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intended against the royal house. "The people of the land slew all them that conspired against Amon, and the people of the land made Josiah king." Something must have moved them to this. Was it that the Queen-mother was a woman worthy of her position and held in honour? She would be, for many years after this, the chief person in the State, and the guardian of Josiah, and this may account for many things—for the early piety of the King, for his determination, as soon as he reached man's estate, to carry out fully the reformation which his grandfather had begun less than twenty years before, and it may account for the readiness of the people to yield to their young King when he came among them, destroying their idols and altars, and calling them to the worship of Jehovah.



Edmund Halley.

By MARY BRADFORD WHITING.

IN this year 1910, when the name of Halley is a household word, it would be interesting to discover how many of those who talk of his comet know anything of the man who gave it its name. Halley's celebrated treatise on the orbits of comets laid the foundation of all subsequent study of the subject, but the details of his life and work are to be found for the most part in books and manuscripts that are not easily accessible—such as the Rigaud MSS. in the Bodleian Library at Oxford—and to those outside scientific circles he remains, therefore, a name and nothing more.

Halley was born on November 8, 1656, and a delightfully quaint little memoir of him exists in John Aubrey's "Lives of Eminent Men," a work which is based on letters and papers that Aubrey was allowed to consult in the Ashmolean Museum. He gives the following account of Halley's parentage and early life :

"Edmund Halley, the eldest son of a wealthy citizen of the

city of London, a soap-boiler. Of the Halleys of Derbyshire, a good family. He was born in Shoreditch parish, at a place called Haggerston, the backside of Hogsdon. At 9 years old his father's apprentice taught him to write and arithmetique. He went to Paule's schoole to Dr. Gale; while he was there he was very perfect in the Celestial Globe, so that I have heard Mr. Moxon (the globe-maker) say that if a star were misplaced in the globe he would presently find it out. At . . . he studyed Geometry, and at 16 he could make a dyall, and then he sayd he thought himself a brave fellow."

It was at the age of sixteen that he became captain of the school, and in the following year he was entered at Queen's College, Oxford, and went up to the University, taking with him his favourite scientific instruments, "among them his tube and sextant, the first 24 feet long, and the second 2 feet in diameter." His first communication to the Royal Society was made from Oxford, while he was still an undergraduate, and consisted of a "Direct and Geometrical method of finding the Aphelia and Eccentricity of Planets," but the course of study at the University did not attract him, and with the idea of observing and revising the places of the fixed stars, he obtained permission from his father to leave without taking his degree, and to make a scientific expedition to St. Helena.

Much good work was done during his eighteen months' stay, among other things the first complete observation of the transit of Mercury, which he made on November 7; but the climate proved unsuitable for investigations, and though he "stuck close to his telescope," he found many difficulties in his way.

In 1678 he returned to England, and King Charles II. told him to choose a reward, when he at once asked that his Majesty might be pleased to send a Mandamus to the University of Oxford for the bestowal of his degree of Master of Arts. "'Tis evident," says his son-in-law, Henry Price, "that our author had a filial affection for his Alma Mater, returning to her arms presently after his landing from St. Helena, and

making the honour she could confer the chief view of his ambition."

The degree was granted on December 3, and Price records that in the space of a single month Halley procured the Mandamus, took the degree, published his catalogue and observations, resolved to go to Dantzic, wrote his letter to Hevelius, and was elected a Fellow of the Royal Society.

The mission to Dantzic was a flattering proof of the young man's ability. Hevelius the Consul, who was a native of Dantzic and a well-known astronomer, had some time before written to the Royal Society, of which he was a member, to recommend someone to aid him with his catalogue of the fixed stars, and meanwhile he was drawn into a dispute with Robert Hooke, the Secretary of the Royal Society, as to the preference of plain or glass sights in astroscopical instruments. The dispute was a long one. "The affair rested some time with sufficient outward decency," says the old chronicler of the doctors' disagreement, "though not without some inward grudge on each side. . . . But now, not being able to contain himself any longer within the bounds of decency, he (Hooke) assumed a magisterial air, and in that spirit threw out several unhandsome reflections upon the Consul."

Halley's verdict seems to have been that both parties were right, but Hooke was generally blamed for his "unhandsome" conduct; nor was this the last time in Halley's career that he was to find annoyance from his behaviour.

During the next year or two, Halley travelled about the Continent, paying visits to eminent scientific men, whose friendship was of much service to him in after-life, and studying many important subjects. In 1682 he returned to England, and married Mary Tooke, the daughter of the Auditor of the Exchequer, whom Rigaud describes as "an agreeable young gentlewoman and a person of real merit; she was his only wife, and with whom he lived very happily and in great agreement upwards of fifty-five years."

