Pioneers of Science Education

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In this series I will look at some of the pioneers of science education, either in terms of pedagogy, curriculum development or science education research. Some of them have an Irish connection, but all have had an influence on the teaching and learning of science in Ireland. In PoSE #1 we looked at Maria Edgeworth, who was a friend of Jane Marcet, and in PoSE #2 at Richard Dawes, a pioneer of child-centred science in context. In PoSE #3 we looked at the life of Mrs Jane Marcet, one of the earliest popularisers of science, especially for women. In this article we look at the work of James Wilson, who pioneered science in English public schools.

#4 James Maurice Wilson: (1836-1931) 'Public school science pioneer'

Introduction

In the 19th century most university graduates and many school teachers were ordained clergymen, and the majority came from Oxford or Cambridge. James Maurice Wilson fitted this mould, being educated at Cambridge, although he was not ordained until 1879, and he spent half his career as a teacher and headmaster and the other half as an Anglican clergyman, rising to the rank of Canon of Worcester Cathedral. Table 1 shows the main dates in his long life. His main interest for us, as a pioneer of science education, was his role in establishing the place of science in the curriculum of English public schools in the second half of the 19th century. In England the public schools, actually private, fee-paying boarding schools, were the upper tier of secondary education. Their curriculum was based on the classics (Latin and Greek) and mathematics, and in the mid 19th century, science and modern languages were seen as 'modern', new-fangled subjects, which had to fight for a place in the curriculum. James (Jim) Wilson was one of the pioneers who established science as a core subject in England's public schools. This recognition of science by the elite schools influenced the adoption of science as a core subject in other secondary schools. In this article I will focus mainly on Wilson's time at Rugby School as this is when he had the most influence on the teaching of science in schools.

Table 1 Major events in Wilson's life

1836	Born to Rev. Edward Wilson and
1843-53	Attended King William's College, Isle of Man (where his father was Headmaster) (http://www.isle-of-man.com/manxnotebook/fulltext/kwc1933/p006.htm)
1853-55	Sedbergh College
1855-59	Went to St John's College, Cambridge to read mathematics
1859	Senior Wrangler in Mathematics and Fellow of St. John's
1859	Appointed assistant maths master at Rugby
1864	Started formal science teaching at Rugby
1868	Published *Elementary geometry* to modernise the teaching of geometry
1868	Married Annie Elizabeth Moore
1871	Founds the Mathematical Association
1878	His wife dies suddenly in childbirth

1879	Co-wrote *Handbook of Double Stars*
1879	Ordained a Deacon and then Priest in the Church of England
1879-1890	Headmaster at Clifton College, Bristol
1883	Married a second wife – Georgina Mary Talbot
1890-1905	Vicar of Rochdale & Archdeacon of Manchester
1905-1926	Canon of Worcester and Vice-Dean of the Cathedral
1926	His second wife dies
1931	Died at 96

Early years and education 1836-1859

James Maurice was born, together with his twin Edward Pears, in 1836 to Edward Wilson, a clergyman and headmaster, and his first wife Elizabeth (neé Pears). His father was the headmaster of King William's College, Isle of Man, when he was born but moved to a parish ministry in 1838, first at Weston-Super-Mare, and then from 1841 to Whitchurch and later to Nocton, Lincolnshire, where he remained with his second wife until he died.. James and his brother went to King William's College as boarders in 1848, having been educated at home before that, where they had learnt Latin and Greek, and became familiar with the Bible. The twins' school experience was bad – the living conditions were poor and the teaching equally bad. James described in his autobiography (Wilson, 1932, p. 12): *"It was a lawless, dirty, degraded life, and few survived it without real damage."* The boys found escape in the outdoors, rambling over the island looking for fossils and collecting bird's eggs. What teaching there was focused on the classics, together with a little mathematics. In 1853 the boys were sent to Sedbergh, a public school in Yorkshire, to finish their education, which again consisted mostly of the classics and mathematics. Wilson was taught any science. *"I am sure I never heard of oxygen, or trilobites, or air pumps or coleopteran before I went up to Cambridge."* (Wilson, 1832, p. 29)

