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In Three Volumes

VOLUME I

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1945

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onditionally admitted. Barrow
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, ISAAC, D.D. (1614–1680),
sively of Sodor and Man and
was the son of Isaac Barrow,
shire squire, and born at his
f Spiney Abbey, near Wickham
. He became a fellow of Peter-
ubridge, and took holy orders.
o the royalist cause resulted in
om his fellowship in 1643, the
which Isaac, his famous nephew
e [q.v.], the future master of

Trinity, entered Peterhouse. In company with his friend and colleague, Gunning, Barrow went to Oxford, where Dr. Pink, warden of New College, appointed him a chaplain of that society. But the fall of Oxford in 1645 drove Barrow away from his new home, and he lived on in quiet retirement until the Restoration gave him back his fellowship at Peterhouse. He was in addition made fellow of Eton College and rector of Downham in his native county. But in 1663 the Earl of Derby appointed him bishop of Sodor and Man, to which office he was consecrated on 5 July in Westminster Abbey, his nephew, already winning fame as an orator, preaching the sermon. To the spiritual supremacy of Man Lord Derby added the temporal, by making Barrow governor of the island in April 1664. He became one of the most respected of Manx bishops, and a great benefactor of the land. He raised by subscription a sum of over 1,000*l.*, with which he bought from Lord Derby all the impropriations in Man, and applied them to augment poor vicarages. He was equally zealous for education, built and endowed schools, and required his clergy to teach in the schools of their respective parishes. Partly from a royal grant, partly from his own purse, he established three exhibitions tenable by Manxmen at Trinity College, Dublin, with the object of raising the tone of clerical education and creating a learned clergy. Though he had left Man many years before his death, he remembered his old flock, and bequeathed in his will 100*l.* to 'buy such books yearly as should be more convenient for the clergy.' As governor he ruled wisely and firmly, built a bridge over a dangerous stream, and did many other good works there. 'The bread the poor clergy eat,' cries the historian of the remote and neglected island, 'is owing to him, as is all the little learning among the inhabitants.' No Manx bishop but the saintly Wilson can approach Barrow in beneficence and liberality. In March 1669 Barrow was translated to St. Asaph, and remained there till his death. Until October 1671 he continued to hold the see of Man *in commendam*, but then resigned it along with his governorship. His government of his new bishopric was marked by the same solid devotion to schemes of practical utility as had characterised his work in Man. He repaired his cathedral; wainscoted the choir; put new lead on the roofs; repaired and added to his palace; established an almshouse in St. Asaph village for poor widows and endowed it himself; and left 200*l.* in his will to establish a free school. His greatest exertions were devoted to obtaining in 1678 an act of parliament for uniting several sinecure and impropriate rectories in his diocese with their impoverished vicarages, and for devoting the proceeds of another sinecure to form a fund to maintain the cathedral fabric, hitherto unprovided for. He died on Midsummer day, 1680, at Shrewsbury, and was buried in the churchyard of his cathedral.

Barrow was a rigid 'high-churchman,' if we may anticipate that convenient phrase. He was celebrated by those like-minded with himself for being almost the only celibate bishop of his generation. The inscription on his tomb, written by himself, excited much scandal among protestants, as it implored all who entered the cathedral to pray for his soul. Wood is amusingly angry with those who imputed popery on so slight a pretext to so sound a churchman. His character, as gathered from his acts, is that of a benevolent, practical, and religious man.

[Willis's Survey of St. Asaph; Thomas's History of the Diocese of St. Asaph; Wood's Athenæ Oxonienses; Sacheverel's History of the Isle of Man.] T. F. T.

BARROW, ISAAC (1630–1677), master of Trinity College, Cambridge, an eminent mathematician and classical scholar, and one of the greatest of the great Anglican divines and preachers of the Caroline period, was born in London, where his father, Thomas Barrow, was linendraper to King Charles I. He was a scion of an ancient Suffolk family; but his grandfather lived at Spivey Abbey, in the parish of Wickham in Cambridgeshire, and was a justice of the peace there for forty years. His mother was the daughter of Mr. Buggin, of North Cray, and died when Barrow was only four years old. His uncle was Isaac Barrow, bishop of St. Asaph [q.v.]. His first school was the Charterhouse, where he made but little progress in his studies, and was chiefly distinguished for fighting and setting on other boys to fight. In fact, he was so troublesome in his early days that his father was heard to say that, if it pleased God to take any of his children, he could best spare Isaac. Charterhouse not proving a success, he was removed to Felstead school, where Martin Holbeach was the head master. Here he improved his ways, and in time so gained the confidence of his master that he made him 'little tutor' to a schoolfellow, Viscount Fairfax, of Emery, in Ireland. At the close of 1643 he was entered at St. Peter's College (Peterhouse), Cambridge, where his uncle Isaac, to whom he always had recourse for direction in his early life, was a fellow; but before he was qualified to come into resi-

