

What became of the Senior Wranglers?

by **D. O. Forfar, MA, FFA, FSS, FIMA, CMath.**

amended version of article first published in *Mathematical Spectrum* Vol. 29 No. 1, 1996

Copyright (c) Applied Probability Trust 1996.

Wrangler, a word that has something to do with American jeans? Not in this case!

During the one hundred and fifty seven years (1753-1909) in which the results of the Cambridge Mathematical Tripos were published in order of merit and divided by class of degree into Wranglers (1st Class), Senior Optimes (2nd Class) and Junior Optimes (3rd Class), great prestige attached to those students who had come out in the top two or three places. The securing of the top position as Senior Wrangler was regarded, at the time, as the greatest intellectual achievement attainable in Britain and the Senior Wrangler was fêted well beyond Cambridge and accorded pre-eminent status among his peers - indeed years in Cambridge were often remembered in terms of who had been Senior Wrangler in that year. It is curious therefore that no systematic study has ever been made, in so far as the author is aware, of what became of these Senior Wranglers in later years after their triumph. This article may shed a little light on the matter.

Until 1850, Mathematics in Cambridge was dominant over all other University subjects so much so that it was obligatory, astonishing as it now seems, for students who were studying for honours in Classics, first to have taken the Mathematical Tripos.

Because of the prestige attaching to the position of Senior Wrangler and the college from which the Senior Wrangler came, the students, especially the most promising, were subjected, like thoroughbred racehorses, to the most intense training for the Tripos race. The training was in the hands of private 'coaches' and not the University professors as often students attended very few lectures and, for example, Charles Babbage gave no lectures in the eleven years, 1828-39, during which he was Lucasian Professor. The best of the coaches, because of their reputation, were able to select the most able students thus perpetuating their reputation for success.

The most famous private tutor was William Hopkins (1793-1866) who himself had been 7th Wrangler in 1827 and was a person of distinction outside his coaching activities being President of the Geological Society 1851-53 and President of the British Association 1853. In 1849 it was said of Hopkins that in the 22 years since his degree he had taught 17 Senior Wranglers, 27 Second or Third Wranglers and 200 Wranglers in totalⁱ. As William Hopkins continued to turn out Wranglers well after that date his final tally must have been much higher. Hopkins' Wranglers included Clerk Maxwell, Cayley, Thomson (Lord Kelvin), Stokes and Tait. It can be seen with the benefit of hindsight that the greatest of Hopkins' pupils was Clerk Maxwell, but remarkably Hopkins recognised this even when Maxwell was an undergraduate saying "*he is unquestionably the most extraordinary man I have met with, in the whole range of my experience*"ⁱⁱⁱ.

The Mathematical Tripos was a formidable examination taken by students after three years and one term at the University. The best students also sat the papers for the two Smith's prizes. For example, in 1854, the Tripos consisted of 16 papers, 2 papers each day for 8 days - a total of 44.5 hours in the examination room. The total number of questions set was 211. The best students then went on for a further three days of Smith's prize examinations consisting of 63 even more testing questions. The questions in the early papers contained bookwork in the first part of the question with riders based

on that bookwork in the second part of the question. The questions became progressively more difficult in the later papers, particularly in the Smith's Prize papers. To solve the more technically difficult problems within the short time available in the examination room the students had to find the correct approach straight away. Sometimes the approach involved use of subtle stratagems which the students could not have been expected to think up on the spur of the moment in the examination room. Hence constant practice at solving similar questions, e.g. as set in previous years, and familiarity with the right method of tackling the questions was all-important and students wishing to perform well had to hone their technique, with the help of their coach, to a fine pitch prior to the examination.

