MATTHEW BAILLIE GAIRDNER, THE ROYAL MEDICAL SOCIETY AND THE PROBLEM OF THE SECOND HEART SOUND

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SUMMARY

In 1830, Matthew Baillie Gairdner (1808–88) was the first to propose that the second heart sound was produced by the closure of the semilunar valves. He proposed this theory, while a student at Edinburgh University, in an oral presentation to the Royal Medical Society (RMS). Gairdner (Figure 1) has been largely ignored by both nineteenth and twentieth century historians of cardiology. This paper presents an account of his life, his discovery and the scientific controversy to which he contributed, and argues that an appreciation of his work and that of his student colleagues should cause us to re-evaluate the significance of the RMS as a research forum in the early nineteenth century. Suggestions are made as to why his contribution to our understanding of the heart sounds has been neglected.

INTRODUCTION

The Harveian Discourse for 1887 was delivered by Dr George W. Balfour, Consulting Physician to the Royal Infirmary of Edinburgh and a former President of the Royal College of Physicians of Edinburgh.[1] He outlined the long debate which had taken place, from Laennec's time to his own, regarding the nature and origin of the sounds of the heart. He reminded his audience that the first elucidation of the second heart sound had been accomplished by one of their compatriots, 'a Scotch country practitioner, still alive, Dr Matthew Baillie Gairdner, late of Crieff'. In 1830, first in the course of his address to the RMS and then in his MD thesis, Gairdner had suggested that the second cardiac sound was produced by the closure of the semilunar valves.

The exact nature of the cardiac sounds is still, more than 100 years after Balfour's lecture, a matter for some discussion, but it remains generally accepted that the closure of the semilunar valves plays a substantial role in the production of the second sound.[2] Gairdner's name is, however, absent from cardiology's role of honour. Louis Acierno, in his recent and very comprehensive history of the subject, accords the priority for the association between the second sound and the semilunar valves jointly to James Hope and Joseph Rouanet, who were working simultaneously, albeit independently, respectively in London and Paris in 1832.[3] Jacalyn Duffin, Laennec's biographer, mentions only Rouanet in this context, while Peter Fleming, in his *A Short History of Cardiology* credits Rouanet, Hope and C.J.B. Williams, the two last mentioned working together.[4] Evan Bedford credited Jean-Baptiste Bouillaud, Laennec's successor at the Charité.[5] No biography of Matthew Baillie Gairdner exists. This paper arose from a wish to unearth whatever information might be available about him, with a view to providing a biographical account. We have pieced together a story of precocious talent, of solid professional success, followed ultimately by personal tragedy.

FIGURE 1
Matthew Baillie Gairdner. From: A. Porteus; *The History of Crieff from the Earliest Times to the Present Day.* Edinburgh: Oliphant, Anderson and Ferrier; 1912. Reproduced with the kind permission of the Trustees of the National Library of Scotland.

The character of Matthew Baillie Gairdner's work and career is intriguing for several reasons. How did an Edinburgh medical student manage to make a discovery of such significance? Why has his contribution to the study of the heart been largely forgotten? And why did he spend his career as a country doctor, rather than seeking the glittering professional prizes that his early success might have appeared to promise?

Gairdner's work on the heart also sheds light on a fascinating period in the history of cardiology.[6] Medical textbooks and disciplinary histories have a tendency to convey the impression that scientific knowledge progresses in straight lines. For example, our modern understanding of the heart's action broadly corresponds to the account advanced by William Harvey in *De Motu Cordis*, published in 1628, and it is therefore often assumed that Harvey's views have commanded general assent continuously from the seventeenth century to the present day. This was not the case. The early decades of the nineteenth century were characterised by intense debate and controversy concerning the cardiac cycle. Once the thorax began to be examined by means of the newly invented stethoscope, many of the issues upon which William Harvey had pronounced were re-opened. Old certainties were vigorously challenged – and not only Harvey's, but also those of eighteenth century authors such as Albrecht Haller and John Hunter.[7] A large number of commentators advanced a complicated and shifting variety of views regarding the action of the heart.[8] The debate circled continuously for many years until a new consensus of the nature of the heart's motion (which incorporated many key Harveian elements) was eventually arrived at. Thus, when Fleming writes that Albrecht Haller 'created a firm foundation on which the physiologists of the nineteenth century were to build', he omits to emphasise that the same physiologists devoted much energy to the task of digging up those foundations and only subsequently re-laying them.[9] Gairdner's dissertation was, in many respects, a typical contribution to this prolonged period of scientific endeavour and dispute.[10]

THE ROYAL MEDICAL SOCIETY AND THE APEX BEAT

Born on 7 September 1808, Matthew Baillie Gairdner was the sixth of seven children.[11] His father, James Gairdner, appears to have been a manufacturer in Lanark, but soon after Matthew's birth he took up the position of Clerk to the Customs House, a post which necessitated the family moving to Edinburgh. Gairdner was educated at the High School of Edinburgh before entering the University at the age of fourteen to study medicine. Whilst at University he was, like many of his contemporaries, apprenticed to a local surgical firm. In Matthew's case this was Bell, Russell & Co.[12] It was probably at this time that he started what was to be a lifetime friendship with Robert Omond, a fellow student later to become President of the Royal College of Surgeons of Edinburgh. Gairdner attained the Licentiate of the College of Surgeons in 1828.

While a medical student Gairdner joined the RMS. The Society had been instituted in 1737 as a forum for study, self-help and debate among an elite of Edinburgh's medical students and young practitioners.[13] A key feature of its meetings was the oral presentation of papers by members. In the nineteenth century, the Society continued to make a significant contribution to the character and range of educational opportunity available to the keen student of medicine in Edinburgh. Its deliberations were characteristically and self-confidently imbued with the ethos that an acquaintance with basic research was relevant to the acquisition of skill and status in medical practice. The papers presented to the Society's meetings were often progress reports toward the members' MD theses. From the 1820s onward, issues relating to the action of the heart and the associated noises formed a regular part of the Society's discussions.

The issue of the sounds of the heart had been brought into medical debate following the invention of the stethoscope in 1816 by French physician, morbid anatomist and physiologist René Laennec. When Laennec applied his new instrument to the chest of his patients he noted what were later termed the first and second cardiac sounds. He also listened to the palpable apex beat or 'impulse of the heart', heard or felt most strongly in the fifth intercostal space, and was immediately curious as to what processes within the thorax produced these various noises.

William Harvey had argued, in the seventeenth century, that the apex beat was produced by the heart rising in the thorax and striking the chest wall during systole. In his major text *De L'Ausculation Mediate*, published in 1819, Laennec articulated a similar position. But there was an alternative theory, historically associated with René Descartes among others, that the apex beat was produced by the heart expanding in size during diastole.[14] Several eminent early nineteenth century investigators adhered to this view, or some variation thereon.[15] To them it seemed more logical to imagine that the heart struck the chest wall when it was expanded rather than when it was contracted.