In 1855 James went to St. John's College, Oxford, while his brother Edward went to Oxford. His Cambridge education was undirected and he read both classics and mathematics, and in 1856 entered and won the Bell Scholarship for the sons of clergymen, like his father before him. At the end of his first year he came top in mathematics and he was persuaded to drop classics and study for the mathematical tripos. At University Wilson was exposed to modern ideas, as he said (*ibid*, p. 34) *"I had been bred in a country Vicarage on old-fashioned Evangelical lines, and at schools into which no modern thoughts penetrated."* In December 1856 he experienced a strange seizure and thought he was dying. He later found out that his brother was ill and had died that night, evidence of the strong bond between twins. At the end of 3 years he sat the Mathematical Tripos in 1859 and came out as Senior Wrangler i.e. the top student, an evidence of his mathematical ability. He then decided to sit for the Classical Tripos to see if he could get a double first, but instead he fell seriously ill. One consequence of the illness was that he forgot all the mathematics he had learned so assiduously, and he had to relearn it all again. Looking around for a job he had several offers but decided to accept an offer to teach science (of which he knew nothing) at Rugby School, under the headmaster Frederick Temple (later Archbishop of Canterbury), who wanted to establish science in the Rugby curriculum.

Figure 1: Rugby School ca.1860
http://richardjohnbr.blogspot.ie/2011/02/educating-middle-classes-1800-1870.html

The Rugby years – getting to grips with teaching science 1859-1879

It was during his years at Rugby School, a major public school founded in 1567 (Figure 1), that Wilson's claim to be a pioneer of science education rests, although he knew no science when he was appointed. This seems strange to us but it was quite common then for someone to be asked to teach subjects of which they knew nothing, indeed it is not unheard of in Ireland even today. Evelyn Waugh in his novel *Decline and Fall* (1928) describes such a practice in a public school.

"Why only last term we sent a man who had never been in a laboratory in his life as senior science master at one of our leading public schools. He came wanting to do private coaching in music. He's doing very well I believe." (Quoted in Brock, 1992, p. 396)

Wilson was qualified to teach mathematics (after a summer relearning the subject) but knew no science. Regular lectures in science had been started at Rugby in 1849 by Dr Sharp, who was replaced by the Rev. Henry Highton, an 'electrician', whose departure to be headmaster at Cheltenham in 1859 opened up a job for Wilson. In 1862 the Public Schools Commission (the Clarendon Commission) visited Rugby to take evidence on teaching at the nine major public schools, and Wilson gave evidence. He described himself as *"impartially and profoundly ignorant of all science, except some parts of astronomy and Newton's Principia, all utterly unsuitable for schools."* (Wilson, 1932, p. 60). In his evidence to the Clarendon Commission, Wilson *"confessed to the Commission that he was a mathematician with no experience of experimental study and had been appointed as a teacher of mathematics but Dr Temple supposed he could 'get it up sufficiently for the purpose' and so he grafted physical science on to the mathematics."* (Roderick and Stephens, 1971, p. 101) At this stage he taught mainly mathematics, while his chemistry pupils worked in the adjoining laboratory working on analyses He did not think that natural science was being taught as well as he would wish, but *"he thinks that the state of instruction and proficiency in physical science at Rugby is as satisfactory as anything else in the school."* Figure 2 shows Wilson in 1859 as a young, unmarried man about to embark on his new career as a schoolteacher.

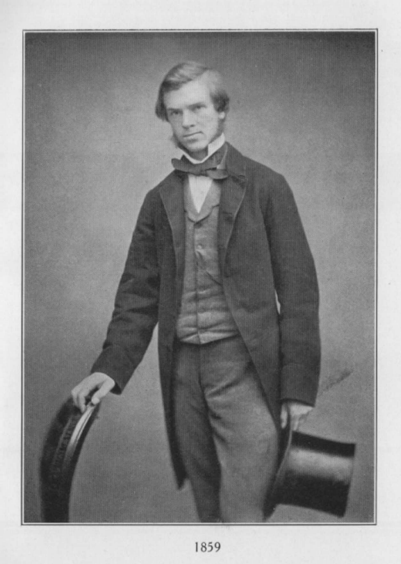


Figure 2: James Wilson in 1859 (from Wilson, 1932)

The Great Exhibition of 1851 had been a shock to Britain, who thought of itself as the leader of the industrial world. The realisation that other countries had caught up and passed Britain in technology and science caused an inquiry into the state of science and technical education in Great Britain. This led to a series of Royal Commissions into the state of education from the 1860s onwards. The first of these was the Public Schools Commission (1861-1864), also known as the Clarendon Commission, which published its report in 1864, and which looked a nine leading public schools, including Rugby. This was followed by the Schools Inquiry Commission (1864-1868), also known as the Taunton Commission, which reported in 1868 on education in the remaining public, grammar and endowed secondary schools. Neither report was very encouraging about the state of science education, which they found was essentially excluded from the education of the higher classes in England. These were followed by the Devonshire Commission (Royal Commission on Scientific Instruction and the Advancement of Science) 1872-75.