The actual marks were never published but Sir Francis Galton in his book *'Hereditary Genius'*ⁱⁱⁱ refers to having obtained marks in respect of three years (unspecified, but probably around the 1860's). In one of these years, out of a total possible mark of 17,000, the Senior Wrangler obtained 7634 marks, the second Wrangler obtained 4123 marks, the lowest Wrangler obtained around 1500 marks and the lowest candidate receiving an honours degree (Junior Optime) obtained 237 marks. In the second of these years the Senior Wrangler obtained between 5500 and 6000 marks, the Second obtained between 5000 and 5500 and the lowest Junior Optime received 309 marks. In the third of these years when, according to Galton, the Senior Wrangler was conspicuously eminent, he obtained 9422 marks and the Second 5642 marks. Galton makes considerable play of the large discrepancy between the marks obtained by the Senior Wrangler and by the lowest Wrangler.

It can be seen that the Senior Wrangler would typically obtain less than 50% of the marks, the lowest Wrangler less than 10% and the lowest honours candidate less than 2%! This seems to the author a rather curious result and it is not clear what conclusions are to be drawn from it. It suggests that the candidates covered a very wide ability range, that the level of the lowest Wrangler and the lowest honours man was really rather poor by to-day's standards (perhaps university life was more relaxed and the average student did not apply himself very hard?) and that the papers were too long and hard even for the best students. This contributed to the criticisms which, in the early 1900's, were leveled against the content and style of such a fierce examination and against publishing the results in order of merit which gave undue prominence to those occupying the top few places. The famous mathematician G. H. Hardy^{iv} was particularly critical of the examination as we shall see later.

A high position in the Tripos was very desirable as it gave a favoured entrée not only into academia and the actuarial profession, but also into professions such as the Law, the Church and even Medicine. The Senior Wrangler often entered these professions and not academic life.

To give examples of Senior Wranglers(SW) and Second Wranglers(2W) who attained eminence in various professions we may cite:-

Legal

J. Rigby (1834-1903), 2W 1856, later Sir John Rigby. Solicitor General 1892-94, Attorney General 1894, Lord Justice of Appeal 1894. Privy Councillor 1901.

J. Stirling (1836-1916), SW 1860, later Sir James Stirling. Lord Justice of Appeal 1900-1906, Privy Councillor 1900.

R. Romer (1840-1918), SW 1863, later Sir Robert Romer. Lord Justice of Appeal 1899-1906, Privy Councillor 1899.

J.L.Moulton (1844-1931), SW 1868, later Lord Moulton of Bank. Lord Justice of Appeal 1906, Privy Councillor 1906.

It is interesting that the connection between mathematics and the law continues with the recent Lord Chancellor, Lord Mackay of Clashfern, being a Wrangler in 1951.

Actuarial

W. Friend, 2W 1780, the first actuary to the Royal Life Assurance Company founded in 1806.

M. B Pell, SW 1849, actuarial consultant to the Australian Mutual Provident Society and director and consulting actuary to the Mutual Life Association of Australasia. Professor of mathematics at Sydney University, Australia.

T. B. Sprague^v (1830-1920), SW 1853, the only person to have been both President of the Faculty of Actuaries of Scotland and President of the Institute of Actuaries. The dominant actuary of the second half of the 19th century both nationally and internationally.

J. J Sylvester, 2W 1837, although better known as a pure mathematician (Savilian Professor at Oxford as Edmund Halley, the originator of the first life table with a rate of mortality at each age, had been) was the first actuary to the Equity and Law, a position he held for eleven years. Founding member of the Institute of Actuaries.

Charles Babbage, Lucasian Professor, was appointed actuary to the Protector Life Assurance Society which advertised its forthcoming operation in the years 1824-26 but never opened (typical Babbage!).

It is interesting to note, in current times, Professor J.J. McCutcheon (Wrangler 1962) a past President of the Faculty of Actuaries and C. D. Daykin (Wrangler 1970) a past President of the Institute of Actuaries. Since actuarial mathematics is a branch of mathematics, it is natural that actuaries should have studied mathematics at Cambridge or elsewhere.

Church

H.Goodwin (1818-91), 2W 1840. Dean of Ely 1858-69, Bishop of Carlisle 1869-91.

C.F. Mackenzie^{vi} (1845-62), 2W 1848. Archbishop of Natal 1855-59, First Bishop in Central Africa 1861-62.

