

THE NORWICH SCHOOL OF LITHOTOMY

by

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A NOTABLE CHAPTER in the long history of human bladder stone has been contributed from Norwich and its county of Norfolk and this came about for several reasons. The main reason was that Norfolk enjoyed the unenviable reputation during the latter part of the eighteenth and throughout the nineteenth centuries of having the highest incidence of bladder stone among its inhabitants of any county in Great Britain. As a result of this high prevalence of bladder stone a local tradition of surgical skill in the art of lithotomy emerged and when the first general hospital in Norfolk, the Norfolk and Norwich Hospital was founded in 1771–2 there were appointed to its surgical staff local surgeons who were most experienced lithotomists. Their skill was passed on to those who followed them and earned for the hospital a European reputation for its standards of lithotomy. Sir Astley Cooper¹ when at the height of his professional fame and influence in 1835 spoke of these standards as follows, 'the degree of success which is considered most correct [for lithotomy] is that taken from the results of the cases at the Norfolk and Norwich Hospital'.² There were not only able lithotomists on the early staff of the Norfolk and Norwich Hospital but also physicians who wrote on the medical aspects of bladder stone with special reference to the problems of incidence and chemical analysis. These writings were based on the registers of admissions to the hospital which were kept from the hospital's inception. The keeping of a hospital register was an uncommon practice at the turn of the eighteenth century as is revealed by Alexander Marcet³ in a monograph on calculous disease of the urinary tract which he published in 1817. Marcet wrote 'In my enquiries I have met with great disappointments . . . it will appear scarcely credible that in the larger hospitals in London, St. Bartholomew's, St. Thomas's, Guy's and the London Hospital, no regular or at least no ostensible records of the cases of lithotomy which occur in them should be preserved. It is with great pleasure, however, that I am enabled to mention one striking exception to this unaccountable oversight in public hospitals. The Norfolk and Norwich Infirmary [Hospital] in this and several other respects, stands as a model of regularity and good management'.⁴ The final reason for Norwich and Norfolk acquiring their reputation in the field of bladder stone is that from the foundation of the Norfolk

¹ Sir Astley Cooper (1768–1841) was born at Brooke, seven miles from Norwich. He was a pupil at the Norfolk and Norwich Hospital and maintained an association with the hospital throughout his life. A. Batty Shaw, 'Astley Cooper, his Norfolk origins and associations', *Guy's Hosp. Rep.*, 1968, 117, 169–92.

² Sir A. Cooper, *Lectures on the Principles and Practice of Surgery*, 8th ed., London, J. T. Cox & E. Portwine, 1835, pp. 309–13.

³ Alexander Marcet (1770–1822), born in Geneva, was physician to Guy's Hospital from 1804–19. An account of his life and work has been given by N. G. Coley, 'Alexander Marcet (1770–1822) physician and animal chemist', *Med. Hist.*, 1968, 12, 394–402.

⁴ A. Marcet, *An Essay on the Chemical History and Medical Treatment of Calculous Disorders*, London, Longman, 1817, pp. 22–36.

and Norwich Hospital all the bladder stones that were removed in its practice were preserved. Many other hospitals at this time made collections of bladder stones, as did individual surgeons, but the collection at Norwich achieved a special reputation as it contained all the stones removed at one hospital in an area where the incidence of bladder stone was high. Jean Civiale of Paris described it in 1838 as 'la belle et riche collection de Norwich'⁵ and Sir Henry Thompson of University College Hospital, one of the leading European urologists of his day⁶ wrote of it in 1863 as 'the most perfect and complete record, literally graven in stone, that the world possesses of calculous experience'.⁷ The passage of the nineteenth century saw the revolution brought about by the introduction of anaesthesia and antisepsis together with other advances in medical science. Surgical techniques changed and the classical operation of lateral lithotomy for the removal of bladder stones was succeeded by lithotrity, litholapaxy and suprapubic cystolithotomy. But throughout the nineteenth century Norwich maintained its reputation as a leading centre in the practice of the surgery of bladder stone until at the beginning of the twentieth century the epidemic of bladder stone which had affected Norfolk for at least two centuries ended for a reason not understood at the time and still defying accurate scientific explanation.

The purpose of this essay is to give an account of the history of bladder stone in Norfolk beginning with the records of the seventeenth and early eighteenth centuries. These provide a number of illustrations of the changing practice in the management of bladder stones and a background to an account of bladder stone at the Norfolk and Norwich Hospital from its opening in 1772 until such stones disappeared from Norfolk in approximately 1909. The account of bladder stones in Norfolk between 1772–1909 is based on the registers of the cases which were operated on at the hospital during this period. These registers have survived together with the hospital's collection of bladder stones from approximately fifteen hundred cases which occurred in the practice of the hospital during the same period. It was for its contribution between 1772–1909 that the Norfolk and Norwich Hospital achieved its greatest fame in bladder lithology and for which the name used as a title to this paper, 'The Norwich School of Lithotomy', has been proposed. The title is deemed appropriate for a contribution to the study of bladder stone in Great Britain which was as important as that of its contemporary, 'The Norwich School of Painting', to landscape painting in the history of British art.

BLADDER STONE IN NORFOLK IN THE SEVENTEENTH CENTURY

In the seventeenth century Norfolk was among the most prosperous of the English counties. Its farmers produced large quantities of corn and reared sheep; a further source of prosperity was its weaving industry. Through the ports of King's Lynn and Great Yarmouth a rich sea-borne trade, greater than that of London, was conducted with the great cities of the Low Countries.⁸ Norwich was the centre of a thriving province, its ecclesiastical capital and probably still the second largest city in the

⁵ J. Civiale, *Traité de l'Affection calculeuse*, Paris, Crochard, 1838, p. 686.

⁶ Sir Zachary Cope, *The Versatile Victorian, being the Life of Sir Henry Thompson, Bt., 1820–1904*, London, Harvey & Blythe, 1951.

⁷ H. Thompson, *Practical Lithotomy and Lithotrity*, London, Churchill, 1863, p. 243.

⁸ N. Riches, *The Agricultural Revolution in Norfolk*, 2nd ed., London, Frank Cass, 1967, chapters 1, 6 and 7.

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realm after London⁹ as it had been since the Middle Ages.¹⁰

Isolated accounts of bladder stone in East Anglia can be traced prior to the seventeenth century but it is in this century that the first reliable accounts are to be found. Most cases of bladder stone went unrecorded for, as in the rest of England and throughout Europe, the treatment of bladder stone was then largely in the hands of those who administered quack medicines or who practised as strolling lithotomists. The surgery of bladder stone was both dangerous in its execution and uncertain in its results and most qualified surgeons were glad to obey the injunction of Hippocrates that surgeons should abstain from lithotomy. But lithotomy was not entirely the preserve of unqualified surgeons, often swine-gelders, at this time. Fabricius Hildanus¹¹ published at Basle at the beginning of the seventeenth century a work on bladder stone describing the five different types of operation which qualified surgeons then carried out for stone and which were practised in the main centres of Germany, Italy, France and Switzerland.¹² The contemporary position in England is illustrated by the practice of St. Bartholomew's and St. Thomas's Hospitals, then London's only two general hospitals. In 1612 the Governors of St. Bartholomew's Hospital felt it their duty not to deny to the poor for whom they cared the relief which a lithotomy could provide and in that year appointed the first of a succession of lithotomists to the hospital, the appointment being distinct from and additional to the appointment of surgeon.¹³ At St. Thomas's Hospital there was also a separate office of 'cutter for stone' which could be held other than by a surgeon on the hospital's staff until 1705.¹⁴ A surgeon to St. Thomas's Hospital, Thomas Hollyer,¹⁵ considered to be the most experienced operator of his day in London, performed a lithotomy on Samuel Pepys in 1658. This operation was performed in a private house when Pepys was twenty-four years of age and a stone the size of a tennis ball was removed from his bladder.¹⁶ The successful outcome of this operation was the exception rather than the rule and even such an experienced lithotomist as Hollyer who performed thirty-four lithotomies at St. Thomas's Hospital in 1661 lost a number of his cases from haemorrhage and infection. But these examples illustrate that the surgery of bladder stone was passing into the hands of qualified and reputable surgeons.

In the seventeenth century Norwich had no hospitals other than the charitable and religious institutions known by that name which cared for the poor and infirm. There are therefore no records from local hospitals in the modern sense of the word which are available for examination. But in its civic records Norwich possesses an account of a series of bladder stone patients treated by lithotomy which is thought to be unique in Great Britain. This series appears in the civic records because throughout

⁹ W. G. Hoskins, *Local History in England*, London, Longmans, 1959, pp. 177–8.

¹⁰ P. Ziegler, *The Black Death*, London, Collins, 1969, pp. 119, 170.

¹¹ E. W. P. Jones, 'The life and works of Guilihelmus Fabricius Hildanus (1560–1634)', *Med. Hist.*, 1960, 4, 112–34, 196–209.

¹² G. Fabricius Hildanus, *Lithotomia vesicae*, trans. into English by N. C. London, W. Harris, 1640.

¹³ N. Moore, *The History of St. Bartholomew's Hospital*, London, Pearson, 1918, 2 vols., vol. 2, pp. 736–8.

¹⁴ F. G. Parsons, *The History of St. Thomas's Hospital*, London, Methuen, 1934, 3 vols., vol. 2, p. 151, though the first recorded lithotomy at the hospital was performed by John Molins one of the surgeons, in 1621 (*ibid.*, p. 30).

¹⁵ Thomas Hollyer also held the appointment of lithotomist to St. Bartholomew's Hospital.

¹⁶ Sir D'Arcy Power, 'Some bygone operations in surgery. IV. An historical lithotomy: Mr. Samuel Pepys', *Brit. J. Surg.*, 1931, 18, 541–5.

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the seventeenth century it was the responsibility of a city's aldermen to supervise the care of the sick and poor in their wards and the records refer to various medical needs in addition to that of bladder stone. These records survive in the Mayor's Court Books of the City of Norwich and were first referred to by Crosse¹⁷ and Beverley¹⁸ both surgeons to the Norfolk and Norwich Hospital in the nineteenth century. In 1903 the series was published by Williams,¹⁹ who was also a surgeon to the Norfolk and Norwich Hospital, and it comprises thirty-two entries of patients, usually boys, suffering with bladder stone and treated under the aegis of the aldermen between 1593 and 1682. A representative entry is as follows:²⁰

18 May 1616. It is ordered that Mr. Mayhew shall have £4 for cutting of Clere's child, and of one John Collins of the disease of the stone whereof 20s. for Clere's child is to be paid by the parish of St. Stephen, 20s. to be presently paid by the parish of St. Andrew, and the residue to be paid out of Hospital (the Great Hospital) upon perfecting the cure. 20s. more is appointed to be paid by the parish of St. Andrew, and is ordered the same to be equally paid and divided between two women who shall have the keeping of the said children.