Rugby was singled out in the Public Schools Commission Report as having the most attention to science, but even this was unsatisfactory and was not compulsory. The report still saw classics as the foundation of secondary education but recommended that one hour a week be spent on natural science and that two main branches of science should be studied. They wished that all boys should study science and deplored the division of schools into the Classical (superior) and Modern (inferior) sides. Frederick Temple took these recommendations seriously and implemented them at Rugby. From 1864 he decided that every boy would study science in the lower school. Wilson had started science teaching in a cloakroom attached to the Town Hall but in 1861 the school invested in a new science school at a cost of £1,000, extended considerably in 1869 (Figure 3).

Wilson's views on teaching science were developed more fully in an article he wrote 'On teaching Natural Science in Schools' for the publication *Essays on a Liberal Education*, edited by the Rev. F.W. Farrar and published in 1867. (Wilson, 1867) He coined the word *ornithhopachynsipaideia* while teaching at Rugby to describe the force feeding of pupils with knowledge in the same way geese were fattened for market. He always had good relationships with his pupils both at Rugby and later at Clifton, and at Rugby was known by the boys as Jim Stinks. Almost by chance, and certainly by default, Wilson had become the expert and the champion of secondary school science education.

In 1931 in his Presidential address to the Educational Science Section of the British Association meeting, Sir Charles Grant Robinson said:
"If Huxley unquestionably is the Achilles and protagonist of this twenty years' battle for the capture of the classical Troy, do not let us forget that one of the first trumpets sounded in the fray was in the famous Essays on a Liberal Education, in which J.M. Wilson, then a master at Rugby, urged the claims of Science." (Quoted in Wilson, 1932, p.61)

Wilson, Huxley, Tyndall and Farrar also served on a committee of the British Association in 1867, which advised on the teaching of science in schools, and Wilson drafted the final report (BAAS, 1868). This committee marked the start of a long friendship with Thomas Huxel (PoSE #5) whom Wilson described as *"one of the best and truest men I have ever met. He remainded my friend and adviser until the end of his days."* (Wilson, 1932, p. 62) This document is widely seen as defining the science curriculum (Layton, 1981) and it identified five purposes of school science education (BAAS, 1868.)
"That general education in schools ought to include some training in Science is an opinion that has been strongly urged on the following grounds:
As providing the best discipline in observation and collection of facts, in the combination of inductive with deductive reasoning, and in accuracy both of thought and language. Because it is found in practice to remedy some of the defects of the ordinary school education. Many boys, on whom the ordinary school studies produce very slight effect, are stimulated and improved by instruction in science; and it is found to be a most valuable element in the education of those who show special aptitude for literary culture. Because the methods and results of science have so profoundly affected all the philosophical thought of the age, that an educated man is under a very great disadvantage if he is unacquainted with them. Because very great intellectual pleasure is derived in after life from even a moderate acquaintance with science. On grounds of practical utility as materially affecting the present position and future progress of civilization.This opinion is fully supported by the popular judgment. All who have much to do with the parents of boys in the upper classes of life are aware that, as a rule, they value education in Science on some or all of the grounds above stated."
In modern language we could translate these aims as: 1) to develop a scientific approach and method; 2) to broaden the scope of education 3) for the cultural value of science 4) for developing scientific literacy 5) for its usefulness and application. In many ways this report laid down the direction of science education for the next 100 years.

In the report Wilson described current science teaching at Rugby and this is worth quoting. Up until 1864 science was optional and a boy could choose between modern languages or science, and about a tenth chose science. From 1864 science became compulsory for the lower and middle school. The first year was devoted to botany, the second year to mechanics, the third year to geology and experimental physics and the fourth year to chemistry.
"Lastly, what are the results of the introduction of scientific teaching in the opinion of the masters. In brief it is this, that the school as a whole is the better for it, and that the scholarship is not worse. The number of boys whose industry and attention is not caught by any school study is decidedly less; there is more respect for work and for abilities in the different fields now open to a boy; and though pursued often with great vigour, and sometimes with great success, by boys distinguished in classics, it is not found to interfere with their proficiency in classics, nor are there any symptoms of overwork in the school. This is the testimony of the classical masters, by no means specially favourable to science, who are in a position which enables them to judge. To many who would have left Rugby with but little knowledge, and little love of knowledge, to show us the results of their two or three years in our middle school, the introduction of science into our course has been of the greatest possible gain; and others who have left from the upper part of the school, without

hope of distinguishing themselves in classics or mathematics, have adopted science as their study at the Universities. It is believed that no master in Rugby School would wish to give up natural science and recur to the old curriculum." (BAAS, 1868, Appendix B)