J. M. Wilson (1836-1931), SW1859. Headmaster of Clifton College 1879-90 Archdeacon of Manchester 1890-1905, Canon of Worcester 1905-26. He was also a great classical scholar.

Medicine

D. McAlister^{vii} (1854-1934), later Sir Donald McAlister of Tarbet, SW 1877. President of the General Medical Council 1904-1931. He was also a very great linguist. His first language was Gaelic. His extraordinary linguistic ability is evidenced by the fact that he spoke well German, Norse, French, Italian, Dutch, Spanish, Portugese, Romansch, Czech, Basque, Turkish, Greek,

Arabic, Swedish, Russian, Serbian, Africans and Romany, and published translations of poems in one foreign language into another.

Political

L.H. Courtney(1832-1918), 2W 1855, later Baron Courtney of Penwith. Financial Secretary to the Treasury 1882-84, Deputy Speaker of House of Commons 1886-92.

To hold a chair in Mathematics at Cambridge it seemed almost a necessary requirement to have been Senior Wrangler as the following table shows, Babbage being the exception (to most things!):-

Lucasian Chair

1760-98 Edward Waring, SW1757
1798-1820 Isaac Milner, SW 1774
1820-22 Robert Woodhouse, SW 1795
1822-26 Thomas Turton, SW 1805
1826-28 George Airy, SW 1823
1828-39 Charles Babbage, did not sit the Tripos in 1813, his graduation year
1839-49 Joshua King, SW 1819
1849-1903 George Stokes, SW 1841
1903-32 Joseph Larmor, SW 1880

Sadleirian Chair

1863-1895 A. Cayley, SW 1842
1895-1910 A.R. Forsyth, SW 1881
1910-1931 E.W. Hobson, SW 1878
1931-1942 G.H. Hardy, 4W 1898
1945-1953 L.J. Mordell, 3W 1909

Among the Wranglers are to be found those who, along with Michael Faraday (1791-1867), William Rowan Hamilton (1805-65) and James Prescott Joule (1818-89), secured for the UK world leadership in physics and mathematical physics in the second half of the 19th century, namely:-

James Clerk Maxwell^{viii} (1831-79), 2W 1854.
William Thomson^{ix}(1824-1907), 2W 1845, later Lord Kelvin.
George Stokes (1819-1903), SW 1841, later Sir George Stokes.
John William Strutt (1842-1919), SW 1865, later Baron Rayleigh, Nobel Prize for Physics 1904.
John Couch Adams (1819-92), SW 1843, predicted theoretically the existence of the planet Neptune (also predicted independently by Le Verrier in France).
George Green^x (1793-1841), 4W 1837, first introduced the concept of potential in a paper of 1828.
Peter Guthrie Tait^{xi} (1831-1901), SW 1852, author with Lord Kelvin of the epoch-making book '*Treatise on Natural Philosophy*'.
J.J. Thomson (1856-1940), 2W 1880, later Sir J.J. Thomson, discoverer of the electron in 1897, Nobel Prize for Physics, 1906.

University professorships throughout the UK and the British Empire were commonly held by Wranglers in the top two or three places. For example the Senior Wranglers of 1834, 1838, 1839,

1847, 1849, 1852, 1861, 1862, 1864, 1867, 1883, 1886 and 1889 were respectively professors at the following universities or colleges- Edinburgh, Royal Naval College (Portsmouth), Gresham College, Melbourne, Sydney, Edinburgh, Auckland, Manchester, Royal School of Naval Architecture, Aberdeen, Bangor, Belfast and Poona.

