

not objected to the practice, and authors are concerned rather to make their discoveries better known. The making of a single copy of an article, by any means, is not a trespass upon the moral rights of the holder of any copyright. Carried to the extreme, such an idea must prevent the loan of books, or even the establishment of libraries for general use. It would be an ill service to science, if the advent of microphotography should be the cause of the suppression of a useful aid to research.

In order to take full advantage of the facilities offered to research workers by the various methods of documentary photography, the organization of the service would require to be placed in the hands of a central institute, which would be in a position to study the many problems involved, to choose the best means of tackling individual cases and to

bring about the standardization of apparatus and material. The present tendency to leave the making of photographs of documents to individuals, commercial firms and miscellaneous institutions, working independently, is both wasteful and a source of confusion. Expensive apparatus is used intermittently, overhead charges are increased and experience wasted. Moreover, the lack of agreement upon standard measurements creates the possibility that microphotographs made by one agency may prove to be unreadable upon apparatus available in another place. Already the United States has led the way by the foundation of the American Institute of Documentation. A similar centre is needed in Great Britain, where production may be organized and the fullest efficiency and minimum cost achieved.

Josiah Wedgwood and his Portraits of 18th Century Men of Science*

By Dr. John Thomas

THE eighteenth century gave birth to some remarkably interesting personalities in the realms of both industry and science. From the Midland manufacturers in the persons of Wedgwood, Boulton and Watt, there can be singled a trio who became fellows of the Royal Society. In science, the Midland men of fame include Joseph Priestley and Erasmus Darwin. The spirit of inquiry of the age, with its zest for experiment, led Wedgwood to convert his manufactory into an industrial "elaboratory", as he termed it. He was determined to convert crude clays into artistic ceramic products. He had to wrestle with all the four familiar elements of philosophers in the pre-scientific age—fire, air, earth and water. His "Trial Books" now in the Etruria Museum justify his claim to be considered a man of science.

Josiah Wedgwood was elected a fellow of the Royal Society in 1783, and made several contributions to the *Philosophical Transactions* in 1782, 1784 and 1786. His pyrometer, which was the subject of his Royal Society papers, was the result of experiments extending over a period of six years. It is a very simple instrument marked and graded to indicate the shrinkage of clay bodies when inserted in the potter's oven. At first, Wedgwood placed small cylinders of clay at the wide tapering end, but later he made cylindrical balls or marbles of clay, which he called pyrometrical

pieces. These "contraction bits" have been used regularly in potteries the world over since the invention of the pyrometer by Wedgwood.

This thoroughness in scientific exactness was not confined to the firing of the ware, but it permeated the earlier stages of preparing the clay. The potter's mill, like "the mills of God", is expected to "grind exceeding small"; hence Wedgwood's anxiety to replace the wind- or water-mill with the more reliable source of power found later in Watt's steam engine. The Boulton and Watt archives* contain ample evidence of Wedgwood's faith in the new scientific inventions of James Watt. At Etruria, the last steam engine installed by Watt in 1800 worked continually until dismantled in 1912. We thus see a powerful link between Etruria and Soho.

There were earlier links between Wedgwood and Boulton when Fothergill was his partner. In the earlier days of his pottery career, Wedgwood sent small cameos and pottery trinkets to Soho to be mounted in metal before being sold by jewellers. Arising out of this kind of trade, where pottery was a subsidiary of the metal trades, we get a further commercial link, where Boulton and Fothergill often acted as wholesale merchants for Josiah Wedgwood until he later set up his own sales room in London. Like the Prince of Potters,

* From a Friday evening discourse at the Royal Institution delivered on December 16. A small selection only of the many medallions by Wedgwood mentioned during the discourse are reproduced here.