The truth of the matter was that the traditional classical curriculum was not very effective in producing proficient classics scholars and only a few boys each year would do well enough to enter Oxford or Cambridge. When they graduated, often also being ordained, they went back into the self-perpetuating system to teach classics. Very few public school boys studied science in the 19th century, around 1%, with 6% studying mathematics and 4% studying engineering. (Roderick and Stephens, 1971) This meant there was a very small pool of people to recruit science teachers from, and graduates from the new universities would find it difficult to fit in socially into the staff rooms of public schools.

The Rev. Frederick Temple appointed Wilson to Rugby and was his first headmaster and a great inspiration to Wilson, both as an educator and as a preacher and theologian. The first issue of *Nature* in 1869 featured the science teaching at Rugby and praised Temple. A later article described the new science schools at Rugby (Figure 3).

"By offering Dr Temple the Bishopric of Exeter, Mr Gladstone has removed from his post the most eminent schoolmaster in England. Dr Temple has done much for the education, present and future, of all classes; and although this is not the place to comment on all he has done in this direction, we may note here what he has done for education in Science.

He may fairly claim to be the first headmaster who has recognised its importance, and effectively introduced it into his school. And its introduction into Rugby is of special importance, because it is the acknowledged leader in educational progress, and because so many headmasters have been trained there. Now Harrow and Eton, and several other schools are doing something, though none yet with quite the same liberality as Rugby: but it will be instructive to look back ten years, and thus to estimate the advance. Rugby was then the only public school where science was taught at all. But even there it was under great disadvantages. No school was assigned to it; it was an extra, and heavily weighed by extra payment. There was no laboratory, scarcely any apparatus, and scarcely any funds for promoting it. About forty to fifty boys attended lectures on it, but there was no possibility of making these lectures consecutive, and of dealing with advanced pupils. Now there is a suite of rooms devoted to science.

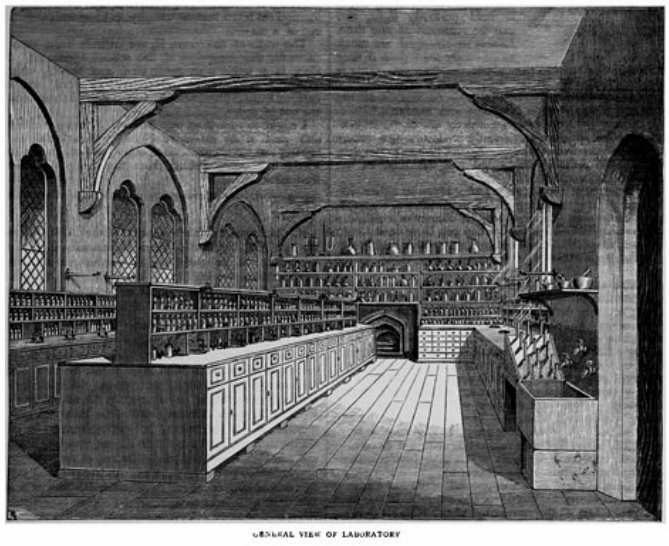
A large and excellent laboratory, where thirty boys are working at the same time at practical chemistry with the assistance of a laboratory superintendent, opens into a smaller private laboratory which is for the use of the master and a few advanced students. This again opens into a chemical lecture room, in which from forty to fifty can conveniently sit. The seats are raised, and the lecture table is fitted with all that is required. Adjoining is the physical science lecture room, in which sixty can sit, and of which a part is assigned to work tables. And out of this the private master's room is reached, in which apparatus is kept, and experiments and work prepared.

There is a considerable geological museum, and an incipient botanical collection. A Natural History Society meets frequently, and publishes reports and papers contributed by the boys. Five masters take part in teaching natural science. It is introduced into the regular school work (about 360 out of 500 appear to be in the Natural Science classes); being compulsory on all the middle school; an alternative in the upper school; and optional in the Sixth Form.

And the result of the teaching has been satisfactory. It has not damaged classics. It has been the means of educating many boys, and has been a visible gain to the great majority, and it has steadily contributed to the list of honours gained at the University.