The procedure for the care of these patients with bladder stone was that an alderman would first present the case to his Court. If the Court was then satisfied of the need for treatment it would authorize the alderman to seek permission from the Bishop of Norwich for a collection to be made in the parish church of the ward, by a house to house collection, or in the case of the poorer wards for a collection in the parish churches of neighbouring wards. The money having been collected it was then usually presented by the Mayor's sword-bearer to the Court who decided how the money should be distributed between the surgeon's fee and family expenses such as linen and the after-care of the patient. The entries give the names of the Norwich surgeons of the period who undertook the lithotomies, John Hubbard, Miles Mayhew and William Rayby whose names appear in the list of members of the Guild of Barber-Surgeons of Norwich²¹ as does that of the most frequently-mentioned surgeon Gutteridge (or Goodrick), together with his son. Gutteridge was a well-known East Anglian lithotomist who first lived and practised at Bury St. Edmunds, where it was written of him that 'he has a great name for lithotomy . . . once, cutting a lad of the stone [he] took out at one time ninety-six small stones all of them of unlike shape, size, corners and sides'.²² In one of the Norwich cases requiring lithotomy in 1655 the Mayor's Court paid the boy's parents travelling expenses for them to take their son to Gutteridge at Bury St. Edmunds in order to be 'cut'.²³ Gutteridge later moved to Norwich but in 1662 was temporarily recalled to Bury St. Edmunds to remove what was to become a celebrated stone in the history of bladder lithology from the

¹⁷ J. G. Crosse, *Report of the Fourteenth Anniversary Meeting of the Provincial Medical and Surgical Association. Held at Norwich, August 19th and 20th, 1846*, Worcester, Deighton & Co., 1846, pp. 70-2.

¹⁸ M. Beverley, *Some Norfolk Medical Worthies*, privately printed, 1890, pp. 13-14.

¹⁹ C. Williams, *The Treatment of the Sick in Norwich during the Seventeenth Century*, Norwich, privately printed, 1903. Williams wrote that the entries were made in the Assembly Books of the Court of Aldermen of the City of Norwich; this is erroneous for the entries were made in the Mayor's Court Books.

²⁰ C. Williams, *ibid.*, p. 5.

²¹ C. Williams, *The Masters, Wardens and Assistants of the Gild of Barber Surgeons of Norwich from the Year 1439-1723*, Norwich, privately printed, 1900.

²² N. Fairfax, 'An account of a great number of stones, found in one bladder', *Phil. Trans. R. Soc.*, 1667, 2, 482. Nathaniel Fairfax (1637-90) was a medical divine of Woodbridge, Suffolk.

²³ C. Williams, *op. cit.* in fn. 19, p. 6.

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deceased wife of a Bury St. Edmund's locksmith. Soon after this event Charles II was on one of his visits to Newmarket, heard of the stone and its great size²⁴ and asked to be shown it. The stone was kept for many years in the library of Trinity College, Cambridge, and was later given to the Department of Pathology of Cambridge University.²⁵

No mention is made in the Norwich civic records of the type of lithotomy that was performed on the patients to whom the entries in the Mayor's Court books refer. Williams suggested that they were all operated on by the Marian operation but it is possible that the Celsian operation may have been that which was used. In essence the Celsian operation consisted of applying abdominal compression to drive the bladder stone into the pelvis, making a perineal incision and then an incision into the bladder wall over the stone and removing the stone by a hook or with the finger. It was named after Celsus who lived in Rome between 25 B.C. to A.D. 50 and was also known as the Lesser operation, Apparatus Minor or Cutting on the Gripe. Among its limitations was that it could only be undertaken in boys, but it was the only operation for bladder stone that was practised for fifteen hundred years. In 1535 Marianus Sanctus Barolitanus, a Neapolitan, described a second operation which was named after him the Marian operation, but was really the invention of his master Johannes de Romanis, and which was also known as the Greater Operation, Apparatus Major or Median Lithotomy. In this operation, which could be performed in adults as well as children, a urethral staff was used to guide the operator to the bladder neck. Through a median perineal incision, the membranous urethra was divided and then a robust pair of metal instruments, called conductors, were forced through the prostatic urethra and bladder neck which were forcibly dilated until the passage was wide enough to permit extraction of the stone. It was later called by Civiale one of the 'most terrible operations' in surgery, an ordeal alike for surgeon and patient. The mortality was high and much local damage was incurred by the urethra and bladder neck but it remained the most frequently performed operation for stone from the sixteenth until the end of the seventeenth century. It was the operation that Pepys underwent for the removal of his bladder stone and as a result of which his vasa deferentia were damaged and Pepys was rendered permanently sterile but not impotent.¹⁶ But because of the terrors of the Marian operation, the Celsian operation was still performed on children in the seventeenth century and may have been the procedure adopted for the relief of the 'poor boys' of Norwich.

The Norwich civic records refer only to the presence of stone among the poor. Among the upper classes stone was common during the seventeenth century but practically always in men and not women and virtually never in boys. As in other parts of England and in other countries of Europe many eminent men suffered with

²⁴ 34 apothecary ounces, 1057 g.

²⁵ A crack in the stone's structure was traditionally attributed to Nell Gwynne having dropped it with a scream when King Charles II put it in her hands (N. Moore, *op. cit.*, p. 738). The stone was first described by William Heberden the elder ('An account of a very large human calculus', *Phil. Trans. R. Soc.*, 1750, 46, 596–98). James Cumming, Professor of Chemistry at Cambridge University later described its chemical analysis ('Notice of a large human calculus in the library of Trinity College', *Camb. Phil. Soc. Trans.*, 1822, 1, 347–50) and a more detailed account of the stone and its history was given by R. Williamson of the Department of Pathology, Cambridge University ('An ancient urinary vesical calculus', *Centaurus*, 1956, 4, 319–24).

stone in the seventeenth century and Civiale lists the names of a number of them.²⁶ In Norfolk such a case was that of Sir Thomas Adams of Spixworth (1586–1667) who had a successful career in London as a draper, became its Lord Mayor and Member of Parliament and was made a baronet by Charles II for his services to the Royalist cause. Adams died at his country seat, Spixworth Hall, near Norwich, and an account of his suffering from stone is recorded on his tomb in the local parish church.²⁷ After his death the bladder stone was kept by his family until 1869 when his descendants presented it to St. Thomas's Hospital, of which Sir Thomas Adams had been President,²⁸ and where it remained until recent years when it had to be removed with other historical specimens when alterations were made to the hospital museum. Though Adams' home at Spixworth was only a few miles from Norwich there is no record that he ever consulted the most famous Norwich doctor of the seventeenth century, Sir Thomas Browne, about it, though Browne may have attended him for he was both medical adviser and friend to Sir Thomas Adams' son and daughter-in-law.²⁹

The writings of Sir Thomas Browne (1605–1682) provide another source of information about stone in Norfolk during the seventeenth century. Browne's patients included the poor of Norwich³⁰ and those of the upper classes whose symptoms and treatment he would often discuss by letter as exemplified in his correspondence with Sir Hamon L'Estrange of Hunstanton, the victim of a bladder stone.³¹ Browne also treated two bishops of Norwich for bladder stone, Joseph Hall, bishop from 1641–1656³² and Anthony Sparrow, bishop from 1676–1685.³³ These two bishops held office for the latter part of the period 1593–1682 which contained the thirty-two cases of bladder stone, mainly among 'poor boys' of Norwich¹⁹ and the bishops were no doubt sympathetic to the approaches from the aldermen for permission to hold collections for the relief of those in their wards suffering from bladder stone. But neither in Hall's nor in Sparrow's case, nor in others in adults which Browne discusses, is the question of operation considered—it was too dangerous. Two medical certificates which Sir Thomas Browne issued to state that Bishop Sparrow was unfit to travel by coach to London to attend official business survive in which no medical details

²⁶ J. Civiale, *op. cit.*, pp. 649–56.

²⁷ Sir Thomas Adams's marble tomb in the parish church of St. Mary and St. Margaret, Sprowston, Norwich, depicts the reclining figures of Sir Thomas and his wife. The inscription on the monument records in Latin that 'after he had completed his eighty-first year and borne with invincible patience the acute pain of the stone—which surpassed twenty five [apothecary] ounces in weight [852 g.]—he was freed from the burdens of life on 24 Feb. 1667.'

²⁸ During his Presidency of St. Thomas's Hospital, Sir Thomas Adams discovered 'the frauds of a dishonest steward' whereby he is said to have 'saved the hospital from financial ruin'. (T. Holmes, for Mr. Williams, 'Cast of a calculus which weighed twenty-five ounces, and which was removed from the bladder after death', *Trans. path. Soc. Lond.*, 1870, 21, 267–70.)

²⁹ M. Toynbee, 'Sir Thomas Browne and some of his friends', *Norfolk Archaeol.*, 1957, 31, pt. 4, 386.

³⁰ As an example one further entry from the Mayor's Court Books of the City of Norwich may be cited, '5 April 1673. David Brand's chylde of St. George Colegate is recommended to ye care of ye Aldermen of ye Warde of Colegate to cause a chyurgeon to view ye sores of ye chylde, and to discourse Sir Thomas Browne thereabouts and request his opinion of such sores as are upon it', (C. Williams, *op. cit.*, in fn. 19, p. 4).

³¹ Sir T. Browne, *The Works of Sir Thomas Browne*, edited by Sir G. Keynes, London, Faber & Faber, 1964, 4 vols., vol. 4, pp. 284–90. An account of the life of Sir Hamon L'Estrange was given by R. W. Ketton-Cremer, 'Sir Hamon L'Estrange and his sons', in his *A Norfolk Gallery*, London, Faber & Faber, 1957, pp. 56–95.

³² R. W. Ketton-Cremer, 'Bishop Hall', *ibid.*, pp. 15–36.

³³ *Idem.*, 'Bishop Sparrow' in his *Forty Norfolk Essays*, Norwich, Jarrold, 1961, pp. 44–6.

