JOHN TYNDALL AND THE ROYAL MEDAL THAT WAS NEVER STRUCK

by

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The Royal Medal is one of the premier awards conferred by the Royal Society, second only to the Copley Medal,1 and was introduced in 1826 after a proposition by the then Home Secretary Robert Peel to George IV. Two Royal Medals were initially awarded each year, and there was much dispute about the criteria in the early years.2 After a review in 1850, the pattern settled down to the award of one in the physical sciences and one in the biological sciences for ‘the two most important contributions to the advancement of Natural Knowledge published originally in Her Majesty’s dominions within a period of not more than 10 years and not less than 1 year of the date of the award.’3 In 1965 a third medal was introduced on behalf of Elizabeth II, covering the applied sciences. The designated medallists in 1853 were John Tyndall and Charles Darwin, and for the first and so far only time in its history one medal was not presented, having been declined by Tyndall.

TYNDALL’S BACKGROUND AND EDUCATION

At the time that he was nominated for the medal on 23 June 1853, Tyndall was 32 years old and had only been active as a researcher for 3 years; Darwin was already 44 years old. From a humble upbringing in County Carlow, Tyndall had worked from 1839 as a surveyor with the Ordnance Survey in Ireland, before moving to northern England where he was dismissed in November 1843 for leading complaints about pay and conditions. He eventually found work in September 1844 as a railway surveyor based in Manchester and Halifax until he was enticed in August 1847 to join the staff of Queenwood School in Hampshire, which

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Keywords: Tyndall; Royal Medal; diamagnetism; Royal Society
offered a unique and practically based approach to education in the sciences. Throughout this
time he was educating himself in mathematics, the sciences and engineering through books,
magazines and lectures at the developing Mechanics Institutes, with at one point the
aspiration of becoming a railway engineer. Edward Frankland joined the staff at
Queenwood shortly after him. Frankland had visited Germany in the summer to meet
many of the German chemists, contacts of Lyon Playfair, in whose laboratory he had
worked from 1845. One of these was Robert Bunsen in Marburg. Tyndall decided to go
with Frankland to Marburg in 1848, that year of revolution across Europe, to study in
Bunsen’s laboratory for a PhD, which he completed in an impressively short time in
1850. Indeed, it was Bunsen ‘from whose lips I first heard of diamagnetism’.

Tyndall now sought to make his way as a natural philosopher, without money or
family connections at a time when there were minimal opportunities for paid work in his
chosen field and the competition was stiff. Yet within three years he was a Fellow of
the Royal Society, the Professor of Natural Philosophy at the Royal Institution and the
designated recipient of a Royal Medal. It was a meteoric rise, founded largely on his
work on diamagnetism.

The significance of Tyndall’s work on diamagnetism has been underplayed in the
literature. His own contribution is underappreciated and its impact on his scientific and
social reputation largely ignored. A summary of his contribution is given in the early
biography of Tyndall by Eve & Creasey and in the collection of essays edited by Brock
et al. But in the most recent extensive biographical study, Ursula DeYoung gives barely
a mention to diamagnetism, dividing his career into three major categories of research:
glaciology, molecular behaviour in varying atmospheric conditions, and bacteriology.
Diamagnetism is in reality the first of his four major areas of research, and the most
significant one for establishing his career and early reputation.

DIAMAGNETISM

Michael Faraday’s paper announcing his discovery of ‘diamagnetics’, substances that are
repulsed from a magnetic pole, was read before the Royal Society on 20 November
1845. This finding, implying that all materials are affected by what Faraday called a
magnetic field, stimulated major efforts in Britain and mainland Europe over the next
10 years to understand this very weak phenomenon and to integrate it into theories of
electromagnetism. Effectively, it became a test case between those who favoured
Faraday’s developing field theory, including William Thomson in this period and later
James Clerk Maxwell, and those who took an approach based on A.-M. Ampère’s
circulating currents or rotating electric charges, diamagnetic polarity and action at a
distance. In mainland Europe, Julius Plücker, a geometer turned physicist, was active
eyearly, publishing two papers in 1847. In the first he claimed to have identified a new
repulsive force related to the optic axis of crystals, and in the second that the magnetic
force diminished less than the diamagnetic in proportion to the increase of distance from
the poles. Wilhelm Weber published related work in 1848 in which he claimed to
show that induced currents in bismuth, a diamagnetic material, were opposite to those in
iron. In March 1848 Plücker published a further paper asserting the existence of
diamagnetic polarity. In the meantime, Faraday had identified and described in the
Bakerian Lecture for 1848 what he called the ‘magne-crystallic axis’, as a line in a
crystal tending to place itself in the magnetic axis, analogous to Plücker’s identification of the optic axis. He explained the effect of the magnecrystallic force as ‘not one of attraction or of repulsion but of position only, and is as far as I can see a new effect or an exertion of force new to us.’\textsuperscript{18} Plücker continued to work with crystals, writing to Faraday on 20 May 1849\textsuperscript{19} to convey his new findings that the optic axis was repelled or attracted depending on whether the crystal was negative or positive, respectively, a letter that Faraday had published in \textit{Philosophical Magazine}.\textsuperscript{20}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{john-tyndall-1850s.png}
\caption{John Tyndall (1820–93) in the 1850s. (Reproduced by courtesy of The Royal Institution of Great Britain.) (Online version in colour.)}
\end{figure}