dence, his uncle had been ejected, and he consequently went as a pensioner to Trinity. His father, who was at Oxford with the king when Barrow went to Cambridge, lost all in the royal cause. Barrow, therefore, would have been obliged to leave college for want of funds, had it not been for the kindness of the great Henry Hammond, who, either personally or by gatherings which he made from the faithful to support young men at the universities 'as a seed-plot of the ministry,' enabled him to pay the necessary expenses. Barrow showed his gratitude to Hammond by writing his epitaph. In 1647 Barrow was elected scholar of Trinity, though he refused to subscribe the covenant; and, in spite of his royalist opinions, he contrived to win the favour of the college authorities. 'Thou art a good lad,' said the puritan master, Dr. Hill, to him, patting him on the head; ''tis pitty thou art a royalist.' Barrow did subscribe the 'engagement,' but afterwards applied to the commissioners, and 'prevailed to have his name razed out of the list.' He took his B.A. degree in 1648, and in 1649 was elected fellow of Trinity, his friend and contemporary, Mr. Ray, the great botanist, being elected at the same time. He had studied physic, and at one time thought of entering the medical profession; but on reconsideration 'he thought that profession not well consistent with the oath he had taken when admitted fellow.' In 1652 he took his M.A. degree, and in the following year was incorporated in the same degree at Oxford. In 1654 the professor of Greek at Cambridge, Dr. Dupont, an eminent man in his day, and, in spite of his position, a royalist, resigned his chair, and was most anxious that his old pupil, Barrow, should succeed him; and Barrow, we are told, 'justified the character given of him by an excellent performance of his probation exercise, but not having interest enough to secure the election, Mr. Ralph Widdrington was chosen.' It is said that he failed through being suspected of Arminianism, and that Widdrington, who was nearly related to men in power, gained the election by favouritism. But it must be remembered that Barrow was at this time only twenty-four years of age—a very young man to be placed in such a post—and that, great as his classical reputation was, he was still more highly thought of as a mathematician. Moreover, he was already laying the foundation of his after-eminence as a divine. In fact, according to one account, his mathetical studies all had reference to this; for 'finding that to be a good theologian he must know chronology, that chronology implies astronomy, and astronomy mathematics, he applied himself to the latter science with distinguished success.'

Barrow was, however, clearly out of sympathy with the dominant party at Cambridge. When he delivered a fifth of November oration, in which 'he praised the former times at the expense of the present,' his brother fellows were so disgusted that they moved for his expulsion, and he was only saved by the intervention of his old friend the master, who screened him, saying, 'Barrow is a better man than any of us.' This want of sympathy with his surroundings determined him to travel; but his means were so straitened that he was obliged to sell his books in order to do so. He set forth in 1655, and first visited Paris, where he found his father in attendance upon the English court, and 'out of his small stock made him a seasonable present.' Thence he proceeded to Italy, visiting, among other places, Florence, where 'he read many books in the great duke's library, and ten thousand of his medals.' He was helped with means to continue his travels by Mr. James Stock, a London merchant whom he met at Florence, and to whom he afterwards dedicated his 'Euclid's Data.' On his voyage from Leghorn to Smyrna an incident occurred which showed that he had not altogether lost his fighting propensities. The vessel was attacked by an Algerine pirate; Barrow remained on deck, kept his post at the gun to which he was appointed, and fought most bravely, until the pirate, who had expected no resistance, sheered off. Barrow has described the conflict in Latin, both in prose and verse. At Smyrna he was kindly received by the English consul, Mr. Bratton, on whose death he wrote a Latin elegy. His reception by the English ambassador at Constantinople, Sir Thomas Bendish, was equally cordial; and he also began there an intimate friendship with Sir Jonathan Dawes. He spent his time at Constantinople in reading the works of St. Chrysostom, whom he preferred to any of the fathers. He resided more than a year in Turkey, and then gradually made his way home, taking on his road Venice, Germany, and Holland. He arrived in England in 1659, and at once received holy orders from Bishop Brownrigg.

Upon the Restoration his fortunes brightened. Widdrington resigned the Greek professorship, and this time there was no difficulty about electing Barrow to the chair. He began lecturing upon Aristotle's Rhetoric; but he is said to have been not very successful as a Greek lecturer. On the death of Mr. Rooke he was chosen professor of geometry at Gresham College, through the recommendation of Dr. Williams. Besides

his own duties, he also officiated
the professor of astronomy, du
sence abroad. In 1662 a valuab
offered to Barrow; but as a c
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son, he refused the offer, 'as toc
niacal contract.' In 1663 he
consecration sermon at Westm
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St. Asaph; and in the same
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Williams, he was appointed th
matical professor at Cambrid
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his own duties, he also officiated for Dr. Pope, the professor of astronomy, during his absence abroad. In 1662 a valuable living was offered to Barrow; but as a condition was annexed that he should teach the patron's son, he refused the offer, 'as too like a simoniacal contract.' In 1663 he preached the consecration sermon at Westminster Abbey when his uncle Isaac was made bishop of St. Asaph; and in the same year, again through the influence of his good friend Dr. Williams, he was appointed the first mathematical professor at Cambridge under the will of Mr. Lucas. He was also invited to take charge of the Cottonian Library, but, having tried the post for a while, he preferred to settle in Cambridge, and therefore declined it. According to the ideas of the time, there was no incompatibility in combining the duties of the Lucasian with those of the Gresham professorship; but Barrow was far too conscientious to undertake more than he could thoroughly perform. He therefore resigned his post at Gresham College, and confined himself to his Cambridge duties. But even these were too distracting for his sensitive conscience. He was afraid, as a clergyman, of spending too much time upon mathematics; 'for,' as we are quaintly told, 'he had vowed at his ordination to serve God in the Gospel of his Son, and he could not make a bible out of his Euclid, or a pulpit out of his mathematical chair—his only redress was to quit them both.' He resigned the Lucasian professorship in 1669 in favour of his still more distinguished pupil, Isaac Newton. He had the acuteness to perceive, and the generosity to acknowledge, the superior qualifications of his great successor. Newton had revised his 'Lectiones Opticæ' for the press, and, as Barrow ingenuously confessed, corrected some things and added others. But other circumstances led him to abandon mathematical for theological studies. The college statutes bound him to compose some theological discourses, these being necessary in order that a fellow may become 'college preacher,' and in that capacity hold ecclesiastical preferment. Accordingly, in 1669, he wrote his very valuable 'Exposition of the Creed, Decalogue, and Sacraments,' which, as he said, 'so took up his thoughts that he could not easily apply them to any other matter.' But this was not all. Barrow was a very sensitive and a very modest man; and the reception of his mathematical works by the public was not altogether encouraging. He had published in 1669 his 'Lectiones Opticæ,' which he dedicated to the executors of Mr. Lucas, 'as the firstfruits of his institution,' and he had found, as we have seen, in the pupil who revised them a better man than himself. He also published his 'Lectiones Geometricæ;' but 'when they had been some time in the world, having heard of very few who had read and considered them thoroughly, the little relish that such things met with helped to loose him more from those speculations, and heighten his attention to the studies of morality and divinity.'

