

The Graham Steell murmur: eponymous serendipity?

ABSTRACT—On 7 March 1888 Dr Graham Steell addressed the Manchester Medical Society in the premises of the Literary and Philosophical Society in George Street, Manchester. He chose as his subject 'The auscultatory signs of mitral obstruction and regurgitation', and later that year published two papers on the same theme in the *Manchester Medical Chronicle* [2,3]. In one he wrote: 'I wish to plead for the admission among the recognised auscultatory signs of disease of a murmur due to pulmonary regurgitation, such regurgitation occurring independently of disease or deformity of the valves, and as the result of long-continued excess of blood pressure in the pulmonary artery' [3]. His observations were later confirmed by pathological correlation [4], and more cases were reported, notably by Paul White [5]. The early diastolic murmur of pulmonary incompetence caused by pulmonary hypertension is now associated eponymously with Dr Graham Steell. We review the life and work of this physician and conclude that the original source of the observation, subsequently validated by modern techniques, was probably George Balfour of Edinburgh, and that Graham Steell was fortunate to have this physical sign attributed to him.

Background

De grace, un peu moins de science,
un peu plus d'art, Messieurs

Trousseau, quoted by Steell [1]

Graham Steell was born in Edinburgh in 1851. He came from an artistic family, his grandfather being a woodcarver and his uncle the Curator of the National Gallery of Scotland. His father, later Sir John Steell, was the foremost sculptor of his time, and his works include the statue of Sir Walter Scott for the Scott Monument in Edinburgh, a memorial to Prince Albert in Charlotte Square, and an equestrian statue of the Duke of Wellington in Princes Street (known locally as the 'Iron Duke in bronze by Steell'). Graham, however, showed no inclination to follow an artistic career and hoped to join the army after completing his education at Edinburgh Academy. Instead, he was persuaded by his brother to study medicine, and qualified from Edinburgh University in 1872.

ALAN G. FRASER, MB, MRCP, *Senior Registrar*
CLIVE F. M. WESTON, MB, MRCP, *Research Registrar*
Department of Cardiology, University Hospital of
Wales, Cardiff

Medical career

After spending a winter in Berlin, studying medicine and learning German, Steell became house physician to Dr George Balfour (1823–1903) in the Royal Infirmary of Edinburgh. Balfour was a prominent Scottish physician, and from him Steell acquired a lifelong interest in heart disease. He then left Edinburgh to work first at Stirling Infirmary and Dispensary, and later at fever hospitals in London and Leeds. During this time he contracted both typhoid and typhus, but he also collected the clinical material for his MD thesis *On scarlatina*. This comprised 66 handwritten foolscap pages, including corrections, and contained detailed charts of four patients with scarlet fever and others with enteric fever or typhus; for it Steell received a gold medal from the University of Edinburgh in 1877. In June 1878 he became resident medical officer at Manchester Royal Infirmary. He lived in the hospital for five years, being constantly on call; apart from holidays, he rarely strayed more than half a mile from the grounds.

The Lancashire cotton industry was then at its zenith, social conditions were poor, and illness common. Infections were rife and the in-patient mortality rate was more than 10%.

Although Steell amassed considerable clinical experience, his excessive workload exacted a heavy personal toll. He was of slight build and below average height, and on arrival in Manchester had been described as a 'very delicate skeleton of a man' (Fig. 1). Later he became even thinner, looked pale and 'alarmingly ill', and in 1888 contracted tuberculosis. He was given leave of absence and went south to recover although it was thought that his prospects of doing so were not good. Nevertheless, he returned to work a stone heavier in weight and sporting a beard, though he was to suffer chronic bronchitis from this time on. In spite of his frail frame, Steell had been a champion boxer as a student, and as a resident he used to spar after work with a surgical colleague. He was an early advocate of the beneficial effects of physical exercise, for example recommending horse riding for patients with mild disability.