\textbf{Tyndall and Knoblauch}

This was the position when, in November 1849, Tyndall (pictured in figure 1) started to work on diamagnetism with Hermann Knoblauch\textsuperscript{21} in Marburg, even though he had not yet completed his PhD thesis. Knoblauch was one of a strong group of German savants, including Helmholtz, Du Bois-Reymond, Siemens and Clausius, who studied in Magnus’s laboratory in Berlin. The primary focus throughout Knoblauch’s career was the study of radiant heat, a subject to which Tyndall himself later turned with great success. Knoblauch did not have much time for the work on diamagnetism, which fell largely to Tyndall, although the advice and help of Knoblauch was substantial. From a practical
point of view, Knoblauch helped with the sourcing of crystals and apparatus, and from a theoretical point of view his exploration of the relationship between crystal structure and the transmission of heat in different directions (he published a paper on this in 1852) may well have influenced Tyndall’s own efforts to relate observed properties to underlying structure; ideas that would resurface in Tyndall’s later work on glaciers and heat in particular. Apart from the two initial papers with Tyndall, Knoblauch published no further work on diamagnetism.

Tyndall immediately began following up Plücker’s work, considering that Plücker might be right with respect to the optic axis but that ‘he never took the time to establish his law’. It soon became clear that Plücker’s results did not hold, and it struck Tyndall that the cleavage rather than the optic axis of the crystal might be significant, an idea that would become the basis of his beliefs about the importance of molecular structure. In his first paper, ‘On the deportment of crystalline bodies between the poles of a magnet’, built on a carefully controlled set of experiments with cubes, discs and thin bars of materials, Tyndall refuted Plücker’s conclusion of the optic axis as the prime determinant of behaviour and pointed to the importance of chemical constitution and structure.

The question of diamagnetic polarity also remained contested. Faraday returned to print after a gap of a year with his paper ‘On the polar or other condition of diamagnetic bodies’ read at the Royal Society on 7 and 14 March 1850, stimulated in particular by Weber’s paper concluding that diamagnetics are polar in a magnetic field. Faraday asserted that a true polarity must be permanent, not induced or temporary, and opposite to ordinary magnetic polarity.

At this point Tyndall published his second paper with Knoblauch, ‘On the magneto-optic properties of crystals, and the relation of magnetism and diamagnetism to molecular arrangement’. It became the ‘First Memoir’—out of six memoirs and several related papers—in Tyndall’s collated work on diamagnetism, and was given also as a paper by Tyndall in August 1850 at the Edinburgh meeting of the British Association, stimulating a sharp debate with Thomson. According to the Athenaeum it gave rise to ‘a very animated discussion’, which Tyndall described as ‘a hand to hand fight’. In this paper, having previously shown that Plücker’s statement that the optic axis alone determined the orientation of the crystal in the magnetic field was incorrect, Tyndall and Knoblauch showed that Plücker’s new law of the behaviour of optically positive and negative crystals was also invalid. They showed that there was no need to posit an ‘optic axis’ (Plücker) or ‘magnecrystallic’ force (Faraday), replacing it by Tyndall’s concept of a ‘line of elective polarity’, and finally demolished Plücker’s argument that the magnetic attraction decreases in a ‘quicker ratio’ than the repulsion of the optic axis. Nevertheless, Plücker maintained his position in a further paper published in late 1850.

The Royal Medal

The citation for Tyndall stated that the award was ‘for his paper “On Diamagnetism and Magnecrystallic Action”, published in the Philosophical Magazine for 1851’, the issue that appeared in September. This paper became the ‘Second Memoir’ and had been presented in July 1851 at the Ipswich meeting of the British Association. It had also been published in Poggendorff’s Annalen in late July 1851. It contained further demolition of Plücker’s work, as Tyndall used a torsion balance to measure diamagnetism...
in bismuth and disprove Plücker’s proposition that the laws that govern magnetism and
diamagnetism are different. *Athenaeum* reported that Faraday spoke at some length on
Tyndall’s contribution, which afforded him ‘great gratification that there was one at least
among us who has followed up this important subject so perseveringly.’36 He ‘felt
prepared to admit that that some of Dr Tyndall’s results seemed to promise an
explanation of Plücker’s perplexing results and conclusions’.