Barrow was now left with nothing but his fellowship. His uncle had given him a small sinecure in Wales, and his friend Seth Ward, now bishop of Sarum, a prebend in Salisbury Cathedral; but the small income derived from these sources he always devoted to charitable purposes. Possibly it was at this time, when he seemed to have fallen between two, or rather several, stools, that he wrote a neat couplet, which has been often quoted as a proof of Charles II's neglect of his friends:—

> Te magis optavit redituram, Carole, nemo,
> Et nemo sensit te rediisse minus.

Dr. Whewell's vindication of the king is unanswerable: 'I do not,' he writes, 'know what his (Barrow's) sufferings were. Charles took the very best way of making himself acquainted with his merits, and of acknowledging them by appointing him his chaplain; and if he wanted to make him master of Trinity, which was certainly a most appropriate and valuable recognition of his merits, he must needs wait for a vacancy.' That vacancy was not long in coming. In 1672 Dr. Pearson was appointed bishop of Chester, and Barrow succeeded him as master of Trinity. His patent to the mastership was with permission to marry, but this permission he caused to be erased, as contrary to the statutes. The appointment was the 'king's own act,' who said, when he made the appointment, that 'he gave it to the best scholar in England.' These were not words of course. Charles had frequently conversed with Barrow as his chaplain; and his comment upon his sermons is wonderfully apposite. He called him 'an unfair preacher, because he exhausted every topic, and left no room for anything new to be said by any one who came after him.' In the St. James's lectures on the 'Classical Preachers in the English Church,' where each preacher is ticketed with an epithet, Barrow is rightly termed 'the exhaustive preacher.' Charles had already shown his appreciation of Barrow by making him D.D. in 1670 by royal mandate.

Barrow enjoyed his new dignity for the brief space of five years, but he made his

mark upon Trinity by commencing the magnificent library. The story runs thus. He proposed to the heads of the university to build a theatre, that the university church might be no longer profaned by the speeches &c. which were held there. He failed to move his brother heads, and went back piqued to his college, declaring that he would get handsomer buildings than any he had proposed to them; and so he gave the impetus to the building of the library, which was not completed until he had gone to his rest. In the spring of 1677 he went to London to assist, as master of Trinity, in the election of the Westminster scholars to Christ Church, Oxford, and Trinity, Cambridge; and on 13 April, 'being invited to preach the Passion sermon at Guildhall chapel, he never preached but once more.' He died during the visit 'in mean lodgings,' Dr. Pope tells us, 'over a saddler's shop near Charing Cross;' but the lodgings must have been his own choice, for the master of Trinity of course had the means to lodge where he liked. He was buried in Westminster Abbey, where a monument surmounted by his bust was erected by his friends. His epitaph was written by his friend Dr. Mapletoft, who, like himself, had been a Gresham professor.

When it is remembered that Barrow was only forty-seven years of age when he died, it seems almost incredible that in so short a life he could have gained so vast and multifarious a store of knowledge. Scholar, mathematician, man of science, preacher, controversialist, he gained enough credit in every one of these departments to make the reputation of an ordinary man; while his blameless, unselfish, christian life would be worth studying if he had gained no intellectual reputation at all.

As a scholar, his many compositions in Latin prose and verse (he had almost a mania for turning everything into Latin verse), as well as in Greek verse, fully justify the confidence which Dr. Dupont showed in him.

As a mathematician he was considered by his contemporaries as second only to Newton, whose towering genius a little overshadowed that of his master; but on the other hand, his credit as a mathematician is enhanced by the fact that he was the first to recognise and develop the extraordinary talents of Newton, one of whose most famous discoveries he was on the verge of making. Dr. Whewell has well summed up his merits without exaggeration or detraction (to both of which Barrow's mathematical fame has been subject). 'The principal part which Barrow plays in mathematical history is as one of the immediate precursors of Newton and Leibnitz in the invention of the differential calculus. . . . He was a very considerable mathematician, and was well acquainted with mathematical literature.' Barrow himself was exceedingly modest in his estimate of his own mathematical powers, as indeed he was of all his powers. It was only in compliance with the judgment of his intimate friend, Mr. John Collins, that he was prevailed upon to publish most of his mathematical works. And when he did suffer them to be published it was with a stipulation that they should not be 'puffed.' 'I pray,' he wrote to Mr. Collins, 'let there be nothing said of them in the Philosophical Reports beyond a short and simple account of them; let them take their fortune or fate *pro captu lectoris*; anything more will cause me displeasure, and will not do them any good.' It was on his mathematics that his contemporary repute chiefly rested.

As to science and philosophy, he fully shared, in his early years, the newly awakened interest in these subjects, studying them, not at second hand, but in the works of such masters as Bacon, Des Cartes, and Galileo.

As a controversialist, his great 'Treatise on the Pope's Supremacy' (1680) would be enough to immortalise any man. He did not live to publish it, but on his deathbed gave Tillotson permission to do so, regretting with characteristic modesty that he had not had time to make it less imperfect. As a matter of fact, it is about as perfect a piece of controversial writing as is extant. He was the very man for the task; for 'he understood popery both at home and abroad. He had narrowly observed it militant in England, triumphant in Italy, disguised in France, and had earlier apprehension than most others of the approaching danger.' Besides this perfect knowledge of the subject, he had other qualifications no less essential for the work: his calm temperament and large-hearted christian charity prevented him from indulging in those anti-papal ravings which were only too common at the time. His logical mind at once detected the weak points in the papal arguments, while his nervous, lucid style set off his knowledge and his reasoning to the best advantage. His 'Exposition of the Creed,' though not directly controversial, will prove a most valuable weapon in the hands of a controversialist. The subject is treated from a different point of view from that taken by his predecessor at Trinity, Dr. Pearson; but though less known and read at the present time, his work does not suffer in the least by a comparison with that masterpiece.