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are spared. The first dated 10 May 1679 reads 'By these I humbly certify that the Right Reverend Father in God Anthonie Lord Bishop of Norwich is now and hath been long afflicted with the stone and paynfull diseases of the bladder and urinarie parts that hee is not possibly able to endure the motion of a coach for a few miles and upon every attempt to go abroad in his coach makes bloody urine and is much payned after, so that it may hazard his life to undertake a London journey. Th. Browne, M.D.' The second certificate is similar.³⁴ Browne's therapeutic advice to patients with stone was to drink the waters at 'Tunbridge' [Tunbridge Wells] or 'Epsam' [Epsom], to give advice on diet and to prescribe medicines;³⁵ his prescriptions contained extracts of marshmallow, white water lily, cumfry, almond milk and other bland excipients.³⁶ Browne was averse to the use of the harsh medicines which were sometimes prescribed during the seventeenth century for bladder stone as is made clear in this extract from a letter dated 24 March 1677 about Goddard's Drops, a prescription which contained Sal Volatile Oleosum, or ammonium. 'Sir Edward Walpole died the last Wednesday he was buried privately upon Thursday night as he desired . . . Goddards Dropps had very ille effects gave him convulsions and a numbness that he was a most sad spectacle a Month before he died . . . Dr. Browne and all his other Phisitions was very much against his taking the Dropps and he himself was not of opinion they could do him good till the Lord Townshend advised him to take them.'³⁷

Browne, in common with many contemporary physicians, had a poor opinion of the surgeons of his day. He wrote in 1679; 'The ignorance of chirurgeons as to chirurgical operations creates so many mountebanks and stage quack-salvers. Here [Norwich] hath been a mountebank these two months who cutts for wry necks,

³⁴ Sir T. Browne, *op. cit.*, pp. 399–400.

³⁵ *Ibid.*, p. 81.

³⁶ It is of interest that these remedies are similar to those prescribed for stone by Browne's contemporary, Thomas Sydenham (1624–1689) who himself suffered from stone. (J. Swan, *The Entire Works of Dr. Thomas Sydenham*, London, E. Cave, 1742, pp. 535–8). Details of Browne's prescriptions for stone survive in his correspondence with Sir Hamon L'Estrange, fn. 31, and in the household book of the Harbord family (R. W. Ketton-Cremer, 'The Gunton household book', in his *Norfolk Assembly*, London, Faber & Faber, 1957, pp. 203–11).

³⁷ Sir Edward Walpole was Member of Parliament for King's Lynn and was knighted in 1661 for his services in promoting the restoration of Charles II. The extract is from a letter written by Judith Isham to her father Sir Justian Isham of Lamport Hall, Northampton. The letter not only refers to Sir Edward Walpole's stone but to her father's and several further cases in the L'Estrange family into which her sister had married (A. Jessopp, 'The wooing and married life of Elizabeth Lady L'Estrange née Isham', in *Norfolk Antiquarian Miscellany*, edited by W. Rye, Norwich, Agas H. Goose, 1883, vol. 2, p. 279). Though Goddard's drops were blamed for the death of Sir Edward Walpole it seems more probable that he died from uraemia. Goddard's drops were prepared by boiling down human bones and were prescribed for 'apoplexy, lethargy, vertigo, megrim headache, carus, palsies and convulsions' as well as for bladder stones (see G. Bate, *Pharmacopeia Bateana; ed. altera. Huic accesserunt Arcana Goddardiana*, London, 1691; and [English] trans. by W. Salmon. 2nd ed., London, S. Smith, 1700, pp. 135–7). There is debate whether the drops were named after Jonathan Goddard, physician to Oliver Cromwell, Professor of Physic at Gresham College and Warden of Merton College, Oxford, or his lesser contemporary William Goddard. Wootton feels that Bate, a contemporary of them both, was correct in attributing the formula of the prescription to William Goddard (A. C. Wootton, *Chronicles of Pharmacy*, London, MacMillan, 1910, 2 vols., vol. 2, pp. 170–82). According to *Munk's Roll of the Royal College of Physicians of London*, William Goddard was born in Norfolk, educated in Padua and became a Fellow of the College; he was later dismissed his Fellowship for 'refusing to attend his place in the College'. Charles II paid £1,500, some said £6,000, to Goddard for the formula of his drops. It was not unusual for monarchs to purchase from the innovators of remedies the secrets of their composition; this was to enable the contents to be published for the benefit of the monarch's subjects (A. C. Wootton, *op. cit.*, vol. 1, p. 319).

coucheth cataracts, cures hare lipp etc., which no surgeon of this place being versed in, hath had a great deal of emplyment to the shame of our chirurgeons'.³⁸ There is no reference in any of Browne's known writings to his contemporary Gutteridge or of Browne having advised lithotomy but that he was familiar with lithotomy which he called 'a great operation' is revealed in the following letter to his son Edward Browne when the latter was on a postgraduate visit to Paris in 1665, 'I am glad you have seene more cutte for the stone and of different sex and ages. If opportunitie serveth you shall doe well to see some more, wch will make you well experienced on that great operation and almost able to performe it your self upon necessite and where none could do it. Take good notice of their instruments, and at least make such a draught there of, and especially of the dilator and director, that you may hereafter well remember it and have one made by it'.³⁹ Unfortunately the letter from Edward Browne to which this was the reply has not survived⁴⁰ but it appears from Thomas Browne's account that his son had been witnessing the performance of the Marian operation. Edward Browne may have made 'draughts' of the instruments but he did not need them in later life; he became a physician like his father, was elected physician to St. Bartholomew's Hospital in 1682 and was President of the Royal College of Physicians of London from 1704 to 1708. Just over thirty years after Edward Browne paid his visit to Paris an unqualified French monk, who had developed his special technique for lithotomy, arrived on the Paris scene with the expressed intention of teaching the surgeons of the hospitals there a new method of cutting for stone. This was Frère Jacques, whose method was adopted by Rau in Holland and later altered and improved by William Cheselden in England in the early years of the eighteenth century. Lateral lithotomy, so called because a lateral incision was made through the prostate gland and bladder neck instead of their being forcibly dilated by instruments, had arrived and a new era in the treatment of bladder stone had been inaugurated.

BLADDER STONE IN NORFOLK, 1700-1772

The first forty years of the eighteenth century were a period of transition between the ideals and feuds of the Stuarts and Dr. Johnson's England, the classical *Age of Elegance* of 1740-80;⁴¹ they were also a time of transition in the treatment of bladder stone for they marked the period in which William Cheselden (1688-1752) of St. Thomas's Hospital did his work on lithotomy which culminated in the operative procedure for lateral lithotomy named after him.⁴² Later surgeons made minor modifications of technique and instruments but Cheselden's operation remained essentially unchanged for the next one hundred and fifty years when it was the

³⁸ Sir T. Browne, *op. cit.*, p. 113.

³⁹ *Ibid.*, p. 27.

⁴⁰ Sir T. Browne, *Sir Thomas Browne's Works including his Life and Correspondence*, edited by S. Wilkin, London, William Pickering; Norwich, Josiah Fletcher, 1836, 4 vols., vol. 1, p. 109.

⁴¹ G. M. Trevelyan, *English Social History*, 2nd ed., London, Longmans & Green, 1946, p. 339.

⁴² From 1720-22 Cheselden performed lithotomy by the Marian operation and from 1722-25 the high or supra-public operation re-introduced to surgery by his contemporary John Douglas—'re-introduced' for Pierre Franco of Lausanne had performed a successful supra-public lithotomy in 1561. Without anaesthesia the results of supra-pubic lithotomy (or cysto-lithotomy) were unsatisfactory and in 1725 Cheselden abandoned it for the operation of Frère Jacques over the next two years. Then in 1727 with his great knowledge of anatomy and consummate surgical skill Cheselden introduced the technique for lateral lithotomy named after him (Sir Z. Cope, *William Cheselden*, Edinburgh and London, E. & S. Livingstone, 1953, pp. 19-30).

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standard procedure for the removal of bladder stone. But both in London and the provinces it took time before Cheselden's method was generally adopted. No contemporary could match his surgical skill and lithotomy was a hazardous operation when performed by most surgeons of the day.⁴³ Since lithotomy was so hazardous the medical treatment of stone still had its advocates and with advances in chemistry this was now attempted on a scientific basis. The story of bladder stone in Norfolk during the first seventy years of the eighteenth century contains accounts of the use of lithonryptics but the main theme was the gradual adoption of Cheselden's method of lateral lithotomy. In 1700 the treatment of stone was little changed from that practised in the days of Sir Thomas Browne; by 1772, when the Norfolk and Norwich Hospital opened, all the early cases of stone were treated by Cheselden's operation. Many factors in addition to the work of Cheselden contributed to this change. The education and training of doctors improved, the teaching of John Hunter (1728–90) placed surgery on a scientific basis and the building of a local hospital in Norwich reflected the humanitarian and philanthropic movement of the eighteenth century with its concern for the needs of the sick and the poor.

At the beginning of the century the Reverend Thomas Prideaux, Dean of Norwich Cathedral, developed symptoms of bladder stone; these symptoms he described in all their painful detail in a diary which is preserved in the Muniment Room of the cathedral he served so well. When Prideaux first fell ill he was advised that an operation for the removal of his stone was too dangerous but his symptoms later became so severe that in 1711 Prideaux decided that the risk would have to be taken. Five pages of his diary record the instructions given and the preparations made should he die under the operation. This was performed in the Dean's house in the Close by John Salter, lithotomist and surgeon to St. Bartholomew's Hospital from 1696–1721⁴⁴ and a stone the size of a 'sheep's kidney' was successfully removed in less than three minutes: Salter returned to London a week later entrusting Prideaux's care to Mr. Pell, one of his former students at St. Bartholomew's Hospital who was in practice in Norwich.⁴⁵ The Dean's later progress was unsatisfactory and after twelve months he recorded that he was 'suffering as much as he had before the stone'. A consultation was arranged with Salter in London where Prideaux was conveyed by a litter; Salter found, according to Prideaux, 'that the urethra was destroyed thro' [the] said Mr. Pell having rip'd it up instead of a sinus thereby ruined his patient'. After three

⁴³ It was considered so dangerous that at Guy's Hospital, founded in 1726, all its early surgeons had to obtain the permission of the hospital's governors before they could perform a lithotomy and by no means all of them ventured to seek permission (H. C. Cameron, *Mr. Guy's Hospital 1726–1948*, London, Longmans & Green, 1954, p. 103).

⁴⁴ N. Moore, *op. cit.* p. 631, 737.