By the time the award was made, and these would have been on the record at the time,
Tyndall had also published in November 1851 his paper ‘On the polarity of bismuth,
including an examination of the magnetic field’,37 which became his ‘Third Memoir’, and
had given a further paper ‘On Poisson’s Theoretic Anticipation of Magnecrystallic
Action’,38 in September 1852 at the Belfast meeting of the British Association.

At this point, although no one could have known it, Tyndall was only halfway through his
eventual work on diamagnetism, but had established a solid body of experimental evidence
and theoretical insight, the latter contrary to Faraday’s interpretation but shared by many
others in Britain and in mainland Europe. He had also shown his ability to disagree in
public with experienced figures such as Thomson and Faraday.

Nominations for the Royal Medal took place over two meetings of the Council of the
Royal Society in 1853.39 On 2 June, three nominations were made:

Charles Darwin, ‘for his work entitled “Geological Observations on Coral Reefs, Volcanic
Islands, and on South America,” and his work “Fossil Cirrhipeda of Great Britain, section
Lepadidae, Monograph of the Cirrhipeda.”’, proposed by Colonel Joseph Portlock,40
seconded by Thomas Bell;41
August Wilhelm von Hofmann, 42 ‘for his Researches on Organic bases, contained in the
Philosophical Transactions and the Journal of the Chemical Society’, proposed by Thomas
Graham,43 seconded by Henry Bence Jones;44
Arthur Cayley,45 ‘as the author of Analytical Researches, published in the Philosophical
Transactions, in the Cambridge Journal, and in the Philosophical Magazine’, proposed by
James Booth,46 seconded by William Hopkins.47

At the next meeting on 23 June, five more nominations followed, making a total of two in
the biological sciences and six in the physical sciences:

Tyndall, proposed by J. P. Gassiot,48 seconded by Charles Brooke;49
Edward Frankland,50 ‘for his paper “On the Organic Radicals,” contained in the Journal of
the Chemical Society and in the Philosophical Transactions’, proposed by Benjamin
Brodie,51 seconded by Thomas Graham;
James Sylvester,52 proposed by James Booth,53 seconded by Thomas Graham;
John Lindley,54 ‘for his numerous works on all branches of Scientific Botany, especially
for his researches in the Natural Order Orchideae (his latest work)’, proposed by Joseph
Hooker,55 seconded by Nathaniel Wallich;56
Robert Bunsen,57 proposed by Benjamin Brodie,58 seconded by Thomas Graham.

Tyndall had by now been a Fellow of the Royal Society for a year, having been elected on
3 June 1852. He had also given his first Discourse at the Royal Institution on 11 February
1853, to considerable acclaim and on this difficult topic of diamagnetism; a challenging
one for a public audience. Negotiations had followed to appoint him as Professor of
Natural Philosophy at the Royal Institution, with Bence Jones playing a major role, a process of which Gassiot and others were well aware and which was formally completed on 4 July with his election.\textsuperscript{59}

The decisions on the award of the Royal Medals were made on 3 November.\textsuperscript{60} The choice of Darwin, against Lindley, seems to have been straightforward, but not so for Tyndall. Not all those who had proposed or seconded candidates attended the Council meeting on 3 November, at which a total of 13 Council members were present: Thomas Bell (the Biological Sciences Secretary), James Booth, Benjamin Brodie, Samuel Hunter Christie (the Physical Sciences Secretary),\textsuperscript{61} J. P. Gassiot, Joseph Hooker, Henry Bence Jones, George Newport,\textsuperscript{62} Edward Sabine (in the chair),\textsuperscript{63} William Sharpey,\textsuperscript{64} William Smyth (the Foreign Secretary),\textsuperscript{65} William Spence\textsuperscript{66} and Nathaniel Wallich. On 4 November 1853 Tyndall heard from Bence Jones that he was the ‘elected candidate’ for a Royal Medal,\textsuperscript{67} against Hofmann, Frankland, Cayley and Sylvester, and also heard some of the political dealing that had resulted in this outcome; Gassiot had proposed him and Brooke seconded. It is surprising that Bence Jones apparently did not mention Bunsen. Tyndall had learnt from Bunsen and worked in his laboratory in Marburg just a few years before, receiving active support, and would have regarded him as a mentor. Bence Jones would have known this and was perhaps being diplomatic.

