

# Origins of the Clerk (Maxwell) Genius

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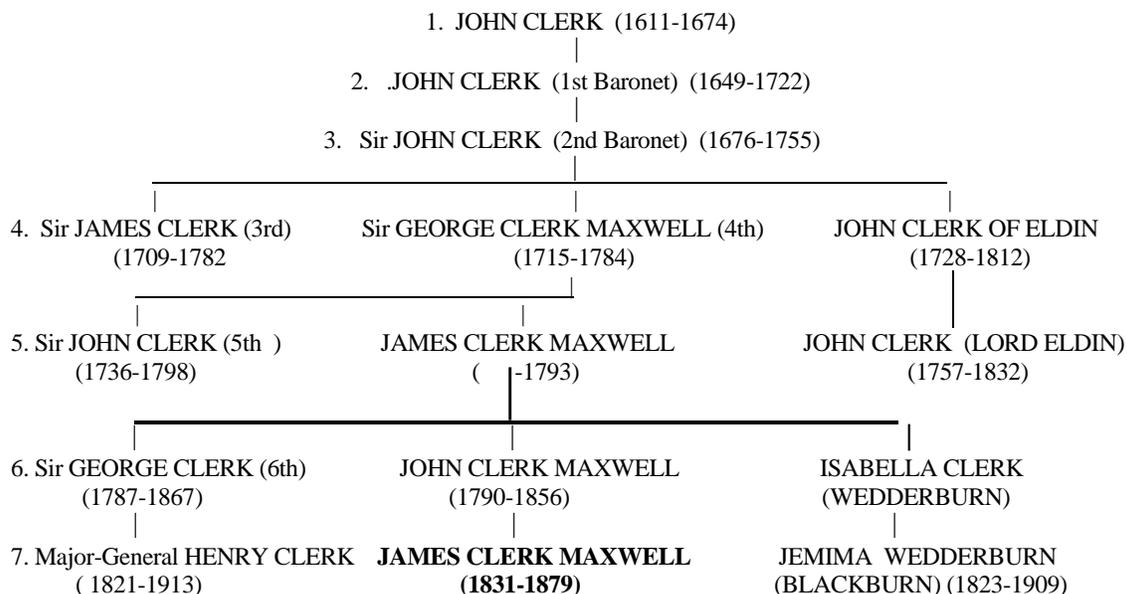
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At the International Science Festival in Edinburgh in 1991 there was a unique meeting when there came together two members of the present generation who are related to James Clerk Maxwell (JCM) and his lifelong friend and scientific colleague Peter Guthrie Tait, Professor of Natural Philosophy at the University of Edinburgh for over 40 years. Present were Sir John Clerk, 10th Baronet and great grandson of Maxwell's uncle Sir George Clerk, and Mr Tait, a great grandson of Professor P.G Tait. It was probably over a hundred years since the Clerks and Tait's had last met, a reminder of a unique era in Scottish intellectual life.

Maxwell came from a remarkable line of progenitors. He seemed to exemplify the relationship of his towering intellect to genetic inheritance. The famous concert pianist John Lill, after winning the Inter-national Tchaikovsky Piano Competition in Moscow, was asked where had he got his music from. He was somewhat perplexed by this question and unable to answer it since none of the previous generations of his family had been at all musical. If James Clerk Maxwell had been asked a similar question he would not have had to look very far for an answer. On his father's side he was a member of the Clerk family, the Clerks of Penicuik, and on his mother's side a member of the Cay family, the Cays of Northumberland.

## THE CLERK FAMILY



The name Maxwell was added to the family tree in the following way. William Clerk, a brother of Sir John Clerk (2nd Bart.) had married Agnes Maxwell and they had a daughter Dorothea. Sir John's son George then married his cousin Dorothea, inheriting the Maxwell estates provided he

assumed the Maxwell name which he did as 'Clerk Maxwell'. It was thus through his grandfather, the son of George, and his father that James Clerk Maxwell inherited the Middlebie estate of Glenlair.

The Clerks of Penicuik were a remarkable family. For two hundred years they produced men of such conspicuous talent and originality in a wide range of fields that use of the word 'genius' is not inappropriate: indeed Sir Walter Scott had spoken about *"the heritable genius of the family"*. Through five generations the family occupied a central place in the cultural history and intellectual life of Scotland.

### **Sir John Clerk FRS, FSA (1676-1755)**

Sir John Clerk (2nd Baronet), coming from the third generation of the Clerks, was the great great grandfather of James Clerk. He was educated at Penicuik school where he learned Latin and Greek. He proceeded from there to the University of Glasgow or Glasgow College as it was called in those days. Of his choice of Glasgow he said *"I love neither Aberdeen nor St Andrews, I abhor Edinburgh and therefore I have fixed upon Glasgow."*

He had a zest for intellectual challenge for his teacher at the University of Glasgow said of him, *"He of all my scholars gives the greatest satisfaction. I find him mightily ambitious to be the first and best and he spares no pains to deserve and acquire that pre-eminence."*

In 1694 at the age of 18 his father sent him to the University of Leiden in Holland to study Law. A period of study at Leiden in the late 17th century was a usual and necessary stage for a well-to-do Scotsman destined for the Bar and John Clerk was one of twelve Scotsmen who proceeded to Leiden that year.

Sir John – as he later would be – would not allow his wide ranging talents to be channelled into the study of law alone and he studied painting, drawing, music and mathematics. Indeed, in his early days at Leiden, mathematics had fired his intellect, and he said that *"without mathematics he would initially have spent his time in idleness."* His father disapproved, saying, *"the Italians call a fool a little mathematician and I hope you are not so great a fool as to aim at being a famous one."* (The family would have to wait for a few more generations for its most famous mathematical physicist).

At Leiden he became friendly with Hermann Boerhaave, later to become one of the greatest medical teachers of the 18th Century and one of the greatest of all time. Indeed such was Boerhaave's fame that a gentleman in China desirous of writing to him addressed his letter, 'Dr Boerhaave, Europe' – it had no difficulty in reaching its destination. Sir John was later to send two of his sons to study medicine under Boerhaave. Among his other achievements Sir John Clerk was a talented musician and composer and, interestingly, Boerhaave wrote the words for two of his compositions.