⁴⁵ John Pell, son of a Norwich apothecary, was Sheriff of Norwich in 1722 and Mayor in 1730 (B. Cozens-Hardy and F. A. Kent, *The Mayors of Norwich, 1403–1835*, Norwich, Jarrold, 1938, p. 118). In 1710, the year prior to Dean Prideaux's operation, Pell placed the following advertisement in a Norwich newspaper, 'Lythotomy being supposed here as distinct from Surgery, and I being thought one of those Surgeons that do not cut for the stone, do find myself obliged from that consideration as well as from the Persuasion of my Friends to make this Public Declaration for the benefit of miserable Mankind, that all who are afflicted with the stone may by my cutting them (and by the Divine Blessing) be cured of the same, I having had the good fortune to be instructed in that dangerous and difficult operation of Cutting for the Stone by the Great Mr. Salter of London, the most Ingenious and Successful lythotomist now in England. Note—All that are truly poor may have advice and be cut gratis by me, John Pell', (C. Williams, *Medical Advertisements in Norwich Newspapers*, Norwich, privately printed, 1901, p. 7).

months' treatment from Salter, Prideaux returned to Norwich 'in a very miserable condition . . . without any hope of having a remedy'. Prideaux was in no doubt that Pell was responsible for his perineal fistula but it is possible that the urethra may have been damaged when Salter operated in pre-Cheselden days by the Marian operation. Prideaux's personal account of what he termed 'the calamitous distemper of the stone' provides a vivid picture of the suffering that a stone victim might endure and is given in some detail to illustrate this point. After his operation Prideaux was unable to preach from the pulpit or take services but lived for twelve further years attending assiduously to Chapter affairs and writing his greatest literary work *The Relationships between the Old and New Testaments*.⁴⁶ In 1712, the year after Dean Prideaux's operation, an Act of Parliament was passed which established boards of Guardians for the care of the poor and sick. In Norwich responsibility for their care was thereby transferred from the Mayor's Court to a newly-constituted Corporation of Guardians of the Poor of Norwich. Four workhouses, administered by the Guardians, were provided in the city of Norwich and their records contain accounts of persons suffering with stone and treated by lithotomy in the workhouse infirmary. The operations were usually performed by surgeons in the regular salaried employment of the Guardians, e.g. John Amyas and David Martineau, but some of the operations were performed by local surgeons not in such employment, for example John Harmer and Benjamin Gooch, two leading Norfolk lithotomists of the period.⁴⁷ There are records of other local lithotomists of the period among whom the Reverend Thomas Havers of Stoke Holy Cross, near Norwich⁴⁸ is of special interest for after his death in 1719 a tablet was erected to his memory which depicted in stone the instruments that he used for lithotomy and this memorial can still be seen on the south wall of Stoke Holy Cross church.⁴⁹

Evidence of the medical treatment of bladder stone in Norfolk with lithonryptics

⁴⁶ R. W. Ketton-Cremer, 'Humphrey Prideaux', op. cit. in fn. 36, pp. 63–91; [Anonymous], *Life of the Rev. H. Prideaux, Dean of Norwich*, London, Knapp, 1748. For permission to read the unpublished *Diarium* (3 vols.) of the Reverend Humphrey Prideaux in the Muniment Room of Norwich Cathedral I am indebted to the Dean and Chapter.

⁴⁷ It has been claimed that John Harmer and Benjamin Gooch did a large number of lithotomies in the Norwich workhouses (C. Williams, op. cit. in fn. 19, p. 5; M. W. Bulman, 'The care of the sick and poor', in *Norwich and its Region*, Norwich, Local Executive Committee of the British Association for the Advancement of Science, 1961, p. 115). However a personal search of the Court Minute Books of the Guardians of the Poor of Norwich, complete from 1712–1842 save for 1714–32, has revealed no entry of a lithotomy by Gooch and only two lithotomies by Harmer (4 February 1735 and 1 June 1736). Presumably most of their lithotomies were carried out in patients' homes though Gooch also had the use of a small hospital at Shotesham near Norwich.

⁴⁸ The Reverend Thomas Havers (1659–1719), member of a well-known Norwich family, entered Trinity College, Cambridge in 1675, was ordained priest in 1683 and in the same year was appointed rector of St. Andrew's, Framlingham Earl, Norwich. In 1710 Havers was also appointed to the living of St. Mary the Virgin, Arminghall, Norwich. Havers was licensed to practise medicine by the Bishop of Norwich in 1692 and acquired great local fame in lithotomy, his fee for the operation being five shillings. The inscription on his memorial at Stoke Holy Cross Church, Norwich, reads, 'Thomas Havers, clerici qui Theologia, Medicina, Chyrurgia et Lythotomia, doctus fuit et expertus.'

⁴⁹ Havers had no children and left his surgical instruments to his wife's nephew Robert Bransby, surgeon, of Hapton Hall, Norwich, who later moved to the nearby village of Shotesham. Bransby's daughter married Benjamin Gooch who succeeded to his father-in-law's practice at Shotesham and she had a second cousin, Maria Susannah Cooper, née Bransby, also of Shotesham, mother of Sir Astley Cooper. The relationship between these four surgeons Havers, Bransby, Gooch and Astley Cooper illustrates the traditional complexities of marriage between Norfolk families and suggests that Gooch may have inherited Havers' lithotomy instruments. Furthermore Sir Astley Cooper and Lady Dorothy, wife of Sir Thomas Browne, had a common ancestor in Sir James Hobart, attorney-general and privy councillor in the reign of Henry VIII and founder of the fortunes of the Hobart family.

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survives in fair-posters and advertisements in local newspapers.⁵⁰ A frequently-advertised lithonryptic was *Mrs. Stephen's medicine* a well-known remedy for stone in the eighteenth century; its contents remained secret until 1739 when Mrs. Stephens was paid £5,000 by Act of Parliament for disclosing them.⁵¹ The Reverend Stephen Hales (1677–1761) was then among those who set about investigation of its active principle⁵² and his experiments on human urinary tract stones indicated that this was soap-lye.⁵³ As a consequence James Jurin (1684–1750), physician to Guy's Hospital and President of the Royal College of Physicians of London in the year of his death, introduced his *lixivium lithonrypticon* containing soap-lye with which he gained a great reputation.⁵⁴ Jurin prescribed this medicine when he was called in consultation by John Ranby (1704–1773), a leading London surgeon of the day and sergeant-surgeon to King George II, to advise on the treatment of the First Earl of Orford, formerly Sir Robert Walpole (1678–1745), who was the victim of bladder stone. After the fall of his Whig ministry in 1742 the Earl of Orford retired to his family home at Houghton, Norfolk, which he had rebuilt and furnished in great taste and style and where, two years later, he first developed symptoms of bladder stone. Operation was not advised by Ranby and hence Jurin was consulted, but the effect of Jurin's *lixivium lithonrypticon*, whether *post* or *propter hoc* was disastrous and the Earl died soon after. Prior to his death the Earl of Orford made an express wish that Ranby should publish a full account of his case so 'that Mankind might reap the proper benefit from a Relation of that Nature, and Physicians be deterr'd for the future from enterprizing with such Edged-Tools, as in his opinion, was the Lithotropic Lixivium'. The Earl of Orford was in no doubt, nor were his relatives, that the *lixivium* had caused his death, and when Ranby published a full account of the Earl's illness it appeared as a public accusation of Jurin, who made an 'anonymous' reply. This interchange became a medical *cause célèbre* of the mid-eighteenth century but it has had the benefit of leaving for posterity a full case-history of the former prime minister and his treatment for bladder stone. Ranby's monograph included the reports he received from Mr. G. Hepburn, the Earl of Orford's Norfolk doctor, and the autopsy findings of a severe cystitis, 'prostate glands [which] were enlarged and harder than they commonly are'⁵⁵ with about thirty small bladder stones.⁵⁶ Three

⁵⁰ C. Williams, op. cit. in fn. 45, pp. 9–11.

⁵¹ Mrs. Joanna Stephens, daughter of 'a Berkshire gentleman', claimed remarkable stone cures with her medicine. In 1735 her 'success' extended to the Hon. Edward Cartaret, Postmaster-General, and this brought about a movement to make public the nature of her secret remedy—hence the Act of Parliament of 1739. After receiving her payment Mrs. Stephens presented the formula of her medicine to the Archbishop of Canterbury with due ceremony and his name headed a list of distinguished members of the state, church and medicine—this group including William Cheselden, Samuel Sharp and Caesar Hawkin—who had confirmed the effectiveness of the remedy (S. Hales, *Mrs. Stephen's Receipts for the Stone and Gravel with Proper Observations and Explanations*, London, Cooper, 1739).

⁵² S. Hales, *Statical Essays containing Haemastatics*, London, Innys & Manby, 1733.

⁵³ *Idem.*, *An Account of Some Experiments and Observations on Mrs. Stephen's Medicine for dissolving the Stone*, London, T. Woodward, 1740.

⁵⁴ A solution of potash formerly used to dissolve oils and fats to make soap.

⁵⁵ J. Jurin, *An Account of the Effects of the Soap-lye, taken internally, for the Stone*, 2nd ed., London, Manby and Cox, 1745. Jurin himself suffered with bladder stone and took his own *lixivium lithonrypticon*.

⁵⁶ The autopsy account suggests that the prostatic enlargement may have been malignant.

⁵⁷ J. Ranby, *A Narrative of the last Illness of the Right Honourable the Earl of Orford, with an Appendix*. 2nd ed., London, J. & P. Knapton, 1745. This volume contains a life-size illustration of the Earl of Orford's bladder stones.

years after the death of the Earl of Orford his younger brother, the Rt. Hon. Horatio Walpole, later first Baron Walpole of Wolterton (1678–1757),⁵⁷ gave two personal accounts of his symptoms of bladder stone to meetings of the Royal Society.⁵⁸ He reported his history and that he had been persuaded by a friend, Lord Harrington, to take the lime-water treatment introduced by Robert Whytt (1714–66), Professor of Medicine at Edinburgh University.⁵⁹ Walpole's family had understandably entreated him not to take this treatment, but such advice did not prevail for he found he obtained great benefit from the lime-water, continuing to take it for seven years until his death at the age of seventy-eight years. Again there was an autopsy examination, showing the presence of three bladder stones and 'a glandular prostate of large size but not distempered', and the findings, with comments by Robert Whytt, were given to the Royal Society by Sir John Pringle.⁶⁰ The brothers were grandsons of Sir Edward Walpole whose treatment for bladder stone with Goddard's Drops has been recounted and their mother suffered with the same complaint.⁶¹ Their case-reports were an important contribution to the medical literature of bladder stone in the eighteenth century and no doubt there were others in Norfolk who were treated with the same lithonryptics as prescribed for the Walpoles by the leading London and Edinburgh physicians of the day.⁶²

⁵⁷ The Rt. Hon. Horatio Walpole, first Baron Walpole of Wolterton, Norfolk, was Member of Parliament for Norwich from 1756 until his elevation to the peerage in 1756 and had a distinguished career as a politician and diplomatist in his elder brother's Whig administration. His country seat was at Wolterton, Norfolk and in his own account of his case (fn. 58) he records how he could drive in a coach round the grass of his Norfolk home without pain from his stone, whereas pain was readily provoked by a drive over the cobbled streets of London.