Tyndall understood that Bence Jones had been a supporter of Hofmann—indeed, he had seconded his nomination. According to Tyndall’s report of his conversation with Bence Jones, Brodie saw that Frankland had little chance and sided with Graham and Bence Jones in favour of Hofmann, after which Cayley had one vote and Tyndall and Hofmann were equal. Cayley had been proposed by Booth and seconded by Hopkins, Booth having also proposed the much more experienced Sylvester, perhaps for reasons of tact.\textsuperscript{68} Whoever voted for Cayley thus seemed to have switched to Tyndall. It seems likely that this was Booth, but it is not possible to identify the other three who voted for Hofmann initially and therefore the six, including Gassiot, who voted for Tyndall.

It is surprising on the face of it that Tyndall outcompeted Hofmann at this point, and is indicative of the impact he had made in a short time. Hofmann, born in 1818 and having had the full benefit of his German education, had already been appointed as the first director of the new Royal College of Chemistry in 1845. Tyndall, born in 1820, came to natural philosophy late and had only just completed his PhD by 1850. Frankland was the youngest, born in 1825, and had been an assistant in the chemical laboratory of the British Geological Survey in 1845, after which he spent time like Tyndall, and indeed with Tyndall, in Marburg. In addition, the medal had not been awarded to a chemist since 1850, when Thomas Graham received it—the recipients in 1851 and 1852 were the Earl of Rosse (astronomy) and James Joule (physics), respectively. Nevertheless, honour was eventually satisfied all round, as Hofmann received the medal in 1854 and Frankland in 1857.

Tyndall wrote about the medal on Sunday 6 November to Gassiot, who at this time was also trying to entice him to the London Institution,\textsuperscript{69} at the same time as Sir Henry de la Beche was trying to secure him for the School of Mines at Jermyn Street, and received a reply on 9 November in which Gassiot indicated that he had proposed him for a discovery that he considered would ‘have an important bearing in that great question which has yet to be solved—the true cause of the variation of the magnetic needle’,\textsuperscript{70} an issue that had recently been exercising Faraday.\textsuperscript{71} He received a congratulatory note from Sabine the same day, and given Sabine’s effective patronage of Tyndall, and his interest in magnetism, one can imagine that his vote would also have gone Tyndall’s way. Tyndall’s
work was not directly aimed at understanding terrestrial magnetism and the causes of its variation, but these two letters are indications of the significance of the study of magnetism at the time, both for its intrinsic understanding and for its application in navigation. Indeed, Faraday had recently suggested that magnetic variation was particularly influenced by the effect of temperature on paramagnetic oxygen in the atmosphere.72

Matters became complicated on 15 November. Gassiot came to see Faraday, and after speaking with him told Tyndall that there were objections. As Tyndall reported, people ‘say that my investigations were partly conducted along with Knoblauch and partly in the private cabinet of Prof. Magnus in Berlin, and add something regarding Plücker’s priority which I do not understand.’73 Tyndall’s instinct was to refuse the medal, and when Faraday told him that he would not offend Gassiot by so doing and that he would have done the same himself, Tyndall resolved so to do. He wrote graciously to Christie, the Physical Sciences Secretary, on the same day. The letter was apparently sent the following day, after Faraday had seen and approved it, ‘saying he would not alter a single word.’74 In the letter Tyndall wrote to ‘resign all claim to the Medal and thus restore to the Council the liberty of making a better choice.’75 He also made it clear that he had never sought a Royal Medal; it was ‘a consummation on which I never based a hope’. As Faraday said, Tyndall by this action had ‘the Council at your mercy, you make them your debtors for ever and destroy all earwigging and petty whisperings.’76 Tyndall met Gassiot to agree an exchange of letters and wrote to him on 18 November to clarify his grounds for rejecting the medal.77

Perhaps it would have been politic to leave matters here, but Tyndall had a strong moral code, frequently expressed in his journal and letters, and felt that in all conscience he should write again to Gassiot to explain what he really felt. He did so on 20 November disavowing the ability of some of the Council members to judge his work, and asking Gassiot to replace his original letter with a revised one. Tyndall asked for the phrase ‘eminently qualified judges’ in his first letter to be replaced by ‘men of eminent standing in science’ in the second; ‘for how high soever their standing may be it is my conscientious conviction that in the matter before us that have not qualified themselves to judge aright and that they are now taking up a position which they will be unable to stand by at a future date.’78 Gassiot replied that he ‘would sooner hold the position you have so promptly taken than be the recipient of 20 medals.’79 Tyndall’s letters of 15 November to Christie and 20 November to Gassiot were read out at the Council meeting on 24 November, and the President was requested ‘to inform the proper authorities that the Royal Society have awarded a Royal Medal to Mr. Charles Darwin.’80 According to Tyndall, it was the letter to Gassiot that caused the Royal Society to write to the Queen informing her that only one Medal would be awarded.82 Tyndall, despite his feeling of moral righteousness, may have had a slight regret at sending this letter, since he wrote in his journal: ‘If I consulted my own feelings I should simply permit the letter I wrote to Christie to stand upon the minutes, reserving to myself the resolution not to accept a medal with a trace of suspicion attached to it.’83