In Holland John Clerk extended his range of cultural interests, in particular in Roman history but by 1697 he was saying that *"Holland had become stultifying and Italy beckoned like a siren"*. His desire was to make a Grand Tour to Italy, Germany and Austria to expand his horizons and cultural interests. In arguing against such a Tour his father feared lest his son would return from Europe *"ruined in morals, religion, health, manners and pocket"*. His son prevailed however but not before receiving the following paternal advice, *"shun whore-dom, drunkenness, squabbling, dycing and such who use these abominations as Hell."*

When John Clerk arrived in Rome he was 'Signor Giovanni Clerk, Cavaliere Scoz-zese'. He made a great impact by his intellectual and scholarly powers, his cultivated taste and great musical abilities. He enjoyed all the honours which a nobleman of the best quality could have

expected including friendship with the famous composer and violin virtuoso Correlli. He was indeed such a fine musician, particularly on the harpsichord, that he could hold his own in the finest musical circles in Europe.

He returned to Scotland in 1700, became an advocate and then the Member of Parliament for Whithorn in the Scottish Parliament. In 1706 he was made a Commissioner for the Treaty of Union and played a part in the negotiation of the Union of the Scottish and English Parliaments.



Sir John Clerk of Penicuik - 2nd Baronet  
(great great grandfather of JCM)

In 1707 he became MP in the first UK Parliament in which there were forty-five Scottish MPs. In the same year he became Baron of the Exchequer of Scotland at a salary of £500 p.a. This suited him very well as he wished to pursue his scholarly interests and the Baron of the Exchequer was only involved in work for three months of the year. As he said *"Nothing could be better calculated for my humour than the office I enjoyed. I had a good deal of time on my hands which I always spent to my own satisfaction."*

He pursued his scholarly interests for nearly 50 years and became Scotland's best informed patron of the arts, and the recognised leader of his generation in the cultural field. He was antiquarian, architect, historian, poet, musician, composer, patron, connoisseur, traveller, writer, man of letters, an astonishing range of accomplishments - a virtuoso in the widest sense. As a musician he was a first class performer although extremely reluctant to perform in public. He said, *"I excelled to a fault and performed better than became a*

*gentleman."* Although his output was small his musical compositions rank him among the finest composers produced by Scotland. His compositions have been performed at the Edinburgh International Festival and are now available on compact disc (CD).

He was a patron of the poet Alan Ramsay and encouraged through his patronage the best painters and architects in Scotland; a connoisseur of fine art and a judge of cultural taste and artistic excellence. As an antiquarian he had a superb knowledge of Roman Britain and archaeology in general and in 1725 was elected a Fellow of the Society of Antiquaries, the first person resident in Scotland to be so honoured. He had a fine knowledge of architecture and helped to establish William Adam as the leading Scottish architect of his day. He was frequently consulted on architectural matters, for example by Lord Aberdeen during the building of Haddo House in Aberdeenshire. As a historian he wrote, in Latin, a six volume 'History of Britain'. He had made a Grand Tour of Europe and others wishing to do the same came for his advice.

He did not confine his vast intellectual repertoire to the arts. As a scientist he helped found the Philosophical Society in Edinburgh which subsequently became the Royal Society of Edinburgh. He was interested in astronomy, meteorology, geology and mining technology. In 1728 he was elected a Fellow of the Royal Society of London. He was interested in medical matters stemming from his friendship with Boerhaave and had a large collection of medical books. His interest in experimental science led him to believe in popularising scientific knowledge as indeed did his great great grandson James Clerk Maxwell.

He was the author of a number of pamphlets on a range of topics and corresponded with the greatest scholars of the day, for example William Stukeley, Roger Gale and Alexander Gordon. It is hardly surprising that he was described as follows:-

By William Adam as - "*A man of taste and genius.*"

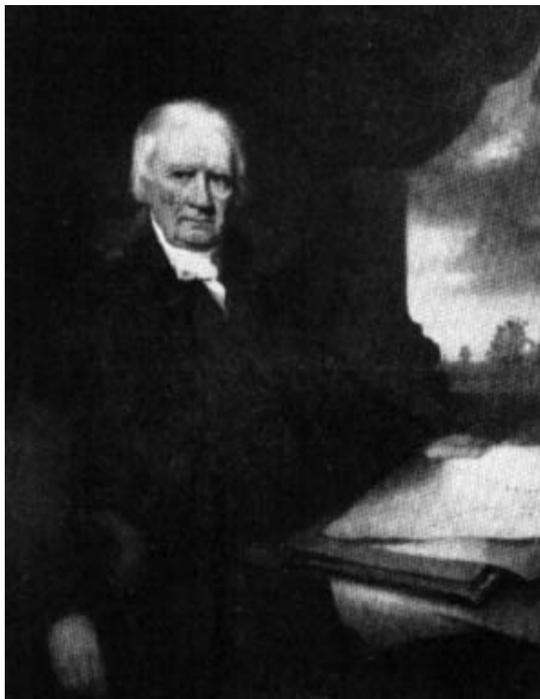
By Stukeley (Scholar and Antiquary) as - "*The great genius of the North*" and on another occasion - "*You see now and then the worthy Mr Baron Clerk - that gentleman is the glory of his country for integrity, learning and other great qualities.*"

By Chambers as - "*One of the most enlightened men of his age.*"

In a memoir about him, his son wrote – "*The subject of this memoir is a name celebrated in the civil history and literature of Scotland yet Sir John Clerk from the great extent of his learning, his cultivated taste and numerous personal accomplishments joined to his active share in the important transactions of the Union with England would have a distinguished place in the history of any country.*"

### **John Clerk of Eldin, FRSE (1728-1812)**

John Clerk of Eldin came from the fourth generation of Clerks, the son of Sir John Clerk described above, and was the great great uncle of James Clerk Maxwell. He attended Dalkeith Grammar School and then the University of Edinburgh where he studied anatomy under the famous Scottish anatomist Alexander Munro *primus*. It was in Edinburgh that he met James Hutton, subsequently to become world famous as a geologist. Hutton has been described as the father of modern geology. His revolutionary geological theory - the '*Theory of the Earth*' - had an impact on geology similar to that which Clerk Maxwell's theory of electromagnetism had on physics and was likewise far ahead of its time.