Thus in 1830 Dominic Corrigan asserted:

> The beat of the heart is produced not by the tilting up of the apex but by its swelling and coming against the ribs, in consequence of the impulse given by the rush of blood from the auricle.[16]

Corrigan supported this position by arguing that the apex beat was not exactly synchronous with the arterial pulse. Later in the same year, William Stokes and John Hart published the results of quite detailed experimental studies, with which they supported Corrigan's view.[17]

Members of Edinburgh's academic medical community were much involved in these discussions as to the action of the heart. Corrigan and Stokes were both Edinburgh graduates and their interest in both stethoscopy and the motions of the heart dated from their time as students in Scotland. Other Edinburgh graduates, notably James Hope, who served as a president of the RMS, defended the Harveian view. Hope presented a lengthy paper on the diseases of the heart to the RMS in 1824 in which he assumed, largely on the basis of stethoscopic observations, the systolic origins of the apex beat.[18]

Not all Hope's fellow students in Edinburgh were convinced, however. One of the more forthright contributions to the impulse controversy was made during a meeting of the RMS on 28 October 1831. Theodore Waterhouse stated that:

> . . . we are brought to the conclusion, that the impulse of the heart cannot occur during the systole of the ventricles . . . (N)ot only is the apex of the heart not tilted up during the systole of the ventricles, but is actually diminished in length and bulk and together with the whole body of the heart, drawn upwards and inwards.[19]

Waterhouse did not merely support Corrigan and Stokes rhetorically. While his argument was primarily founded upon observations of the pulse and with the stethoscope, Waterhouse matched their experimental evidence with the results of his own series of investigations on the action of the hearts of rabbits and frogs. On this basis, he felt able to offer robust advice to experimenters more senior, but less acute, than himself:

> It may be well to state that in experiments made on small animals it is necessary to look at the Heart in profile for, if viewed from above, the advance of the apex, after the contraction of the ventricles, takes place so quickly, that it may very easily be mistaken for the effect of the contraction, and not of the dilatation and hence this optical delusion, will explain the mis-statements of Physiologists, if it should be asked how it has happened that so many Physiologists in describing their experiments on the heart have so frequently alluded to the tilting forward or advance of the apex during the systole of the ventricles.[20]

MATTHEW BAILLIE GAIRDNER AND THE HEART SOUNDS

Running in parallel with the dispute over the cause of the apex beat was a controversy over the nature and origin of the cardiac sounds. Laennec described the normal heart as producing two distinct sounds. One was, by his account, synchronous with both the carotid pulse and the palpable apex beat. He noted that this sound was heard more loudly lower in the thorax than the other sound. Believing that muscular contraction itself directly produced sounds audible with the stethoscope, Laennec inferred that this heart sound must be the result of ventricular contraction. Similarly, he concluded that the other sound must be the result of auricular contraction, due to its being heard more loudly higher in the thorax. Thus, in his view, the two cardiac sounds were produced directly by the contraction of the muscular walls of the chambers of the heart, first by the ventricles and then by the auricles.

It will be noted that, from the modern perspective, Laennec would seem to have got the order of the contraction of the chambers the wrong way round. Harvey described the auricles contracting before the ventricles and this is, of course, also our present understanding. In 1825 William Stokes, when he was still a medical student in Edinburgh, wrote a short treatise on the stethoscope with a view to popularising auscultation.[21] In this text, Stokes, who was the first to use the ordinal terminology of 'first' and 'second' sounds, endeavoured to harmonise Laennec's explanation of the genesis of the sounds with Harvey's description of the cardiac cycle. He tried to respect the Harveian sequence of contraction by calling the sound which is heard before the long pause, and which Laennec identified with auricular contraction, the 'first' sound. Likewise he called the sound heard after the long pause, which Laennec had identified with ventricular contraction, the 'second' sound. This is, of course, the reverse of the modern, and indeed the intuitive, ordering. Stokes's 'solution' would seem to have created more problems than it solved. Laennec's account of the genesis of the heart sounds was the starting point for a long period of controversy – controversy that was undoubtedly exacerbated by other commentators being confused as to which sound was supposed to be which.[22]

While composing his treatise on auscultation, Stokes drew principally upon the published medical literature rather than upon his own practical experience with the stethoscope.[23] By the late 1820s, however, the stethoscope was in widespread clinical use within Edinburgh's medical community.[24] William Cullen, the grand-nephew of the more famous bearer of that name, studied auscultation in Paris under Laennec, probably in 1822.[25] Sometime around 1824, while a house surgeon in the Royal Infirmary, Cullen delivered a series of special lectures on stethoscopy. These classes were attended both by students and by his fellow members of staff. In 1825, James Hope, also a house surgeon in the Infirmary, undertook a successful trial of the clinical potential of the stethoscope in the investigation and diagnosis of arterial disease.[26]

Initially, academic Edinburgh practitioners accepted Laennec's writings on the clinical application of mediate auscultation unquestioningly but, as practical experience with the instrument grew, a more critical and questioning frame of mind developed vis-à-vis the accepted French authority. This more self-confident attitude was well in evidence in 1828 when John William Turner, then Professor of Surgery to the Royal College of Surgeons of Edinburgh, read a paper before the Edinburgh Medico-Chirurgical Society in which he challenged Laennec's interpretation of the heart sounds and their causation.[27] Turner, unlike Stokes, referred to the sound heard after long pause as the 'first' sound. He agreed with Laennec as to the origin of this sound, 'that the first of the two consecutive sounds or sensations of motions is connected with the contraction of the ventricles, is obvious . . .'.[28] However, since Turner accepted the Harveian sequence of the cardiac cycle, it followed that the contraction of the auricles could not produce the second heart sound. He therefore proposed that the second sound might be accounted for 'by the falling back on the pericardium of the relaxed heart in its diastole, after it has been elevated or moved from its place in the systole'.[29]

From this point on there were as many opinions as to the origin of the cardiac sounds as there were investigators.[30] Eighty-five distinct theories have been counted in the period up until 1870.[31] Many of these theories were advanced by men who had received their education in Edinburgh, such as Stokes, Corrigan, Hope and Charles J.B. Williams. To this list of names we can now add that of Matthew Baillie Gairdner.

On 5 March 1830 Gairdner delivered an address to the RMS entitled *On the Impulse and Sounds of the Heart*, a verbatim copy of which is contained in the archives of the Society.[32] Gairdner's presentation was founded upon extensive reading of both the English and the French medical literature.[33] He, like Hope and Waterhouse before him, also took care to emphasise his appreciation of the especial significance of the invention of the stethoscope:

> The valuable and important discovery of the late M. Laennec has opened up to Physiologists as well as to Physicians, a new field of investigation enabling them to analyse in the human subject many of the living actions that take place in the chest and more particularly those of the heart.[34]

Like Laennec before him, Gairdner self-consciously identified himself as a 'physiologist', which is an indication of his commitment to a role for fundamental research within the improvement of medicine.[35] But, like Turner, his perspective upon the functioning of the human body was very much that of a physician. There is no record in his dissertation of his having undertaken vivisection experiments and little mention of post-mortem dissection.[36] As he acknowledges in his introduction, Gairdner's principal means of studying the heart was through auscultation.[37] By the time he delivered his dissertation, he evidently had already acquired considerable practical experience with the stethoscope. His clinical observations of alterations in the structure and behaviour of the circulatory system in the course of disease, moreover, provided him with much information which he incorporated into his characterisation of the heart's action.

Gairdner's dissertation also displays that confident independence of mind seen in Waterhouse and which is characteristic of much of the material presented to their peers by the young members of the RMS at this time. For instance, early in his presentation, Gairdner launched into an attack on Dr David Williams's theory of the mode of action of the auriculo-ventricular valves.[38] In 1829 Williams, a Liverpool physician whom Gairdner describes as 'an eminent physiologist',[39] had argued that the auriculo-ventricular valves were actively opened by the muscular papillaries, which had a contraction separate and distinct from that of the ventricles.[40] Gairdner, in contrast, maintained that the papillary muscles had no independent contraction and that the valves were opened entirely by the increase of pressure in the auricles.