But, after all, it is as a preacher that

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Barrow is best known; though, curiously enough, his fame in this capacity was posthumous rather than contemporary. He does not appear to have been either a very frequent or a very popular preacher; but his sermons now deservedly rank among the very finest specimens of the art. One of their merits has been already touched upon, but they have many others. Barrow had qualms of conscience lest his mathematics should interfere with his divinity, but in fact they greatly helped it. 'Every sermon,' it has been truly said, 'is like the demonstration of a theorem.' The clearness, directness, and thoroughness of mind which are so conspicuous in the sermons were no doubt strengthened by the habit which mathematical pursuits foster. Controversy he carefully avoided in his preaching, going straight to the broad facts of christian belief and moral duty. Nevertheless, no one can read his sermons without feeling that he is in the presence of a first-rate controversialist. He appeals, perhaps, too much to the reason and too little to the feelings. No one would ever think of applying the common epithet 'beautiful' to any of Barrow's sermons, and yet they are full of eloquence of the very highest order; and now and then he rises into a strain which can only be described as sublime. But what strikes one most in the sermons is their thorough manliness of tone: they are free from the slightest touch of affectation; there is no vestige of extravagance or bad taste in them. One can well understand how it is that men of the greatest eminence have admired them the most: how John Locke, e.g., regarded them as 'masterpieces of their kind;' how Bishop Warburton 'liked them because they obliged him to think;' how the great Earl of Chatham, 'when qualifying himself in early life for public speaking, read Barrow's sermons again and again, till he could recite many of them *memoriter*;' and how the younger Pitt, at the recommendation of his father, studied them frequently and deeply. We have to descend to men of a feebler frame of mind for depreciation of Barrow. One hardly knows whether to smile or be provoked to see Blair, once the admired preacher of the coldest and tritest of sermons, looking down as from an eminence upon Barrow, and, while admitting 'the prodigious fecundity of his invention,' complaining of his 'genius often shooting wild and unchastened by any discipline or study of eloquence,' and of his style being irregular and incorrect; or to find a Mr. Hughes, who gave to the world a sort of Bowdlerised edition of Barrow, 'thinking his sermons inferior to Sherlock's. The drawback to Barrow's sermons is their inordinate length—inordinate even for those days of long sermons. Everybody knows the story of his preaching in Westminster Abbey, and encroaching so long upon the time which the vergers utilised between sermons for lionising the church that they caused the organs to play 'till they had blowed him down;' and of the sermon that he wrote on the text, 'He that uttereth slander is a liar' (1678), from which he was prevailed upon to omit the half about slander, and yet the remaining half lasted an hour and a half; and again, of the famous Spital sermon (the only one he ever saw in print), 'On the Duty and Reward of Bounty to the Poor' (1671), which is said to have occupied three hours and a half in delivery, though it was not preached in full. But there seems to have been a little exaggeration in these stories—at any rate, in that relating to the Spital sermon; for the court of aldermen desired him to print it 'with what further he had prepared to preach,' which no doubt Barrow did. Now the sermon is extant, and it fills ninety-four octavo pages—long enough in all conscience, but yet not long enough to occupy four hours in delivery. Still, prolixity is unquestionably a fault of Barrow's sermons, as it is of his mathematical works also. Barrow took immense pains over the composition of his sermons, as his manuscripts prove. He is said to have written some of them four or five times over.

It remains to say a few words about Barrow's character and habits. He was, scholar-like, negligent of his dress and personal appearance to a fault. Once, when he preached for Dr. Wilkins at St. Lawrence, Jewry, the congregation were so disgusted with his uncouth exterior that all but a few rushed out of church. Among the few who remained was Richard Baxter, who had the decency to sit out, and the good taste to admire, the sermon. Barrow is said to have been 'low of stature, lean, and of a pale complexion.' He would never sit for his portrait; but his friends contrived to hold him in conversation while a Mr. Beale took it without his knowing what was going on. He was very fond of tobacco, which he called his panpharmacon, declaring that it 'tended to compose and regulate his thoughts;' and he was inordinately fond of fruit, which he took as a medicine. He was a very early riser, and was in the habit of walking out in the winter months before daybreak. This habit once brought him into danger, and also gave him the opportunity of showing his extraordinary strength and courage. He was visiting at a house where a fierce mastiff was kept, which was chained during the daytime, but allowed

to run loose in the garden at night, as a protection against thieves. Barrow was walking in the garden before daybreak, when the mastiff attacked him; he caught the brute by the throat, threw him down, and would have killed him; but he reflected that this would be unjust, as the dog was only doing his duty. He therefore called aloud for help, keeping the dog pinned down until some one from the house heard his cries and released him. Barrow had a keen sense of humour and a readiness of repartee, as the following story will show. He was attending at court as the king's chaplain, when he met the famous Earl of Rochester, who thus accosted him: 'Doctor, I am yours to the shoetie.' Barrow: 'My lord, I am yours to the ground.' Rochester: 'Doctor, I am yours to the centre.' Barrow: 'My lord, I am yours to the antipodes.' Rochester (scorning to be foiled by a musty old piece of divinity, as he termed him): 'Doctor, I am yours to the lowest pit of hell.' Barrow (turning on his heel): 'There, my lord, I leave you.'