* The Soho order book for steam engines sold to Staffordshire shows orders from Etruria in 1782, 1784, 1793 and 1800. In 1793 Wedgwood drafted a document for Boulton and Watt stating the performance he expected of the steam engine in his pottery.

these two Soho manufacturers, Matthew Boulton and his later partner James Watt, were elected fellows of the Royal Society, in 1785. But as the versatile Watt was in his way more or less a skilled artist and sculptor, another link was forged between Watt and Wedgwood. When the former retired from the Soho factory, he carried on his experiments in his garret at Heathfield. Here he invented his now famous mechanical sculpturing machine for producing enlarged or reduced cameos or busts, "made," as Watt wrote to his friends, "by a young artist just entering on his eighty-third year." The moulds and pottery models for this work were supplied to Watt by his bosom friend, Wedgwood.

Sir Humphry Davy, in a discourse introductory to a course of lectures on chemistry at the Royal Institution in 1802, remarked that the knowledge of chemistry has improved the art of pottery, but he rightly emphasized also that the pottery industry has provided much of the apparatus used in scientific research. Many of these pottery implements Wedgwood supplied freely to his friend, Dr. Joseph Priestley, and even after his death his sons, Josiah and Thomas, provided Davy with porcelain and other apparatus for chemical experiments and demonstrations at the Royal Institution. In fact, Josiah Wedgwood II, when this Institution was founded in 1799, became one of the first proprietors by subscribing one hundred guineas to its funds.

WEDGWOOD PORTRAYS MEN OF THE 18TH CENTURY

With his love of science and association with scientific men, it is not surprising that Wedgwood devoted his energies to portraying the features of some of his famous scientific contemporaries by means of his "jasper" ware. This triumph he was enabled to achieve through the medium of his new and perfect pottery "bodies".

The soul of Wedgwood ware lay to a large extent in its "body". One body, used for black busts, he called "basaltes". Later he discovered a body called "jasper", generally blue, green or lilac, which he used for the base or background of his portrait medallions, using white jasper for the raised faces or heads and shoulders. This body, while plastic and unfired, is pressed into a mould, which has been cast or made in plaster of Paris, usually from a design by some artist.



ERASMUS DARWIN.



JOSIAH WEDGWOOD.



JOSEPH PRIESTLEY.



SIR JOSEPH BANKS.

SOME WEDGWOOD MEDALLIONS.

Photo: E. Harrison and Son.

THE MAKERS OF THE MEDALLIONS

The three partners asso-

ciated in the production of most of the medallions [a large collection was on view in the library of the Royal Institution] were Josiah Wedgwood, Thomas Bentley, his first partner at Etruria, and, after the latter's death, Wedgwood's nephew, Thomas Byerley.

Bentley was a cultured Liverpool gentleman who, while in the North, was one of the founders of the famous Warrington Academy, which was the training ground of so many fellows of the Royal Society, for example, Joseph Priestley, Thomas

Pennant, and others. When Bentley removed to Chelsea his artistic temperament delighted in the company of a neighbour, Sir Joseph Banks. Bentley was a regular subscriber to the Royal Society of Arts, and he it was who spotted young Flaxman, at the age of twelve years, as a premium winner, and recommended him to the notice of Wedgwood. Until his death in 1795, Wedgwood made his nephew Byerley his partner, after giving him a good training in his own business methods at Etruria. In addition, Wedgwood had his two sons, Josiah and Thomas, as active partners from 1793. For some strange but presumably good reason, Wedgwood never made a medallion of any of his children. He was content to leave them to the skill of the artist George Stubbs, R.A., in his well-known painting of the Wedgwood family.

There was a host of artists engaged by Wedgwood for the designing and modelling of many of his medallions. From the artistic point of view the best was undoubtedly the master sculptor Flaxman.

LEARNED SOCIETIES IN THE PROVINCES: THE STAFFORDSHIRE LUNAR SOCIETY

Long before Wedgwood became a fellow of the Royal Society, he had been introduced to the circle of Midland men of science or philosophers calling themselves the "Lunar Society". It was an informal club or association of scientific men formed about 1766 by Erasmus Darwin and Matthew Boulton. The "Lunar Society" was later joined by new and brilliant recruits, like Joseph Priestley and James Watt. The members met at each other's houses every Monday nearest to the full moon, "in order to have the benefit of its light in returning home," stated Priestley. Hence its name, "Lunar Society". The members were accustomed to dine at 2 o'clock, and parted company at 8 p.m., after exchanging views on scientific topics. Wedgwood made two excellent medallions of Darwin and Priestley.