On the question of the apex beat, Gairdner aligned himself firmly on the Harveian side of the debate:

> Upon contraction . . . the ventricles perform a considerable

locomotion and an obscure lateral undulation, towards the base or fixed point between the two large arterial ducts. At the same time that the organ then twists upon itself, the point is suddenly tilted up so as to produce the beat which is usually felt between the cartilages of the fifth and sixth ribs.[41]

Gairdner noted that Laennec had suggested that 'the intensity of the impulse is in the direct ratio of the thickness of the vessels (i.e. the chambers of the heart)'.[42] Here again Gairdner had his own opinion, arguing that it is only 'where we find increased energy of contraction that increased impulse follows'.[43]

Although Gairdner was broadly Harveian in his conception of the action of the heart, he was by no means a slavish adherent to all of Harvey's doctrines. He aligned himself with a number of contemporary investigators, including Pousielle, Beau and indeed Laennec himself, in maintaining that the major arteries had an active contraction independent of the heart, a proposition explicitly denied by both Harvey and John Hunter.[44] The idea of an arterial contractility had, however, been championed by the Glasgow surgeon and anatomist, Allan Burns, whose *Observations on some of the most frequent and important diseases of the heart* was published in Edinburgh in 1809.[45] Here again, however, Gairdner's views were distinctly his own. Whereas Burns assumed that all the major arteries participate, to a greater or lesser extent, in the propulsion of the blood, Gairdner located this secondary contractile power principally in the aortic arch. In support of the existence of an active aortic systole, Gairdner adduced his own perception, based upon clinical experience, that the impulse of the heart was not always a single beat. '(I)n many cases, we distinctly perceive two beats following each other in immediate succession after which there is a short interval before they are again felt.'[46] The second cardiac impulse was produced, argued Gairdner, by the contraction of the aorta again lifting up the left ventricle as it was entering diastole.

Gairdner returned to the question of an aortic systole later in his presentation when again he referred to his own clinical experience in support of his argument:

> I had lately an opportunity of observing the occurrence in an old man of 70 affected with a severe cough and dyspnoea but seemingly without any organic disease of the heart, in which there was distinctly felt a double pulsation at the wrist synchronous with the double sound and . . . impulse of the heart. The pulse counted at the time about 98 and was full but easily compressed; that corresponding with the systole of the ventricles being stronger than the succeeding which immediately followed it and occasionally intermitted.[47]
>
> The rationale of the pulsation I suppose to be the same as that given of the second impulse . . . namely, that it is produced by the systole of the aorta which after closing the semi-lunar valves will propel the blood onwards in the arteries.[48]

The bulk of Gairdner's treatise was taken up with his discussion of the cardiac sounds and their causes:

> . . . by applying the ear either directly or through the medium of the stethoscope to the pericardial region, we perceive two distinct consecutive sounds synchronous with the pulsation already mentioned. The first is dull and prolonged coinciding with the arterial pulse and with the first shock or impulse communicated to the wall of the chest; immediately and without any interval the second is heard clear and rapid, resembling, according to the description of Laennec that of a valve or the lapping of a dog.[49]

Gairdner agreed with both Laennec and Turner that the first cardiac sound was associated with the contraction of the ventricles. However, he did not accept Laennec's attribution of the first sound to the muscular contraction of the ventricular walls *per se*, although he was willing to concede that such contraction might indeed, under certain circumstances, be audible. Gairdner pointed to the attenuation of the cardiac sounds in cardiac hypertrophy as evidence that these sounds were not produced by the cardiac muscle itself. His theory of the first sound was that it was produced by the turbulent motion of the blood as it flowed through the ventricular cavity and out into the aortic arch.

Gairdner was, however, highly critical of Laennec's view of the second heart sound:

> There is perhaps hardly a better instance showing the necessity of cautious induction in physiology than the remarkable error which had crept into the work of the late M. Laennec. I allude, of course, to the explanation he has given of the cause of the second of the two consecutive sounds which he ascribed to the contraction of the auricles. This error first was pointed out by Mr Turner in a paper read before the Medico-Chirurgical Society of this place; in which he proves from the observations of physiologists from the time of Harvey that the contraction of the auricles immediately precedes that of the ventricles, and consequently that the interval of repose or diastole takes place before the action of the auricles and not after as Laennec supposed.[50]

Turner had suggested, as noted above, that the second sound might be produced by the heart falling back in the thoracic cavity after systole. But Gairdner again drew upon a clinical observation to clarify the matter:

> But this opinion is not borne out by what we observe from the effects of disease; in well marked hypertrophy (more particularly when complicated with contraction of the arterial orifices or with diminution of the cavity of the ventricles) when the action of the heart is often extremely energetic, causing violent pulsations on the sides of the thorax and where we should expect the consequent relaxation to be correspondingly increased, the sound is generally much diminished and often nearly imperceptible.[51]

Gairdner noted that David Williams had also dissented from Turner on this point and had suggested that the sound was 'produced by the stroke of the mitral and tricuspid valves upon the sides of the ventricles owing to their rapid retraction by the contraction of the columnae carneae'.[52] But Gairdner did not credit the papillary muscles with a separate contraction independent of the walls of the ventricles. Accordingly, he could not accept this explanation.

Gairdner stated his own conclusion:

> Now the only action I conceive of which could produce the sound corresponding with the foregoing description is the closing of the semilunar valves by the reaction of the aorta and pulmonary artery on the blood propelled into them by the contraction of the ventricles . . .[53]

Gairdner's address to the RMS formed the basis of his MD thesis of 1830, *De Motu Impulsu et Sonu Cordis*. Unfortunately, no copies of this work appear to have survived. Gairdner never published a scientific paper on the subject and his contribution remained largely unknown outside the Edinburgh medical community. Indeed, even within nineteenth century Edinburgh, Gairdner's claim was often overlooked. William Pulteney Alison, the eminent Professor of the Institutes of Medicine in his major textbook *Outlines of Human Physiology*, initially credited William Elliot as having been the first to associate the second sound with the closure of the semilunar valves, Elliot having mentioned this mechanism in his 1831 Edinburgh MD thesis *De Corde*. Elliot had, however, been quoting Gairdner. In 1839, upon the publication of the third edition of his book, Alison amended the passage and accorded priority to Gairdner.[54] However, Charles Williams, in his influential *The Pathology and Diagnosis of Diseases of the Chest* published in 1835, credited Robert Carswell with having suggested the cause of the second sound during a lecture given to the Paris Academy of Medicine in July 1831.[55] The London physician, Archibald Billings, claimed that he and Carswell had arrived at the same conclusion independently and by different routes.[56] Williams argued that he, with Hope's assistance, had been the first to elucidate the origins of the sounds experimentally. James Hope claimed all the credit for himself.[57] As we have already noted, twentieth century historians of medicine have similarly overlooked Gairdner.

GAIRDNER'S LATER LIFE

After gaining his MD, Gairdner became a house surgeon to the fever ward of the Royal Infirmary of Edinburgh. He was then offered the position of personal physician to Sir Robert Dundas, who owned the Dunira estate near Comrie in Perthshire, which he accepted. By the time of Sir Robert's death in 1835, Gairdner seems to have become well established within the local community, 'having acquired all of the leading families to the west of Crieff for his practice'.[59] In 1839 he was invited to move his residence to the town of Crieff so that he could also serve families to the east of the town. He acquired a local reputation as a skilled horseman and he was a member of the local hunt.

No doubt it was the success of his Perthshire practice which enabled Gairdner to embark on married life. On 10 April 1845, he and Elizabeth Campbell Orr were married – he was 36, she 18.[60] Over the next 20 years they had 12 children, five daughters and seven sons, two of whom were to follow their father into the medical profession.

Gairdner was later to be described as 'one of the old school of Country Practitioners . . . a neat and singularly successful surgeon, numbering all ranks as his patients from the peasant to the peer'.[61] Gairdner was also a 'careful accoucher', twice delivering triplets. His operative endeavours were admired by no lesser authority than the 'Napoleon of Surgery', James Syme.[62] Syme congratulated Gairdner following his successful amputation of the arm of Lord Strathallan with the comment that he himself had 'never winged a Viscount'. As well as conducting amputations, Gairdner kept up with the advancement of surgical techniques, quickly providing his patients with the new operation for the correction of squints. He became a Fellow of the Royal College of Surgeons in December 1858, having been proposed by his old friend Robert Omond, then President of the College, and seconded by Mr Benjamin Bell.[63]

In addition to his commitment to his practice Gairdner was also, for a short while, surgeon to his local Volunteer Regiment. Sir William Keith Murray invited Gairdner to take up the post when he was placed in command of the 8th Crieff Volunteer Company in 1860.[64] Such companies were raised throughout the country at this time as relations with France became strained as a result of the aggressive foreign policy of Napoleon III. Gairdner attended the Royal Scottish Volunteer Review held in Holyrood Park that August,[65] but his association with the Company ended when, later that year, many of the local companies were merged into the 1st Perthshire Rifle Volunteers. Murray apparently offered Gairdner the post of Surgeon to the Battalion but he declined the appointment. In 1864, Gairdner became a Commissioner to the Burgh of Crieff, a position he held for four years and in which capacity he was partly responsible for initiating a number of public health measures in the town.