Barrow's theological works were published soon after his death under the editorship of Dean Tillotson, in four volumes folio (1683–9), but not because Tillotson and Abraham Hill were left by his will his literary executors; for Barrow died intestate. In fact, he had nothing to leave except his books, which were so well chosen that they were sold for more than their prime cost, their value no doubt being enhanced by the fact that they had belonged to so famous a man. Barrow's papers would naturally revert to his father, who survived him for more than ten years; and according to Mr. Ward, the old man entrusted them to the care of Tillotson and Hill, with power to print such as they thought proper. Tillotson took immense pains over his editorial labours, which extended over ten years; but one part of those labours we could certainly have very well spared. He thought it necessary to alter many words which seemed to him incorrect or obsolete, and to subdivide the sermons, so that they differ both in matter and extent from the manuscript copies. Tillotson's edition was reissued in three folio volumes in 1716, 1722, and 1741. Editions were published by the Clarendon Press in 1818 and 1830, and another by the Rev. James Hamilton at Edinburgh in 1841–2. Mr. Hughes published a further edition in 1830, omitting Barrow's learned quotations, and adding summaries of the discourses. But by far the best, indeed the only complete edition, is that which was prepared for the syndics of the Cambridge University Press by the Rev. A. Napier in 1859. Here at last we have the true text restored from Tillotson's 'improvements,' the acquisition of Barrow's manuscripts by Trinity College enabling the accomplished editor to effect the restoration. There is a scholarly preface, which contains, among other things, the best bibliography of Barrow's theological works which is extant. An unpretending little work, entitled 'The Beauties of Barrow,' by B. S., Esq., barrister-at-law, 1846, is worth notice as giving, in 274 very short pages, well-chosen specimens of Barrow's style, which may be acceptable to the reader who has not time to wade through nine or ten octavo volumes. It is satisfactory to learn that Barrow's father received from Brabazon Aylmer, the bookseller, for the copyright of his son's theological works, 470*l*. It should be added that the sermons published under Barrow's name by Dr. (afterwards Bishop) Prince Lee were not, in the opinion of Dr. Whewell and Mr. Napier (two excellent judges), really Barrow's.

Whewell published an edition of Barrow's mathematical works in 1860. They include 'Euclidis Elementa' (1655); 'Euclidis Data' (1657); 'Mathematicæ Lectiones' (1664–6); 'Lectiones Opticorum Phænomenωn' (1669); 'Lectiones Opticæ et Geometricæ' (1669, 1670, 1674); 'Archimedis Opera;' 'Apollonii Conicorum lib. iv.;' 'Theodosii Sphærica nova methodo illustrata et succincte demonstrata' (1675); 'Lectio in qua Theoremata Archimedis de sphæra et cylindro per methodum indivisibilium investigata . . . exhibentur' (1678). All these were written in Latin, but some of them have been translated by Messrs. Kirby and Stephen and others. Barrow's Latin poems, 'Opuscula,' are included in the ninth volume of Mr. Napier's edition.

[Barrow's life has never been fully written, and his theological works have, until the present day, been most imperfectly edited. A very brief life was written immediately after his death by Abraham Hill, in the form of a letter to Tillotson. It is racily written, and accurate as far as it goes, but too brief. There is a life of Barrow in Ward's 'Lives of the Gresham Professors,' but there he only figures as one of a multitude. Another life was prefixed by the Rev. T. S. Hughes to his edition of Barrow's theological works in 1830. The writer laments that so little has been written about so great a man, and purposes to supply the want; but his 'Life' amounts to little more than a repetition of Hill, swelled out with a large amount of padding. Dr. Pope tells us much about Barrow in his life of Seth Ward; but, unfortunately, he is very inaccurate. By far the best narrative of Barrow's life is to be found in the Davy MSS. in the British Museum (to which the present writer's attention

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was kindly directed by the Rev. A. B. Grosart, D.D.). And finally, there is a most admirable 'notice of Barrow's life and academical times,' written by one of his greatest successors at Trinity, Dr. Whewell, and prefixed to the ninth volume of Napier's edition of Barrow's theological works. With such a paucity of materials, it is no wonder that inaccuracies have crept into many of the biographical notices of Barrow. To take one instance out of many: he is absurdly said to have resigned his *Gresham* professorship in favour of Newton, instead of the Lucasian.]

J. H. O.

BARROW, JOHN (*fl.* 1756), geographical compiler, died at the end of last century. His first work was a geographical dictionary, which was published in London anonymously, as was also (in 1756) the first edition of his principal work, 'A Chronological Abridgment or History of the Discoveries made by Europeans in the different parts of the world.' The second edition of the latter compilation appeared in 1765, and was so successful that in the year following a French translation, by Targe, was published at Paris, in twelve volumes. In his introduction Barrow shows a considerable acquaintance with astronomical geography, so far as relates to the finding of latitude and longitude by the stars. The French translation seems to have had more repute than the original work, but even in France Barrow's 'History of Discoveries' was in a few years superseded by that of the Abbé Prévost. The voyages selected by Barrow are those of Columbus, V. de Gama, Cabral, Sir F. Drake, Sir W. Raleigh, Sir T. Cavendish, Van Noort, Spelbergen, Tasman, Dampier, Wafer, Rogers, Ulloa, Lord Anson, Ellis, and others.

[Barrow's Works.] R. E. A.