The young couple were soon to find the first flush of their

happiness clouded over, for the death of Halley's father in 1684 revealed the fact that his affairs were in a very different condition from what had been supposed. Instead of inheriting a fortune, his son was henceforward entirely dependent upon his own exertions. This fact makes the offer which Halley made to Sir Isaac Newton in this same year of 1684 all the more striking. Visiting Cambridge in August for the purpose of seeing Newton, he found him occupied with the preparation of his "Principia," and when his desire to see it published met with no response from the philosopher, he offered to have it brought out at his own charges, and to lay aside his own work to correct the proofs.

It was in this last task that he once more came into collision with Robert Hooke, who stated that Newton's method of computing the motions of the planets was not original, but was borrowed from his (Hooke's) observations—a charge which so disgusted Newton that he resolved to withdraw the third part of the "Principia" from publication.

Halley's arguments prevailed, however, for on April 6, 1687, an entry appears in the minutes of the Royal Society: "The third book of Mr. Newton's treatise 'De Systemate Mundi' was presented." The work was published, and it is satisfactory to know that its sale was large enough to reimburse Halley for his spirited outlay.

That the disciple continued to urge on his master to publication is shown by an amusing allusion in a letter written by Newton in August, 1696, in which, after describing the amount of work that he had on hand, he says: "I write this purposely to you, because I know a sparke (Halley) is with you that complains much I have lived here twenty years and printed nothing."

But Halley himself was now to be assailed by the bitter blasts of envy. In 1691 the Savilian Professorship of Astronomy at Oxford fell vacant, and his heart was set on obtaining the post, but the authorities passed him over on the ground that he was an infidel, and appointed another. The story is thus

told by Mr. Whiston, who describes himself as a friend of Halley's :

“ Bishop Stillingfleet was desired to recommend him at Court, but hearing that he was a sceptic and a banterer of religion, the Bishop scrupled to be concerned till his chaplain, Mr. Bentley, should talk to him about it, which he did ; but Mr. Halley was so sincere in his infidelity that he would not so much as pretend to believe the Christian religion, though he thereby was likely to lose a Professorship, which he did accordingly ; and it was then given to another, Dr. Gregory.”

The instance that Whiston brings forward of Halley's “ bantering of religion ” does not seem very conclusive, for he relates with much solemnity that when he refused to take a glass of wine on a Friday, Halley remarked that he was afraid that he had “ a Pope in his belly.”

The whole question of Halley's rejection is gone into in a pamphlet called “ The Defence of Halley against the Charge of Religious Infidelity,” which was printed for the Ashmolean Society in 1844, and is obtainable in the Bodleian bound up with other Oxford tracts. Stephen Rigaud, Professor of Astronomy at Oxford, intending to write a life of Halley, made a collection of materials for that purpose, but died in 1839 before he had been able to use it. His son, Stephen Jordan Rigaud, hoped to carry out the idea, but also died without accomplishing it, and only left this pamphlet.

He begins with the statement that his object in printing it is “ to induce some to think more leniently of one who is gone to his account, and whose feelings while he lived were no less violated than his prospects were for a while destroyed by reports without foundation, or the foundation of which, we fear, rests upon the jealousy of those who felt themselves hopelessly surpassed.” He points out that Whiston's memoirs were written at the age of seventy-nine, and that as the election had taken place when he was only twenty-four, it was hardly possible that he should have a distinct remembrance of the circumstances, and he quotes from a letter written by Halley in June, 1691, in which

he asks Abraham Hill, the Comptroller of the Archbishop of Canterbury, to delay the election for at least a fortnight—"this time will give me an opportunity to clear myself in another matter, there being a caveat entered against me till I can show that I am not guilty of asserting the eternity of the world."

This assertion was ascribed to other scientific writers besides Halley, but there seems to be no trace in his works of any statement that the world had existed from all eternity without an act of creation; as far as can now be ascertained, the accusation was based on the fact that in 1687 he had written a paper which was printed in the Philosophical Transactions of the Royal Society, in which he says, speaking of the Deluge, that the Almighty "may have made use of natural means to bring about His will."

A remark such as this, incredible as it seems, was quite enough at that time to give rise to a charge of infidelity, but when there was added to it a speculation as to whether changes had taken place on the earth before the creation of man, the case was black indeed. The whole of the evidence brought forward is of the same flimsy description. Bishop Berkeley is said to have spoken of him as an infidel, but when the matter was sifted, the sole fact left was that Berkeley had said to a friend that Addison had assured him that the infidelity of a certain noted mathematician now living (meaning Halley) was one principal reason given by a witty man of those times for being an infidel.