We have been unable to determine exactly when Gairdner retired from medical practice. We do know, however, that his practice in Perthshire was eventually taken over by his eldest son, James. By the time of the signing of his will in September 1885, Gairdner was residing in Edinburgh.[66] He was probably already suffering from the dementia which would necessitate his admission to the Royal Edinburgh Asylum on 9 May 1886.

Dr Cuthbertson Sym examined Gairdner on 6 May 1886 and found him to be 'rambling in speech and aphasia, (he) forgets while speaking what he is going to say . . . talks mostly of things that took place fifty years ago'.[67] Upon Gairdner's admission to the Asylum, Dr George Robertson noted that his patient 'says he has been here 57 years and has delusions about the civil war in which he is to take part'. A physical examination revealed that 'general bodily health and condition is weak, has bronchitic cough . . . and a little spit occasionally'. It is ironic that it was noted, upon stethoscopic examination, that his 'second heart sound (was) accentuated (but) otherwise normal'.

Throughout the period of Gairdner's stay in the Asylum, there are records of visits from family and friends but often it was noted that 'soon after he forgot all about their visit'. An entry made on 6 August 1886 stated 'no change in the patient's mental state, his memory is defective and he often mistakes those faces around him for old acquaintances'. One of the last entries paints a very sad picture of Gairdner's condition. It simply reads 'Patient was found standing in front of mirror conversing familiarly with his own reflection in which he recognised an old friend.' On 30 June 1887 he was transferred to the James Murray Royal Asylum at Perth, so that he could be closer to his family in Crieff. He died there on 18 May 1888, probably from pneumonia, at 79 years of age.[68]

Gairdner's estate, doubtless depleted by the expense of his stay in the private wards of the Royal Asylum and by the transfer of assets to his son, was valued at £1,418 0s 1d.[69] His widow Elizabeth survived him, dying in Crieff in 1915, aged 89. Gairdner's obituary in the *Edinburgh Medical Journal*, while generous and appreciative, made no specific mention of the scientific investigations of his youth, noting only that his MD thesis had 'indicated great original research'.[70]

THE ROYAL MEDICAL SOCIETY AND MEDICAL RESEARCH

Gairdner's address to the RMS indicates that a keen medical student in early nineteenth century Edinburgh could be close enough to the cutting edge of medical research to make a significant original contribution. Moreover, Gairdner's involvement, and that of a significant number of his contemporaries, in meaningful research into the action of the heart must be attributed to the intellectual atmosphere that pertained within the Edinburgh Medical School in the early decades of the nineteenth century. It is evident that there was a collective acknowledgement that scientific inquiry should play a central role within medicine and medical training. It may also be concluded that the development of a questioning and autonomous attitude among medical students was being tolerated and encouraged.[71]

The Royal Medical Society played an important part in expressing and sustaining this ethos of independent and fundamental inquiry, at least among an elite minority of Edinburgh's medical students and young practitioners. As we have noted, Gairdner presented the results of his investigations on the heart to the Society, as did Hope and Waterhouse, among others. The robust and confident originality of these verbal presentations was undoubtedly structured by the expectations and established practices of the institution for which they were written. This is perhaps worth stressing since opinions have varied as to the value and scientific status of the deliberations of the RMS.

The Society's historians, both in the nineteenth and twentieth centuries, have emphasised the lofty ideals of its founders and the serious intent and sustained application of succeeding generations of its members.[72] On the other hand, Charles Darwin, who was very nearly a contemporary of Gairdner, studying medicine in Edinburgh from 1825 to 1827, wrote of the Society, 'much rubbish was talked there'.[73] Lisa Rosner, in her recent study of medical education in Edinburgh in the late eighteenth and early nineteenth centuries, acknowledges that the members of the Society 'took the business of medical improvement seriously'.[74] However, she lays the greatest stress on the literary and social advantages of membership:

> The locus of Society activity . . . was the neo-classical hall on Surgeons' Square . . . If members were aware of other possible loci, such as laboratory, dissection room, hospital and morgue, their dissertations do not reflect it.

Thus she downplays the scientific activities of the RMS:

> The Society was not a scientific society and the students did not regularly carry out discoveries. Neither the cases nor the questions make for exciting reading. They were student exercises, rather than original research, and varied in quality . . . not even the best presented much that was new . . . Students then did not join the Royal Medical Society for the purpose of engaging in ongoing medical or scientific research . . .[76]

We can only conjecture why Gairdner joined the RMS, but whether he, and a number of his contemporaries, engaged in 'ongoing medical or scientific research' during their membership cannot be gainsaid, nor that they were aware of the bedside and, to a lesser extent, the laboratory and even the dissection room, as loci of medical inquiry. Doubtless Darwin was right that much of the material presented at the meetings of the RMS was not of lasting significance and Rosner is certainly correct to characterise many, perhaps the majority, of the presentations as literary endeavours, as the study of clinical medicine 'by the book'.[77] But, certainly in the early decades of the nineteenth century, we may identify a sufficient number of exceptions to alert us to the fact that at least a minority of able and highly motivated students did participate in serious medico-scientific inquiry, and that the RMS functioned, albeit perhaps only for a few decades, as an important outlet for the research findings of young Edinburgh medical men.

While the causes of the impulse and sounds of the heart were key research issues in the decades after the invention of the stethoscope, discussions in the RMS were not, of course, confined to cardiology. In his biography of James Syme, Alexander Miles notes that the 'Royal Medical Society afforded Syme, as it has done to so many others, the earliest opportunity of submitting his opinions to the criticism of his contemporaries'.[78] In 1821, Syme presented to the Society several original observations on the pathology of bone. When, in 1892, the RMS published a collection of dissertations delivered before it, Syme's essay was duly included – as was Richard Bright's (1813) on gangrene, Marshall Hall's (1813) on 'the dispersive and refractory powers of the human eye', Robert Liston's (1820) on fractures of the femur, William Sharpey's (1823) on cancer of the stomach, Allan Thomson's (1829) on the formation of the chick, and James Young Simpson's (1835) on diseases of the placenta.[79] Nor were these pieces merely the juvenilia of later-to-be-eminent men. The scientific quality, if judged by contemporary criteria, of the selected presentations is undeniable.

Of the 20 dissertations chosen for printing, some 14 date from between 1813 and 1845. It will be noted that Gairdner presented his essay virtually in the middle of what was evidently something of a golden age for the RMS. Why did it function so successfully as a research forum in this period? An accurate characterisation of the research that the Society sponsored in the early decades of the nineteenth century will help us toward an answer to this question.