Given the great attention and prestige attaching to mathematics over the 157 years (1753-1909) we are considering it is curious that the Tripos produced, in contrast to mathematical physics, only a few world class pure mathematicians-only Cayley, Sylvester, Clifford, Hardy and Littlewood^{xii}. World leadership in pure mathematics in this period remained firmly in France and Germany with each of these countries producing a plethora of world class mathematicians e.g. Gauss, Bessel, Jacobi, Dirichlet, Kummer, Riemann, Dedekind, Kronecker, Weierstrass, Cantor, Klein, Hilbert, Landau, Weyl in Germany and d'Alembert, Lagrange, Laplace, Legendre, Fourier, Poisson, Cauchy, Louville, Galois, Hermite, Bertrand, Jordan, Poincaré, Hadamard, Cartan, Borel and Lebesgue^{xiii} in France.

It was this relative failure of British pure mathematics after the death of Professor Colin Maclaurin in 1748 that so irked G.H. Hardy and he put a large part of the blame on to the Tripos as is evident from his 1926 Address to the Mathematical Association.^{xiv} Hardy's thesis was that the syllabus for the Tripos was out of date and far behind the times since it did not contain any of the important ideas which were dominating contemporary thought in pure mathematics at the time. It was therefore a poor training for a pure mathematician. Furthermore the questions put too much stress on technique rather than ideas and were questions in which professional mathematicians had lost interest many years previously. While accepting these criticisms, it seems curious that those who became professional pure mathematicians apparently found difficulty in shaking off the legacy of the Tripos. After all, the Professors had spent only three years of their active lives on the Tripos during their undergraduate careers and often took little interest in the Tripos thereafter apart from setting some questions for the Smith's prizes. Given their small lecturing load, they had much free time for research, for familiarising themselves with the latest mathematical ideas and for trying to publish work matching the originality of the papers coming from continental pens. The *Cambridge Mathematical Journal* had been founded in 1837 by two Scotsmen, A. Smith, SW 1836, and D. F. Gregory, SW 1837^{xv}. The relative failure of British pure mathematics during this period in comparison with France and Germany remains something of a paradox. A comparative study of the way mathematics was taught and research organised during this period at the Ecole Polytechnique and Ecole Normale Supérieure in Paris and at the Universities of Göttingen and Berlin, the centres of European pure mathematics, would be fascinating.

In contrast to pure mathematics, the British mathematical physicists, like Clerk Maxwell, were producing work of great originality by initiating wholly new ideas like the importation of statistical ideas into the Theory of Gases and the development of a field theory of electrical and magnetic disturbances.

The Tripos was not without its amusing anecdotes. One concerns Lord Kelvin. He was undoubtedly the best and most original mathematician of his year and thought he was a 'dead cert' for Senior Wrangler. He said to one of the college servants on the day the Tripos results were published "Oh, just run down to the Senate House, will you, and see who is Second Wrangler". When the servant returned he said "You, Sir".

Lord Kelvin had been beaten by Stephen Parkinson, later President of St. John's College who, although not possessing great originality in mathematics was highly intelligent and had schooled himself to perfection in the executional skills of solving Tripos problems at speed.

It perhaps rankled a little with Kelvin that he had not been Senior Wrangler. G.H. Hardy seems to have felt the same although he took the Tripos a year earlier than was normal as did James Jeans. The persons who beat Hardy were:-

- (1) R. W. H. T. Hudson, SW 1898, who went into mathematics but was not able to fulfil his potential as he tragically died in a climbing accident on Snowdon in 1904 after producing his book *Kummer's quartic surface*. Although women were not placed, his sisters were placed equivalently to the 7th and 8th Wranglers of 1903 and 1900 respectively and both his father and mother were Cambridge mathematicians,
- (2) James Cameron, 2=W 1898, later Master of Caius College and Vice-Chancellor of the University.
- (3) James Jeans, 2=W 1898, later Sir James Jeans, the famous mathematical physicist.

Family connections with the Tripos are interesting. For example W.E. Littlewood, 34=W 1854, E. T. Littlewood, 9W 1882, and J. E. Littlewood (the famous mathematician), SW 1905, are grandfather, father and son respectively. Women were first listed in the Tripos in 1882 but in a rather curious way. Only the men were ranked but the position of the women Wranglers was indicated by giving the placings between which the women fell (e.g. between the 6th and 7th Wrangler etc). A noteworthy result was achieved in 1890 when Philippa Fawcett (who, the author believes, was a cousin of Littlewood) was placed above G.T. Bennett, the 'official' Senior Wrangler and therefore rightly should be considered the Senior Wrangler of 1890. Her father Henry Fawcett had been 7W of 1856. This is the only occasion that a woman was the Senior Wrangler.

