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B.Sc., F.R.S.E.

Abstract

Based on the writer's Presidential Address to the Royal Scottish Society of Arts.

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THE STORY OF TWO PORTRAITS

By JAMES WALLACE
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Based on the writer's Presidential Address
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My story begins in the year 1710 in the town of Hamilton where WILLIAM CULLEN was born. His father was an attorney who acted as factor to the Duke of Hamilton. William was the second son of a family of seven sons and two daughters, and the children received their early education at the local Grammar School, the forerunner of the present Hamilton Academy. At the age of 17, William attended some of the Arts Classes at Glasgow University, and shortly after this he decided to follow a medical career.

He was bound apprentice to a Mr John Paisley, a member of the Faculty of Physicians and Surgeons in Glasgow who had an extensive practice in the city. At that time, to serve an apprenticeship was almost the only way in which a knowledge of medicine could be acquired in Scotland. Professorships for teaching some of the branches of medicine *had* been established in some of our universities, but in none of them, except in Edinburgh, had a regular shool for teaching medicine been formed. In Glasgow, although a professorship of medicine had been instituted in 1714 and a professorship of botany and anatomy in 1719, it does not appear that the persons appointed to these offices had ever, during Cullen's time as a student, delivered any lectures upon the subjects they were supposed to teach.

Fortunately for Cullen, his master, John Paisley, was of a studious turn of mind, and had collected a large and valuable library of the medical books available at that time. The young apprentice was allowed to use this library freely and he made full use of this opportunity. It has been left on record by one of his friends of this period that Cullen was distinguished by a lively manner, by an uncommon quickness of apprehension and by a most retentive memory, qualities which were to remain with him throughout his whole career.

Towards the end of 1729, having completed his apprenticeship, Cullen went to London with a view to acquiring practical knowledge of his profession. He was fortunate in being appointed Surgeon to a merchant ship, the Captain of which was a far-out relation, Mr Cleland, whose family lived at Auchinlee near Shotts. The vessel was engaged in trading to the Spanish settlements in the West Indies and Cullen spent a year in this work. In 1730 he returned to London and attached himself to a Mr Murray, an Apothecary in Henrietta Street. Here he helped in the preparation of drugs and chemicals used in the practice of medicine at that time. In particular he became interested in the study of Materia Medica and read all the available books on the subject.

In 1731 Cullen's father died and, as his elder brother had died during his absence, on William devolved the duty of settling his father's affairs and arranging for the education of his younger brothers and sisters. At this time Captain Cleland invited him to come and reside with him at Shotts

and take charge of the health of his son who was suffering from a lingering illness. Cullen accepted the invitation and commenced his medical practice a few miles from his birthplace, Hamilton, and in the vicinity of the residences of many of the families of consequence in the County of Lanark. By a happy chance he met the Duke of Argyll who was paying a visit in the neighbourhood. The Duke was interested in Chemistry and, being in need of some apparatus, this was supplied by Dr Cullen. The Duke was much impressed by the young man's ability and this patronage from Scotland's leading peer was of advantage to Cullen, standing him in good stead at an important later stage in his career.

For the space of two years Cullen resided with Captain Cleland, leading a very busy life, visiting patients, preparing medicines for them, and reading all the medical books he could acquire.

On the death of a relative Dr Cullen succeeded to a small legacy and resolved to give up active practice for a time and devote his attention exclusively to his studies. He decided to go to Edinburgh where the foundations of a new and extended medical school had been laid some ten years before. Here there were available systematic lectures on the different branches of medicine, and here Cullen found among the students others like himself ardent in pursuit of medical knowledge. Some of them formed themselves into a "mutual improvement" society to meet weekly to read essays on subjects connected with their studies and to discuss and debate various topics of a professional character. This was the beginning in 1735 of the Royal Medical Society in whose Hall we meet this evening.

By 1736 Cullen was ready to return to Hamilton to take up his practice once more. He quickly made his mark as a reliable medical adviser, and his ledgers, which have been preserved, show that he was medical attendant to the Duke and Duchess of Hamilton and almost all of the county families in the district. It has been said of him that he became the friend and companion of every family he visited.