The Rt. Hon. Horatio Walpole was also known as Horace Walpole and has thereby been confused by some writers on human bladder stone with his elder brother's third son, also christened Horatio, who is better known as Horace Walpole of Strawberry Hill. The false claim is made that Horace Walpole of Strawberry Hill, who became the 4th Earl of Orford on the death of the only son of his eldest brother in 1719, suffered with bladder stone. I was assured that this was not so by the late R. W. Ketton-Cremer, who wrote a notable biography of him, R. W. Ketton-Cremer, *Horace Walpole*, 3rd ed., London, Methuen, University Paperbacks, 1964.

⁵⁸ Rt. Hon. H. Walpole, 'An account of the Right Honourable Horace Walpole Esq.; drawn up by himself', *Phil. Trans. R. Soc.*, 1751–2, 47, 43–8.

Idem., 'A sequel of the case of the Right Honourable Horace Walpole Esq.; relating to the stone, since his first account in April 1750', *ibid.*, 472–73.

⁵⁹ R. Whytt, *An Essay on the Virtue of Lime-water in the Cure of the Stone. With an Appendix containing the Case of the Honourable Horatio Walpole Esquire, written by himself*, Edinburgh, Hamilton, Balfour & Neil, 1752. This work is discussed in chap. 2 of *Robert Whytt, the Soul, and Medicine*, by R. K. French, London, Wellcome Institute, 1969.

⁶⁰ Sir John Pringle (1707–82), surgeon-general to the British Army, served at Dettingen and Culloden and was the founder of modern military medicine and the idea of the Red Cross.

J. Pringle, 'An account of the case of the late Right Honourable Horace Lord Walpole; being a sequel to his own account', *Phil. Trans. R. Soc.*, 1757, 50, pt. 1, 205–9.

Idem., 'A letter to the Rev. Thom. Birch, D.D., Secret. R. S. from John Pringle, M.D., F.R.S., inclosing two papers communicated to him by Robert Whytt, M.D., F.R.S.', *ibid.*, 383–86.

The autopsy showed that Lord Walpole's stones were still present after several years' treatment with lime-water, but Whytt felt this had relieved the symptoms from the stones and 'had prevented their increase in size'. R. Whytt, 'Some observations on the case of the late Right Honourable Lord Walpole of Woolerton', *Phil. Trans. R. Soc.*, *ibid.*, 209–20.

⁶¹ W. Cadge, 'Address in surgery', *Brit. med. J.*, 1874, ii, 212.

⁶² The use of lithonryptics dated from Arabian and Indian medicine but it had a special vogue during the eighteenth century. This may have been due to contemporary advances in chemistry but both the public and their physicians in the eighteenth century appeared extremely gullible to the claims that were made for them, see E. S. Clarke, 'A history of the stone', *Hosp. Med.*, 1968, 2, 1054–57. The vogue for lithonryptics did not end in the eighteenth century for Sir Benjamin Brodie was injecting them locally into the bladder in 1831 and the alkaline waters of Vichy were taken for their claimed lithonryptic properties until well into the nineteenth century, R. Willis, *On the Treatment of Stone in the Bladder by Medical and Mechanical Means*, London, Baillière, 1842, pp. 39–46.

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While the Walpoles were being treated with lithonryptics the practice of lithotomy was spreading throughout England and in the villages and market-towns of Norfolk a generation of surgeons emerged, skilled in the art of lithotomy for the relief of the stones that were so prevalent in their midst. John Pell, John Amyas and David Martineau were among those who practised lithotomy in Norwich, and in Norfolk there were Thomas Havers of Stoke Holy Cross, William Donne of East Dereham, and the first of seven members of the Crowfoot family, all skilled lithotomists, who practised at Beccles on the Norfolk-Suffolk border between 1751-1918. The most notable local lithotomists of 1700-1770 were John Harmer of Norwich and Benjamin Gooch of Shotesham, a village south of Norwich. John Harmer, a native of Norwich,⁶³ reported in 1746 that he had performed over 170 lithotomies. In the same year he gave an account of the largest bladder stone he had removed, measuring twelve by eight inches and weighing fourteen and a half apothecary ounces (450 g.). He removed this stone from the bladder of a forty-eight-year-old gardener from Porland (Poringland) near Norwich, the patient living for five years after operation.⁶⁴ Sir George Humphry later claimed that this was the largest stone removed by lateral lithotomy from a patient who subsequently lived,⁶⁵ but Gooch, who assisted Harmer at the operation and left an account of it, makes it clear that it was the Marian operation and not a lateral lithotomy which was performed.⁶⁶ This is of interest in showing that the two most experienced Norwich lithotomists were still performing the Marian operation in 1746, twenty years after Cheselden's operation had been introduced.⁶⁷ Benjamin Gooch (1708-1776), the son of a parson, was, like Harmer, of Norfolk birth; he lived and practised from Shotesham for most of his professional life but such was his reputation that he was called to see patients throughout East Anglia.⁶⁸ His erudition and surgical skill, revealed in his writings, were remarkable for a country surgeon of his time. These writings show evidence of his being familiar with all the classics of surgical literature, that he was in regular correspondence with William Hunter, Joseph Warner and other leading figures of the day and that he presented cases and communications to meetings of the Royal Society.⁶⁹ In 1758 Gooch published the first of three editions of a surgical textbook, that has been considered one of the most important surgical works by a provincial surgeon of the

⁶³ He lived in the parish of St. Clement, Norwich, but little is known about his life or training.

⁶⁴ C. Williams, *op. cit.* in fn. 45, pp. 8-11.

⁶⁵ Sir G. M. Humphry, 'Urinary calculi; their formation and structure', *J. Anat. Physiol.*, 1896, 3, 296-311.

⁶⁶ B. Gooch, *The Chirurgical Works of Benjamin Gooch: a new edition, with his last corrections and additions*, 3 vols., London, J. Johnson, 1792, vol. 2, pp. 166-7.

⁶⁷ It is also of interest in describing 'an original method' for dealing with the perineal fistula, which, like Dean Prideaux, followed the lithotomy. The gardener 'endeavoured to tempt a little favourite dog to lick the parts and in a short time he was so well instructed in his business that whenever his master laid down and uncovered them he immediately went to work with his tongue which afford a pleasing sensation . . . As long as he lived his dog was his surgeon and kept the wound tolerably clean and easy to his great comfort and satisfaction', B. Gooch, *ibid.*, p. 167.

⁶⁸ Short biographical notes on Gooch have been published in the *D.N.B.*, 22, 107 and by H. Bailey and W. J. Bishop, *Notable Names in Medicine and Surgery*, London, H. K. Lewis, 1944, pp. 22-3.

⁶⁹ B. Gooch, 'Extract of a letter from Mr. B. Gooch, surgeon of Shottisham near Norwich, to Mr. Joseph Warner, F.R.S. and surgeon to Guy's Hospital', *Phil. Trans. R. Soc.*, 1769, 59, 281-3. *Idem.*, 'Remarks and considerations relative to the performance of amputation above the knee', *Phil. Trans. R. Soc.*, 1775, 65, 373-7. *Idem.*, 'Concerning aneurysms in the thigh', *Phil. Trans. R. Soc.*, 1775, 65, 378-83.

eighteenth century⁷⁰ and he was an ingenious designer of 'machines' and instruments. The splint of canvas and strips of wood which he devised for the treatment of fractures was named after him *Gooch's splint* and remained in use for two centuries. His writings contain accounts of lithotomy⁷¹ and he appears to be the first, or one of the first, to have removed a bladder stone by vaginal cystotomy.⁷² In addition to these contributions Gooch played an important role in the foundation of the Norfolk and Norwich Hospital in 1771–2, first in association with William Hayter, Bishop of Norwich, and then with William Fellowes, squire of Shotesham, the hospital's founder. At the request of Bishop Hayter, Gooch visited all the hospitals in London in order to study their working and design; his reports were used as the basis for designing and organizing the Norfolk and Norwich Hospital and when it opened Gooch was appointed the first consulting surgeon. By this time Norfolk lithotomists were practising the operation which Cheselden had devised and from among them the leading exponents were selected for appointment to the hospital's surgical staff.⁷³

BLADDER STONE AT THE NORFOLK AND NORWICH HOSPITAL, 1772–1909

Norwich achieved its greatest fame as a centre of bladder stone from 1772–1909 and for its contribution to lithology during this period the title of the Norwich School of Lithotomy has been proposed. It was a period when Norfolk's economy underwent several changes of fortune. At the beginning Norfolk agriculture was in a flourishing state and the county exported more corn than the rest of England combined; during the Napoleonic War of 1793–1813, though exports fell, the price of corn soared and the income of the land-owning class rose. But the land-owning employers had no sympathy for their labourers' needs and farm-workers' wages were inadequate to provide the necessities of life, even when corn commanded famine prices. Wages fell further when an agricultural depression recurred after Waterloo and farm-workers and others emigrated by boatloads from Great Yarmouth and other ports to Canada and America. Agricultural prosperity slowly returned in the 1830s and Norfolk built up its production of corn and meat but it was unable to meet the mounting competition from the Argentine, Canada and America in the late nineteenth century and from 1880 to the beginning of the First World War experienced a severe agricultural depression.⁸ The prosperity of Norwich varied with the economic climate of the agricultural community of which it was the centre and Norwich had in addition economic problems of its own with which to contend. Possessing no local resources of iron and coal and showing a reluctance to introduce machinery, the city's staple industry of weaving succumbed to increasing competition from overseas and from the West Riding of Yorkshire. As a result of playing no role in the Industrial Revolution Norwich had by 1801 dropped to eleventh place in the population table

⁷⁰ The first volume entitled *Cases and Practical Remarks in Surgery* was published in 1758; the first two volumes of its expanded second edition were published in 1767 and a third volume in an unstated year which from the text was after 1773. In the year of his death, 1776, Gooch completed a third edition in three volumes, published sixteen years later as *The Chirurgical Works of Benjamin Gooch; a new edition, with his last corrections and additions*, 3 vols., London, J. Johnson, 1792.

⁷¹ B. Gooch, *op. cit.* in fn. 66, pp. 166–89.

⁷² *Ibid.*, pp. 178–9. See also W. Cadge, 'Lectures on the surgical treatment of stone in the bladder', *Brit. med. J.*, 1886, 1, p. 1149 and C. Williams, 'A case of vaginal lithotomy', *Lancet*, 1885, II, 847–8.

⁷³ No record has been found of a Norfolk lithotomist studying under Cheselden but this does preclude that it occurred.