John Clerk of Eldin c. 1800  
(great great uncle of JCM)  
(naval tactics plans before him: ships beyond)

John Clerk of Eldin spent a period of his life as a merchant. In the 1760s he managed a coal mine. Coal mining and the study of geological strata were for him intimately related. The study of the strata in the family pits offered a valuable field of enquiry for his curious and perceptive mind.

As a result of his success as a merchant he was able to buy the property of Eldin near Edinburgh and devote himself predominantly to artistic and scientific pursuits as his father had done. He was an etcher, topographical artist, geologist and above all naval tactician. His skill at etching in copper was such that a collection of his etchings was presented to the King by the Earl of Buchan and is now in the British Museum. In this field he achieved, and still retains, an established reputation. Reference works on Scottish artists give him a significant mention

In the 1780s he made a series of excursions with James Hutton and with his knowledge of geology and his skill as an artist he was able to record for posterity the geological observations which he and Hutton made. Professor John Playfair, Professor of Natural Philosophy at Edinburgh University said at the time,

*"The interest Clerk took in studying the surface of the Earth, his extensive information in most branches of natural history, a mind of great resource, a great readiness of invention, made him to Dr Hutton an invaluable friend and coadjutor. It cannot be doubted that in many parts the system of the latter has had great obligations to the ingenuity of the former. Mr Clerk's pencil was ever at the command of his friend and has certainly rendered him most valuable service."*

There is no doubt that Hutton found in Clerk a perceptive colleague with whom to evaluate critically his scientific theories. The 'Theory of the Earth.' which Hutton propounded in 1785 was broadly speaking as follows:-

- 1 There occurs gradual degradation of the land by erosion, particularly through river action.
- 2 The eroded matter is transported out to sea and deposited as sediments.
- 3 The sediments consolidate at the bottom of the sea.
- 4 In due course these sediments are elevated owing to land upheavals and form new land surfaces which are in turn subject to erosion producing the repetition of the same cycle.

Hutton's Theory was far ahead of those of his contemporaries and, except for Clerk, the Theory was not accepted until well after Hutton's death. Curiously, while the first two volumes of Hutton's 'Theory of the Earth' appeared in 1795 the third volume did not appear until 1899. Even more curiously the drawings done by Clerk to illustrate the third volume did not see publication until 1978, some 150 years after they were made.

Perhaps Clerk of Eldin's greatest claim to fame and the one which showed more than a touch of genius is his 'Essay on Naval Tactics' which he wrote in 1779. He circulated this privately, but did not publish it until 1790. It was quite extraordinary that Clerk, who was a landsman and had never been to sea, should publish such a work yet of it Professor Playfair said:-

*"The author of 'Naval Tactics' was one of those men who by force of their own genius have carried great improvements into professions not properly their own."*

Until Clerk's 'Essay on Naval Tactics' there was no book in English on the subject. In the 1770s the Americas, France, Spain and Holland had joined forces against Great Britain and the tactics which the British Navy had employed against them had proved quite ineffective. In particular against the French the previous superiority of the British Navy seemed to have disappeared. Some of the most inglorious naval campaigns in the annals of British Naval history were recorded at this time. As Professor Playfair said:-

*"The circumstances of the nation had never called on every individual to think more seriously of the situation of his country; nothing had ever proved so clearly that, at sea, the system of offensive warfare was yet but imperfectly understood nor was there ever a juncture when such discoveries as Mr Clerk had made could be brought forward with so great effect."*

Clerk's highly original idea on naval tactics was to sail into the enemy's line of ships - so called 'cutting the line' - and attack the rear ships of the enemy's line with the whole force of the attacking fleet. From the 1770s onwards there followed a great and brilliant series of victories using Clerk's system culminating in Nelson's victory at Trafalgar in 1805. The orders given by Nelson before the battle of Trafalgar contain several sentences taken directly from Clerk's 'Essay on Naval Tactics'. Playfair regretted that no honour was bestowed on Clerk and said,

*"It cannot but appear extraordinary that no mark of public favour was ever bestowed on the author nor any acknowledgement made by Government of merit so distinguished."*

Sir Walter Scott put into the mouth of Guy Mannering an assessment of John Clerk of Eldin's many sided genius as follows:

*"You who are a worshipper of originality should come a pilgrimage to Edinburgh to see this remarkable man. The table at which he sits is covered with a miscellaneous collection of all sorts - paints and crayons, clay models, books, letters, instruments, specimens of mineralogy of all sorts, vials and chemical liquors for experiments, plans of battles ancient and modern, models of new mechanical engines, maps, sheets of music - in short an emblematical chaos of literature and science."*

He was described as:-

*"frank, liberal and communicative, his extensive information is at the service of every stranger who is introduced and is so general and miscellaneous that everyone must find a subject of entertainment and information."*

### **John Clerk, Lord Eldin, FRSE (1757-1832)**

John Clerk, later Lord Eldin, was the son of John Clerk of Eldin. He trained both as a solicitor and as an accountant and practised initially as an accountant. He became a Fellow of the Royal Society of Edinburgh in 1784 at the age of 27.

In 1785, at the age of 28, he became an advocate at the Scottish Bar. Previous generations of the Clerk family had studied law but not produced an advocate worthy of their pedigree. This changed in the fifth generation. John Clerk was a superb advocate with an intellect in the Clerk Maxwell class and his professional income never fell below £5,000 p.a. for twenty years. To put this in perspective, James Clerk Maxwell's income on being appointed Cavendish Professor at Cambridge in 1871 was only £500 p.a. John Clerk had a long and brilliant career at the Bar. A contemporary description of him was:-

*"John Clerk is the present Coryphaeus of the Bar - others there are that surpass him in a few practical points both of learning and of practice but on the whole his superiority is entirely unrivalled and undisputed".*

Indomitable energy, intense zeal, wide and exact knowledge of the Law, brilliant forensic gifts, unflinching resourcefulness were the factors in Clerk's success. He could remain cool under pressure, but if thwarted could become very excited; indeed it might be said that in his pleadings at the Bar John Clerk could exist in one of two states, the 'excited' state and the 'unexcited' state. In the unexcited state:-