About this time Dr Cullen became acquanted with a young man, William Hunter, who was a student at Glasgow University. Hunter had intended to enter the Church but he changed his mind and determined to study medicine. He came to reside with Dr Cullen and stayed assisting him for two years. It was agreed that Hunter should go first to Edinburgh, and then to London to study medicine there. On his return to Hamilton a partnership was to be formed in which Hunter would undertake the surgical work while Cullen would be the physician.

As it happened, things did not work out this way. In London, Hunter was introduced to a Dr Douglas who was engaged in preparing an anatomical work on bones. Dr Douglas was looking for a young man of ability to help him as a dissector. Impressed by Hunter's abilities, he invited him to be his assistant. Hunter let Dr Cullen know about this and Dr Cullen readily gave his consent to the new arrangement, although it deprived him of Hunter's partnership to which he had been looking forward. Incidentally, William Hunter was to attain fame as an anatomist, and his bequest of his museum and library to Glasgow University has made his name a household word there—The Hunterian Museum.

Dr Cullen found himself another surgeon partner and in 1740 he took the degree of M.D. of Glasgow University. Shortly afterwards he married Anna Johnstone, daughter of a Kilbarchan minister. The marriage was a happy one and the couple were very popular in the district. There were seven sons and four daughters of the marriage.

In the midst of his busy practice in Hamilton Dr Cullen still found time to interest himself in civic affairs, and he became a magistrate.

But his genius and energy demanded a wider outlet and his ambition was to be a founder of a Medical School at Glasgow, similar to the schools of Leyden and Edinburgh. With this object in view, he removed to Glasgow in 1744.

In 1744 the Medical Faculty consisted of a Professor of Medicine and a Professor of Anatomy and Botany, but apparently these gentlemen did not deliver lectures on their subjects and it is difficult to find out exactly what duties they did carry out. Into this rather inert atmosphere came Cullen, and almost at once he was lecturing on Medicine in a semi-official capacity. Very soon he became convinced of the need for the teaching of CHEMISTRY within the University. He persuaded the authorities to spend £52 in establishing a suitable laboratory, and Cullen as lecturer was paid £20 per annum.

Cullen was an admirable teacher of chemistry. He inspired enthusiasm in his students and his classes increased in numbers each year. He took a deep personal interest in the welfare of his students and placed at their disposal his knowledge, his library and on many occasions his purse.

As well as lecturing on Chemistry, Cullen lectured also on Materia Medica, on Botany and on Physiology. One medical writer referred to him at this time as "a Medical Faculty in himself."

In addition to all this activity he conducted a busy medical practice so that his leisure moments must have been very few indeed. In 1751, when one of the "inert" professors resigned, Cullen was appointed to the Chair of Medicine and regularly delivered courses of lectures on the Theory and Practice of Medicine.

This busy life, with little leisure, left little time for private scientific studies and those considerations seem to have led to some of his friends proposing that he should remove to Edinburgh when a suitable opportunity should arise.

This oportunity was to come in 1755, but, before proceeding further, let us look at the subject of the other portrait, JOSEPH BLACK.

Joseph Black was born in France of Irish and Scottish forebears. His father, John Black, was a native of Belfast. He was a wine merchant in Bordeaux and he married a daughter of another wine merchant, Robert Gordon from Aberdeenshire, also settled in Bordeaux. (Incidentally, Mrs Black's sister was the mother of Mr Russel who became Professor of Natural Philosophy in Edinburgh. Their aunt was mother of ADAM FERGUSON who became Professor of Moral Philosophy in Edinburgh University, and in due course this family was to supply yet another Professor to the same University.)

John Black was well liked in Bordeaux. He was a cheerful man, contented, benevolent, liberal minded, with no ambitions to be very rich. Later, his son Joseph was to write of him that he was "industrious and prudent in business, of the strictest probity and honour, temperate and regular in his manner of life." Some of these characteristics were inherited by his famous son, and this family of eight sons and five daughters all did well for themselves in later life.