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for cities and towns in England and was to fall still lower during the nineteenth century. The decline in weaving brought industrial decay and poverty to Norwich and in the 1830s many of its citizens emigrated with their country neighbours. But one branch of the textile industry, silkweaving, survived, shoemaking succeeded weaving as the staple industry of Norwich and many light industries of diverse character became established during the century, greatly assisted by the vigorous local growth of banking and insurance.⁷⁴ By the end of the nineteenth century Norwich had regained something of its former prosperity but for the greater part of 1772–1909, the years of the Norwich School of Lithotomy, the economy of the area was in straitened circumstances. But by somewhat of a paradox, when Norwich was at a low level of economic decline in the early years of the nineteenth century, the city became something of an intellectual centre. During this period John Crome and John Cotman were leaders of the Norwich School of Painting. William Taylor, a famous German scholar, lived in the city, as did Sir James Smith the botanist who purchased the Linnaean Collection and founded the Linnaean Society. Amelia Opie, wife of John Opie, the painter, and daughter of one of the early surgeons to the Norfolk and Norwich Hospital, held literary salons in her Norwich drawing-room. Harriet Martineau the political economist and writer was born and brought up in Norwich before moving to London whence her sharp pen wrote caustically of Norwich's pretence to be an Athens of the early nineteenth century. Among others were George Borrow, the novelist, and Elizabeth Fry, the prison reformer, born into the philanthropic Quaker family of Gurney. Several early members of the staff of the Norfolk and Norwich Hospital contributed to this cultural circle in Norwich. Philip Meadows Martineau, a renowned lithotomist, and uncle of Harriet Martineau was mainly responsible for the founding of its subscription library in 1784 and played a leading role in the city's first triennial music festival of 1824.⁷⁵ Henry Reeve, a physician who conducted the first chemical analysis of the Norwich stones, founded the Norwich Philosophical Society in 1812 and John Alderson, surgeon and later physician, imparted his own radical views to his daughter, Amelia (later Amelia Opie). Edward Rigby, in turn obstetrician, lithotomist and physician, played a prominent role. Mayor of Norwich, an active contributor to progressive agriculture, and a close friend of Coke of Holkham, it has been claimed that the Norwich School of Painting might not have existed had it not been for his influence.⁷⁶ Rigby was a life-long friend of Crome, who had worked for him when young as a surgery-boy, and one of Rigby's daughters married Sir Charles Eastlake (1793–1865), President of the Royal Academy. There seems little doubt that the close association of these medical men, and others on the hospital staff, with the intellectual coterie that thrived in Norwich at the turn of the eighteenth century did much to influence the high standard of medicine that was practised at the Norfolk and Norwich Hospital after its opening in 1772.

When the Norfolk and Norwich Hospital was first built it contained one hundred beds of which about eighty were usually occupied. The number was increased to

⁷⁴ B. Green and R. M. R. Young, *Norwich: the Growth of a City*, Norwich, Norwich Castle Museum, 1968.

⁷⁵ R. H. Legge and W. E. Hansell, *Annals of the Norfolk and Norwich Triennial Festival, 1824–93*, Norwich and London, Jarrold, 1896.

⁷⁶ D. Clifford, *Watercolours of the Norwich School*, London, Cory, Adams & Mackay, 1965, pp. 1, 4.

two hundred when the hospital was rebuilt in 1879–83 and successive additions followed.⁷⁷ It was the practice of the Norfolk and Norwich Hospital, as of other county hospitals until the time of the Second World War, to make most appointments to the honorary staff from the ranks of local practitioners showing especial ability. This was the method employed to make the hospital's first appointments and they included, as has been said, several men who had achieved local eminence as lithotomists. With the appointment of known and respected lithotomists to the surgical staff and with many local patients seeking relief from their symptoms of bladder stone, it was not surprising that such cases should figure prominently among the early admission lists to the hospital.

THE HOSPITAL REGISTERS AND THE INCIDENCE OF BLADDER STONE IN NORFOLK

From July 1772 when the first patients were admitted to the Norfolk and Norwich Hospital a record was kept of all admissions together with a special register of the stone cases, and it was for these entries that the hospital earned the praise of Marcet in 1817 for being 'one striking exception' among public hospitals of the time in keeping a record of its lithotomy cases.⁴ The original register of stone cases has not survived but in 1819 the Reverend C. J. Chapman⁷⁸ presented to the hospital a vellum-bound book into which the original entries were transcribed and into which, until 1889, details of all further stone cases were entered. This register survives and is entitled 'A Record of the Stone Patients in the Norfolk and Norwich Hospital. Not to be Taken Away'. Its cover is charred as a result of fire caused by an air-raid on the hospital during the Second World War and some of its pages show damage from water which it sustained at this time, but fortunately the register escaped destruction. Each entry in the register contains the name, age and sex of the patient, the name of the surgeon, the weight of the stone and the outcome of the operation, for all but ten cases (autopsy cases of stone) underwent operation. A second register labelled 'Norfolk and Norwich Hospital. Catalogue of Calculi 1909' was a catalogue for the collection of stones in the hospital's museum.⁷⁹ This has also survived together with a third undated catalogue bound in a maroon cover entitled 'Analysis of Calculi' that contains a fair copy of the entries in the two previous catalogues up to 1871 and no additional information.

In 1779, the hospital's admission figures were published by Matthew Dobson in *A Medical Commentary on Fixed Air*.⁸⁰ Part of Dobson's *Commentary* was a survey of the number of admissions for bladder stone among the total hospital admissions to provincial hospitals in different areas of England, and the results showed striking

⁷⁷ After the passage of a further century a second main reconstruction is now taking place and the plans at the time of writing are for 950 beds by 1978.

⁷⁸ The Reverend C. J. Chapman (1767–1826) was priest in charge of St. Peter Mancroft, Norwich, a member of the Board of Management of the Norfolk and Norwich Hospital and its honorary auditor from 1798–9.

⁷⁹ The second is the largest of the three catalogues and contains a list of all the stone patients in Chapman's register together with those up to 1909. It also contains details of gallstones and renal stones together with a list of those bladder stones presented to the hospital museum and not occurring in the hospital's practice. A special museum room to house the hospital's pathological collection was opened in 1845 and was claimed to be among the first museums at a provincial hospital.

⁸⁰ M. Dobson, *A Medical Commentary on Fixed Air*, Chester, J. Monk, 1779. Three years previously Matthew Dobson of Liverpool had been the first to demonstrate that the sweetness of the blood and urine in diabetes mellitus was due to sugar, M. Dobson, 'Experiments and observations on the urine in a diabetes', *Medical Observations and Inquiries*, London, Cadell, 1776, vol. 5, pp. 298–316.

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variations. At Cambridge one in 1,650 admissions was for stone, at Manchester one in 557 and at Newcastle-upon-Tyne one in 287, and there were other returns given. The highest was that at Norwich where the figure was one in 55 admissions. The Norwich figures were provided for Dobson by John Manning, one of the first physicians appointed to the hospital, and were based on records showing that out of its first 3,016 admissions 55 had been cases 'cut for stone'. This was the first statistical study to suggest that Norfolk might have the highest incidence of bladder stone in Great Britain, but the hospital admission rate was affected by many factors and only suggests but does not prove that the incidence among the population was also the highest. The factors affecting the hospital admission rate in different areas included not only the local prevalence of stone but the skill and aptitude of the hospital's surgeons for lithotomy, the local standards of diagnosis of bladder stone and the readiness with which the local population was prepared to enter hospital for operation at a time when the surgeon's knife was justly feared. The results of Dobson's survey of bladder stone in England were quoted in an important three-volume treatise on medical geography published at Leipzig by Leonhard Ludwig Finke between 1792–95;⁸¹ this work attracted attention throughout Europe and thereby Norwich's reputation as a centre of bladder stone became widely known only twenty years after its hospital was founded.

Marcet was the next to attempt a regional survey of bladder stone in England and came down to Norwich where he was shown the hospital's registers and collection of bladder stones by Edward Rigby. By this time 506 lithotomies had been performed out of 18,859 admissions, a rate of 1:38 which Marcet said 'exceeds in an astonishing degree that obtained from any of the other public institutions to the records of which I have access'. Marcet found the records of other institutions so inadequate that he was unable to make a careful comparison, but at a time when ten to twelve lithotomies a year were then being performed at the Norfolk and Norwich Hospital Marcet 'understood by word of mouth' that about ten lithotomies a year had been done at St. Thomas's Hospital when Henry Cline had been on its active staff and had fallen to five since his retirement; at St. Bartholomew's Hospital the annual figure was about eleven. These London Hospitals were both larger than the Norfolk and Norwich Hospital and drained patients from wider areas. Marcet's findings were published in his *Calculous Disorders* in 1817⁴ but he appeared not to know that a careful record had been kept of all the cases of stone admitted to the Bristol Infirmary from its opening in 1735. These figures were published in 1821 by Richard Smith, senior surgeon to the Bristol Infirmary as his father had been before him, together with a study of the prevalence of stone in different areas of the West Country and of a national survey conducted on the same lines as that of Dobson but which Smith extended to Scotland and Ireland. Like Dobson, Smith found a great variation in the known incidence of stone between different areas in the West Country and between those in different areas of Great Britain. He again found that the hospital admission rate for bladder stone at Norwich was the highest in England and that this rate exceeded

⁸¹ L. L. Finke, *Versuch einer allgemeinen medicinisch-praktischen Geographie, worin der historische Teil der einheimischen Völker-und-Staaten-Arzeneykunde vorgetragen wird*, Leipzig, Weidmann, 1792–5, vol. 2, pp. 279–83.

that in either Scotland or Ireland. Another outcome of Smith's inquiry was that in 1820 there were about two hundred lithotomies in Great Britain of which almost a half were performed in London.⁸² Smith's figures for Scotland were challenged by Hutchinson in 1830 who pointed out that if the incidence of stone in Scotland were calculated on a population basis and not on the basis of the number of stone cases in relation to the total hospital admission rate then bladder stones could be shown to be more common in Scotland than England; among the reasons to which Hutchinson attributed this discrepancy was the aversion of some Scottish surgeons to lithotomy 'lest their reputation suffer in the event of failure'.⁸³

Hutchinson made use of the figures from the national census which was first carried out in 1801 and from then onwards it became possible to relate the number of lithotomies and known bladder stone cases to a population figure and not to the hospital admission rate. John Yelloly, a physician to the Norfolk and Norwich Hospital,⁸⁴ made such a study in two detailed reviews of the Norwich stone cases before the Royal Society in 1829 and 1830.⁸⁵ In his analyses Yelloly found, as had Smith in the West Country, that there was a marked local variation in the number of known stone cases and often between two adjacent hundreds in Norfolk; he observed that the incidence of stone was higher in east than west Norfolk and was twice as common among those who lived in Norwich as those in the county of Norfolk. Between 1772–1828 there had been 128 stone cases from Norwich and 447 from Norfolk admitted to the hospital. Norwich then had a population of 50,000 among whom the annual incidence of stone was 1:21,000 compared with an incidence of 1:38,000 among the rest of Norfolk where the population was 301,000. These figures for incidence were both considerably higher than the national incidence of stone for England and Wales as a whole which Smith had found to be 1:188,000.⁸⁶

In 1838 Civiale of Paris studied the records for the incidence of bladder stone from twenty countries, mainly in Europe, based on known hospital cases and related to population figures. Civiale quoted the high figures from Norfolk but in general found the incidence of stone to be higher in southern than northern European countries.⁸⁶ Among other surveys was one carried out by Thompson in 1863 when he collected details of 1,827 cases of lithotomy from three London hospitals and six provincial centres in England. He was more concerned with a study of the results of lithotomy compared with lithotripsy than in making a study of incidence. But his

⁸² R. Smith, 'A statistical inquiry into the frequency of stone in the bladder in Great Britain and Ireland', *Med.-chir. Trans.*, 1821, 11, 1–53.

