the peering *putto* stands, contains the names of Bennett's heroes of his own subject: Malpighi, Grew, Lewenhoeck, Fontana, Ehrenberg, Berzelius, Mittcherlich, Prout and Liebig.

Source: National Museums of Scotland, purchased.

Literature: For class cards, see Anderson and Simpson (1976), 60.

8. Polariscope: Deleuil à Paris, c.1850.
This device uses a black glass mirror polarizer (and a Nicol prism analyzer) to demonstrate that light is polarized when reflected at a critical angle. This angle is now known as 'Brewster's Angle', after the Scottish physicist Sir David Brewster, although the effect was discovered in 1808. This example was made by Deleuil of Paris in about 1850: a trade catalogue of about that date describes 'Appareil pour la polarization, d'après celui qui est décrit dans la *Physique* de M. Biot: 200 [francs]'.

Source: National Museums of Scotland, purchased.

Literature: For Deleuil see Payen (1985); also Deleuil (1846), item 888.

9. Nicol prism: unsigned, c.1900
The Nicol prism is a device which polarizes light by exploiting the ability of crystalline Iceland spar to split incident light into two beams with different characteristics: one beam is extracted at an internal surface and by choosing an appropriate geometry, the emerging beam can be fully polarized. Used in pairs, as polarizer and analyzer, the Nicol prism enabled minerals to be identified from optical characteristics which derive from their crystal structures. It can also be used in polarimeters, where by rotating one prism relative to the other, it was found that the brightness of the reflected beam could be varied and even extinguished.

Source: National Museums of Scotland, Hugh Auld Collection.

Literature: Nicol (1829); for Nicol, see Morrison-Low (1992).

10. Saccharimeter: Soleil, Paris, c.1845
The first polarimeter specifically adapted to measure sugar concentration was developed by François Soleil in 1845: it employed Nicol prisms and was adapted for use with white light. It was developed from the polarimeter, an instrument which uses the Nicol prism as polarizer and analyzer. This early example (no. 76) was acquired by Peter Guthrie Tait, who was professor of natural philosophy (now physics) at the University of Edinburgh, and was a contemporary of Bennett.

Source: National Museums of Scotland, from the Natural Philosophy Classroom of the University of Edinburgh.

Literature: Pellin (1900), fascicule VIII, 1-14; For the firm of Duboscq-Soleil-Pellin, see Brenni (1994) and Simpson (1994).

11. *Polarimeter: Schmidt & Haensch, Berlin, c.1870*
The polarimeter continued to be refined for the analysis of 'optical activity' - the rotation of the plane of polarization in a column of liquid containing a sugar or a similar solution. A variety of sophisticated instruments were produced, which allowed direct reading of concentrations, and this is one of the range of such instruments produced by the leading manufacturer of polarimeters in the period leading up to the First World War, the Berlin firm of Schmidt & Haensch.

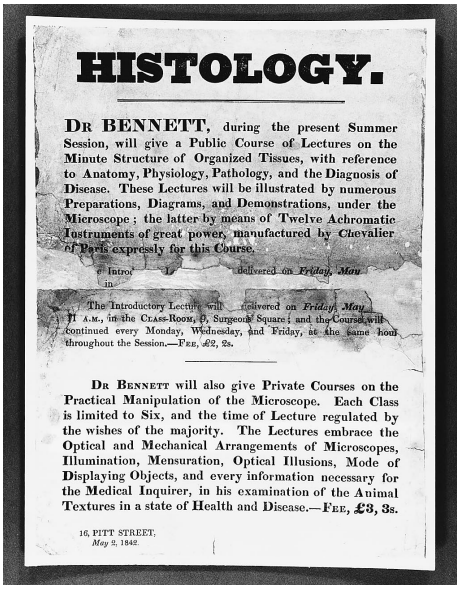
Source: National Museums of Scotland, purchased.

Literature: Reichsdruckerei (1900), 97-104; For the firm of Schmidt & Haensch, see Brachner (1985) and Davis and Merzbach (1994).

12 and 13. Saccharimeters: J. Duboscq, Paris, c.1870 and Ph. Pellin, Paris, c.1890
The saccharimeter was widely used in breweries and more generally in the food industry for process and quality control. Perhaps its most significant use was in medicine, where it was being used in Paris from at least 1839 to analyze glucose levels in urine. Although Bennett would have been drawn to this new form of diagnostic instrumentation, he also came to have a personal interest, as he is understood to have developed diabetes himself in about 1865. These two French-made instruments survive from his old department, although only the earlier of them can have been used by him.

Source: Department of Physiology, University of Edinburgh: on loan to the National Museums of Scotland.

Literature: Pellin (1900), fascicule VIII, 1-14; Morrison-Low (1990). For the use of the saccharimeter in the diagnosis of diabetes, see Davis and Merzbach (1994). For the firm of Duboscq-Soleil-Pellin, see Brenni (1994) and Simpson (1994).



HISTOLOGY.

DR BENNETT, during the present Summer Session, will give a Public Course of Lectures on the Minute Structure of Organized Tissues, with reference to Anatomy, Physiology, Pathology, and the Diagnosis of Disease. These Lectures will be illustrated by numerous Preparations, Diagrams, and Demonstrations, under the Microscope; the latter by means of Twelve Achromatic Instruments of great power, manufactured by Chevalier of Paris expressly for this Course.