Their mother taught them to read English, and Joseph, who was born in 1728, was sent "home" to Belfast in 1740 to begin his education as a British subject. This he did at a Grammar School where he remained for six years. In 1746 he was sent to continue his studies at the College of Glasgow. Here he wanted to study physical science and in order to do so he chose the profession of Medicine within which his physical studies would have greatest scope. Now, about this time, Dr Cullen had been appointed lecturer in Chemistry in Glasgow. Hitherto the subject had been treated as a curious and, in some respects, useless art and Cullen, taking

a wide and comprehensive view, saw the unoccupied field of philosophical chemistry wide open before him. He was satisfied that with liberal enquiry and investigation the subject could be greatly improved.

It was young Joseph Black's good fortune to come under the influence of such a master and it is little wonder that the student almost at once showed a decided bent in favour of chemical investigation.

Dr Cullen was remarkable for the personal attention he paid to his students and he soon became aware of the aptitude shown by Black for scientific investigation. Very soon Black was assisting Cullen in original experiments and the results of some of his experiments were often publicly quoted in Cullen's lectures as sufficient authority for new facts brought to light.

The friendship between the two men grew rapidly during this period and indeed was never interrupted during their lifetime.

In 1751 Black departed for Edinburgh to complete his Medical Studies there and in 1754 he took his M.D. degree. For this degree each candidate had to present a thesis. At this time efforts were being made to find some solvent for urinary calculi. Many chemicals were tried, including lime water and various alkalies—some of a dangerous nature, and Black became interested in the problem.

He conceived the idea of trying to prepare an alkaline solvent of a mild type starting from Epsom salt, magnesium sulphate. From this substance he prepared a white powder which he called "magnesia alba"—magnesium carbonate. This magnesia alba effervesced with acids. When strongly heated, it changed to a white powder which did not effervesce with acid. Roasting caused it to lose seven-twelfths of its weight. Black showed that the property of effervescence with acids could be restored to the white powder by dissolving it in dilute sulphuric acid and adding pearl ashes—potassium carbonate—to the solution, thus obtaining the original magnesium carbonate.

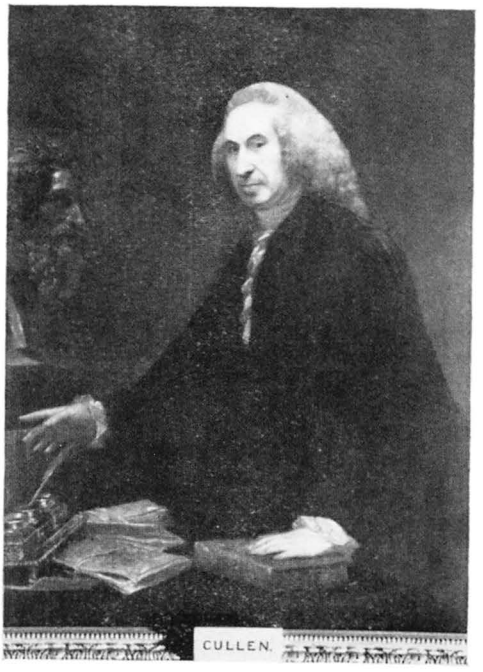
In this work Black did two important things:

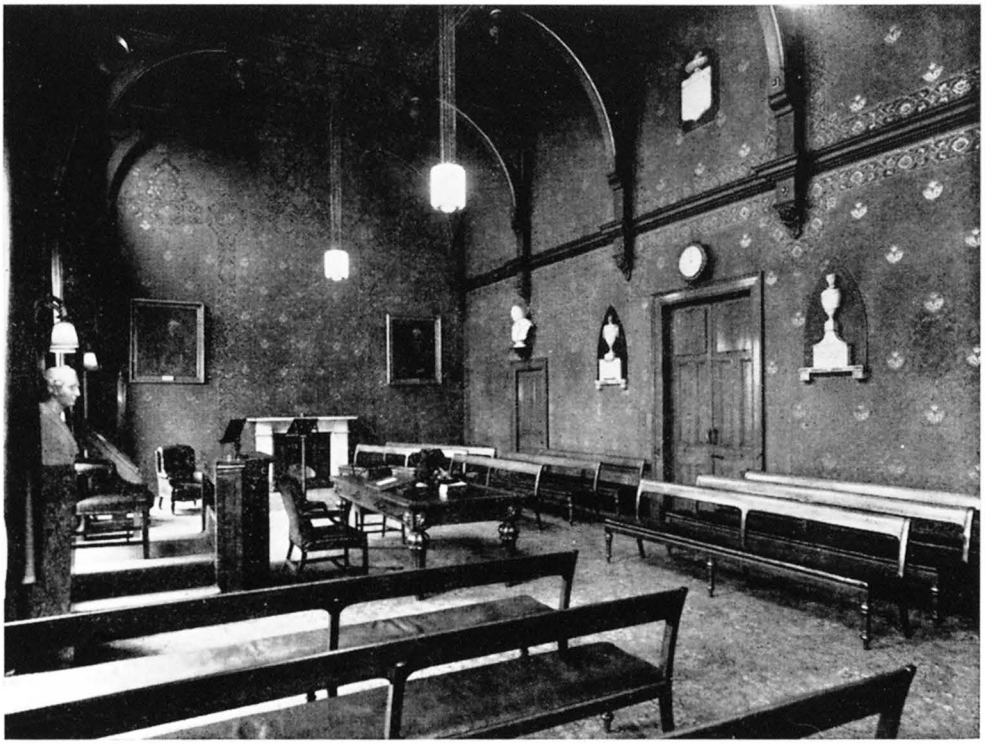
1. He dispelled the idea commonly held that the causticity of alkalies was due in some way to some igneous matter gained from fire—as in the preparation of quicklime from limestone; and
2. By the careful use of a balance, he showed that such calcinations were accompanied by a loss of weight due to some "fixed air" leaving the roasted material.

His "fixed air" was the gas we know as carbon dioxide and the results of his further experiments on magnesia alba, quicklime and other alkaline substances were presented in his thesis for the degree of M.D. One year later, these results were embodied in a paper which he read before the Philosophical Society of Edinburgh who published them in their Transactions. (It is possible to obtain a reprint of this famous paper, published by the Alembic Club in 1944.)

The reputation this work acquired for Black was the means in 1755 of placing him in the Chair of Chemistry at Glasgow vacated by his friend and former teacher, Dr Cullen, when he transferred to Edinburgh.

We return now to Dr Cullen leading his busy life in Glasgow. His lectures on Chemistry continued to attract ever increasing numbers, He did not repeat the same lectures year after year. Manuscript notes taken by students in consecutive years show how Dr Cullen was continually improving the treatment of the subject, incorporating new discoveries—





The Hall of the Royal Medical Society showing the two portraits (reproduced above) hanging on the South wall.

many of them due to original investigations of his own—and spreading among his students the information he had obtained from the latest chemical works as they became available.

His enthusiasm for original investigation infected many of his students with a similar desire and it is little wonder that his classes grew.

During this time he conducted a considerable correspondence with various gentlemen interested in the improvement of agricultural practices in Scotland. He gave several courses of lectures on agricultural chemistry and practised what he preached on a farm at Parkhead, near Glasgow, belonging to his brother. In the meantime his work in medicine continued with regular courses of lectures on the Theory of Medicine and an extensive private practice. One wonders when he found time to pursue any of his private investigations in the midst of all his duties and it was at this time that the opportunity of coming to Edinburgh presented itself.

In 1755 Dr Plummer, Professor of Chemistry in Edinburgh University, became seriously ill and incapable of continuing to lecture. In November of that year Dr Cullen was appointed Joint Professor of Chemistry during the life of Dr Plummer, with succession to the Chair after his death. Dr Plummer died in July of 1756 and Dr Cullen was elected sole Professor, a post which he was to hold for ten years.

Dr Plummer had confined his teaching of chemistry for the most part to Pharmacy, but Dr Cullen took a much wider view and gave the subject much more liberal treatment. He continued the practice he had started at Glasgow University of lecturing in the English language instead of in Latin, and from the start his classes were popular with the students and, as in Glasgow, the numbers attending increased year by year. His classes were attended not only by students of medicine, but by others who wished to study Chemistry as a philosophical subject. We find the idea growing that attendance at such lectures was part of a gentleman's cultural education and many notable personages of the day were members of Cullen's classes.

In 1757 Dr Cullen gave courses of lectures on Clinical Medicine in the Royal Infirmary. This was work for which his experience, habits of observation and scientific training peculiarly fitted him, and his popularity as a teacher and as a practical physician continued to grow. During this time he also had a successful medical practice.