BARROW, SIR JOHN (1764–1848), secretary of the admiralty, was born at the village of Dragley Beck, near Ulverston, in a small thatched cottage, still standing, which had been in his mother's family nearly two hundred years. It faces seawards, is of one story, and may be identified by the motto, 'Parum sufficit,' over the door. Almost as the visitor leaves this humble dwelling, he sees before him, to the north-east of Ulverston, on a bold thyme-covered bluff, 417 feet above the sea, called the Hill of Hoad, a round tower 100 feet high, conspicuous from the Leven estuary, and commanding a view of the chief heights of the lake district and Yorkshire. The cottage testifies to Sir John Barrow's lowly origin, the monument to the honour in which he was held by his countrymen when he died. Educated at the Town Bank Grammar School at Ulverston, the master of which was 'an old gouty gentleman named Ferdinand Hodgson, usually called Fardy by the boys,' who had the good sense to discern his pupil's merits, he was taught mathematics by 'a sort of perambulating preceptor, who used to pay an annual visit of about three months.' A son of the Robert Walker whom Wordsworth immortalised succeeded to the mastership, and helped young Barrow to his first step in life by recommending him to assist in the survey of Conishead Priory. The knowlege thus gained he utilised some years later in his first contribution to the press, in which he explained the practical use of a case of mathematical instruments. Five or six of the upper boys of the school subscribed to purchase a celestial globe and a map of the heavens, and he never let a starlight night pass without observing the constellations. In return for instruction given in mathematics he was taught navigation by a midshipman. He fell in with an account of Benjamin Franklin's electrical kite, and, by means of a schoolboy's kite, obtained abundance of sparks, and gave a shock to an old woman who came to see what he was about. She spread a report that he was no better than he should be, for he was bringing fire down from heaven. The alarm ran through the village, and at his mother's request he laid aside the kite. By an old farmer named Gibson—a 'wise man' and 'self-taught mathematician and almanack maker'—he was helped in his mathematical difficulties, of which he tells a curious story. For two days and nights he had been puzzling over a problem in Simson's 'Conic Sections.' Another night he fell asleep with his brain still at work on the problem. In his dreams he went on with it, so that next morning he easily sketched with pencil and slate the correct solution. His parents wished him to enter the church; but when he was fourteen he accepted an offer of a three years' engagement as timekeeper in a Liverpool ironfoundry, and in the last year of his engagement was offered a partnership by his employer, who, however, immediately afterwards died. While in Liverpool he saw Mrs. Siddons act in a farce, and displayed his instinctive love of adventure by begging for a place in a balloon, which Leonardi, the proprietor, said was the first to ascend in England with a human freight. Captain Potts, his late employer's friend, now offered to take him a voyage in a Greenland whaler, where he took part in the chase, and brought home a couple of jawbones, which were set up as gateposts close to his parents' cottage. In this voyage he learned what it was to be

he avoids . . . philosophical meditation on the origin and relationships of living beings. Paleontology is for him a chronology of organic life, as exact as possible . . . for the use of the geologist." When Barrois undertook the unrewarding but useful task of translating into French the five large volumes of Zittel's *Handbuch der Palaeontologie* (1883–1894), he made it difficult for others to publish treatises on paleontology that openly praised theories of evolution. Although he wrote "All scientific effort broadens our freedom of action," he was inhibited from speaking freely by his religious convictions: he and his friend Albert de Lapparent had been among the militants of what he called the Catholic party. He did not scorn honors and became a corresponding member of numerous academies; although not a resident of Paris, he was successful in being elected a titular member of the Académie des Sciences, after several defeats. During the last year of his life the pope made him a member of the Pontifical Scientific Academy.

Barrois was one of the last geologists to be *complet,* as Pruvost put it—that is, to be capable of carrying his research almost to perfection in both the field and the laboratory, whether the research was paleontological or petrographic. Barrois would have been outstanding among geologists had he been a bit more daring and had he had more of a feeling for synthesis.

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I. Original Works. A list of Barrois's scientific works includes 268 titles, of which twenty-five are geological maps; it may be found on pp. 251–262 of Pruvost's article in *Bulletin de la Société géologique de France* (see below). His principal works are *Recherches sur le terrain crétacé supérieur de l'Angleterre et de l'Irlande,* his thesis (Paris, 1876), *Mémoires de la Société géologique du Nord de la France,* **1;** "Mémoire sur le terrain crétacé des Ardennes . . .," in *Annales de la Société géologique du Nord de la France,* **5** (1878), 227–287; *Recherches sur les terrains anciens des Asturies et de la Galice, Mémoire de la Société géologique du Nord de la France,* **2** (1882); *Mémoire sur la faune du Calcaire d'Erbray (Loire-inférieure), Mémoire de la Société géologique du Nord de la France,* **3** (1889); "Mémoire sur la constitution géologique du Sud de l'Andalousie . . .," in *Académie des sciences, Mémoires des savants étrangers,* 2nd ser., **30** (1889), 79–169, written with Albert Offret; "Étude des strates marines du terrain houiller du Nord," in *Gîtes minéraux de la France* (1912), pt. 1; "Description de la faune siluro-dévonienne de Liévin," in *Mémoires de la Société géologique du Nord de la France,* **6,** fasc. 2 (1922), 67–223, written with P. Pruvost and Georges Dubois; and "Les grandes lignes de la Bretagne," in *Livre jubilaire de la Société géologique de France* (1930), pp. 83 ff.

II. Secondary Literature. Barrois's pupil and friend Pierre Pruvost analyzed the man and his work in *Bulletin de la Société géologique de France,* 5th ser., **10** (1950), 231–262, with a portrait. Charles Jacob attempted a sketch of the social milieu in which Barrois lived in *Obituary Notices of Fellows of the Royal Society,* **5** (1947), 287–293, with a portrait.

Franck Bourdier

BARROW, ISAAC (*b.* London, England, October 1630; *d.* London, 4 May 1677), *geometry, optics.*

Barrow's father, Thomas, was a prosperous linen-draper with court connections; his mother, Anne, died when Isaac was an infant. A rebel as a dayboy at Charterhouse, Barrow came later, at Felsted, to accept the scholastic disciplining in Greek, Latin, logic, and rhetoric imposed by his headmaster, Martin Holbeach. In 1643, already as firm a supporter of the king as his father was, he entered Trinity College, Cambridge, as pensioner. There he survived increasingly antiroyalist pressure for twelve years, graduating B.A. in 1648, being elected a college fellow (1649), and receiving his M.A. (1652), the academic passport to his final position as college lecturer and university examiner. In 1655, ousted by Cromwellian mandate from certain selection as Regius professor of Greek (in succession to his former tutor, James Duport), he sold his books and set out on an adventurous four-year tour of the Continent. On his return, coincident with the restoration of Charles II to the throne in 1660, he took holy orders and was promptly rewarded with the chair previously denied him. In 1662 he trebled his slender income by concurrently accepting the Gresham professorship of geometry in London and acting as locum for a fellow astronomy professor; he was relieved of this excessive teaching load when, in 1663, he was made first Lucasian professor of mathematics at Cambridge.