Inquiry at the bedside played a key role in the investigations undertaken by Gairdner and by his fellows in Edinburgh – Turner, Waterhouse and Hope, for example.[80] A fine example of this use of clinical observation as a research tool may be seen in another RMS dissertation on the heart sounds, that read by Patrick Newbigging in 1833.[81] It is revealing, first of all, that Newbigging felt a need to justify his presenting to the Society the results of an investigation of the working of the normal heart. His defence lay in the potential clinical usefulness of such knowledge:

> . . . as it is obviously impossible to understand the diseased action of any organ, without a thorough acquaintance with all the phenomena of its actions in the normal state, it cannot be denied that an accurate knowledge of the cause of the impulse and sounds which attend the healthy action of the heart is of paramount importance as well to the Practical man as to the Physiologist.[82]

The major part of Newbigging's dissertation is devoted to a critical examination of the Stokes/Corrigan/ Waterhouse hypothesis that the apex beat results from ventricular diastole. Newbigging identified the key issue as being Corrigan's contention that the radial pulse was not synchronous with the apex beat. If the apex beat were produced during diastole, it should not coincide with the arterial pulse, which is the effect of the influx of blood into the arteries upon the contraction of the ventricles. Newbigging's first objection to Corrigan was based upon physical examination of a normal subject:

> If we place one hand on the praecordial region and apply the finger of the other to the artery of the wrist, we shall undoubtedly find that there is an interval varying according to the rapidity of the pulse: but if instead of applying one hand to the wrist, we do so to the carotid or subclavian, it will immediately be evident that the impulse of the heart and pulse in these arteries are synchronous . . . we must therefore conclude that the very short period which elapses between the impulse of the chest and the pulse of the radial artery is attributable to the distance which the impulse has to travel.[83]

But Newbigging's second and pivotal counter-argument derived from observation of a diseased subject within his own clinical experience:

> We met with a case . . . which confirms the position we are desirous of affirming better than any experiment which could be performed . . . the pulse was so low as 28 in a minute and regular. The rhythm also seemed to us to be natural. It was in this case quite evident on applying the hand at once to the chest, and to the subclavian artery, that the pulsations were simultaneous, but on feeling the radial artery there was a perceptible difference which was still greater at the ankle . . . We may state that the case presented itself after we had perused Corrigan's paper on the subject and, at a time, when we considered that there could not be two opinions as to the justice of his views but here it appeared so clear to us that the impulse at the chest corresponded with the pulse of the contiguous arteries . . . that we resolved on following with the inquiry. The case was visited along with us by a gentleman who was requested to examine the various phenomena of the heart's action, without mentioning our own opinion, and he stated that he found the impulse at the chest and the impulse of the subclavian artery entirely simultaneous but that there was a slight interval between the former and the pulse at the wrist.[84]

Accordingly, Newbigging concludes that Corrigan is wrong and the apex beat is produced by, and thus coincides with, the systole, rather than the diastole, of the ventricles.

As seen in the work of Hope and Waterhouse, the centrality of the clinic within Edinburgh medical science did not preclude the undertaking of other forms of investigation. Indeed, experimental and instrumental inquiry was actively supported by the RMS through its Apparatus Committee, which was established in 1796.[85] A room was set aside in the Society's meeting hall as a laboratory and several of the dissertations presented in this period describe innovative work undertaken therein. For example, Charles Hastings's dissertation, *What is the state of the blood vessels in inflammation?*, presented in 1816, is noteworthy for his intensive use of the microscope in the examination of living tissue, long before microscopy was taught as part of the formal curriculum.[86] Marshall Hall's dissertation describes a number of original experiments on the optics and physiology of vision.[87] A series of vivisections was undertaken by Waterhouse. In 1820, the Society augmented its provisions for research with the establishment of a museum of anatomical and natural historical specimens.[88]

However, accomplished as their deployments of experiment and microscope undoubtedly were, for the members of the RMS these forms of inquiry complemented rather than displaced clinical observation as the primary research tool. As the Newbigging example indicates, study at the bedside was not a naive or unsophisticated form of inquiry. It could produce results, as Newbigging put it, 'better than any experiment'. The stress on the clinical expressed the members' professional identity and aspiration. In terms of dichotomies employed by Gairdner and Newbigging, they were, or intended to be, 'physicians' and 'practical men' first and foremost, however much they might also regard themselves as 'physiologists'.

In arranging their research priorities in this way, the Edinburgh students were doing no more than reflecting the dominant mode of medical research of the period. Nicholas Jewson has characterised the first half of the nineteenth century as being the era of 'hospital' or anatomico-clinical medicine'.[89] Throughout most of the eighteenth century, medical inquiry had been based principally upon the patient's own account of his or her symptoms.[90] However, in the late eighteenth century, with the developments of the Paris school, medical knowledge began to be based predominantly upon physical examination and post-mortem dissection.[91] There is little evidence of systematic use of the autopsy by the members of RMS, presumably due to lack of regular access, but in other respects their inquiries express the new pattern of research quite comprehensively.[92] Gairdner, as we have seen, based his hypothesis upon his observations with the stethoscope, his general clinical experience, a limited amount of post-mortem dissection and his extensive reading of the (mostly French) literature.

The invention of the stethoscope, the emblem of the French anatomico-clinical method, undoubtedly played an important role in allowing the elaboration of meaningful research practice within the RMS. In developing proficiency with the stethoscope, members developed skills which they felt would be directly relevant to their future clinical practice,[93] but they were simultaneously learning to use what was, at the time, a premier research instrument in both physiology and pathology. Thus, expertise in mediate ausculation made some of the major medical research problems of the day accessible to young men like Gairdner.

During the course of the nineteenth century, the dominant mode of medical research moved from the clinical to the non-clinical setting. Anatomico-clinical medicine was replaced by 'laboratory medicine'. A different kind of physiology arose which was characterised by the use of recording instruments. In his manifesto for the new age of scientific medicine, first published in 1865, Claude Bernard claimed the elucidation of the movements of the heart as one of laboratory physiology's defining triumphs. He noted that two opinions had previously existed as to the cause of the apex beat:

> An old one . . . according to which the heart beat results from the contraction of the ventricles; and the other, which . . . at

> first seems simpler and more satisfactory and attributes the phenomenon to the propulsion of the apex of the heart through the surge of blood from the auricular systole. The graphic method provided the answer. An examination of the resultant graphs completely eliminated uncertainty. The relationship between the beat of the heart and the contraction of the ventricle was demonstrated by the synchronous upward movement of the two levers and by the simultaneous elevation in the two curves they recorded.[94]

Thus, by the 1850s, a different ethos of medical research coupled with the need for expensive, specialised equipment and for longer, more intensive training in laboratory methods began to make it more difficult for the young men of the RMS to sustain original inquiries of the highest quality. The era in which the members of the Society could meaningfully contribute to the debate on the action of the heart had passed.

THE NEGLECT OF GAIRDNER

Why did Gairdner not receive wider recognition for his elucidation of the nature of the second sound? The immediate neglect of Gairdner's discovery can be substantially attributed to his failure to publish his findings in a form which could readily have been taken note of outside of Edinburgh itself. He left the academic environs of the University and the Royal Infirmary for provincial obscurity. He did not pursue his academic or scientific interests, and never campaigned on his own behalf to establish his priority claim. However, these factors cannot wholly explain his neglect in the longer term. Why has he been so ignored by twentieth century historians of cardiology?

Perhaps clues might be discerned both in the nature of Gairdner's methods of inquiry and in those of his advocate, George W. Balfour. As far as we are aware, Balfour was the first, from a historical rather than a contemporary perspective, to accord credit to Gairdner. The author of the major text *Clinical Lectures on Diseases of the Heart and Aorta* (1876), Balfour was an important figure in the development of the clinical study of the heart and its circulation in the 1860s and 1870s. Born in 1823, graduated MD in 1845, he had been a general practitioner in Midlothian before becoming a Fellow of the Royal College of Physicians of Edinburgh in 1857. Balfour had studied diagnostic methods under Josef Skoda (1805–81) in Vienna in 1846 and was said to have been the finest auscultator of his generation. Balfour's mode of cardiological inquiry was firmly based upon the twin foundations of physical examination and clinical experience, as his famous symptomatic description of heart block exemplifies.[95] But by the time Balfour gave his Harveian Discourse in 1887, a new mode of cardiological research had been developed and a new conception of the heart was evolving.[96] The first graphic recording of complete heart block was obtained in 1875. In 1883, W.H. Gaskell published the definitive paper on the myogenic origin of the heart's rhythm. By the 1880s, James Mackenzie had begun investigations of heart disorders using first a sphygmograph and then a polygraph. As Christopher Lawrence has described, these developments were accompanied by a reconceptualisation of heart disease. The older emphasis on structural, chiefly valvular, disorders was replaced by a concern with the heart's actual functioning. The 'new cardiologists', as they came to be known, employed recording equipment, valued quantitative rather than qualitative data, and had a much closer relationship to laboratory physiology than their older colleagues.