In 1883 Graham Steell was appointed to the staff of Manchester Royal Infirmary as Assistant Physician, after spending the unusually long period of ten years resident in hospitals as a junior doctor. Steell had sent 25 testimonials to the Appointments Committee in Manchester, including recommendations from Clifford Allbutt, later Professor of Physic at Cambridge, and Lauder Brunton, the pioneer of nitrates for angi-

na. To judge by his testimonials, Graham Steell was a conscientious and skilful clinician who showed great kindness and consideration to his patients, but he was also unusually reserved and desperately shy. He spoke laconically with a rather nasal twang, so that communication with his patients was difficult, and junior staff not infrequently had to cover up for his gaucheries, especially with female patients. Perhaps as a result of his diffidence, Steell was slow to establish a private practice although he eventually became the leading cardiologist in the North of England.

Graham Steell used a monaural stethoscope made of light boxwood which had a large bell ear-piece, and was of unusual length: 'longer than a flea could jump'. He worked without other diagnostic aids. Although his first paper was on the measurement of urea, no laboratory was established in the Manchester Royal Infirmary until 1898. Furthermore, X-rays were only possible from 1904 onwards after part of the hospital chapel had been painted black and partitioned off for this purpose. A string galvanometer for electrocardiographic recordings was not available in Manchester until two years before his retirement.

Steell was an enthusiastic bedside teacher who revelled in the interpretation and discussion of physical signs. His rule in clinical practice was 'never to trust to one physical sign' [6]. While he was a resident medical officer, he wrote two small books for medical students on clinical examination techniques [6,7]. When first asked to accept the post of lecturer he did so only under pressure, but later was reluctant to relinquish his teaching commitments. In 1907 he was elected to the Chair of Clinical Medicine of the Victoria University of Manchester. Although his bedside teaching was greatly appreciated, his lecturing technique was extremely poor. He used to read verbatim from crumpled pieces of paper in an old-fashioned, discursive style. When he had difficulty in reading his own writing, he would finish in mid-sentence and move on to the next one without comment; once he even finished a lecture abruptly without completing the sentence when the bell interrupted him. Rather unkindly but perhaps not unfairly, a cartoon in the *Manchester Medical Students' Gazette* of 1902 depicts Steell in the operating-cum-lecture theatre addressing an audience of only three students!

Steell seems to have had few interests outside medicine, but he was a staunch member of the Manchester Medical Society, and served as its president in 1897. Elsewhere, he was probably too reticent to be an effective committee man or medical politician. It is possible that his shyness was a reaction to the fame and attention which surrounded his family when he was young, but it certainly limited his potential.

Steell wrote about 50 medical papers, always as sole author. Most were published in the *Manchester Medical Chronicle*. For example, he reported that a palpable gallop rhythm at the apex is a sign of failure [8], and he advocated reliance on symptoms rather than signs



Fig. 1. Dr Graham Steell (1851–1942) photographed as a young man (Courtesy of Miss P. Cummings, Manchester Medical Collection.)

when diagnosing cardiac muscle failure [9]. He recognised similarities between the heart failure of alcoholic heart muscle disease and that of malnutrition or beriberi, since both were associated with neuritis [10,11]. He felt that left ventricular function determined the prognosis of heart disease, sharing this view with James MacKenzie who is widely credited with the concept. MacKenzie was a personal friend who used to visit Steell's wards from his practice in Burnley, while Steell himself was usually absent. Apart from this contact, Graham Steell seems to have made little impact on the emergence of modern cardiology, epitomised by MacKenzie and Lewis [12]. Nevertheless, he was one of the first three honorary members of the British Cardiac Society, and MacKenzie described Steell's textbook on heart disease [13] as 'by far the best book on the heart'. then available, full of 'pungent and pithy remarks and a delight to read' [14].

In 1886 Steell married Agnes McKie, who had come from Glasgow to become Lady Superintendent (Matron) of Manchester Royal Infirmary in 1881. They had one son who became a doctor and with whom Graham Steell lived following his retirement and his wife's death. In later life he had a sizeable plot of land added to his own garden so that he could ride his horse on a special circular track but avoid contact with traffic on the roads.