During the next six years, forbidden by professorial statute to hold any other university position, Barrow devoted himself to preparing the three series of *Lectiones* on which his scientific fame rests. In 1669, however, increasingly dissatisfied with this bar to advancing himself within his college, he resigned his chair (to Newton) to become royal chaplain in London. Four years later he returned as king's choice for the vacant mastership of Trinity, becoming university vice-chancellor in 1675. Barrow never married and, indeed, erased from his master's patent the clause permitting him to do so. Small and wiry in build, by conventional account he enjoyed excellent health, his early death apparently being the result of an

overdose of drugs. He was remembered by his contemporaries for the bluntness and clarity of his theological sermons (published posthumously by Tillotson in 1683–1689), although these were too literary and long-winded to make him a popular preacher. His deep classical knowledge resulted in no specialized philological or textual studies. Although he was one of the first fellows of the Royal Society after its incorporation in 1662, he never took an active part in its meetings.

As an undergraduate, Barrow, like Newton a decade later, endured a traditional scholastic course, centered on Aristotle and his Renaissance commentators, which was inculcated by lecture and examined by disputation; but from the first he showed great interest in the current Gassendist revival of atomism and Descartes's systematization of natural philosophy. (His 1652 M.A. thesis, *Cartesiana hypothesis de materia et motu haud satisfacit praecipuis naturae phaenomenis,* is based on a careful study of Descartes and Regius.) That, also like Newton, he mastered Descartes's *Géométrie* unaided is unlikely. The elementary portion of Euclid's *Elements* was part of Barrow's college syllabus, but some time before 1652 he went on to read not only Euclidean commentaries by Tacquet, Hérigone, and Oughtred, but also more advanced Greek works by Archimedes and possibly Apollonius and Ptolemy. His first published work, his epitomized *Euclidis Elementorum libri XV* (probably written by early 1654), is designed as a quadrivium undergraduate text, with emphasis on its deductive structure rather than on its geometrical content, its sole concessions to contemporary mathematical idiom being its systematic use of Oughtred's symbolism and a list "ex P. Herigono" of numerical constants relating to inscribed polyhedra. To its reedition in 1657, Barrow added a similar epitome of Euclid's *Data,* and in his 1666 Lucasian lectures expounded a likewise recast version of Archimedes' method in the *Sphere and Cylinder;* a full edition, in the same style, of the known corpus of Archimedes' works, the first four books of Apollonius' *Conics,* and the three books of Theodosius' *Spherics* appeared in 1675. Overloaded with marginal references, virtually bare of editorial amplification, and fussy in their symbolism, these texts can hardly have been easier to read than their Latin originals, and only the conveniently pocket-sized *Euclid* reached a wide public. Barrow himself commented that his Apollonius had in it "nothing considerable but its brevity." His early attempt at a modern approach to Greek mathematics was a short, posthumously edited *Lectio* in which he analyzed the Archimedean quadrature method in terms of indivisibles on the style of Wallis' *Arithmetica infinitorum.*

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Barrow's Gresham inaugural, still preserved, tells little of the content of his lost London lectures: perhaps they were similar to works of his on "Perspective, Projections, Elem^{ts} of Plaine Geometry" mentioned by Collins. The first of his Lucasian series, the *Lectiones mathematicae* (given in sequence from 1664 to 1666), discourse on the foundations of mathematics from an essentially Greek standpoint, with interpolations from such contemporaries as Tacquet, Wallis, and Hobbes (usually cited only to be refuted). Such topics as the ontological status of mathematical entities, the nature of axiomatic deduction, the continuous and the discrete, spatial magnitude and numerical quantity, infinity and the infinitesimal, and proportionality and incommensurability are examined at length. Barrow's conservatism reveals itself in his artificial preservation of the dichotomy between arithmetic and geometry by classifying algebra as merely a useful logical (analytical) tool which is not a field of mathematical study in itself. The *Lectiones geometricae* were, no doubt, initially intended as the technical study of higher geometry for which the preceding course had paved the way, and the earlier lectures may indeed have been delivered as such.

About 1664, having heard (as he told Collins) that "Mersennus & Torricellius doe mencõn a generall method of finding y^{e} tangents of curve lines by composition of motions; but doe not tell it us," he found out "such a one" for himself, elaborating an approach to plane geometry in which the elements were suitably compounded rotating and translating lines. In his first five geometrical lectures he took some trouble to define the uniformly "fluent" variable of time which is the measure of all motion, and then went on to consider the properties of curves generated by combinations of moving points and lines, evolving a simple Robervallian construction for tangents. Later lectures (6–12), evidently thrown together in some haste, are in large part a systematic generalization of tangent, quadrature, and rectification procedures gathered by Barrow from his reading of Torricelli, Descartes, Schooten, Hudde, Wallis, Wren, Fermat, Huygens, Pascal, and, above all, James Gregory; while the final *Lectio,* 13, is an unconnected account of the geometrical construction of equations. We should (despite Child) be careful not to overemphasize the originality of these lectures: the "fundamental theorem of the calculus," for example, and the *compendium pro tangentibus determinandis* in *Lectio 10* are, respectively, restylings, by way of propositions 6 and 7 of Gregory's *Geometriae pars universalis* (1668), of William Neil's rectification method (in Wallis' *De cycloide,* 1659) and of the tangent algorithm thrashed out by Descartes and Fermat in their 1638

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correspondence (published by Clerselier in 1667). In theory, as Jakob Bernoulli argued in 1691, Barrow's geometrical formulations could well have been the basis on which systematized algorithmic calculus structures were subsequently erected; but in historical fact the *Lectiones geometricae* were little read even by the few (Sluse, Gregory, Newton, Leibniz) qualified to appreciate them, and their impact was small. Perhaps only John Craige (1685) based a calculus method on a Barrovian precedent, and then only in a single instance (*Lectio 11*,1).