The Royal Society upheld their Fellow, and desired Dr. Gale, his former head-master at St. Paul's School, to write a testimonial embodying their opinion that he was a fit person to hold the Professorship; and what is more striking, the authorities of Queen's College were bold enough to take a contrary view to that of the University, and granted him a testimonial couched in the following high terms:

"We judge him to be every way most fit and accomplished for the performance of the duties, as well from our own long experience of his mathematical genius, probity, sobriety and

good life, as also from the very many testimonials of all foreigners eminent in that science."

All was in vain, however; the adverse opinion was too deeply rooted, and Mr. Rigaud gives it as his deliberate verdict that it took its rise from the jealousy of the Rev. John Flamsteed, Astronomer Royal. A letter, which is preserved in the Smith Collection in the Bodleian (vol. lxxix.), from Flamsteed to Professor Barnard, shows that he had heard that Barnard was about to resign, and resolved to try for the Professorship, but was much disgusted to find that Halley, being an Oxford man, was considered to have a better chance. Halley had before this criticized Flamsteed's tide-tables, and Flamsteed, who was of an irritable and envious disposition, could not forgive the injury. Sir David Brewster, in his "Life of Newton," takes this view, and says: "Flamsteed never scrupled to denounce Halley as a libertine and an infidel, and we regret to see that a modern writer (in the *Quarterly Review*, vol. lv.) has ventured to say that Halley was low and loose in his moral conduct, and an avowed and shameless infidel. Had such been his character, he would never have been the friend and companion of Newton."

The last proof might not, perhaps, have been looked upon as convincing by Flamsteed, for his accusations against Newton were as bitter as those against Halley; but the writer of the article on Flamsteed in the "Encyclopædia Britannica," who has gone into the whole matter, says that the charges have no evidence to support them, and that the reputations of both Newton and Halley are unharmed by the calumny; it is clear, at any rate, that the Oxford authorities felt that they had been misled, for in the year 1703 they appointed Halley to the Professorship of Geometry.

At the time Halley felt the slight keenly; but he was not the man to sit down and bewail himself. Shut out from one sphere of activity, he at once sought for another, and through Newton's influence he was made Deputy Controller of the Mint at Chester.

It was not much wonder, however, that he should long to escape from England for a time. His former travels had been full of interest, and he wished to extend them further, and in particular to make a series of observations by which he hoped to be able to aid the determination of longitudes. King William III. was now upon the throne, and was as favourable to his projects as Charles II. had been ; he readily granted him the use of a war-sloop, which rejoiced in the euphonious name of the *Paramour Pink*, desiring him to study the variations of the compass and to try to discover what land lay to the south of the western ocean.

It was with high hopes that Halley set out in November, 1698, but once again opposition awaited him ; sickness broke out on board, the crew became insubordinate, and his first lieutenant mutinied. He was obliged to put back in the following June, and having had the lieutenant tried and cashiered, he reorganized his crew and set sail again in September, 1699. This time the voyage was successful ; he made a complete survey of the Atlantic Ocean and brought back much valuable information, and, as Price tells us, “ did not lose a single man from sickness, which no doubt must be owing in a great measure to the extraordinary care he took of them, and to that humanity which was a distinguishing part of his character.”

The King was so well pleased with the results of Halley's voyage that he commanded him to make a survey of the tides and coasts of the British Channel ; nor was he less esteemed by Queen Anne, for, shortly after her accession, she selected him to go to the Adriatic to advise the Emperor Leopold on the state of the harbours in that sea, and also on the fortifications of Trieste. That the Emperor was satisfied was shown by the fact that he presented him with a diamond ring from his own finger, and wrote an autograph letter of commendation of him to Queen Anne.

This distinction, no doubt, was gratifying to him, but what must have pleased him still more was his election to the Savilian Professorship of Geometry on his return, for it cleared his

character from the aspersions of his enemies and assured his future prospects.

Recognition came now to Halley in full measure, but nothing could lessen his appetite for work; he was appointed Secretary to the Royal Society on the resignation of Sir Hans Sloane in 1713, and in 1721 he was made Astronomer Royal, thus succeeding Flamsteed, who had written of him to Newton in 1695 as "impudently and ingrately base."