Members of the Lunar Society were allowed to introduce friends, and thus many distinguished guests were present at these philosophical and scientific banquets. Among these were fellows of the Royal Society from London and sometimes from abroad. Wedgwood made medallions

of several of them, including Sir Joseph Banks, Dr. Solander, Sir William Herschel, and Dr. Peter Camper. Some writers place Wedgwood among the *visitors* to the Society, but judging from his correspondence, I would be inclined to rate him as a *member*.

The Lunar Society in the Midlands was only one of many provincial learned societies. Spalding's Gentlemen's Society, of which Sir Isaac Newton was a member, goes back as far as 1710. In Liverpool, Bentley, Roscoe and Currie formed a scientific group. At Warrington, Dr. Aikin and, later, Dr. Priestley, before he removed to Birmingham, had been the scientific centre of another active coterie. Later, at Bristol, we had Dr.

Beddoes, with his young assistant, Humphry Davy, the centre of a scientific circle. At Norwich a scientific group centred round the Taylors and the Martineaus.

Wedgwood made medallions of several presidents of the Royal Society, and there are in existence two by him of Sir Christopher Wren and Dr. Martin Folkes. Of the Royal Society medallists portrayed by him, I will comment upon two only, although all are worthy of passing note.

Dr. Joseph Priestley was awarded the Copley medal in 1772 for his experiments and paper on soda water. Then, when Priestley resigned his post with Lord Shelburne to reside in Birmingham, Wedgwood generously afforded him

an annual allowance of 25 guineas, a sum continued after Josiah Wedgwood's death by his son until Priestley died. In addition, Wedgwood readily came forward with generous gifts of money and goods to Priestley when the rioters burnt down his laboratory and house in Birmingham. In addition to his medallions of Priestley, Wedgwood made a fine black basalt bust.

The Wedgwood medallion of Captain James Cook is a fine one, showing the courageous face of the circumnavigator. The portrait is a replica of the Cook medal by Pingo, specially struck by the Royal Society at the instigation of Sir Joseph Banks in 1779. Though Captain Cook died on his third voyage to the South Seas, he immortalized himself, and the two fellows of the Royal Society who accompanied him, Sir Joseph Banks and Dr. Solander, naming parts of the land discovered in



WEDGWOOD BLACK BASALTES BUST OF NEWTON.

New South Wales after them; they also insisted on naming a river Cook's River. The name "Botany Bay" was a special tribute by Captain Cook to his scientific companions.

Naturally, Banks was lionized on his return with Cook. Wedgwood made a medallion of Banks and his wife, fine studies by Flaxman himself. It resembles the features of Banks as a young man in Reynolds' painting. There is a Wedgwood medallion of Sir Joseph Banks, as a much older man, probably based on a portrait when in his prime, as president of the Royal Society.

Banks visited the Lunar Society, while Wedgwood was a frequent caller, when in London, at 32 Soho Square, where Sir Joseph and Lady Banks kept open house for scientific inquirers. Wedgwood supplied the historic plaque, "The Offering to Flora", symbolic of his regard for Banks as a botanist and founder of the Linnean Society, for the Adam mantelpiece in its library.

Sir Joseph Banks had the services as librarian of Dr. Carl Solander, F.R.S., a pupil of Linnaeus. Solander was responsible for Banks's botanical collection, and was his boon companion on Cook's first voyage, and on Banks's voyage to Iceland. This latter trip was undertaken in 1772, when difficulties arose with the Admiralty concerning his accompanying Cook on his second voyage to the South Seas. It is interesting to note, in passing, that had Banks joined Cook on his second voyage, he would have chosen Priestley to accompany him as official astronomer. But the Board of Longitude, as the Admiralty was then called, showed no "latitude" regarding Priestley's unorthodox religious opinions.