Balfour was thus one of the last of the great 'old' cardiologists. Through his personal connection with Skoda, he was a living link to the founding fathers of nineteenth century clinical investigation.[97] Indeed, the young Gairdner and the mature Balfour stand virtually at opposite ends of the history of cardiology as a purely clinical subject in Britain. It will be noted that Gairdner's methods of inquiry, auscultation and observation, were substantially the same as Balfour's. In emphasising Gairdner's priority with regard to the elucidation of the second heart sound, Balfour was thus according the laurels to someone with whom, as a clinician, a country doctor and a cardiologist, as a Scot, a product of the Edinburgh Medical School and, indeed, as a distinguished former member of the RMS, he had a great deal in common.

Similarly, one might conjecture that it is relevant to the neglect of Gairdner that, from the first decades of the twentieth century until relatively recently, cardiology and the writing of its history were in the hands of new cardiologists. The experimental inquiries of Hope, Williams and Rouanet doubtless seemed more cognate with late-nineteenth and twentieth century developments than did the purely clinical investigations of Gairdner. Nor have any twentieth century historians of cardiology shared Balfour's evident pride in Edinburgh medicine as a whole, or the Royal Society of Medicine in particular.

Provincial, obscure and unsung as Gairdner undoubtedly was, it would still not be appropriate to view his progression to country practitioner as representing a failure. As we have noted, Gairdner himself never made any attempt to secure recognition of his scientific priority – as he might have done had he been unsatisfied with his professional circumstances. To the majority of his contemporaries, and doubtless to Gairdner himself, success in the over-crowded and fiercely competitive world of nineteenth century medicine was best gauged not by the acquisition of fame but by the attainment of financial independence. Securing the post of medical attendant to a scion of one of the leading noble families of Scotland while a newly-qualified physician of only 22 years of age was indeed a remarkable achievement. A skilled horseman and an active sportsman, Gairdner was well-equipped both to mingle socially with the sporting Perthshire gentry and to bear the physical demands of travelling around an extensive rural practice.[98] He evidently did not squander the social and professional opportunities that his association with Sir Robert Dundas brought. He successfully established himself as the family physician of many of the households of a prosperous market town and its surrounding countryside. There would have been very many in his profession who would have envied his position as a well-respected and comfortably off country doctor.

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2 Weatherall DJ, Ledingham JGG, Warrell DA, editors. *Oxford textbook of medicine*. 3rd ed. Oxford: Oxford University Press; 1996; 2153.

3 Acierno LJ. *The history of cardiology*. London and New York: Parthenon; 1994; 511.

4 Duffin J. *To see with a better eye: A life of R.T.H. Laennec.* Princeton: Princeton University Press; 1998; 200. *Idem*: The cardiology of R.T.H. Laennec. *Med Hist* 1989; **33:**42-71; Fleming P. *A short history of cardiology*. Amsterdam: Rodopi; 1997; 92-3.

5 Bedford E. Cardiology in the days of Laennec: the story of auscultation of the heart. *Brit Heart J* 1972; **34:**1193-8.

6 It is acknowledged that the term 'cardiology' is employed with some danger of anachronism in this context. The use of the word can be traced back only as far as 1847. See: Lawrence C. Moderns and ancients: the 'new cardiology' in Britain 1880–1930. In: Bynum WF, Lawrence C, Nutton V, editors. *The emergence of modern cardiology*. London: Wellcome Institute; 1985; 1-33. The beginnings of cardiology as a discrete clinical specialty characterised by distinctive expertise and training are much later still.

7 It is not a coincidence that the first English translation of *De Motu Cordis* to be published since the seventeenth century appeared in 1832: Ryan M. Dr Harvey on the motion of the heart and the blood. *Lond Med Surg J* 1832; **1:**556-9; 590-4; 649-52; 685-7; 810-12; 1833; **2:**42-5; 102-5; 197-9; 230-2; 259-60; 684-6.

8 Some impression of the character of this debate may be gained from the pages of the *Lancet* and, especially, the *London Medical Gazette* between 1830 and 1840. Clendinning J. Experiments on the motions and sounds of the heart. *Lond Med Gaz* 1840; (new series) **1:**104-8; 152-6; 186-91; 267-70 is a good place to start.

9 Duffin, op. cit. ref. 4, 12.

10 The revisiting of particular matters of dispute did not end with the nineteenth century. As late as 1949, CJ Wiggers argued that the semilunar valves closed noiselessly and that the second sound occurred after these valves had closed. See: Acierno, op. cit. ref. 3, 511.

11 Birth Certificate Entry: Gardner (sic), 7 Sept 1808, Old Parish Records, Glasgow and Lanark, in the National Archives of Scotland. According to his obituarist, Gairdner was named after the famous Scottish physician/anatomist Matthew Baillie (1761–1823), but we have not been able to identify any direct link. See: Anon. Dr Matthew Baillie Gairdner of Crieff. *Edin Med J* 1888; **33:**1150-1. Nor, as far as we can ascertain, was Matthew Baillie Gairdner related to the medical dynasty of John Gairdner (1790–1876), President of the Royal College of Surgeons of Edinburgh, and Sir William Tennant Gairdner (1824–1907), Professor of Medicine at the University of Glasgow.

12 Bell B. *The life, character and writings of Benjamin Bell.* Edinburgh: Edmonston and Douglas; 1868. Bell, Russell and Co. was founded by the Edinburgh surgeons Benjamin Bell (1749–1806) and James Russell, probably in the 1780s. Bell's son George (1777–1832) joined the firm in 1798 and eventually took it over.

13 Gray J. *History of the Royal Medical Society.* Edinburgh: Edinburgh University Press; 1952. See also: Rosner L. *Medical education in the age of improvement: Edinburgh students and apprentices.* Edinburgh: Edinburgh University Press; 1991; 126. Rosner estimates that membership of the RMS did not exceed 13% of the Edinburgh medical student body.

14 Hall TS. *Ideas of life and matter: Studies in the history of general physiology, 600 BC–1900 AD.* Chicago: Chicago University Press; 1969; 257-9. This gives an outline of the Cartesian explanation of the actions of the heart.

15 Cournand A. Cardiac catheterization: development of the technique, its contribution to experimental medicine, and its application to man. *Acta Medica Scand* 1975; **579(Suppl):**1-32.

16 Corrigan D. On the motions and sounds of the heart. *Dublin Med Trans* 1830; **1:**151-203. *Idem*: On permanent patency of the mouth of the aorta. *Edin Med Surg J* 1832; **37:**225-45. For Corrigan, see: Agnew RAL. The achievement of Dominic John Corrigan. *Med Hist* 1965; **9:**230-40.

17 Stokes W. and Hart J. Observations on the actions of the heart. *Edin Med Surg J* 1830; **34:**269-73.

18 Hope J. *On the organic diseases of the heart.* RMS Dissertations. Edinburgh: Library of the Royal Medical Society; 1824-5; 134-84.

19 Waterhouse T. *On the causes of the impulse and sounds of the heart.* RMS Dissertations. Edinburgh: Library of the Royal Medical Society; 1830-1; 632-50.