Tyndall learned from Gassiot on 25 November that Charles Wheatstone,84 who was not a member of Council at the time of the decision, had said at the Committee for the Kew Magnetic Observatory that Plücker had really made the discovery, and the medal ought to be awarded to him if to anybody.85 In a subsequent conversation with Bence Jones, Tyndall learned that Wheatstone’s motivation seemed to be to secure the medal for Hofmann, though when understanding that it could not be awarded to another, had suggested it should go to Tyndall and Knoblauch.86 Tyndall was also not impressed by the apparent opposition of Hopkins, a member of Council at the time of the decision but
not present at the decisive meeting, who had ‘never read a single one of my papers’;\textsuperscript{87} Tyndall wrote to Hopkins the following day, sending the relevant papers. Hopkins replied later, on 29 December, impressed by Tyndall’s refutation of Plücker but with some very pertinent comments on the effect of pressure in tending to lessen the distances between constituent particles perpendicularly to the applied pressure.\textsuperscript{88} Hopkins had in fact written to Gassiot approving of Tyndall’s action.\textsuperscript{89} William Francis, the publisher of *Philosophical Magazine* and a close friend of Tyndall’s, told him that Thomas Huxley was furious with him for refusing the medal.\textsuperscript{90}

The presentation of medals took place at the Royal Society on 30 November. Sabine received the Copley Medal on behalf of Dove, and Darwin his Royal Medal. Huxley then stood up to ask ‘why his intimate friend whom he would not name was not beside Mr Darwin.’\textsuperscript{91} Tyndall’s two letters to Christie and Gassiot were read out ‘and received with great applause’, although Booth apparently regretted he had sent the second because he thought Tyndall ought to accept the medal if awarded it a second time.

Tyndall gave an amusing account of the machinations to his friend Thomas Hirst:\textsuperscript{92}

They set about scrutinizing the affair; first they found that Thomson was opposed to me, second that my two first papers were joint papers with Knoblauch, third that my third paper had been got up in the private laboratory of Prof. Magnus, fourth that this same paper was published in German before it appeared in England.\textsuperscript{93} fifthly that one or two men who have got a name in England thought that I had not quite made out my point.\textsuperscript{94}

The affair rumbled on into the New Year with a further apparent misunderstanding when Tyndall heard from Hirst on 30 January 1854 that Williamson\textsuperscript{95} had told Atkinson,\textsuperscript{96} who had told Hirst, of a rhyme that Bence Jones had made, an adaptation of the familiar English nursery rhyme, which ran:

\begin{quote}
The Lion and the Unicorn  
Were fighting for the crown  
When up came the little dog  
And knocked them both down.\textsuperscript{97}
\end{quote}

Hirst said that Williamson had claimed that the intention was to give Hofmann the medal but that Frankland was put up in opposition and, not being able to decide, it was given to Tyndall. Faraday, on seeing the claim, said that it was a ‘manifest absurdity’ and surely the rhyme was done as a joke and not to deprecate Tyndall. Tyndall was inclined to agree, although he recalled that Bence Jones had said something to him about his success depending on a split between Hofmann and Frankland. Faraday read the extract to Bence Jones that evening, who immediately came to Tyndall and told him that he had repeated the rhyme to Sharpey but that he meant Tyndall and Hofmann by the Lion and the Unicorn (in the nursery rhyme, the Lion beat the Unicorn); ‘it would be preposterous to mean Frankland since he had not a single vote. When it was found that Hofmann and I were equal somebody suggested that the medal ought to be given to some mathematician; and the mathematician was the little dog.’\textsuperscript{98} Tyndall accepted this explanation and wrote to Hirst to draw a line under it, saying, ‘I hope I shall never hear another word about the Royal Medal.’\textsuperscript{99} Hirst replied on 5 February: ‘The explanation of the “little Dog” business although not quite satisfactory, makes matters a little better. Either Bence Jones or Williamson, however, have been guilty of considerable narrow-mindedness and as you say the best way is to leave the matter entirely to them.’\textsuperscript{100}
THE AFTERMATH