As an example of his popularity and versatility, in 1760 he undertook, at the request of the students, to finish a course of lectures on Materia Medica on the death of the lecturer, Charles Alston. He delivered an entirely new course and notes taken by students during this course were later published in an unauthorised version in London. At a later date Dr Cullen tackled the monumental task of writing a comprehensive Treatise on Materia Medica which left out items of an absurd or revolting character of no medicinal value whatever—animal products such as goose fat, cobwebs, boiled toad dried and crushed to powder, toad spawn, ants (entire), ants' eggs, dried bees, snails, earthworms, powdered pearls, slaters, scorpions, viper's flesh, pieces of human skull, and mummy flesh. This new Treatise on Materia Medica was published in 1789 and continued for a long time to be the accepted guide to Scottish Medical students.

In 1766 Dr Cullen was elected to the Professorship of the Theory of Medicine, while a Dr John Gregory from Aberdeen was appointed Professor of the Practice of Physic and the two professors gave alternate courses on the Theory and Practice of Physic until Dr Gregory's death in 1773 when Dr Cullen was appointed sole Professor of Physic. He was then 63 years of age. Nevertheless he applied himself with energy to the duties of his new office and at the same time continued his consulting practice.

During his teaching life in Edinburgh Dr Cullen maintained a strong interest in the activities of the Royal Medcal Society. This Society, of which he had been a founder member during his student days still met regularly, having been granted the use of a room in the Royal Infirmary of the day, standing in Infirmary Street.

By 1770 need for more space for patients, growth of student members of the Society, and the steady growth of the library of medical books made it clear that the Society would benefit by having a building of its own. Here Dr Cullen's influence was invaluable. He was a leading member of a committee which opened a subscription list, and by 1775 sufficient funds were in hand for the Society to begin building a Hall on ground granted by the College of Surgeons near their Hall on the west side of Surgeons' Square adjoining the old High School.

The foundation Stone of the new Hall of the Royal Medical Society was laid on 21st April 1775 by Dr Cullen who was at that time the President of the Royal College of Physicians. The new building was ready for occupation

SACRED to *MEDICINE*
FOUNDED April 21st 1775
BY THO^{S} M^{c}INNES *MASON*

the following year 1776 and gave accommodation for weekly meetings, a large room for the library of medical books and collection of anatomical preparations, and a third large room suitable for demonstration experiments. There was even a cupola on the roof intended to be used as an observatory, although there is no record of it having been regularly used for this purpose. Dr Cullen's portrait, painted that year by David Martin for the Society, was hung in the main room, and it is that portrait which hangs in the Hall today.

In course of time, the Royal Medical Society had to give up their Hall as much-needed extensions to the Royal Infirmary swallowed up the buildings nearby—including the High School.

When the Hall was being demolished in 1853, the Foundation Stone laid by William Cullen was discovered. It contained a bottle in which was a silver medal and some remains of what may have been paper (which had not survived). The medal now forms the badge of office of the Junior President of the Royal Medical Society. The Foundation Stone was covered by a carved slab bearing the inscription: *Sacred to Medicine. Founded April 21st* 1775. *By Thos. McInnes Mason.* At a later date this stone was built into the wall of the staircase facing the entrance door of the present building in Melbourne Place.

About the year 1778 Dr Cullen purchased a small landed property called Ormiston Hill, in the parish of Kirknewton, eight miles from Edinburgh. Here he put into practice many of his ideas on agriculture. He cleared heathland, reclaimed, levelled, drained, covered gravel with new soil, and planted trees, shrubs, and flowers. The relics of some of this work are still to be traced at Ormiston Hill. In 1789 failing health caused him to relinquish his Chair, and a few months later he died at the age of 80.

Cullen's name is not associated with any epoch-making discovery. He was not a brilliant experimental investigator nor was he a great anatomist.

But he possessed qualities of clearness of perception, accuracy in observing, soundness of judgment and logical precision in reasoning, which gave him the power of distinguishing and selecting from a great mass of heterogeneous material only these facts which were constant and regular, and discarding those which were accidental, unusual or insufficiently substantiated. These qualities permeated all his teaching and exercised a great influence on all the students who passed through his classes. One has only to contrast the state of medical practice in the 1740's with that towards the close of the century to realise how powerful Cullen's influence had been.