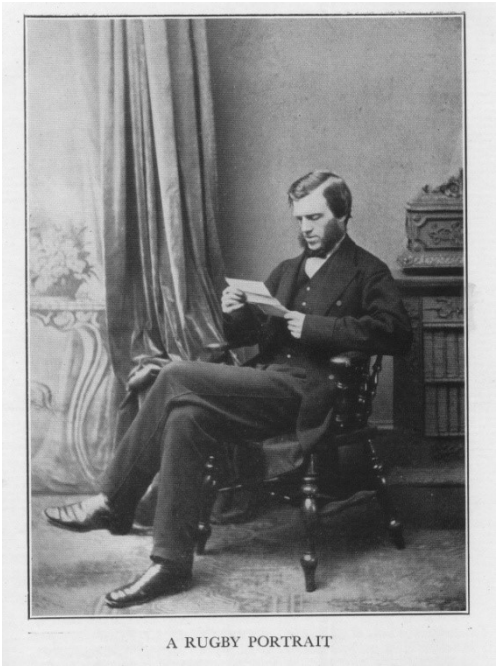
If Dr Temple had done nothing else, his name would deserve honour at our hand for having brought about this change. Let us hope his successor will be equally liberal to science, and maintain its efficiency." (*Nature*, (1869)1(1), 25-26; Quoted in Sutton, 1992, p. 86)

Temple rightly gets credit for supporting and promoting science education at Rugby, but it was James Wilson who did the work.



GENERAL VIEW OF LABORATORY

Figure 3: The new science schools at Rugby in 1870 (Hutchinson, 1870)



A RUGBY PORTRAIT

Figure 4: A portrait of Wilson at Rugby (Wilson, 1932)

It is interesting to ask why Wilson (Figure 4) became the spokesman and figurehead for science teaching in public schools in the mid 19th century. His claim rests on his published contributions to the Royal Commissions, the BAAS report (1868), articles in educational journals and his chapter in *Essays on a Liberal Education* (1867), deriving from the prestige of Rugby School and its headmaster, Frederick Temple. Other public schools (for example Dulwich College and Clifton College) and some endowed schools were also teaching science

successfully but none had such an able and influential advocate. In his chapter in *Essays on a Liberal Education* Wilson outlines the value of science education (Wilson, 1867, p. 251-2).
"Science teaches what the power and what the weakness of the senses is ; what evidence is, and what proof is. There is no characteristic of an educated man so marked as his power of judging of evidence and proof. The precautions that are taken against misinterpretation of what is called- the evidence of the senses, and against wrong reasoning, and racing the thoughts backward down to the ground of belief ; the constant verification of theories ; the candid suspension of judgment where evidence is still wanting ; that wedding of induction and deduction into a happy unity and completeness of proof, the mixture of observation and ratiocination — are precisely the mental processes which all men have to go through somehow or other in their daily business, and which every human being who is capable of forming an intelligent opinion on the subject sees would be better done if men had familiarised themselves with the models of these processes which are furnished by science."

Wilson also pursued serious research in astronomy and geology. He bought and then presented an 8 ¼ inch reflecting telescope to Rugby, which was located in the Temple Observatory. (Marriott, 1971) Together with former pupil, George Seabrooke, Wilson produced a *Handbook of Double Stars* (1879) and published several papers on astronomy. He also used the observatory for teaching while at Rugby.

Headmaster at Clifton 1879 – 1890

Following the sudden death of his first wife in childbirth in 1878, and following a period of upheaval at Rugby after Temple's departure, Wilson nearly gave up on teaching altogether. He applied for ordination to Bishop Temple and was ordained a deacon and then a priest in the Church of England in 1879. He was persuaded to apply for the vacant headmaster's post at Clifton College (founded 1862), in succession to his friend John Percival. Percival had been at Rugby as an assistant master for 2 years and left to be the founding headmaster of Clifton College. He would later return as headmaster to Rugby. From the start Clifton had a modern side and taught science, so that when Wilson took over there in 1879 there was already a thriving science school. An article in *Nature* (1871, p. 329) lauded the science teaching at Clifton:
"We have long insisted in NATURE on the extreme importance of science teaching in the higher grade schools in this country, and we are glad to find that at length its importance has begun to be recognised by the head masters themselves; so that, on the whole, the progress now being made in this direction is such that we may confidently expect that at no very distant future science instruction will be provided for in all our superior schools. Foremost, if not positively the first among the schools in which the sciences are taught stands Clifton College, under the able direction of the Rev. J. Perceval, in which scientific study is introduced to the utmost, and keenly pursued by the boys, with the encouragement of all their masters .."