So ended a somewhat unedifying episode in the scientific and personal politics of the time, and Tyndall’s name does not appear in the list of Royal Medallists in the Record of the Royal Society. He might have been better advised to write the letter to Christie and either not to send or to tone down the letters to Gassiot, but his sense of personal honour did not permit this. It would not be the last time that his desire to defend what he believed to be right caused him difficulties with other savants, notable cases being his disputes with J. D. Forbes over the motion of glaciers and his defence of the contributions of J. R. Mayer to the conservation of energy. He was also relatively young. Only 14% of recipients of the Royal Medal in the period 1825–1914 were under 35 years of age, and the average age increased significantly after about 1855. This episode does not, however, seem to have significantly damaged his relationships among the Fellows, nor affected his career in any substantial way. Indeed, he was invited to give the Bakerian Lecture on this very topic of diamagnetism on the next possible occasion in January 1855, the first of four invitations to give that prestigious lecture. He was later to win the Rumford Medal in 1864 for his work on the absorption and radiation of heat by gases and vapours. He was an important and influential figure in the scientific politics of the mid-century, not least as a member of the X Club, that coterie of nine who were so influential in the period 1865–85, and as a Council member and, memorably in 1874, President of the British Association. However, unlike many of his friends in the X Club he never received the Copley Medal nor did he achieve office in the Royal Society, beyond election as a member of Council and Vice-President late in life in 1879–80. He repeatedly stated in his journal and letters that he did not seek awards and positions, rather that they should come to him; however, one cannot help thinking that if he had been offered more he would have been minded to accept, and that the prickly manner in which he dealt with the Royal Medal at the least coloured views towards him within the Royal Society, even if it did him no major damage.

Tyndall’s avowal that he did not seek awards and positions is ironic in the context of the purpose for which the Royal Medals were established. As Macleod has pointed out, they were one of the earliest instruments of Royal patronage created specifically to encourage original scientific research. Yet the existence of the medal can have had no effect at all in encouraging Tyndall; he may well have been entirely unaware of it when he started his research, and he was motivated by the intrinsic desire to understand nature, not by any competitive notions (which it was Peel’s intent to foster through the introduction of these medals) or by the desire for public glory, at least insofar as he confided truthful sentiments to his private journal and letters, including in his letter to Christie. The controversy surrounding the nomination of Tyndall as the medallist was by no means unique: both the purposes of the award and the choice of recipients were frequently disputed. But Tyndall’s award remains the only occasion on which the medal was not in consequence presented.

ACKNOWLEDGEMENTS

I should like particularly to thank Professor Frank James for his advice and suggestions. I also thank the following for their generous help: Charlotte New, Jane Harrison and Katherine Doyle at the Royal Institution, and the staff of the Library of the Royal Society
of London. I have benefited greatly from discussions with Sir John Rowlinson FRS on the theory and early history of diamagnetism. I am grateful for the award of a Visiting Fellowship at the Royal Institution, and for permission to quote from their manuscript collections and from those of the Royal Society.

NOTES


3 *The Record of the Royal Society of London*, 4th edn (Morrison & Gibb, Edinburgh, 1940), p. 117.

4 A dedication in the back of his only surviving laboratory notebook on diamagnetism, RI/MS/JT/3/45.


8 M. Faraday, ‘On new magnetic actions, and on the magnetic condition of all matter’, *Phil. Trans. R. Soc. Lond.* 136, 21–40 (1846).

9 William Thomson (1824–1907), later Sir William and then Lord Kelvin. Tyndall challenged Thomson’s interpretations at their first meeting at the British Association in Edinburgh in 1850, and subsequently in Belfast in 1852, in Liverpool in 1854 and in Glasgow in 1855. Tyndall was particularly sharp in the Glasgow encounter, although Thomson did not respond to the provocation.

10 A detailed paper on Tyndall’s contribution to the understanding of magnetism is currently in preparation by the current author.

11 Julius Plücker (1801–68) was originally a geometer but dedicated many years of his life to physical science. He published 59 papers on physics, the magnetic properties of gases and crystals, and electric discharge in evacuated gases. Although Plücker’s accomplishments were unacknowledged in Germany, English savants did value his work more than his compatriots did (*Dictionary of Scientific Biography*, hereafter *DSB*). He was elected a Foreign Member of the Royal Society in June 1855 (Tyndall did not sign the nomination certificate) and was awarded the Copley Medal in 1866. The relationship between them was acrimonious until they mended fences in 1858 at an encounter brokered by August Hofmann (J. Tyndall, *Journal*, 10 April 1858, RI MS JT/2/13c; hereafter Tyndall journal entries are referenced as ‘Tyndall, Journal, date’).


14 Wilhelm Weber (1804–1891) is best known for his *Elektrodynamische Maassbestimmungen*, seven long works published between 1848 and 1878. He extended Ampère’s theory to cover diamagnetism, arguing that it is caused when resistanceless molecular currents are induced in diamagnetic substances. His lasting impression on physical theory was his atomistic conception of electric charge and its role in determining the electrical, magnetic and thermal
properties of matter (DSB 1981). He was elected a Foreign Member of the Royal Society in 1850 and was awarded the Copley Medal in 1859.


17 M. Faraday, ‘On the crystalline polarity of bismuth and other bodies, and on its relation to the magnetic form of force’, Phil. Trans. R. Soc. Lond. 139, 1–41 (1849).