20 *Ibid*. p. 646. The argument was substantially resolved in 1861 when the invention of the technique of closed thorax catherisation allowed recording of the changes of pressure within the heart on a rotating drum. See: Chauveau A, Marey EJ. Détermination graphique du rapports du choc du coeur avec les mouvements des oreillettes et des ventricles: Expérience faite à l'aide à un appareil enregistreur sphygmographe. *Compte rend des Scéances Acad Sci* 1861; **53:**622. Also: Cournand. op. cit. ref. 15.

21 Stokes W. *An introduction to the use of the stethoscope with its application to the diagnosis in diseases of the thoracic viscera.* Edinburgh: MacLachlan and Stewart; 1825.

22 The leading Laennec scholar, Jacalyn Duffin, (see reference 4) has pointed out that Laennec was familiar with Harvey's work and has followed Stokes in arguing that the contradiction between Laennec and Harvey may be more apparent than real. Atrial contraction follows as well as precedes ventricular contraction, albeit after an interval. The present authors are not however convinced by this argument. Even if Laennec's first sound was synchronous with the apex beat, the time interval between the first sound (ventricular systole to Laennec) and the second sound (auricular systole to Laennec) would still be greater than the time interval between the second sound and the next first sound. In other words, Laennec's explanation of the sounds must imply that he imagined the cycle of the heart to be ventricular systole, auricular systole, long pause, ventricular systole, etc., whereas to Harvey it was auricular systole, ventricular systole, long pause, etc. It should be noted that Harvey and Laennec approached the phenomena of the heart from differing investigative perspectives, Harvey via vivisection, Laennec via auscultation and post-mortem dissection. Harmonising the two modes of understanding the action of the heart turned out to be an inherently problematic matter.

23 Anon. On auscultation and percussion. *Glas Med J* 1828; **1:**59-77. The authors are grateful to James Beaton, Librarian of the Royal College of Physicians and Surgeons of Glasgow, for bringing this essay to our attention.

24 Nicolson M. The introduction of percussion and stethoscopy to early nineteenth-century Edinburgh. In: Bynum WF, Porter R, editors. *The five senses in medicine.* Cambridge: Cambridge University Press; 1992; 134-53.

25 Huard P, Grmek M. Les élèves étrangers de Laennec. *Revue d'histoire de sciences* 1973; **26:**315-37.

26 Hope J. *Dissertio medica inauguralis de aortae aneurismate.* Unpublished MD thesis from the University of Edinburgh,

1825. Hope later published a translated and somewhat enlarged version of this work, *On the diagnosis of aneurisms of the aorta by general and stethoscope signs*. *Lond Med Gaz* 1829; **4:**353-8, 391-4, 417-24, 449-53. For Hope, see: Flaxman N. The Hope of cardiology: James Hope (1801–1841). *Bull Inst Hist Med* 1938; **6:**1-21.

[27] Turner JW. Observations on the causes of the sound produced by the action of the heart. *Edin Med-Chir Trans* 1828; **3:**205-29. Turner had been President of the RMS in 1807 and was elevated to the University's Chair of Systematic Surgery in 1831. Although Turner was well aware of the experimental investigations of Harvey, Haller, Lancisi and so on, his own experience of vivisection had been, he admitted, 'limited'. His arguments, where original, are chiefly based upon clinical observations, especially of pulsations of the jugular vein.

[28] *Ibid*. p. 221.

[29] *Ibid*. p. 224.

[30] As late as 1832 David Badham, a Glasgow physician, defended in its entirety, on clinical grounds, Laennec's interpretation of the heart sounds. Badham D. The second sound of the heart not ventricular. *Lond Med Gaz* 1832; **10:**82-4.

[31] Bynum WF. *Science and the Practice of Medicine in the Nineteenth Century*. Cambridge: Cambridge University Press; 1994; 50.

[32] Gairdner MB. *On the impulse and sounds of the heart*. RMS Dissertations. Edinburgh: Library of the Royal Medical Society; 1829-30; 406-27.

[33] In this aspect of his study of the heart, Gairdner would doubtless have found the excellent library of the RMS a valuable resource. See: Anon. *List of Members, Laws and Library Catalogue of the Medical Society of Edinburgh*. Edinburgh: Aitken; 1820.

[34] Gairdner, op. cit. ref. 32, 415-6.

[35] For Laennec as a physiologist, see: Duffin, op.cit. ref. 4; chapters 4 and 12.

[36] *Ibid*. p. 411. Gairdner seems to have undertaken relatively crude experiments with a dead heart, the provenance of which is not specified.

[37] *Ibid*. p. 406.

[38] *Ibid*. p. 412-3.

[39] *Ibid*. p. 411.

[40] Williams D. On the sounds produced by the action of the heart. *Edin Med Surg J* 1829; **32:**297-305. Williams's views were extensively discussed in: Williams CJB. *The pathology and diagnosis of diseases of the chest*. 3rd ed. London: Churchill; 1835. See also: Schott A. Historical notes on the mechanism of closure of the atrioventricular valves. *Med Hist* 1980; **24:**163-84.

[41] Gairdner, op. cit. ref. 32, 410. It is possible that this description of the action of the heart was derived, at least partially, from an uncredited literary source. To compare with Harvey's account, see: Harvey W. *An anatomical disputation concerning the movement of the heart and blood in living creatures*. Whitteridge G, translator. Oxford: Blackwell; 1976; 32-7.

[42] Gairdner, op. cit. ref. 32, 417.

[43] *Ibid*. p. 428.

[44] Fleming, op. cit. ref. 4, 33-4, 76.

[45] Burns A. *Observations of some of the most frequent and important diseases of the heart*. Edinburgh: Bryce; 1809; 119-29. This text was, like most of the books referred to by Gairdner, in the Library of the RMS, see: Anon, op. cit. ref. 33. Burns, like Gairdner, based his argument for arterial contractility upon anatomico-clinical observation. He noted that some patients could function quite effectively with severe pathological deformities of the heart muscle, as revealed by later post-mortem investigation. The circulation was maintained by the major arteries, Burns argued. For Burns, see: Herrick JB. Allan Burns: 1781-1813, anatomist, surgeon and cardiologist. *Bull Soc Med Hist* 1935; **4:**457-83.

[46] Gairdner, op. cit. ref. 32, 415.

[47] *Ibid*. p. 425-6.

[48] *Ibid*. p. 426.

[49] *Ibid*. p. 418.

[50] *Ibid*. p. 422.

[51] *Ibid*. p. 423. Gairdner quotes: Bertin RJ. *Traite des maladies du coeur et des gros vaisseaux*. Paris: Bailliere; 1824; 356, as his authority on this point.

[52] Gairdner, op. cit. ref. 32, 423.

[53] *Ibid*. p. 424.

[54] Alison WP. *Outlines of human physiology*. 3rd ed. Edinburgh: Blackwood; 1839; 49-50. Alison cites Gairdner in the context of refuting the claim, made shortly before by the French physiologist, François Magendie, that the source of the 'cardiac' sounds lay outside of the heart itself. The attribution to Gairdner's discovery to Elliot was, however, repeated: O'Farrell PT. A famous cardiac controversy: Hope v. Williams. *Irish J Med Sci* 1957; **378:**278-85. For Magendie's views, see: Magendie F. Lectures on the physical conditions of the human body, XVI. *Lancet* 1835; **1:**633-9.

[55] Williams, op. cit. ref. 39, 170.

[56] Billings A. Causes of the sounds of the heart. *Lond Med Gaz* 1840; **2:**64-7. *Idem*. On the auscultation and treatment of affections of the heart. *Lancet* 1832; **1:**198-201.

[57] O'Farrell, op. cit. ref. 54.

[58] For Robert Dundas, see: Omond GWT. *The Arniston memoirs: Three centuries of a Scottish house*. Edinburgh: Douglas; 1887; xxxi.

[59] Op. cit. ref. 11.