The Introductory Lecture will be delivered on *Friday, May* 11 A.M., in the CLASS-ROOM, 6, Surgeon's Square; and the Course will be continued every Monday, Wednesday, and Friday, at the same hour throughout the Session.—FEE, £2, 2s.

DR BENNETT will also give Private Courses on the Practical Manipulation of the Microscope. Each Class is limited to Six, and the time of Lecture regulated by the wishes of the majority. 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.—FEE, £3, 3s.

16, PITT STREET,
May 2, 1842.

FIGURE 1.
Handbill for Bennett's Second Course of Lectures on Histology, 1842.

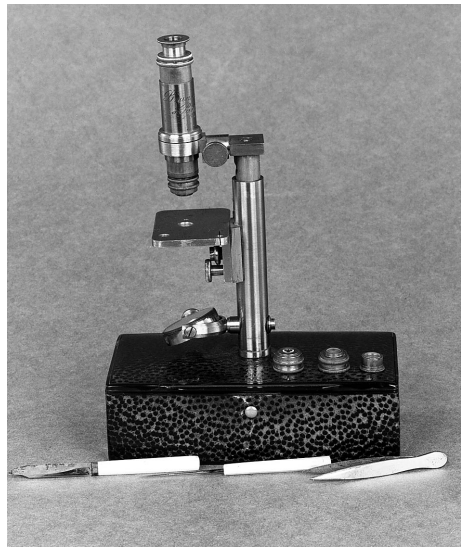
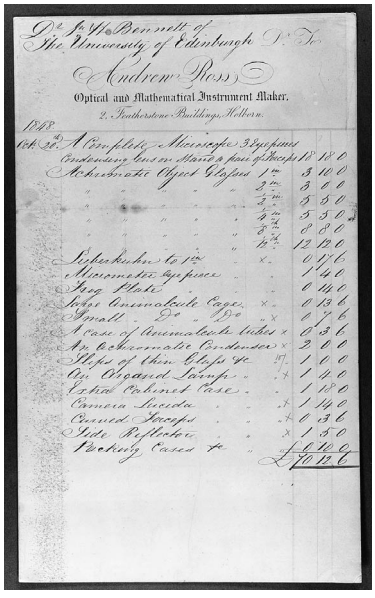


FIGURE 2.
Pocket achromatic microscope: Brunner à Paris, c.1846.


Dr. to Dr. J.H. Bennett of
The University of Edinburgh Dr. to
Andrew Ross
Optical and Mathematical Instrument Maker,
2, Featherstone Buildings, Holborn.

1848		
10th Dec.	A Complete Microscope 3 Eyepieces Condensing lens on stand & pair of Forceps	18 18 0
	Achromatic Object Glasses 1st	3 10 0
	" " " " 2nd	3 0 0
	" " " " 3rd	3 3 0
	" " " " 4th	3 3 0
	" " " " 5th	2 8 0
	" " " " 6th	12 12 0
	Lifeclusher to 1st	0 17 6
	Micrometer Eyepiece	1 4 0
	Frog Plate	0 14 0
	Large Animalcule Cage	0 13 6
	Small Do Do	0 7 6
	A case of Animalcule tubes	0 3 6
	An Achromatic Condenser	2 2 0
	Slips of thin Glass &c	1 1 0
	Gas Argand Lamp	1 4 0
	Ivory Cabinet Case	1 18 0
	Camera Lucida	1 14 0
	Curved Forceps	0 3 6
	Side Reflector	1 3 0
	Pockety Cases &c	1 10 0
		£70 12 6

FIGURE 3.
Invoice addressed to Dr J.H. Bennett for an achromatic microscope by Andrew Ross, London, 1848.

FIGURE 4.
Achromatic microscope: Andrew Ross, London, 1848.

FIGURE 5.
Triple demonstration microscope: Nachet et Fils, Paris, c.1860.

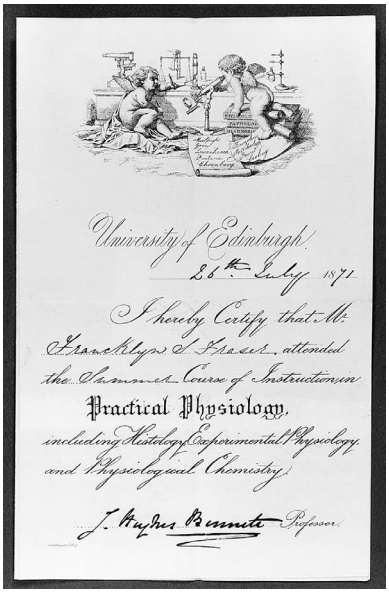

University of Edinburgh
28th July 1871
I hereby Certify that Mr Franchlyn S Fraser attended the Summer Course of Instruction in
Practical Physiology,
including Histology, Experimental Physiology, and Physiological Chemistry.
J. Hughes Bennett Professor.

FIGURE 6.
Class certificate: University of Edinburgh, Practical Physiology, 1871.

FIGURE 7.
Saccharimeters: J. Duboscq, Paris, c.1870 and Ph. Pellin, Paris, c.1890.

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