After 33 years on the staff of the Manchester Royal Infirmary he retired reluctantly in 1911 at the statutory age of 60; true to form, he declined the offer of a

retirement dinner. That same year he gave the Bradshaw Lecture at the Royal College of Physicians in London, on thoracic aneurysm [15]. In retirement he pursued a dwindling private practice for a few years, and he was eager to discuss recent developments with practising physicians. In old age his health deteriorated. He had heart trouble from the age of 47, with a grossly irregular heart beat, and ultimately he experienced paroxysms of dyspnoea. He also had tic douloureux, and one year before he died at the age of 91 his sight failed, preventing him from reading which was his greatest pleasure. Despite his enthusiasm for clinical medicine he became rather wistful, writing that 'clinical medicine seems to me at the present moment to be in danger of losing something of its old charm, and in the future of losing much more' [15].

The Graham Steell murmur

Graham Steell observed a soft blowing early diastolic murmur at the upper left sternal edge in some patients who had mitral stenosis and a normal arterial pulse. He noted that it was 'not usually constant, at least when first developed', and he associated it with a palpable pulmonary second sound although not with a right ventricular heave [3,6]. He suggested that this murmur was due to pulmonary regurgitation caused by high pressure in the pulmonary artery.

Since 1888, each new diagnostic technique in cardiology has confirmed Steell's observations. Pulmonary regurgitation has been demonstrated by phonocardiography [16], and by platinum electrode [17] or dye dilution [18] techniques at cardiac catheterisation. The Graham Steell murmur is increased in intensity on inspiration, and reduced during a Valsalva manoeuvre. It may disappear after cardiac surgery [19]. More recently, Doppler echocardiography has confirmed that the velocity of pulmonary regurgitant flow correlates with pulmonary artery pressure [20]. When good quality echocardiographic images are obtained, colour Doppler techniques demonstrate that all normal individuals have a trivial whiff of pulmonary regurgitation, but the regurgitant jet is short and of low velocity, and it is not associated with an audible murmur [21]. However, when a pulmonary early diastolic murmur is audible, pulmonary regurgitation is more severe and pulmonary hypertension is present [21]. A typical Doppler echocardiographic tracing from a patient with mitral stenosis and a Graham Steell murmur is illustrated in Fig. 2.

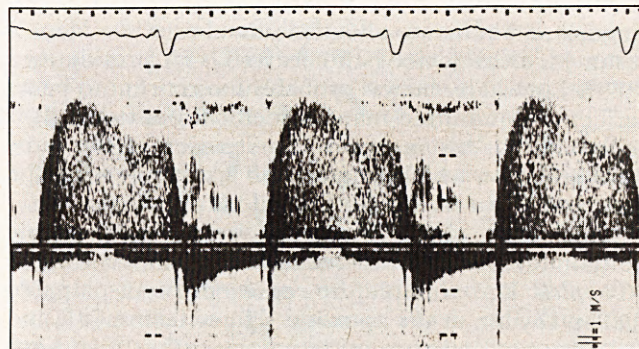
Graham Steell had no reliable means of differentiating between pulmonary regurgitation and trivial aortic regurgitation associated with a normal pulse, and for this reason some authors have disputed the origin of his murmur. Sir Thomas Lewis thought that a Graham Steell murmur should never be diagnosed without X-ray evidence of a dilated pulmonary artery [22]. Runco noted that patients with mitral stenosis frequently had mild aortic regurgitation and a normal

arterial pulse [23], and Brest stated that the Graham Steell murmur was due to aortic regurgitation [24], but most patients in both series did not have clinical or haemodynamic evidence of pulmonary hypertension. These comments therefore do not invalidate reports that isolated pulmonary regurgitation does occur in mitral stenosis, due to dilation of the pulmonary valve ring from pulmonary hypertension [25], but it is a rare event. Paul Wood found the murmur in only 10% of surgical cases and 1% of medical cases with mitral valve disease, always in association with a high pulmonary vascular resistance (>6 units) [26], and Steell himself in a review of patients with mitral stenosis found the sign with certainty in only one of 60 cases examined [27]. However, it may be present in as many as 75% of patients whose mean pulmonary arterial pressure exceeds 50 mm Hg [28]. The murmur also occurs in severe pulmonary hypertension from other causes, such as atrial septal defect or primary pulmonary hypertension.