*"His coolness and self possession, borne of an unwavering belief that John Clerk was endowed with superlative gifts, amazed everybody and at times probably himself. No rebuff deflected him from the even tenor of his ways, no amount of legal hair splitting confused him. He would neither be banned, cajoled nor allured."*

However it was rather different when he was in the excited state when:-

*"He was a tornado, heedless of the consequences. He would bully witnesses, insult opposing counsel and abuse the bench. Clerk was the gladiator of the Bar and was there to win against all comers. But, scornful though he is, what a display of skilfulness in the way of putting his statements; what command of intellect in the strength in which he deals the irresistible blows of his argument. It is a truly delightful thing to be a witness of this mightily intellectual gladiator scattering everything before him like a King on his old*

*accustomed arena, with an eye swift as lightening to discover the unguarded points of his adversary."*

Of the sharpness of his wit the following is an example: Clerk, who had a strong Scottish accent, was pleading a case in the House of Lords before the Lord Chancellor. The case concerned the right of a miller to continue using a stream at his mill. As Clerk said, *"The watter had rin that way for forty years, indeed naebody ken't how long, and why should his client be deprived of the watter."* Said the Lord Chancellor in haughty tones, *"Tell me, Mr Clerk, do you spell the word watter with two t's?"* Clerk answered *"No, my Lord, but you spell the word manners with twa n's."*



John Clerk, Lord Eldin, 1820  
(son of JCM's great uncle)

Clerk's skill and intellect were in demand in other fields of activity. For example he gave invaluable help to the insurance company - the Scottish Widows at the time of its foundation. The first bonus distribution of the Scottish Widows was to be in 1825 some ten years after the foundation of the company. The bonus was to be given, in proportion to the sum assured, to all those who had entered between 1815 and 1819 - that is to say the same bonus would be given to policies of the same sum assured whether they had been in force for six, seven, eight, nine or ten years and this was felt to be unfair. John Clerk served on the committee which recommended a fairer solution, namely that the bonus should be proportional not only to the sum assured but also to the number of premiums paid.

Knowing his interest as a collector of paintings and fine objects the Scottish Widows Fund, in appreciation for the advice he had given them, presented him with a gold snuff box which, after his death, came

back to the Scottish Widows and is a treasured possession of that Society. The inscription on the snuff box is as follows:-

*PRESENTED BY THE SCOTTISH  
WIDOWS' FUND AND  
LIFE ASSURANCE SOCIETY  
TO  
THE HONOURABLE  
JOHN CLERK OF ELDIN  
ONE OF THE SENATORS OF THE COLLEGE  
OF JUSTICE  
IN GRATEFUL RECOGNITION  
OF THE BENEFITS RECEIVED FROM HIS  
ADVICE  
IN THE FORMATION OF THE SOCIETY  
AND UPON OTHER IMPORTANT CASIONS  
1825*

Away from the courts there was a much more sociable side to Lord Eldin's character. He attended each year the annual dinner of the Ballantyne Club over which Sir Walter Scott presided. There

is a story that on one such occasion he had imbibed at the dinner to an excessive degree. Returning at 2 a.m. to his house at Picardy Place his scullery maid came to the door Lord Eldin asked, "Is this Lord Eldin's house?" Surprised, the scullery maid replied, "But you are Lord Eldin" to be met with the riposte, "I know who I am, but it's his house I want."

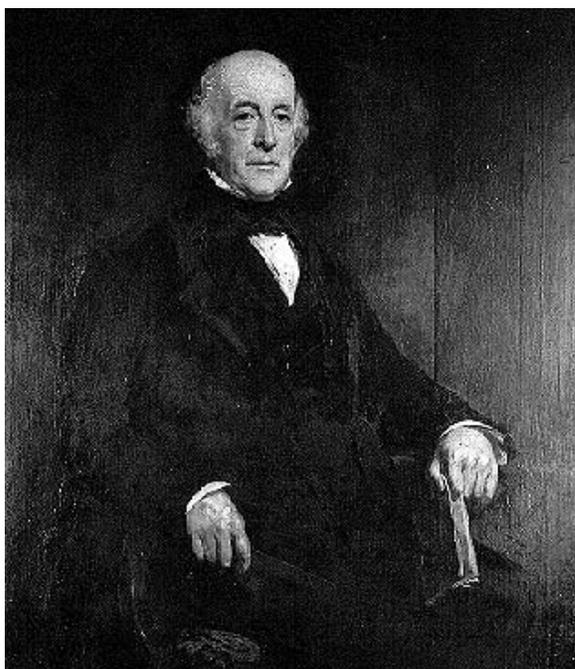
John Clerk was also skilled in drawing and was a friend of Sir Henry Raeburn. He was also a connoisseur of the arts and acquired a collection of valuable pictures and rare books. He was raised to the bench as Lord Eldin in 1823 but resigned 5 years later. He was not a success as a judge, the calling of advocate had suited him very much better.

In 1832, following his death, his picture collection was sold. Over 150 people crammed into his house at Picardy Place whereupon the floor collapsed killing Mr Smith the Banker. Mr McKean the Manager of the Scottish Widows, who had been a friend of Lord Eldin, was also present but being a cautious actuary had carefully taken his stance on the hearth stone. As is recorded in the annals of the Scottish Widows Fund:-

*"Mr McKean, the Manager of the Society, being in a room of the late Lord Eldin's house in Picardy Place, in company with Mr Alexander Smith, Banker, the floor suddenly collapsed carrying with it Mr Smith who was killed while Mr McKean was left standing on the hearth stone."*

### **Sir George Clerk, FRS, FRSE (1787-1867)**

Sir George Clerk belonged to the sixth generation of Clerks and was the uncle of James Clerk Maxwell. He was educated at the High School in Edinburgh from where he proceeded to Trinity College, Oxford where he was a contemporary of Sir Robert Peel - the two remaining great friends in subsequent years. In 1811, at the age of 24, he became MP for Midlothian representing the Tory party. In 1812 he was elected a Fellow of the Royal Society of Edinburgh and in 1819 a Fellow of the Royal Society of London. When Sir George applied for Fellowship of the latter body his application stated that he was "a gentleman well versed in mathematics and attached to science in general" - his main interests, however, lay in zoology and not in mathematics.