[60] Marriage Certificate Entry: Matthew Baillie Gairdner, physician, Crieff (36 yrs) and Elizabeth Campbell Orr, Largs (18 yrs, soon to be 19 yrs). 14 April 1845, Old Parish Records, Crieff, in National Archives of Scotland.

[61] Op. cit. ref. 11.

[62] Syme was Professor of Surgery in Edinburgh University 1833–69. See: Miles A. *The Edinburgh school of surgery before Lister*. London; 1918.

[63] Benjamin Bell was the nephew of George Bell and the grandson of Benjamin Bell. See note 12 above.

[64] Grierson JM. *Records of the Scottish volunteer force, 1859–1908*. Edinburgh: Blackwood; 1909; 247. Jewitt L. *Rifle and volunteer rifle corps: Their constitution, arms, drill laws and uniform*. London: Ward and Lock;1860.

[65] Gairdner is listed in: Vernon R. *A narrative of the Royal Scottish volunteer review in Holyrood Park on the seventh August 1860*. Printed pamphlet, no publisher given, in Library of Edinburgh Castle.

[66] Extract: Registered Trust Disposition and Deed of Settlement of Dr Matthew B. Gairdner. 10 Sept 1885, Court Books of the Commisseriat of Perth, National Archives of Scotland.

[67] Medical Records of the Royal Edinburgh Asylum, Logbook 1886, pp. 427-8. Lothian Health Board Archive: Edinburgh University Library; 1886.

[68] Death Certificate Entry: Matthew Baillie Gairdner, Medical Practitioner, etc., 18 May 1888. National Archives of Scotland.

[69] Confirmation of Matthew Baillie Gairdner, MD, etc., Court Books of the Commissariat of Perth, 18 August 1888. National Archives of Scotland.

[70] Op. cit. ref. 11.

[71] For much valuable insight into the role and status of original inquiry in the academic medical culture of the early nineteenth century Edinburgh Medical School, see: Jacyna LS. *Philosophic whigs: Medicine, science and citizenship in Edinburgh, 1789–1848*. London and New York: Routledge; 1994; see especially 115-29. Also: Lawrence C. The Edinburgh Medical School and the end of the 'old thing', 1790–1830. *Hist of Universities* 1988; **7:**259-86. Barfoot M. Brunonianism under the bed: an alternative to university medicine in Edinburgh in the 1780s. In: Bynum WF, Porter R, editors. *Brunonianism in Britain and Europe*. *Med Hist* 1988; **8(Suppl):**22-45. It is evident, moreover, that the RMS enjoyed the patronage and encouragement of many of the leading medical professors of the time. The Society was, in other words, integrated within

Edinburgh's academic medical culture. See: Stroud W. *History of the Medical Society of Edinburgh.* In: Gairdner, op. cit. ref. 32, iii-ci; Gray, op. cit. ref. 13.

[72] Stroud W. In Anon. op.cit. ref. 32, iii-ci; Gray, op. cit. ref. 13.

[73] Barlow N, editor. *The autobiography of Charles Darwin, 1809–1882.* London: Collins; 1958; 51. Darwin did, however, acknowledge that some of the presentations to the Society were of good quality. He had, moreover, already become disillusioned with the study of medicine by this time. Janet Browne, in her authoritative recent biography of Darwin, notes the high standard of the work accomplished by the student members of the other Edinburgh society that Darwin joined, the Plinian, which sponsored natural history and antiquarian researches. Browne J. *Charles Darwin: Voyaging.* London: Cape; 1995; 76.

[74] Gray, op. cit. ref. 13.

[75] *Ibid.* p. 134.

[76] *Ibid.* p. 125.

[77] *Ibid.* p. 132. See also: Rosner L. Eighteenth-century medical education and the didactic model of experiment. In Dear P, editor. *The literary structure of scientific argument.* Philadelphia: Pennsylvania University Press; 1991; 182-94.

[78] Miles, op. cit. ref. 62, 32.

[79] Anon. *Dissertations by eminent members of the Royal Medical Society.* Edinburgh: Douglas; 1892.

[80] Burns, op. cit. ref. 45.

[81] Newbigging PSK. *On the causes of the impulse and sounds attending the action of the heart in its normal state.* RMS Dissertations. Edinburgh: Library of the Royal Medical Society; 1833; 441-65.

[82] *Ibid.* p. 441.

[83] *Ibid.* p. 454.

[84] *Ibid.* p. 454-5.

[85] Gray, op. cit. ref. 13, 62.

[86] Hastings C. *What is the state of the blood vessels in inflammation?* RMS Dissertations. Edinburgh: Library of the Royal Medical Society; 1815, 201-35. Sir Charles Hastings was a founder of the Provincial Medical and Surgical Association, later the British Medical Association. See: Gray, op. cit. ref. 13, 117. Medical microscopy was not taught in Edinburgh as part of the formal curriculum until the appointment of John Hughes Bennett to the Chair of the Institutes of Medicine in 1848. See also: Jacyna S. John Hughes Bennett and the origins of medical microscopy in Edinburgh: Lilliputian wonders. *Proc Royal Coll Phys Edinb* 1997; **2(Suppl 3):**12-21.

[87] Hall M. On the dispersive and refractory powers of the human eye and on some notions of the iris. In: Anon, op. cit. ref. 79, 84-94.

[88] Gray, op. cit. ref 13, 119.

[89] Jewson N. The disappearance of the sick man from medical cosmology. *Sociology* 1976; **10:**225-44.

[90] Nicolson M. The art of diagnosis: Medicine and the five senses. In: Bynum WF, Porter R, editors. *Companion encyclopedia of the history of medicine.* London: Routledge; 1993; **2:**801-23.

[91] For the Paris school, see: Ackernecht EH. *Medicine at the Paris School, 1794–1848.* Baltimore: Johns Hopkins University Press; 1967; Foucault M. *The birth of the clinic: An archaeology of medical perception.* London: Tavistock; 1973; and for its impact in Britain, Maulitz R. *Morbid appearances: the anatomy of pathology in the early nineteenth century.* Cambridge: Cambridge University Press; 1987.

[92] Lawrence and Jacyna (op. cit. ref. 71) discuss the impact of the French clinico-pathological style of research on Edinburgh; also, Jacyna S. Robert Carswell and William Thompson at the Hôtel-Dieu of Lyons: Scottish views of French medicine. In: French R, Wear A, editors. *British medicine in the age of reform.* London and New York: Routledge; 1991; 110-35.

[93] See, for instance, the remarks on the stethoscope in: Seagram WB. *On sundry organic diseases of the heart.* RMS Dissertations. Edinburgh: Library of the Royal Medical Society; 1827-8; 80-102.

[94] Bernard C. *An introduction to the study of experimental medicine.* Green HC, translator. New York: Dover; 1957; 108. See also note 20 above.

[95] Balfour GW. *Clinical lectures on diseases of the heart and aorta.* London: Churchill; 1876; 243; see also: Acierno, op. cit. ref. 3, 119.

[96] See note 6 above.

[97] For Skoda's influence, see: Lesky E. *The Vienna Medical School of the nineteenth century.* William L, Levij IS, translators. Baltimore: Johns Hopkins University Press; 1976. See also: Sakula A. Joseph Skoda 1805–81: a centenary tribute to a pioneer of thoracic medicine. *Thorax* 1981; **36:**404-41; Neuberger M. *British medicine and the Vienna school.* London: Heinemann; 1943.

[98] For the importance of horsemanship to the rural medical practitioner, see: Loudon I. *Medical care and the general practitioner.* Oxford: Claredon; 1986; 117-25. It has also been pointed out that the landed gentry often chose their physicians as much for their social graces and their sporting abilities as their medical acumen. See: Lawrence C. Incommunicable knowledge: Science, technology and the clinical art in Britain, 1850–1914. *J Contemp Hist* 1985; **20:**503-20. Gairdner, we may presume, possessed all three sets of qualities – the medical, the social and the sporting.