Earlier descriptions

In retrospect, and perhaps like many other eponyms, the Graham Steell murmur may have been attributed fortuitously. Like Austin Flint, Steell resisted having his name attached to a heart murmur. He first referred to the murmur in his book *The physical signs of cardiac disease* published in 1881, when he divided regurgitant murmurs into those due to valvular disease and those due to yielding of the valve ring secondary to dilation of the adjoining cavity. He further stated: 'I am inclined to believe that a murmur of similar mechanism occurs on the right side of the heart, when there is much obstruction to the pulmonary circulation with a dilated pulmonary artery' [7].

Fig. 2. Continuous wave Doppler echocardiogram of flow in the right ventricular outflow tract and main pulmonary artery in a patient with mitral stenosis, recorded from a left upper parasternal approach. Diastolic regurgitant flow is seen towards the transducer, starting after the second (pulmonary) component of the second heart sound signal. The velocity of flow indicates that the pulmonary artery diastolic pressure is more than 40 mm Hg.



As a footnote he mentioned that his former chief at the Royal Infirmary of Edinburgh, George Balfour, had described the same murmur heard over the pulmonary area [29] (the 'region of romance', as Balfour sarcastically called it), although their ideas on its aetiology differed. Balfour, although he was aware that the murmur was associated with a raised pulmonary pressure, believed that it was produced directly from blood-flow through a stenosed mitral valve.

It appears that James Hope in his *Treatise on the diseases of the heart and great vessels* (first edition 1832) was the first physician to describe a pulmonary regurgitant murmur [30]. In Sir Clifford Allbutt's *System of medicine* (published in 1910) credit is given to John Hunter for first suggesting the mode of production of functional pulmonary incompetence, and to William Stokes for further writings on the matter [31]. In 1888 before Steell's article was published, a case report from Sir Dyce Duckworth appeared in the *British Medical Journal* [32], and in 1894 further cases were documented by George Gibson [33]. Gibson quoted both Steell and Duckworth, but claimed some precedence because of earlier experimental work in which he had shown that human cadaver pulmonary valves were incompetent when subjected to fluid under high pressure. However, like Steell, Gibson had been house physician to George Balfour, so perhaps it is to Balfour that most credit is due.

It seems likely that the eponym was first used in North America following the publication of Osler's *Principles and practice of medicine* in 1898. Although Osler mentioned both Gibson and Steell in the context of the murmur, it is Steell's description that he quotes [34]. By 1914 the usage was established [35].

Conclusion

Graham Steell was perhaps the archetypal Victorian physician. He was a dedicated and industrious doctor whose long apprenticeship gave him much experience, which few today could match. It would be a pity if the clinical acumen which Steell exemplified were to be lost in inappropriate reliance on technology in medicine. Yet, despite all of this conscientious hard work, the association of his name with the murmur described here is fortuitous. This eponymous serendipity is an example of 'that process of collective negotiation and judgment which leads to immortality for a select handful of doctors' [36].

Acknowledgements

We thank Mrs S. K. Reddy, Archivist and Librarian of the Jefferson Library, Manchester Royal Infirmary, and Miss P. Cummings, Librarian of the Manchester Medical Collection, the John Rylands University Library of Manchester, for their help with research. Dr Weston is Proffit-Rosser Fellow of the Royal College of Physicians of London.

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Address for correspondence: Dr Alan G. Fraser, Department of Cardiology, University Hospital of Wales, Heath Park, Cardiff CF4 4XW.

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