Banks's party to Iceland visited the Western Isles of Scotland. The Isle of Staffa, with its geological interest, was discovered by Banks, and Wedgwood promptly decorated one of his famous Catherine II plates with the Isle of Staffa scene as a tribute to his friends, Banks and Solander. The latter was also engaged by the Dowager Duchess of Portland as her librarian in charge of her rare collection of plants and rare antique vases. Among the latter was the now famous Barberini vase, which Wedgwood reproduced so perfectly in pottery.

In dismissing the many-sided connexions of Wedgwood with these three world voyages to the Antipodes, it will be interesting to study the famous Sydney Cove medallion specially executed by Wedgwood in 1789 to commemorate the founding of Sydney in 1788. It was made from clays from Sydney Cove, originally obtained through the good services of Sir Joseph Banks from Captain Phillip, first Governor of New South Wales. The subject of the medallion is "Hope addressing Peace and Plenty, Art and Labour".

The medallion inspired Dr. Erasmus Darwin to poetry in his "Botanic Garden".

Dr. Erasmus Darwin, the poetical and philosophical physician of Lichfield, was the subject of one of the finest portrait medallions in the group of Staffordshire fellows of the Royal Society. By his side is Dr. Johnson, his one-time fellow-resident of Lichfield. At one of the famous meetings of these two Staffordshire literary giants, Darwin, who stammered badly, was asked by Johnson: "Don't you find it very inconvenient stammering, Dr. Darwin?" "No, sir," replied Darwin, "because I have time to think before I speak and I don't ask impertinent questions."

Two Staffordshire peers figure among Wedgwood's portraits: Admiral Lord Anson, who circumnavigated the world in 1744, and was a neighbour of Wedgwood, as also was the Marquis of Stafford, better known as Earl Gower, and the illustrious ancestor of the present Duke of Sutherland.

Leaving these Staffordshire celebrities, we can study a few of the medical fellows of the Royal Society, who are portrayed in the medallions. Many of them were leading lights of the Royal College of Physicians. Among those of whom medallions were made by Wedgwood were John Woodward, famous as a geologist, Henry Pemberton, a physician employed by Newton to superintend the third edition of the "Principia" in 1726, and John Freind, brother of the equally famous Robert Freind, headmaster of Westminster School. The former was physician to Queen Caroline. Two other notable men were Dr. Ingenhousz and Dr. Peter Camper, both of whom were guest lecturers to the Lunar Society. Wedgwood made a fine medallion by Flaxman of Dr. John Fothergill, reputed to have had one of the finest botanical gardens in Europe. Another fine but smaller medallion is that of Richard Mead, physician to George I., Sir Isaac Newton and Sir Robert Walpole.

Two very interesting medallions depict the secretaries of the learned societies of which Wedgwood was a fellow; one is of William Stukeley, secretary of the Society of Antiquaries, the other is of Samuel Horsley, secretary of the Royal Society, who later became the Bishop of St. Asaph. It is a proof of Wedgwood's impartiality in the choice of subjects for his medallions that Horsley, who led the abusive personal attack on Sir Joseph Banks, when president of the Royal Society, is included in his collection. Not unconnected with this incident was the violent and protracted attack on another of Wedgwood's personal friends, Priestley, by the virulent pen of this politically minded prelate. He personally attacked Priestley and his views in his famous

theological work, entitled "Seventeen Letters to Dr. Priestley". In his fight with Banks, this pugnacious priest was completely routed, along with his second, Prof. Charles Hutton, who had to beat a hasty retreat in their assault on the august and dignified president of the Royal Society.

ARTISTIC AND LITERARY FELLOWS OF THE ROYAL SOCIETY

One of the foremost of these was Sir Joshua Reynolds, P.R.A., the most famous British artist of the eighteenth century, if not of all time. He was a personal friend of Banks and Wedgwood, both of whom he painted from life. The Wedgwood portrait medallion of Sir Joshua Reynolds is by Flaxman, who also modelled Reynolds' intimate friend Warren Hastings.

Another personal friend of Sir Joseph Banks was Thomas Pennant, the antiquary and naturalist, and author of the famous books "Tours in Wales" and "Tours in Scotland". He was a constant companion of Banks and Solander on their botanical excursions through Wales, a favourite haunt of Wedgwood also.