Sir George Clerk  
(uncle of JCM)

He had a very distinguished political career being successively a Lord of the Admiralty under the Premiership of the Earl of Liverpool, then Under-Secretary of the Home Department under the Duke of Wellington. After losing his seat to the Whig, Sir John Dalrymple, he was re-elected for Stamford in 1838. From 1834-35, and again from 1841-45, he was Secretary to the Treasury under Sir Robert Peel and in 1845 was Vice-President of the Board of Trade. In 1845 he was elected a Member of the Privy Council and appointed Master of the Royal Mint, a position which had been held by Sir Isaac Newton from 1699-1727. In 1862 at the advanced age of 75 he was elected President of the Zoological Society, a position he held until his death in 1867. In the annals of the Zoological Society it is stated that 'Sir George Clerk became a member in 1830 and before his election as President in 1862 had frequently served on the Council for which he was for many years

*a most active and efficient member. As President he was unremitting in the discharge of the duties of his office and ever anxious to promote the interest of the Society.'*

The meeting of the British Association in Aberdeen in 1859 must have been one of its greatest. At that meeting James Clerk Maxwell presented his first revolutionary paper on the '*Kinetic Theory of Gases*' and Charles Darwin intimated to the Association a work which he called '*Origin of Species*'. Thus a few years after the publication of '*Origin of Species*' Sir George became President of the Zoological Society with two Vice-Presidents, Professor T H Huxley and Bishop Wilberforce, the Bishop of Oxford (the so called 'Soapy Sam') who had diametrically opposed views on evolution. At a British Association meeting in Oxford in 1860 the audience had gathered to hear Wilberforce discredit Darwin and to hear Huxley defend him.

Wilberforce asserted with finely honed sarcasm:-

*"He had been told that Professor Huxley had said that he didn't see that it mattered much to a man whether his grandfather was an ape or not. Let the learned Professor speak for himself...."*

To which Huxley gave his famous rejoinder:-

*"I assert, and I repeat, that a man has no reason to be ashamed of having an ape for a grandfather. If there were an ancestor whom I should feel ashamed in recalling it would rather be a man, a man of restless and versatile intellect, who not content with an equivocal success in his own sphere of activity plunges into scientific questions with which he has no real acquaintance only to obscure them by aimless rhetoric and distract the attention of his hearers from the real point at issue by eloquent digressions and skilled appeals to religious prejudice."*

One can only imagine how poor Sir George managed to cope with these two turbulent Vice Presidents. No doubt he would have had to draw on his recognised political skills.

Huxley and Clerk Maxwell were joint scientific editors of the ninth edition of the Encyclopaedia Britannica.

### **Major General Henry Clerk, FRS (1821-1913)**



Major-General Henry Clerk  
(cousin of JCM)

Sir George Clerk's sixth son, Henry Clerk, was first cousin to James Clerk Maxwell. He became a Major-General in the Royal Artillery and was elected a Fellow of the Royal Society in 1848, one of his proposers being the astronomer Sir John Herschel. He published some half-dozen or so papers whose titles include -'*Meteorological Observations made on H.M.Bark Pagoda*', '*Magnetical Observations made on a Voyage in the Antarctic Circle*', '*On the change of form assumed by wrought iron and other metals when heated and then cooled by partial immersion in water*' and '*On the hydraulic buffer, and experiments on the flow of liquids through small orifices at high velocities*'. Clerk Maxwell refers in a letter to Henry to having received from him a paper on the errors and corrections of sextant observations. Henry's particular interest was in terrestrial magnetism. Maxwell visited Henry on a number of occasions in Woolwich where Henry was based and, given Henry's interest in magnetism, discussed with him the work which he (Maxwell) was doing on Faraday's theory of lines of magnetic force.

### **Jemima Blackburn (née Wedderburn) (1823-1909)**

Jemima Blackburn of the seventh generation of Clerks was James Clerk Maxwell's cousin, being the daughter of his aunt Isabella Clerk who had married James Wedderburn, the Solicitor General for Scotland. Jemima was a prolific water-colourist of outstanding technical ability and one of the Victorian age's foremost illustrators, particularly of ornithological subjects. The latter were particularly exemplified in her book '*Birds from Nature.*' In 1843 when she was aged twenty Landseer had said that "*in portraying animals he had nothing to teach her*". Jemima's skills were recognised by artists such as Landseer, Millais and Ruskin, with whom she was on friendly terms.

In 1849 she married Hugh Blackburn, Professor of Mathematics at the University of Glasgow, and a great friend of Lord Kelvin. In 1845 Hugh Blackburn had been Fifth Wrangler in the



Jemima Blackburn (née Wedderburn)  
(cousin of JCM)

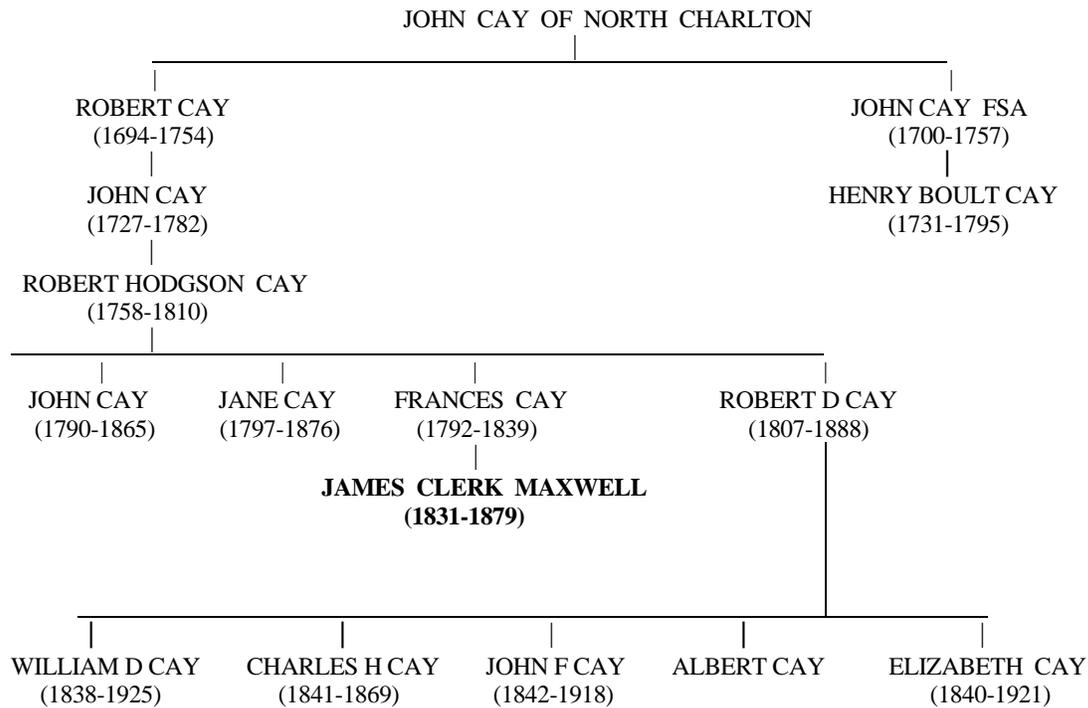
Mathematical Tripos and Lord Kelvin (then William Thomson) Second Wrangler and First Smith's Prizeman. Hugh's brother, Sir Colin Blackburn, had been Eighth Wrangler in 1835 and after going into the law became one of the greatest common lawyers of his generation. Jemima's sister had married James Mackenzie whose brother Charles Mackenzie had been Second Wrangler in 1848.