⁸³ A. C. Hutchinson, 'A further enquiry into the comparative infrequency of calculous diseases among sea-faring people, with some observations on their frequency in Scotland', *Med.-chir. Trans.*, 1830, 16, 94–127.

⁸⁴ John Yelloly (1774–1842), a Northumbrian, was a graduate of medicine of Edinburgh and was elected physician to the London Hospital in 1807. He was a Fellow of the Royal Society and one of those most active in establishing the Medico-Chirurgical Society (now the Royal Society of Medicine) of which he was the first joint secretary. In 1818 he resigned from the London Hospital and settled in his wife's native county at Norwich, where from 1820–32 he was physician to the Norfolk and Norwich Hospital, Munk's *Roll* and *D.N.B.*, 63, 313–14.

⁸⁵ J. Yelloly, 'Remarks on the tendency to calculous diseases; with observations on the nature of urinary concretions and an analysis of a large part of the collection belonging to the Norfolk and Norwich Hospital', *Phil. Trans. R. Soc.*, 1829, 119, 55–81.
Idem., 'Sequel to a paper on the tendency to calculous diseases, and on the concretions to which such diseases give rise', *Phil. Trans. R. Soc.*, 1830, 120, 415–28.

⁸⁶ J. Civiale, *op. cit.* in fn. 5, p. 882.

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survey reveals that by this date the records of the London hospitals had improved after Marcet's strictures and that Marcet's own hospital of Guy's was able to provide details of 250 lithotomy cases. Thompson analysed the results of 1,827 cases of lithotomy of which 793 came from the records of the Norfolk and Norwich Hospital.⁸⁷

The last regional study between 1772–1909 of the incidence of bladder stone in different areas of Great Britain was carried out by William Cadge of Norwich in 1874 and was the most thorough of the period.⁸⁸ In the detailed tables which accompany his paper Cadge recorded the Registrar-General's figures for the mortality from stone in Great Britain between 1866–71 and analysed the figures by counties and in relation to population figures. He also wrote to the senior surgeon at eight London teaching hospitals, the Edinburgh and Glasgow Royal Infirmaries, and to 'nearly all' the provincial hospitals in Great Britain for the number of lithotomy cases admitted to them between 1867–73. As evidence of the care he took in collecting his figures, Cadge ascertained the county of origin of the cases admitted to the London hospitals so that he could relate the total hospital admission figures to those of the population figures for the areas from which they came. Cadge found that the figures from the Registrar-General's returns and those from the hospital study 'agreed fairly'. Among his results was that although the absolute number of stone cases in Norfolk was exceeded in areas of larger population, the incidence of bladder stone in Norfolk hospitals and from the Registrar-General's returns when related to population figures was the highest for any county in Great Britain. The claim that Norfolk had the highest incidence of stone in Great Britain was thus firmly established but the study was only just made in time. For thirty years later when Haslam of Birmingham was collecting figures for his Lettsomian Lectures on operations for bladder stone he wrote to Norwich and other provincial centres for their current figures for bladder stone. The reply he received from Norwich, as from elsewhere, was that 'stone had disappeared'.⁸⁹ It had 'disappeared' throughout northern Europe and in 1909 through lack of cases the stone register which for so long had been carefully kept at the Norfolk and Norwich Hospital was discontinued.

THE NORWICH COLLECTION OF BLADDER STONES AND ITS ANALYSIS

On 20 February 1773, seven months after the hospital opened, the governors of the Norfolk and Norwich Hospital resolved that the 'Apothecary do provide a suitable nest of drawers to deposit the stones [urinary calculi] extracted in this House, in order to show to strangers, and be referred to occasionally—and none suffered to be taken away'.⁹⁰ As a result, all the bladder stones that occurred in the practice of the hospital from 1772–1909 were preserved.⁹¹ There have been larger collections of urinary

⁸⁷ H. Thompson, *op. cit.* in fn. 7, pp. 223–69.

⁸⁸ W. Cadge, *op. cit.* in fn. 61, pp. 207–12.

⁸⁹ W. F. Haslam, 'Lettsomian lectures; a review of the operations for stone in the male bladder', *Trans. med. Soc. Lond.*, 1911, 34, 145–95.

⁹⁰ Sir P. Eade, *The Norfolk and Norwich Hospital, 1770–1900*, London, Jarrold, 1900, p. 43.

⁹¹ They were preserved in a 'nest of drawers provided by the apothecary' and this needed successive enlargement over the years to house the increasing number of stones. At the present time the main collection is stored in eighteen drawers, each approximately three by two feet in size, in a wooden cabinet in the hospital's department of pathology. Other drawers in the cabinet contain gallstones, renal stones, about sixty bladder stones presented to the hospital from outside donors, together with the miscellanea that are often to be found in a historical collection of pathological specimens such as a large renal stone from a horse and a bladder stone from a pig.

calculi, such as that in the Hunterian Museum at the Royal College of Surgeons of England which was largely destroyed during an air-raid in 1941, and in areas where bladder stone is still endemic e.g. Thailand,⁹² but it is thought that the Norwich collection is unique as a complete collection of the stones from one hospital over 137 years (1772–1909) at a time when bladder stone was endemic in Britain and throughout Europe.

The hospital registers contain records of 1,498 cases of bladder stone of which all but ten, autopsy specimens, were removed by operation. Out of the 1,498 cases, stone specimens survive from 1,453 and these are either single stones, multiple stones or the fragments removed by lithotrity or litholapaxy so that the actual number of stone in the collection is greater than 1,453. The total number of stone specimens in the collection at the Norfolk and Norwich Hospital is 1,657. The difference of 204 (1,657 minus 1,453) is accounted for by sixty bladder stone specimens presented to the hospital for its museum collection, housed in the same cabinet, and 144 stone specimens in a separate cabinet that were removed by William Cadge, surgeon to the Norfolk and Norwich Hospital from 1854–1909, in his private practice.⁹³

The collection of sixty stone specimens presented to the hospital's museum reveal from their labels some points of interest. Fifty came from Norfolk or north Suffolk and the remainder from other English counties e.g. Yorkshire and Middlesex, and three came from India. The local stones were often given to the hospital's museum after they had been shown at meetings of the Norwich Pathological Society held at the hospital between 1848–66 or of the Norwich Medico-Chirurgical Society which succeeded it in 1867 and the cases are recorded in the minute books of these societies.⁹⁴ Some of the specimens were obtained at autopsies performed by members of these societies but a number are recorded on their labels and in the minute books as lithotomy specimens from operations by local practitioners.⁹⁵ Another source which provides details of stone cases operated upon by local East Anglian practitioners is the catalogue of the pathological exhibition at the Annual General Meeting of the British Medical Association held at Norwich in 1874.⁹⁶ The hospital's collection of then 'upwards of 1,200' stone specimens was on display together with a number of other local collections.⁹⁷ The largest of these, numbering 143 stones, was of those removed by three members of a Norwich practice, C. M. Gibson, E. Lubbock and R. E. Gibson—a collection which will be referred to again. Such specimens show that the stone figures from the Norfolk and Norwich Hospital do not take into account

⁹² C. Chutikorn, A. Valyasevi, and S. B. Halstead, 'Studies of bladder stone disease in Thailand. II. Hospital experience. Urolithiasis at Ubol Provincial Hospital, 1956–62', *Amer. J. clin. Nutr.*, 1967, 20, 1320–28.

⁹³ The Cadge collection was presented to the hospital by one of his nephews in 1907 two years after Cadge's death; it comprises 65 specimens of complete stones and 79 of stone fragments in glass-stoppered bottles but no clinical details concerning these specimens are extant. A plaque on the cabinet records that it was provided by Cadge's nephew in 1907 and that it was made of oak, then over four hundred years old, from the roof of South Walsham Church, Norfolk.

⁹⁴ A. Batty Shaw, *The Norwich Medico-Chirurgical Society*, Norwich, The Society, 1967, pp. 21–2.

⁹⁵ Among the local practitioners who presented stones which they had removed by lithotomy and the years of the operations were Dix of Smallburgh (1856), Fulcher of King's Lynn (1856), W. E. Crowfoot of Beccles (1883) and J. W. Gooch of Bredmish (1892).

⁹⁶ British Medical Association, Forty-second Annual Meeting, Norwich, 1874. *Museum Catalogue*, Norwich, 1874, pp. 33–5.

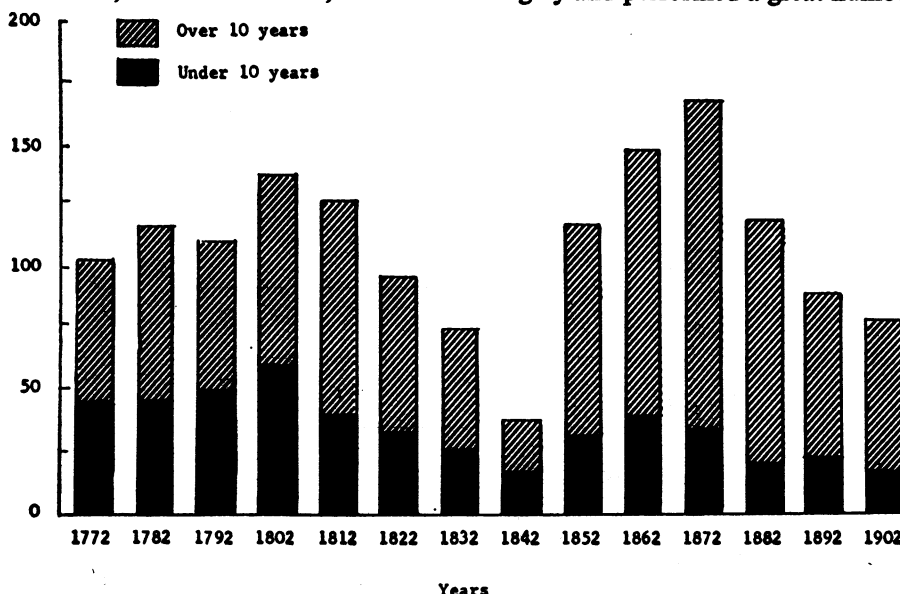
⁹⁷ These included bladder stones removed by J. and J. L. Currie of Bungay and W. H. Clubbe and F. Worthington of Lowestoft.