Other interesting family connections are the Hudson's mentioned above, the four Niven brothers from Aberdeen who were respectively 3W, SW, 8W and 15W in 1866, 1867, 1874 and 1881; also the three Aldis brothers who were respectively SW, 2W and 6W in 1861, 1866 and 1863, and the three Phear brothers who were respectively 2W, 4W, 6W in 1849, 1852, 1847. A previous member of Clerk Maxwell's family on his mother's side had been ranked 2nd in the Tripos in 1752. Between 1748 and 1752 the candidates were listed in order of merit but the term Wrangler was not used. Also Clerk Maxwell's first cousin Charles Cay^{xvi} was 6W in 1864. Ability in both mathematics and classics is evinced by Cornelius Neale, SW 1812, who also won one of the two Chancellor's Classical Medals (the top awards for classics) and whose brother, Samuel, was 8W in 1810.

The Tripos had its share of sadness as well as triumph. Owing to the poorer medical facilities of the 19th century mortality was much higher and those who died relatively soon after taking the Tripos include J. Savage, SW 1855, Slessor, SW 1858, Purkiss, SW 1864, Hartog, SW 1869, J.E. Wright, SW 1900.

It is interesting to note that the philosopher Bertrand Russell was 7W 1893 and Lord Keynes 12W 1905. However, lack of excellence in mathematics was no hindrance to being Chancellor of the Exchequer as evidenced by H.C.E. Childers, 14 Senior Optime 1850, and Sir William Harcourt, 27 Senior Optime 1851, Chancellor 1886 and 1892-95. Indeed it was clearly no hindrance to being Prime Minister - Sir Henry Campbell Bannerman, 22 Senior Optime, Prime Minister 1906-08.

ⁱ Rouse Ball, W. W. (1889), *A History of the Study of Mathematics at Cambridge*.

^{i.i} Campbell, Lewis and William Garnett (1882), *Life of James Clerk Maxwell*.

-
- ⁱⁱⁱ Galton, F. (1869), Hereditary Genius-An Enquiry into its Laws and Consequences.
- ^v Snow, C.P., (1969), Variety of Men.
- ^v King, George (1921), 'Memoir of Thomas Bond Sprague', Journal of the Institute of Actuaries, Vol. 52.
- ^{vi} Goodwin, Harvey (1864), Memoir of Bishop Mackenzie.
- ^{vii} McAlister, E. F. B. (1935), Sir Donald McAlister of Tarbet.
- ^{ix} Thomson, Sylvanus P. (1910), The Life of William Thomson-Baron Kelvin of Largs.
- ^x Challis, L. J. (1988), 'George Green-miller, mathematician and physicist'- Mathematical Spectrum, Vol. 20, No. 2.
- ^{xi} Knott, C. G. (1911), Life and Scientific Work of Peter Guthrie Tait.
- ^{xii} Littlewood, J.E. (1986), Littlewood's Miscellany, edited by Bela Bollobas.
- ^{xiii} Articles on Babbage, Littlewood, Fourier, d'Alembert, Lagrange, Cauchy and Kronecker in Mathematical Spectrum, Vols. 1, 7, 11, 13, 16, 19, 22 and 24.
- ^{xiv} Hardy, G.H. (1926), 'The Case against the Mathematical Tripos'-Presidential Address to the Mathematical Association.
- ^{xv} Walton, W. (1865), The Mathematical Writings of Duncan Farquharson Gregory.
- ^{xvi} Forfar, D.O. (1992), 'Origins of the Clerk (Maxwell) Genius', Bulletin of the Institute of Mathematics and its Applications: Jan/Feb 1992 28 Nos 1/2.