20 J. Plücker, ‘On the magnetic relations of the positive and negative optic axes of crystals’, Phil. Mag. 34, 450–452 (1849).

21 Herman Knoblauch (1820–95), just a few months older than Tyndall, had completed his doctorate in 1847, studying with Magnus in Berlin. Although his major interest was the study of radiant heat, like others in the German-speaking countries he had become intrigued by Faraday’s discovery and had some apparatus made in Berlin to ‘repeat and follow out the investigations of Faraday’ (Tyndall, Journal, 28 November 1849). He moved to the University of Halle in 1853, where he remained for the rest of his career, and kept in touch with Tyndall over many years.

22 Tyndall, Journal, 18 December 1849.


25 In both cases Tyndall appeared as first author in Philosophical Magazine and Knoblauch in Poggendorff’s Annalen.


29 Athenaeum (10 August), 842 (1850).

30 Tyndall, Journal, 7 August 1850.


36 Athenaeum (12 July 1851).

37 J. Tyndall, ‘On the polarity of bismuth, including an examination of the magnetic field’, Phil. Mag. 2, 333–344 (1851).

Colonel Joseph Portlock, an officer in the Royal Engineers and a natural historian, elected FRS in 1837.

Thomas Bell (1792–1880), a surgeon, was the Biological Sciences Secretary 1848–53 and Vice-President 1853–54. Bell later seconded Tyndall’s nomination for membership of the Athenaeum in 1859.

August Wilhelm von Hofmann (1818–92) studied with Liebig in Giessen, and became professor and director of the Royal College of Chemistry on its establishment in 1845. In a series of papers in 1849–51 on substituted ammonias he laid the basis for the theory of atomic valence, with Edward Frankland and others, and the theory of chemical structure, proposed formally by Kekulé and Couper in 1858. He was elected FRS in 1851, and was awarded the Royal Medal in 1854 and the Copley Medal in 1875 (Oxford Dictionary of National Biography, 2004; hereafter ODNB).

Thomas Graham (1805–69), a chemist. He was awarded the Royal Medal in 1838 and 1850 and the Copley Medal in 1862.

Henry Bence Jones (1813–73), a physician and chemist. He was instrumental in the appointment of Tyndall as Professor of Natural Philosophy at the Royal Institution in 1853, coincident with the Royal Medal episode. As a member of the Council of the Royal College of Chemistry he had become a friend of the director, Hofmann. He became a manager of the Royal Institution in April 1853 and was Secretary from 1860 to 1872 (ODNB).

Arthur Cayley (1821–95), a mathematician, published early in his career on determinants and invariant theory, and was the first to write a paper on quaternions after their discovery by William Rowan Hamilton in 1843. He was elected FRS in 1852 and was awarded the Royal Medal in 1859 and the Copley Medal in 1882 (ODNB).

James Booth (1806–78), a mathematician, elected FRS in 1846.

William Hopkins (1793–1866), a mathematician and geologist, elected FRS in 1837, was an important figure in Cambridge, particularly in the education of mathematicians such as William Thomson and George Stokes.

John Peter Gassiot (1797–1877) was a wealthy wine merchant who had his own laboratory on Clapham Common in which he concentrated on the study of voltaic electricity and the discharge of electricity through gases at low pressure, for which he received the Royal Medal in 1863. He was elected FRS in 1840 and was active in the reform movement. He was a Vice-President of the Royal Society in 1852–53 (ODNB).

Charles Brooke (1804–79) was a surgeon and lecturer on surgery at Westminster Hospital. He was elected FRS in 1847.

Edward Frankland (1825–99) was a chemist and early friend of Tyndall’s. He discovered organometallic chemistry, publishing an important paper on the subject in May 1852, and made major contributions to the development of valence theory and the chemical bond. He was elected FRS in June 1853, just before the nomination for the Royal Medal, and was awarded the Royal Medal in 1857 and the Copley Medal in 1894 (ODNB).

Sir Benjamin Brodie (1783–1862), a surgeon, was awarded the Copley Medal in 1811, was Vice-President several times (although not in 1853) and was PRS from 1858 to 1861.

James Sylvester (1814–97) was a mathematician working particularly, like Cayley, on invariants. He was elected FRS in 1839, and was awarded the Royal Medal in 1861 and the Copley Medal in 1880 (ODNB).

No reason for the nomination is given in the minutes.

John Lindley (1799–1865), a botanist, was elected FRS in 1828 and awarded the Royal Medal in 1857.

Joseph Hooker (1817–1911), a botanist, elected FRS in 1847, was awarded the Royal Medal in 1854, the Copley Medal in 1887 and the Darwin Medal in 1892. He was PRS from 1873 to 1878.
Nathaniel Wallich (1786–1854), a botanist, was elected FRS in 1829 and was Vice-President in 1852–53.