In 1848 Jemima Blackburn had her first picture hung in the Royal Academy and in 1857 she exhibited pictures in New York and other American cities when an '*Exhibition of British Paintings*' visited the USA. She travelled extensively, visiting Algeria, Greece, Egypt, Italy and completed hundreds of water-colour paintings. Thackeray said "*Mrs. Blackburn will not be displeased by what critics her genius is appreciated*" (the critics referred to being Landseer, Millais and Ruskin). Towards the end of her life Jemima recorded her memoirs which include interesting references to James Clerk Maxwell.

In this remarkable family nine members were Fellows of one or other, or both, of the Royal Society or the Royal Society of Edinburgh. James Clerk Maxwell and his uncle Sir George Clerk (6th Baronet) were Fellows of both the Societies; his great great grandfather Sir John Clerk (2nd Baronet) and his cousin Major General Henry Clerk were Fellows of the Royal Society; his great grandfather Sir George Clerk Maxwell (4th Baronet), his great uncle John Clerk of Eldin and his son John Clerk, Lord Eldin, his great uncle Sir John Clerk (5th Baronet) and his father John Clerk Maxwell were all Fellows of the Royal Society of Edinburgh.

## THE CAY FAMILY

On his mother's side James Clerk Maxwell was a member of the Cay family - the Cay's of Northumberland. The Cays had achieved distinction in the legal and mathematical fields. In the mathematical field, for instance, James Clerk Maxwell was not the first member of the Cay family to be Second Wrangler in the Mathematical Tripos at Cambridge University. Just over a century earlier a previous member of the Cay family, Henry Boulton Cay, had been Second Wrangler (1752). Two members of the Cay family were Fellows of the Royal Society of Edinburgh.



### **John Cay, FSA (1700-57)**

John Cay (1700-1757) was a distinguished barrister and antiquary. He was elected a Fellow of the Society of Antiquaries in 1736, some eleven years after Sir John Clerk (2nd Baronet) and the two may have met at meetings of the Society.

### **Henry Boulton Cay (1731-1795)**

The son of John Cay, FSA, Henry Boulton Cay, Second Wrangler in 1752, was subsequently elected a Fellow of Clare College, Cambridge. His professional career was as a barrister, Deputy Steward of the Marshalsea and Steward of the Country Court of Middlesex.

### **Robert Hodgson Cay, LL. D. (1758-1810)**

Robert Hodgson Cay, James Clerk Maxwell's grandfather, was called to the Scottish Bar in 1780. He was the Commissary of Edinburgh and then Judge of the High Court of Admiralty and was well acquainted with Sir Walter Scott. He would doubtless also have been well acquainted with Lord Eldon with whom he was a contemporary.

### **John Cay, FRSE (1790-1865)**

John Cay was James Clerk Maxwell's favourite uncle and one of his father's closest friends. He had been educated at the High School in Edinburgh and the University of Edinburgh. He was called to the Bar in 1812, the year after James Clerk Maxwell's father, John Clerk Maxwell. In 1812 he was elected a Fellow of the Royal Society of Edinburgh (the same year as John Clerk

Maxwell). He had an enthusiasm for the acquisition of scientific knowledge and although not specially trained in mathematics was extremely skilled in arithmetic and fond of calculation as a voluntary pursuit - his interest in these areas acting as an inspiration to James Clerk Maxwell. His wide ranging interests included membership of the Scottish Society of Arts of which body he was the President from 1848-1849. For some 43 years (1822 and 1865), he was the Sheriff of Linlithgow. He was a “*sound and judicious judge who discharged his duties with great credit to himself and great satisfaction to the public*”.

### **Robert Dundas Cay (1807-1888)**

Robert Dundas Cay (1807-1888), Writer to the Signet, another uncle of Clerk Maxwell, was the Registrar to the Supreme Court of Hong Kong. His brother-in-law was the artist Sir William Dyce R.A.

### **William Dyce Cay, FRSE, MICE (1838-1925)**



William Dyce Cay  
(cousin of JCM)

William Dyce Cay was one of the sons of Robert Dundas Cay and was James Clerk Maxwell’s cousin. He had studied at Edinburgh University where he won the highest mathematical prize, the Straiton Gold Medal, in 1856. Between 1856 and 1858 he served his pupilage in engineering in Belfast with Lord Kelvin’s brother, James Thomson, whose ingenuity James Clerk Maxwell has once described as “*quite equal to that of his brother.*” In 1872 he was elected a Member of the Institution of Civil Engineers and in 1882 a Fellow of the Royal Society of Edinburgh. He was an expert on the construction of harbours and for many years was the resident engineer at Aberdeen Harbour. He made numerous contributions to engineering journals.