Last but not least famous in this group was Edward Gibbon, the author of "The Decline and Fall of the Roman Empire". It is from Gibbon that we have a pen picture of Sir Benjamin Thompson, later known as Count Rumford, the founder of the Royal Institution. In a letter to Lord Sheffield, dated September 17, 1783, writing before a vile crossing which he had to France from Dover, Gibbon says: "Last night the wind was so high that the vessel could not stir from the harbour. . . . What a cursed thing to live in an island! . . . The triumvirate of this memorable embarkation will consist of the Grand Gibbon, Henry Laurens . . . and *Mr. Secretary, Colonel, Admiral, Philosopher Thompson*, attended by three horses, who are not the most agreeable fellow-passengers" (italics mine).

I have been unable to trace any Wedgwood portrait medallion of the illustrious founder of the Royal Institution. The explanation is quite simple. Wedgwood discovered that Sir Benjamin Thompson had sat for his portrait to James Tassie, who made several paste medallion portraits of him. A magnificent Tassie medallion of Count Rumford is in the possession of the Royal Institution. Maximilian, the Elector of Bavaria, the patron of Count Rumford, is the subject of another interesting Wedgwood medallion.

My search for a medallion of Sir Humphry Davy has been a barren one. Both Count Rumford and Davy, of course, were connected with the Royal Institution long after the death of Wedgwood in 1795, although Josiah had met young

Davy in Cornwall on one of his many visits there. Through his sons Josiah and Thomas, in later years, Wedgwood had close connexion with Humphry Davy and the work of the Royal Institution.

JOSIAH WEDGWOOD PASSES THE TORCH OF SCIENCE TO HIS DESCENDANTS

Wedgwood's youngest son Tom is recognized as the father of photography. He was in his way a remarkable scientist and chemist. He had studied at the University of Edinburgh, but through chronic ill-health he had to retire from active business. After this he endeavoured to seek health and strength, through travel and association with cultured persons, among whom were counted Coleridge, Southey, Poole and Davy.

Tom Wedgwood, in an indirect way, was responsible for the training and early discovery of Humphry Davy. Count Rumford found Davy installed at the Pneumatic Institution of Dr. Beddoes at Clifton, but it was Tom Wedgwood who made a donation of £1,000 to enable Beddoes to establish his Institution and employ Davy as an assistant. When Davy was later engaged at the Royal Institution as a lecturer and professor, he became a firm friend of Tom Wedgwood. The elder Josiah Wedgwood had also contributed substantially towards the erection of the Pneumatic Institution, in which his friends Darwin, Watt and Dr. James Black had such faith, because of the enthusiasm of Beddoes. Davy recorded in the *Journal of the Royal Institution* (1, 171, 1802) some of the chemical experiments of Tom Wedgwood. The paper was entitled: "An Account of a Method of Copying Paintings upon Glass and of making Profiles by the agency of Light upon Nitrate of Silver. Invented by T. Wedgwood. With observations by H. Davy."

The female descendants of Josiah Wedgwood made their due contribution to science. Susannah ("Sukie") Wedgwood, a favourite of her father, married Robert Waring Darwin, the son of Erasmus Darwin.

The Wedgwood-Darwin pedigree shows the contribution to the realms of science made by these two illustrious families. The issue from this first Darwin-Wedgwood marriage gave to the nineteenth century no other than Charles Robert Darwin. He further embraced the Wedgwood family by marrying his cousin Emma, the daughter of the second Josiah Wedgwood. The fertile mind of Charles Darwin showed that in the nineteenth century he had inherited the remarkable scientific spirit and genius of his two grandfathers, both outstanding eighteenth century philosophers. The descendants of the Prince of Potters have preserved the remarkably fine features of their

illustrious ancestor Charles Robert Darwin in a fine plaque which now hangs in his room in Christ's College, Cambridge.

In conclusion, may I apply to the Prince of Potters who has inspired this discourse, words once spoken of Sir Humphry Davy by Samuel

Taylor Coleridge, Thomas Wedgwood's bosom friend, who said: "If Davy had not been the first Chemist, he would have been the first Poet of his Age." We can equally declare: "If Josiah Wedgwood had not been the first Potter, he would have been the first Scientist of his Age."