In his autobiography Wilson says nothing about science teaching at Clifton, where he stayed for 11 years. No doubt his experience as a science teacher at Rugby helped in supporting science teaching in the new college. Clifton quickly achieved a reputation as a good school and has maintained a strong science teaching tradition to this day. Wilson couldn't have become headmaster as a layman and, having been ordained, he now took his religious role more seriously, both inside and outside the college. Wilson became an apologist for the Christian faith and worked to promote a good relationship between science and faith, showing that Christian belief was still possible in a scientific age. During his time in Clifton he married again, but never intended to stay for a long time and after eleven years he decided

to move out of education to a parish ministry, although this was a fairly normal career path for ordained Anglican at that time.

From vicar to canon – the clerical years 1890-1926

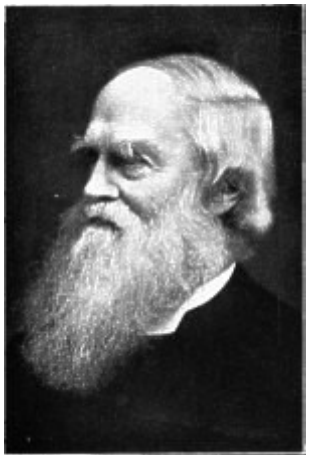


Figure 5: Wilson in later life
http://www.isle-of-man.com/manxnotebook/fulltext/kwc1933/p006.htm

The last third of his long life was spent as a clergyman after 31 years in education as master and headmaster. The first 15 years he was the vicar in Rochdale, where he did much to defuse the suspicion and hostility between established church and nonconformist chapel. He had no experience of parish ministry and he seems to have no further involvement with science education, judged by his publications. He spoke and wrote widely on theological topics, particularly the relationship between science and faith. The last period of his life he spent as a Canon of Worcester Cathedral (1905-1926) where he undertook the major job of cataloguing their archives. He retained his intellectual vigour to the end. Wilson lived to see science take its rightful place in the school curriculum and he saw both Rugby and Clifton, the two schools he was associated with, continue to build and strengthen their science teaching, with increasing numbers of qualified science teachers entering the profession. In 1901 the Association of Public School Science Masters was launched, the first science teachers' association in England, which was later absorbed into the Association for Science Education.

Conclusion

William Brock (1977, p. 605) gives this appreciation of Wilson.

"Wilson himself was very much aware of the practical difficulties and objections to science teaching – the supposedly overcrowded curriculum, the expense, the lack of trained teachers, and the absence of science scholarships at the ancient universities. Through modest example, supported by a sympathetic headmaster and the scientific community, and by appealing directly to the universities, he was able to transform the situation. In a long life-time, this 'Nestor of Science Teachers' lived to see the public schools, through their powerful Association of Public School Science Masters (founded 1900), lead the filed in curriculum innovation and become exemplars for science teaching in the state schools. Wilson also perceived one of the problems of today's debate over the content and functions of universal science education: 'A present (1867) science is only taught by clever and enthusiastic men who could teach anything. But when it is taught by everybody there will be another story.'"

It is clear from Wilson's own experience, that teaching in secondary schools in the 1850s was poor and science was non-existent. Even when science was introduced it was seen as the poor relation compared to classics and was often badly taught, by what today we would call non-

specialists. As well as recognising the importance of science in the school curriculum, as recommended by the Royal Commissions, it was also necessary to change the climate of opinion in the universities to produce more science graduates and to professionalise the teaching of science. This would prove to be a long process but James Wilson played a key role in the initial campaign to carve out a place for science and the value of science teaching, initially in public schools, but extending though the BAAS 1868 report to all secondary schools. His colleague on the BAAAS Committee, Thomas Huxley, would play a greater role in getting science established in education at all levels (see PoSE #5).

In a memorial address given in Clifton College Chapel in 1931 (Wilson, 1932, p. `67), the Rt. Hon. J.N. Whitley said of Wilson:
"James Maurice Wilson was a great teacher. Every subject he touched became alive with human interest. The sciences took their place as pieces of the great Divine Revelation. We were bidden to see how, bit by bit, the finite mind of man can lay hold on fragments of the inficnite: how Science and Religion are twin paths of man's searching toward knowledge of the Divine purpose."

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Other Sources

For a summary of his life and achievements see:
https://en.wikipedia.org/wiki/James_Wilson_(priest)