When Dr Cullen resigned his Chair of Chemistry in Glasgow to come to Edinburgh in 1756, Dr Joseph Black was appointed to succeed him. He was 28 years of age and during the ten years of his work in Glasgow he maintained a large medical practice as well as delivering regular courses of lectures on Medicine and Chemistry. It was during this period that Black developed his ideas on latent heat and specific heat following a series of careful original researches which he planned and carried out. Black's interest in this work had been aroused when, as a student under Dr Cullen, he had taken part in experiments devised by Cullen to investigate the variations in temperature resulting from various chemical reactions. Dr Cullen had also noted that, when liquids evaporated, a cooling effect was produced and, when ice melted, heat was absorbed without temperature rising. Cullen had been unable to explain this phenomenon, but had directed Black's attention to the problem. In due course, Black's careful experiments, using the balance wherever possible, using thermometers as accurately scaled as was then possible, and with his flair for devising just the right type of experiment to give the required data, yielded results on which he based his theory of specific heats and latent heats. In December 1761 he showed that, when a quantity of water froze, it gave up an amount of heat equal to the amount absorbed (or rendered latent) during the melting.

It was not until three years later, in 1764, that he obtained satisfactory evidence regarding the heat latent in steam. The results of these experiments were given to Black's classes and were not published as a separate work until after Black's death.

This pioneer work on latent heat was to have another far-reaching result. In 1757 there arrived at the College of Glasgow a young instrument maker called James Watt. He and Dr Black became very friendly and on one occasion Watt had to repair a model of Newcomen's water-pumping steam engine, used for demonstrations to students in the Natural Philosophy Department. Black's work on the latent heat involved in making and condensing steam was known to Watt, and the great waste of heat in this engine led Watt to attempt a better method of condensation. Before long he had evolved the separate condenser, a new steam-tight packing and the steam-jacket to prevent loss of heat by radiation. During this period Black's encouragement and generous financial help gave Watt the incentive he needed to bring his steam engine to successful industrial application.

In due course, in 1766, the call came for Dr Black to go to Edinburgh to follow once again in the footsteps of his friend, Dr Cullen, as Professor of Chemistry.

In Edinburgh, Black devoted himself almost entirely to the teaching of Chemistry. During this period he carried out little or no research. He still maintained an interest in industrial applications including the attempts to manufacture alkalies, the bleaching industry, the manufacture of coal tar and a few others. He did not publish anything but continued to give his discoveries to his students in his lectures. Each year his lectures became plainer and more convincing, his experiments well chosen and admirable

for their simplicity and elegance. The number of students and others attending the lectures continued to grow.

Dr Black maintained a light medical practice among his friends throughout this period, but it is left on record that his health was not robust and that exertion easily tired him.

He was precise in speech, neat in dress and appearance, and skilful in manipulation of appartus. It is said that his lecture table was as spotless at the end of a lecture as when he began.

This love of orderliness and precision was one of his leading characteristics. Even his death in December 1799 took a calm, orderly form. He died while sitting at table with a cup of milk in his hand. He had set the cup down on his knees and held it steady with his hand. In this position he was found, with not a drop spilled, as if an experiment had been required to show the facility with which he departed this life.

In his will Black gave further evidence of his orderly precision of thought. He divided his quite considerable fortune into 10,000 equal shares and distributed it according to the degree in which each individual was the object of his care.

In assessing Joseph Black's contribution to science, one would stress two contributions of a fundamental nature:

One in Chemistry—the discovery and identification of fixed air (carbon dioxide) involving work which helped to elucidate the relationships between acids, alkalies and salts; and

One in Physics—the proper appreciation of the relationship between heat and temperature, specific heats of different materials and latent heat of ice and steam.

In two other directions Black's influence on science was far-reaching—his manner of lecturing and his way of inspiring his students. His large audiences testified to the excellence of the former and the work of James Watt in developing steam power is only one example of the latter.

Black's portrait, painted in 1787 by the same artist, David Martin, hangs side by side with that of his master, colleague and friend, Wm. Cullen, and it is fitting that it should be so, for it can be said that together they influenced to a marked degree the trend of scientific thought for generations after they had gone.

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