### **Charles Hope Cay 1841-1869)**

William's brother Charles H. Cay was educated, like Clerk Maxwell, at the Edinburgh Academy where he won the Mathematics Medal in 1857. Possessed of a versatile intellect he was undecided whether to study classics or mathematics when he proceeded to Caius College, Cambridge, on a classics scholarship in 1860. He opted for mathematics, graduating as Sixth Wrangler in 1864 and being elected a Fellow of Caius College in the same year. He proceeded to Clifton College as Mathematics Master but died at the tragically young age of twenty-eight, his potential unfulfilled. It was to Charles Hope Cay that Clerk Maxwell wrote, “*I have also a paper afloat, with an electromagnetic theory of light, which, till I am convinced to the contrary, I hold to be great guns*”. Perhaps only to his favourite cousin would Clerk Maxwell have vouchsafed such a personal opinion of his own work



Charles Hope Cay  
(cousin of JCM)

### **Elizabeth Cay (1840-1921)**

It is reputed that Clerk Maxwell had been fond of his cousin Elizabeth (1840-1921), a beautiful and highly intelligent girl, but for reasons of consanguinity this attachment was not pursued. Elizabeth ('Lizzie') married Thomas William Dunn who graduated in 1864 with First Class honours in the Cambridge Classical Tripos and was elected as a Fellow of Peterhouse College. He was the Headmaster of Bath College from 1878 to 1897. The Cambridge tradition was kept up through Lizzie's daughter Mary who married Peter Giles, later Master of Emmanuel College, and through her son Charles, classical scholar of Trinity College.

### **JAMES CLERK MAXWELL FRS, FRSE (1831-1879)**

The confluence of the seventh generation of Clerks and the sixth generation of Cays in the form of James Clerk Maxwell produced the greatest Clerk and Cay of them all, but that was not fully evident early on. Measured against the qualities of his relatives and friends Clerk Maxwell's success as Second Wrangler and First Smith's prizeman in 1854 was not, at that stage of his career, so remarkable given the achievements of the Blackburns, the Mackenzies, the Cays and his school friends at the Edinburgh Academy (P.G. Tait - Senior Wrangler and First Smith's prizeman (1852); A. Stewart - Ninth Wrangler (1853); R. Campbell - Fourteen Wrangler (1854)). What was so remarkable was the brilliance, as a whole, of the group of which Clerk Maxwell was a member. It was extraordinary that the only two First Smith's prizemen to come from the Edinburgh Academy were both born in the same year and attended the school at the same time (although in different classes).



The Blackburns, Mackenzies, Cays, Clerk Maxwell (and some fifteen of Clerk Maxwell's forty first cousins) had attended the Edinburgh Academy and had come under the influence of the mathematics master Mr. Gloag. Gloag had some ten Wranglers to his credit including one Senior (Tait) and two Seconds (Clerk Maxwell and Mackenzie). Gloag took great pride in the achievements of his former pupils; indeed when a dinner was held for Tait to celebrate his Senior Wranglership, Gloag was invited and "*was so beside himself that it was hard for the casual onlooker to discern whether it was Tait or Gloag who had been Senior Wrangler*". Tait's view on the basis of Gloag's success as a teacher would hardly have accorded with modern cultural attitudes. He said, "*To use a well known cricketing phrase, Gloag could get more work on the tawse than any other master. His secret was in large measure a dynamical one*".

Maxwell showed talents which could be traced to the creative abilities of the Cays and the special genius of the Clerks. The '*special genius*' runs through the generations of the Clerks like a common thread – great ability, originality, intense curiosity and acquisition of knowledge in a wide range of fields. The public statements which were made about Maxwell often had their counter-parts in statements which had been made about others in the long line of Clerks.

#### Statement I:

re John Clerk of Eldin - great great uncle:-

*'His extensive information is at the service of every stranger who is introduced and is so general and miscellaneous that everyone must find a subject of entertainment and information'*

re James Clerk Maxwell:-

*'He showed himself acquainted with every subject on which the conversation turned. I never met a man like him. I do not believe there is not a single subject on which he cannot talk and talk well to, displaying always the most curious and out-of-the-way information'*

### Statement II

re Sir John Clerk - great great grandfather:-

*'A man of taste and genius'.*

re John Clerk of Eldin - great great uncle:-

*'One of those men who by the force of their own genius.....'*

re James Clerk Maxwell:-

*'Everyone of his works is stamped with the subtle but unmistakable impress of genius'*

re Jemima Blackburn (née Wedderburn) - cousin:-

*'She will not be displeased at hearing by what critics her genius is appreciated'.*

### Statement III

re John Clerk of Eldin - great great uncle:-

*'He possessed a strong and inventive mind to which the love of knowledge and the pleasure derived from the acquisition of it were always sufficient motives for application'*

re John Clerk, Lord Eldin - son of great great uncle:-

*'He was remarkable both for his acuteness, marvellous powers of reasoning and fertility of resource'.*

re James Clerk Maxwell:-

*'To those who could catch a few sparks that flashed as he thought aloud or when he twinkled with wit and suggestion he was supreme as an inspiration'.*

## **The Genius of James Clerk Maxwell**

Having inherited the special genius, originality and creative ability of the Clerks as well as the abilities of the Cays it is not surprising that James Clerk Maxwell had a superb and wide ranging intellect as well as physical intuition and geometrical imagination of the very highest order.



John Clerk Maxwell  
(father of JCM)



Mrs Frances Maxwell (née Cay)  
(with son, James Clerk Maxwell)

His private tutor at Cambridge, William Hopkins said:-

*“It appears impossible for Maxwell to think incorrectly on physical subjects.”*

Professor Coulson said:-

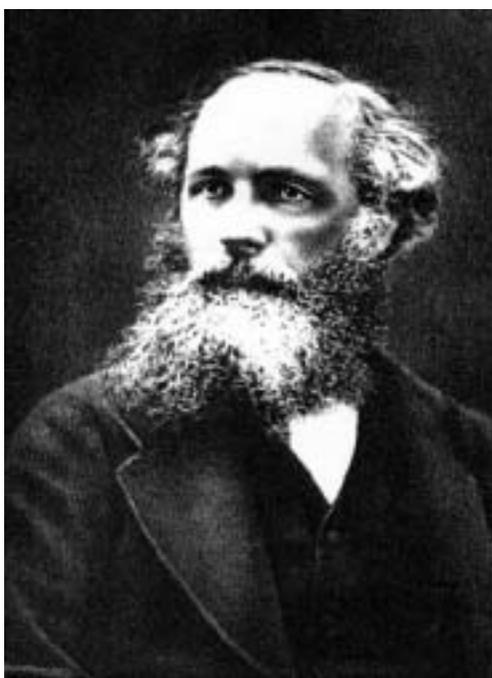
*“there is scarcely a single topic that he touched upon which he did not change almost beyond recognition.”*

Peter Guthrie Tait said in 1879 in his obituary tribute to Clerk Maxwell:-

*“he had one of the most piercing intellects of modern times.”*

Through his pioneering contributions to the Kinetic Theory of Gases, the Theory of Colour, the Theory of Saturn's Rings, Thermodynamics, Elasticity and Optics and in particular through his Theory of Electromagnetism James Clerk Maxwell ranks along with Newton and Einstein as one of the greatest men in the history of science.