He was now sixty-four, an age when most men feel that they may begin to take life a little more easily, but it was far otherwise with this eager spirit. His salary was only £100 a year, there was no allowance for an assistant, and he was hampered by the extraordinary dearth of instruments; but he set to work undauntedly, and was successful in procuring a grant for fresh apparatus, mainly through the assistance of the Earl of Macclesfield.

"The observatory thus furnished," says Rigaud, "Dr. Halley again set himself to observe, with a diligence hardly to be credited. He has left us a complete set of lunar observations without neglecting at the same time those of the sun and the other planets, at all convenient opportunities from the 1st of Jan., 1722, to the 29th of Dec., 1739."

It was full forty years since the young astronomer had conceived the idea of observing the moon accurately for a period of eighteen years, and of basing on those observations a set of lunar laws and conditions—first one task and then another had frustrated it, but now, when old age was within sight, he took it up once more and proceeded to carry it out.

Earnestly as he begged for his observatory, he asked nothing for himself; but once again Royalty came to his aid. Queen Caroline, the wife of George II., visited the Royal Observatory in 1729, and on discovering that he had held a commission in the navy during his voyages of exploration, she procured him a pension.

It was soon after his appointment to the Professorship at Oxford that the first edition of his "*Astronomiæ Cometiciæ*

Synopsis" was published as the 297th number of the Philosophical Transactions of the Royal Society (March, 1705).

Professor Rigaud says that he intended his Synopsis to be only the introduction to a fuller treatise, and that he published it in order that astronomers might at once benefit by his investigations, and also that these investigations might not perish if any accident should happen to himself before he had time to complete them.

In a letter written by Newton to Flamsteed, which is preserved in the library of Christ's College, Cambridge, he says (September 14, 1695): "Mr. Halley was with me about a design for determining the orbs of some comets for me." But though he worked upon the design in connection with others, Professor Rigaud states that "he was the first who ever strictly calculated a comet's orbit in the section of a cone; and for very many years he continued to be the only man who had courage to undertake it. His investigations on the comets of 1456, 1531, 1607 and 1682, led him to believe that they were recurring apparitions of the same body; but though in his first edition he speaks of its return in 1758 with absolute confidence, his courage had a little cooled before the next, in which he puts it, "I dare venture to foretell," and in the 1715 edition he still further modifies it—"I think I may venture to foretell." Later on, however, he discovered that a comet which he believed to be the same had been observed in 1305 and 1380, and his former confidence returned to him, and was expressed in the subsequent editions. His appeal to "candid posterity to acknowledge that this was first discovered by an Englishman" was not forgotten; but when on Christmas Day, 1758, the comet duly appeared, Halley's long labours were ended, and he lay in his grave in Lee Churchyard.

Till the year 1737 he worked unremittingly, but, symptoms of paralysis appearing in his right hand, he was forced after that time to abate a little of his energy. The loss of his only son, a surgeon in the Royal Navy, and the death of his dearly loved wife, further weakened his hold upon life, and on January 14,

1742, he passed quietly away, at the age of eighty-six. His two daughters survived him—Katherine, wife of Henry Price, and Margaret, who died unmarried in 1743, and was laid by her father—"interred in linnen and the penalty payd," as the register of the church records.

Of Halley's achievements it is the place of astronomers to speak ; but as this article deals rather with the man than with his work, it may fittingly conclude with the personal appreciation sent in 1742 by Mr. Folkes, the then President of the Royal Society, to M. Mairan, who read an *Éloge* before the Royal Academy of Science in Paris, of which body Halley was a member. After speaking of the marked attentions paid to him by Peter the Great during his stay in England, he says :

"Dr. Halley also possessed the qualifications necessary to obtain him the love of his equals. In the first place, he loved them ; naturally of an ardent and glowing temper, he appeared in their presence with a generous warmth which the pleasure of seeing them seemed to inspire ; he was open and punctual in his dealings, candid in his judgments, uniform and blameless in his manners, sweet and affable, always ready to communicate, and disinterested. The reputation of others gave him no uneasiness, and restless jealousy and anxious emulation were strangers to his breast. He was equally ignorant of those extravagant prejudices in favour of one nation which are injurious to all others. The friend, countryman, and disciple of Newton, he spoke of Des Cartes with respect ; and successor to Dr. Wallis, he did justice to the merits of our antient geometricians. To conclude, these uncommon and valuable qualifications were tempered by Mr. Halley with a vein of gaiety and good-humour, which neither his abstracted speculations, the infirmities of old age, nor the palsy itself, which seized him some time before his death, could impair ; and this happy disposition—the gift of Nature—was the more perfect as it was still attendant upon that peace of mind which is the nobler endowment of virtue."