Obituary Notices

Prof. Victor Grégoire

THE death of Prof. Victor Grégoire on December 12 removes one who was not only a leader among the cytologists of his time but was also one who, as a botanist, was deeply concerned with problems of plant morphology and applied essentially cytological methods to their solution. Especially in the pre-War period, his influence in cytology was wide and many of his contributions were of fundamental importance. He was essentially an observer rather than a theorist, and although many of his best observations were on chromosome structure and behaviour he did not follow cytology far into its later intimate relations with genetics, although his pupil and colleague, Janssens, was the founder of the theory of chiasmata.

In more recent years, Grégoire became deeply immersed in problems of floral morphology, and an extensive memoir on the carpel (*La Cellule*, 47, part 3) which is the result of ten years of research, has recently appeared. This was intended to be the first of a series of contributions setting forth his views, based on extensive investigations of floral structures.

Grégoire was born at Anderlues, Belgium, on December 5, 1870. From 1887 until 1894 he studied philosophy and theology in Rome. The following year he returned to Belgium and studied science at Louvain for three years under Carnoy. In 1897 he became assistant in botany and in 1899, after two further years of foreign study, he was appointed extraordinary professor of botany, succeeding to the professorship of cytology and botany at the Carnoy Institute in 1903. The rest of his life was spent as a professor in the Catholic University of Louvain. He always adhered to his priestly robes, and he showed outstanding courage during the occupation of Louvain in the Great War. In 1925, the twenty-fifth anniversary of his professoriate was celebrated and two jubilee volumes of *La Cellule* (of which he became co-editor in 1928) were published. These consisted of contributions from his former students, many of whom had visited his laboratory from foreign countries in Europe and the United States.

Grégoire spoke with great clarity of diction and taught with vigour and enthusiasm. A man of very gentle disposition, he lived a very quiet life in a quaint old house of eighteenth-century Flemish style, completely absorbed in his scientific work. In some respects he might be regarded as the counterpart of Mendel in modern life; but in his view, as expressed

in 1925, he limited Mendelian behaviour to varieties and held that specific differences were non-mutational in origin and non-Mendelian in inheritance.

Nearly all the more important publications of Grégoire appeared in *La Cellule*. His first paper (1899) was an extensive memoir on the pollen meiosis in Liliaceæ. He concluded that the spireme thread (peloton) divides first longitudinally into two interlaced threads and then transversely into twelve chromosomes, which are therefore constituted of two longitudinal halves. But this is not the place to enter in any detail into the intricate history of the development of ideas regarding meiosis.

In 1903, in collaboration with his pupil Wygaerts, Grégoire made a careful study of the events of telophase in root-tips as regards the history of the chromosomes and their transformation into the resting nucleus. These papers immediately gave him a deservedly high reputation as an observer. The phenomena of meiosis shortly reclaimed his attention, and a series of memoirs followed until 1916 on various aspects of mitosis and meiosis in plants and animals. Several of these were extensive critiques of the current literature. In 1905 he concluded that if there was a real reduction division of the chromosomes it must be the first division. In 1907 he introduced the term zygotene for the stage in which the threads pair longitudinally to form a thick spireme or pachytene nucleus. (Dr. C. D. Darlington's suggestion in *NATURE* of February 4, p. 206, that my first paper (1907) was responsible for the conception of the continuous spireme in pollen mother cells is therefore erroneous, because the conception was current if not universal for some years before my work was begun.) By 1910 he had clearly adopted parasynaptic pairing at the zygotene stage as characteristic of meiosis in plants and animals generally.

In the post-War period, Grégoire transferred his main interest to other fields of botany. He published several text-books dealing with general botany, anatomy and the systematics of angiosperms, only once returning to cytology in a paper on chromocentres in plants, although many cytological papers continued to appear from his laboratory.

In recent years, the nature and origin of the carpel has been the subject of much investigation, and many diverse views and theories of its morphology have been propounded. Grégoire's extensive memoir on this subject adds a different view. Having discarded the classical theory of its leaf-like nature, he also