The span of Clerk Maxwell's work was enormous. Only three examples of it can be mentioned here.



James Clerk Maxwell

### **Colour Photography**

The first colour photograph ever taken was taken by Clerk Maxwell in 1861. Maxwell's work on colour had confirmed the theories of Young and of Helmholtz, namely that all colours could be made by adding together three basic or primary colours which Maxwell took as red, blue and green - the so called tri-chromatic theory of light. Maxwell considered that the tri-chromatic theory could be cleverly illustrated by photography and arranged for three photographs to be taken of a tartan ribbon. The first photograph was taken through a red filter, the second through a blue filter and the third through a green filter. The secret was then to project the three photographs back on to the screen, the red photograph being projected back through a red filter, the blue the blue filter and so on, the picture being reassembled again from the three primary colours

It turns out that Maxwell's photographic experiment should not have worked and that he was extremely lucky to obtain a coloured photograph at all. The photographic plate which he used was not sensitive to red light and no photograph should have appeared when the ribbon was photographed in red light but by a stroke of luck the red colour in the ribbon also reflected ultraviolet light to which the photographic plate was sensitive. Instead of photographing the

ribbon under red light Maxwell was actually photographing it under ultraviolet light so the mixture of colours which Maxwell obtained was ultraviolet, blue and blue-green, not the mixture red, blue, green he believed he had obtained. Maxwell made his colour photograph at least 20 years ahead of the time when it should have been possible, such was the way of his genius.

### **Saturn's rings**

The second topic concerns Saturn's rings and the Adams Prize which was set in 1855. The subject of the Adams prize was 'the motions of Saturn's rings' and the problem was to ascertain whether:

1. the rings were solid bodies, regular or irregular;
2. the rings were fluid bodies, liquid or gaseous;
3. the rings were composed of disconnected masses.

Clerk Maxwell responded to the prize competition by submitting in 1857 an essay entitled, 'On the Stability of Motion of Saturn's Rings' and won the Adams prize.

It was known prior to Maxwell's essay that the rings could not be a uniform solid ring because the dynamical equilibrium of a solid uniform ring would be unstable and it therefore would crash into the planet. Maxwell proved that it was possible for the ring to be a non-uniform solid body but it would have to have almost exactly 82 per cent of the weight of the ring in one lump on the side of the ring. Observations showed such an irregularity in the structure of the ring did not exist and therefore this possibility was discounted. He showed furthermore that if the rings were a fluid then waves would be formed in the ring which would result in the ring breaking up. He concluded therefore that the ring could only be a series of disconnected masses. The essay which he wrote in 1857 was over eighty pages long and was described by Professor Airy, the Astronomer Royal, as one of the finest applications of mathematics to physics that he had ever seen.

### **Electromagnetism**

Maxwell's Theory of Electromagnetism, and his great contributions to the Kinetic Theory of Gases and other areas of physics, were the outcome of research of the highest order and constituted major contributions to scientific knowledge. His derivation of the famous Maxwell's equations and his deduction that light was an electromagnetic wave is generally held to have been the greatest advance in physics since the time of Newton and have resulted in Maxwell's name being celebrated throughout the world.

While the famous equations which Clerk Maxwell derived to describe the electro-magnetic field are universally known as Maxwell's equations and will no doubt remain that way for all time perhaps they would be better named the Clerk-Cay equations as a fitting tribute to the remarkable families from which he came.

### **The pawky humourist**

Two examples of Maxwell's pawky humour will end this discourse.

When he was an undergraduate he had a brush with the Dean of Trinity College, Cambridge, John Alexander Frere, who had sent him a note upbraiding him for insufficient attendance at Chapel. The letter which Clerk Maxwell drafted to send back to J.A. Frere was as follows - although it is not clear it was ever sent:

*"Dear Sir*

*Looking back on the past week I find I have kept only seven chapels. I have no excuse to offer. The reason, however, for the deficiency is this. Unaware that a Saint's Day would occur in the course of the week I parted with my surplice on*

*Monday in order to have it washed. I was thus prevented from appearing in chapel on the evenings of Wednesday and Thursday as otherwise I would have done. I might even after this have completed the requisite number but, unfortunately, reading until a late hour on Friday night I found myself unable to attend chapel on Saturday morning.*

*I can but hope that more forethought on my part may prevent the recurrence of such accidents.*

*I have also to acknowledge receipt of a small paper from you relative to the observance of Sunday. I have read it, and will keep it in mind.*

*Trusting that my past and future regularity may atone for my present negligence. I remain*

*Yours sincerely*

*J.C. Maxwell"*

Maxwell wrote the following poem (only three verses quoted) shortly before the same J. A. Frere left Trinity to go to the parish of Shillington. It is written in the style of Robert Burns' "John Anderson."

John Alexander Frere, John  
When we were first acquaint  
You lectured us as Freshmen  
In the holy term of Lent;  
But now you're getting bald, John  
Your end is drawing near  
And I think we'd better say 'Goodbye  
John Alexander Frere'

The Lecture Room no more, John  
Shall hear thy drowsy tone  
No more shall men in Chapel  
Bow down before thy throne  
But Shillington with meekness  
The oracle shall hear  
That set St. Mary's all to sleep  
John Alexander Frere

Then once before we part, John  
Let all be clean forgot  
Our scandalous inventions  
Thy notelets prized or not  
For under all conventions  
The small man lived sincere  
The kernel of the Senior Dean  
John Alexander Frere.

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