Robert Bunsen (1811–99), a chemist, concentrated on inorganic chemistry and analytical techniques. His students included Kolbe, Frankland, Mendeleev and Lothar Meyer. With Playfair he developed means of efficiently recycling gases in furnaces and he later collaborated with Roscoe from 1852 to 1862 on photochemical research, and with Kirchhoff in the 1860s to develop the field of spectroscopy. He was elected a Foreign Member of the Royal Society in 1858 and awarded the Copley Medal in 1860. Bunsen and Kirchhoff received the first Davy Medal in 1877 (DSB 1981).

No reason for the nomination is given in the minutes.

Minutes of General Meetings of the Royal Institution, RI MS AD/02/B/01/A06, p. 93.

Samuel Hunter Christie (1784–1865), a mathematician and physicist, elected FRS in 1826, was Physical Sciences Secretary from 1837 to 1854.

George Newport (1803–54), a surgeon and entomologist.

Edward Sabine (1788–1883) was Treasurer of the Royal Society at the time of the Royal Medal episode. Elected FRS in 1818, he was awarded the Copley Medal in 1821 and the Royal Medal in 1849. He was PRS from 1861 to 1871. He was a particular supporter of Tyndall, and initiated and managed Tyndall’s election as FRS in 1852 when it seemed possible that Tyndall would leave for Toronto.

William Sharpey (1802–80) was a Council member and present at the vote on 3 November 1853. An anatomist, he was elected FRS in 1839 and succeeded Thomas Bell as Biological Sciences Secretary in 1853.

William Henry Smyth (1788–1865), Foreign Secretary of the Royal Society and Rear-Admiral at the time of the decisions, elected FRS in 1826.

William Spence (1783–1860), an entomologist, elected FRS in 1834.


The London Institution had similar aims to the Royal Institution and was located at Finsbury Square; F. Kurzer, ‘Chemistry and chemists at the London Institution 1807–1912’, Ann. Sci. 58, 163–201 (2001).

Tyndall, Journal, 9 November 1853.

Frank A. J. L. James, Michael Faraday: a very short introduction (Oxford University Press, 2010), pp. 84–86.


Tyndall, Journal, 15 November 1853.

Tyndall, Journal, 16 November 1853.

Tyndall to Christie, 15 November 1853, RS MC.5.123.

Tyndall, Journal, 15 November 1853.

Tyndall to Gassiot, 18 November 1853 (in Tyndall, Journal).


Gassiot to Tyndall, 21 November 1853 (in Tyndall, Journal).


This letter cannot be found in either the Royal Archives or the archives of the Royal Society.

Tyndall, Journal, 24 November 1853.

Tyndall, Journal, 20 November 1853.

Charles Wheatstone had been elected FRS in 1836. He was awarded the Royal Medal in 1840 and 1843, and the Copley Medal in 1868. Tyndall became a good friend of his after the Royal Medal episode, often spending time at his house in Hammersmith.


Tyndall, Journal, 28 November 1853.
88 Hopkins to Tyndall, 29 December 1853, RI MS JT/1/TYP/2/604–605.
90 Tyndall, Journal, 26 November 1853.
91 Tyndall, Journal, 30 November 1853.
92 Thomas Hirst (1830–92) was a mathematician and friend of Tyndall’s since their days surveying the railways in northern England in 1845. Elected FRS in 1861, he was awarded the Royal Medal in 1883.
93 Indeed, the rules stated that the paper must be ‘published originally in Her Majesty’s dominions’: Royal Society, *op. cit.* (note 3), p. 117. It had been published first in Poggendorff’s *Annalen, op. cit.* (note 35).
94 Tyndall to Hirst, 25 November 1853, RI MS JT/1/T/581.
95 This was probably Alexander Williamson (1824–1904), a chemist who was elected FRS in 1855.
96 Atkinson was not a Fellow of the Royal Society.
97 Hirst to Tyndall, in Tyndall, Journal, 30 January 1854.
98 Tyndall, Journal, 30 January 1854.
99 Tyndall to Hirst, 1 February 1854, RI MS JT/1/T/586.
100 Hirst to Tyndall, 5 February 1854, RI MS JT/1/H/191.
101 Royal Society, *op. cit.* (note 3), p. 350. However, the website of the Royal Society (accessed 11 November 2013) does give Tyndall as a Royal Medallist, stating: ‘For his paper on diamagnetism and magne-crystallic action, published in the Philosophical Magazine in 1851. (the award of this medal was declined by Dr Tyndall)’.
102 MacLeod, *op. cit.* (note 2).
104 MacLeod, *op. cit.* (note 2), p. 82.