Barrow's optical lectures, highly praised on their first publication by Sluse and James Gregory, had an equally short-lived heyday, being at once rendered obsolete by the Newtonian *Lectiones opticae,* which, both in methodology and in subject matter, they inspired. In his introduction he lays down the scarcely novel mechanical hypothesis of a lucid body (a "congeries corpusculorum ultra pene quam cogitari potest minutorum" or "collection of particles minute almost beyond conceivability") as the propagating source of rectilinear light rays. His hypothesis of color (in *Lectio 12*) as a dilution in "thickness" and swiftness, of white light through red, green, and blue to black, is no less shadowy than the Cartesian explanation to which it is preferred. Structurally, the technical portion of the *Lectiones* is developed purely mathematically from six axiomatic "Hypotheses opticae primariae et fundamentales [seu] leges . . . ab experientiâ confirmatae," notably the Euclidean law of reflection and the sine law of refraction, and presents a reasonably complete discussion of the elementary catoptrics and dioptrics of white light. Not unexpectedly, the organization and mathematical detail are Barrow's, but his topics are mostly taken from Alhazen, Kepler, Scheiner, Descartes, and others: thus, his improvement of the Cartesian theory of the rainbow (*Lectio 12*, 14) derives from Huygens by way of Sluse. The most original contributions of the work are his method for finding the point of refraction at a plane interface (*Lectio 5*, 12) and his point construction of the diacaustic of a spherical interface (*Lectio 13*, 24): both were at once subsumed by Newton into his own geometrical optics, and the latter (in ignorance) was triumphantly rediscovered by Jakob Bernoulli in 1693.

Barrow's relationship with Newton, although of considerable historical importance, has never been clarified. That Newton was Barrow's pupil at Trinity is a myth, and Barrow's name does not appear in the mass of Newton's extant early papers; nor is there good evidence for supposing that any of Newton's early mathematical or optical discoveries were in any way due to Barrow's personal tutelage. In his old age, the furthest that Newton would go in admitting a mathematical debt to Barrow was that attendance at his lectures "might put me upon considering the generation of figures by motion, tho I not now remember it." It may well be that Barrow came to know Newton intimately only after his election to senior college status in 1667. Certainly by late 1669 there was a brief working rapport between the two which, if it did not last long, at least resulted in Newton's consciously choosing to continue the theme of his predecessor's lectures in his own first Lucasian series.

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D. T. WHITESIDE

BARRY, MARTIN (*b.* Fratton, Hampshire, England, 28 March 1802; *d.* Beccles, Suffolk, England, 27 April 1855), *embryology, histology*.

Barry was trained for a career in his father's Nova Scotia-based mercantile concern, which sent ships to various parts of North America and the West Indies. After a short time in business, Barry began medical studies to prepare himself for work in science. Before receiving the M.D. at Edinburgh in 1833 he studied medicine at London, Paris, Erlangen, and Berlin. After graduation he specialized in anatomy and physiology for about a year under Friedrich Tiedemann at Heidelberg. On his return to Edinburgh, Barry attended the Royal Infirmary to further his medical knowledge.

Since he had a private income, Barry never had to practice medicine and did not hold any permanent appointment. As a result, he was able to divide his residency between Scotland, England, and Germany. In 1843 he presented a course of physiological lectures at St. Thomas' Hospital, London. The following year Barry became house surgeon at the new Royal Maternity Hospital, Edinburgh, and made observations on the position of the fetus both before and during delivery. These observations were noted by Sir James Young Simpson in various papers. Barry had a partiality for his obstetric work, of which Simpson spoke highly, but he soon had to resign this position because of recurring ill health.

Barry received the Royal Society's Royal Medal in 1839 for his 1838 and 1839 papers on embryology, and the following year was elected a fellow of the Royal Society. Other societies in which he was active were the Royal Society of Edinburgh and the Wernerian Society.

In 1835 Barry began to study the embryological literature, having been led into microscopical researches by an embryological work given to him by Robert Jameson. This was soon after K. E. von Baer and his fellow workers in Germany had stimulated the study of embryology. His interest in embryology led him into general histological studies at about the time that the cell theory was being formulated. The bulk of microscopic research was then being published in German, and Barry was one of few British scientists interested in and conversant with the German microscopic literature of the 1830's and 1840's.

Barry's first embryological paper was "On the Unity of Structure in the Animal Kingdom," in which he started from the assumption that all of nature is part of the same grand design. Barry recognized that the germ cells of several species of animals were essentially the same and that there is a general law directing the development of animal structure from a homogeneous or general state to a heterogeneous or special one. He adapted his description of the general development of animals from Baer, on whom he relied quite heavily.

In 1837 Barry was in Germany again, this time using the facilities of Johannes Müller, C. G. Ehrenberg, Rudolph Wagner, and Theodor Schwann. After his return to England he presented his results to the Royal Society as "Researches in Embryology" (1838–1840). In this three-part series Barry tried to follow the history of the mammalian ovum from its first appearance within the ovary through its early stages of development. His numerous observations (mostly on rabbits) resulted in a series of descriptions and illustrations (drawn by himself) that give a good account of that development.

Barry made two notable embryological observations: the segmentation of the yolk in the fertilized mammalian ovum and the penetration of the spermatozoon into the mammalian ovum. In 1839 he pictured the two-, four-, eight-, and sixteen-cell stages in mammals and described as similar to a mulberry that stage which Ernst Haeckel later named the morula. Barry concluded that the process he described

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