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those cases operated on outside the hospital but Cadge estimated that in 1874 the annual number removed in this way was small as was the number removed at the smaller hospitals which arose at Great Yarmouth, King's Lynn and Lowestoft during the nineteenth century.⁹⁸

The term 'Norwich Collection of Stones' is used to describe the 1,498 stone cases referred to in the hospital registers and occurring in the practice of the Norfolk and Norwich Hospital.⁹⁹ The details of these stone specimens given in the stone registers are more legible and reliable than the labels appended to the specimens in their cabinet; from the entries in the stone registers the following analyses of the collection have been made.

The number of stone cases in decennial periods is shown in Table 1 and Figure 1 together with the distribution of cases between patients above and below the age of ten years. It will be seen that an average number of sixteen cases of bladder stone was admitted annually to the hospital from 1772–1909. There was a fall in the number of cases admitted between 1832–1851, a slight rise from 1862–82 mainly accounted for by a rise in older cases and then a fall from about 1880 onwards. The explanation for the drop in figures between 1832–51 is that one of the physicians to the hospital at this time, Edward Lubbock, was keen on surgery and performed a great number of



Years
Figure 1

An analysis of the 1,488 cases of bladder stone that were operated upon at the Norfolk and Norwich Hospital between 1772–1909 and the number of cases above and below ten years of age (shown in decennial periods).

The fall in the number of cases between 1822–52 was caused by Edward Lubbock, one of the hospital physicians, operating on patients with bladder stone in private houses and nursing homes. These patients should properly have been admitted to hospital under the surgeons' care.

⁹⁸ W. Cadge, *op. cit.* in fn. 61, p. 208.

⁹⁹ As has been noted 45 of these stone specimens have not survived. They were stone fragments from lithotripsy or litholapaxy stored in open watch-glasses and their fragments had been spilt and dislodged during moves of the cabinet during and since the Second World War; they were discarded when the collection was cleaned in 1968.

Table 1
 The number of cases of bladder stone operated upon at Norwich during decennial periods from 1772-1909, showing the number of patients above and below ten years of age. The population of Norfolk increased from 273,479 in 1801 to 460,120 in 1901. (Ten of the 1,498 stone specimens were obtained from autopsies on patients who had not undergone operation.)

<i>Years</i>	1772 — 1781	1782 — 1791	1792 — 1801	1802 — 1811	1812 — 1821	1822 — 1831	1832 — 1841	1842 — 1851	1852 — 1861	1862 — 1871	1872 — 1881	1882 — 1891	1892 — 1901	1902 — 1909	Total
TOTAL NUMBER OF STONE CASES	101	115	109	136	124	92	70	36	115	146	165	118	85	76	1,488
NUMBER OF CASES IN PATIENTS OVER TEN YEARS	57	71	62	80	85	62	45	25	87	111	135	99	65	61	1,045
NUMBER OF CASES IN PATIENTS UNDER TEN YEARS	44	44	47	56	39	30	25	11	28	35	30	19	20	15	443

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lithotomies in private houses and nursing homes upon patients who should properly have been referred to a surgeon at the hospital. Furthermore Lubbock, as was the custom of the time, was also in general practice and his partner, C. M. Gibson, was also a keen lithotomist. Gibson was an able surgeon who performed twenty successive lithotomies without a death but was unsuccessful in several applications that he made for the appointment of surgeon to the hospital because his non-conformist religious views conflicted with the beliefs of the hospital's governors. This reason is somewhat surprising in an area where the nonconformist religion was strongly entrenched and where his Unitarian beliefs did not prejudice the appointment of Philip Meadows Martineau to the staff in 1777. It is said to have been the reason by Shepherd Taylor,¹⁰⁰ a later physician to the hospital, though Lubbock's unpopularity with the surgical staff of the hospital may well have prejudiced the election of his partner to the staff. Lubbock's collection of 85 stones and C. M. Gibson's of 51 were those that were displayed after their deaths at the British Medical Association meeting at Norwich in 1874 by the latter's son, R. E. Gibson, who added seven stones that he himself had removed. The activities of Lubbock and Gibson 'so depleted the supply of cases to the hospital that only one or two were admitted during several years'¹⁰¹ and this is well brought out in Figure 1 where it can be seen that there was a steady fall in the number of cases in the three decades between 1822 and 1852.

An analysis of the Norwich stone cases by age and sex is shown in Table 2 and Figure 2, where the ages given are those at which operation was performed and not when the symptoms from stone first developed. This analysis demonstrates the significant sex difference of bladder stone, only 53 out of the 1,498 cases occurring in females. The greatest number of cases occurred between 0–10 years of age and the second highest number between the ages of 60–70 years. The proportion of older patients with bladder stone was found to be higher in the Norwich series than those from any other centre in Britain at the time of Thompson's report of 1863⁸⁷ and from 1863–1909 the proportion of older cases increased still further.

The weights of the first 1,408 stone specimens in the collection, divided into the years 1772–1834 and 1835–97, are given in Table 3. This table and the additional analysis given beneath it show a progressive fall in the average weight of each stone specimen, attributable to earlier diagnosis in the later period. A feature of the Norwich stones that strikes a contemporary observer is their large size, especially of those removed from children. However they appear small when compared with a photograph published in 1967 of the gigantic bladder stones removed from children, and adults, at Ubol Hospital, Thailand, during the previous decade.⁹²

In 1776 the foundation of the chemical analysis of bladder stone was laid by Carl Scheele of Sweden when he identified uric acid (bezoardic acid; lithic acid) from a human urinary stone. It was thought for a time that all urinary tract calculi consisted of uric acid and hence its synonym of lithic acid, but in 1797 William Hyde Wollaston, a leading English chemist and the son of a vicar of East Dereham, Norfolk, gave

¹⁰⁰ S. T. Taylor, *The Diary of a Norwich Hospital Medical Student 1858–60*, Norwich, Jarrold, 1930, pp. 47–8.

¹⁰¹ W. Cadge, 'Lectures on the surgical treatment of stone in the bladder', *Brit. med. J.*, 1886, i, 1149.

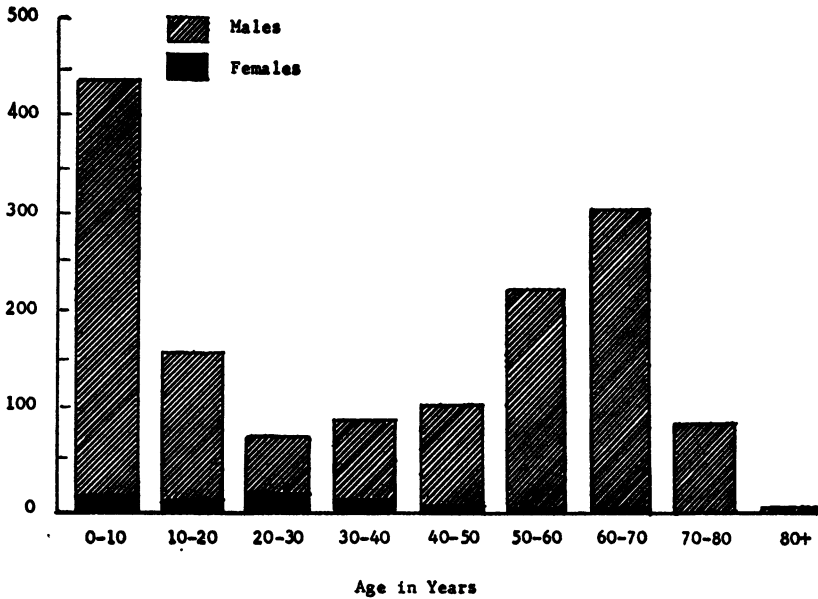


Figure 2
The distribution by age and sex of 1,498 patients with bladder stone that were admitted to the Norfolk and Norwich Hospital between 1772-1909. 1,488 cases underwent an operation for stone and in ten cases the stones were removed at autopsy.

Table 2
Age, in years and sex, of the 1,498 stone cases in the Norwich Collection.

AGE IN YEARS	0-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	80+	TOTAL
MALES	431	152	70	84	100	222	299	84	3	1,445
FEMALES	12	9	13	8	5	3	3	0	0	53
TOTAL	443	161	83	92	105	225	302	84	3	1,498

accounts of three additional types of calculi of different composition. These were the mulberry calculus (calcium oxalate), the bone-earth calculus (phosphate of lime) and the fusible calculus (phosphate of lime, uric acid and ammonium phosphate).¹⁰² These and other studies together with the general advances in the chemistry of the time were followed by the chemical analysis of other series of bladder stones; among the most important were the studies by Marcet, already cited⁴ and by his friend and

¹⁰² W. H. Wollaston, 'On gouty and urinary concretions', *Phil. Trans. R. Soc.*, 1797, 87, 386-400.

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Table 3
Weight of the first 1,408 bladder stones in the Norwich Collection.
(1 Apothecary ounce=31.1 g.)

WEIGHT	ozs.	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9
	gms.	0-31.1	31.1 — 62.2	62.2 — 93.3	93.3 — 124.4	124.4 — 155.5	155.5 — 186.6	186.6 — 217.7	217.7 — 248.8	248.8 — 279.9
704 stones 1772-1834		529	119	35	11	5	2	2	1	0
704 stones 1835-1897		619	45	23	3	2	2	0	0	1

The weight of each stone was recorded in the Norwich registers using the Apothecary's Scale where one Apothecary ounce=31.1 g. The weights of the first 704 stone specimens were tabulated by Crosse (123) and are shown in Table 3 together with the weights of the second 704 stone specimens. A fall in weight of the stones between the first and second periods can be seen. The same point can be made in another way. The average weight of the first hundred stones was 8.6 Apothecary drachms (33.7 g.), of the second one hundred 7.7 Apothecary drachms (27.6 g.) and of the next four hundred stones 5.9 Apothecary drachms (23.2 g.).

pupil William Prout.¹⁰³ The first chemical analysis of the Norwich collection of stones was made by Henry Reeve, physician to the Norfolk and Norwich Hospital from 1808-14, but the results of his findings have not survived.¹⁰⁴ Reeve also made a significant contribution to the chemical study of bladder stone through a stone that was removed from his younger brother when five years of age; his brother later had a recurrence of stone from which he died. Reeve sent the first stone for analysis to Wollaston who found it consisted of cystine as did one which had been sent to him from Guy's Hospital; the description which Wollaston published of these two specimens was the first recognition of cystine stone.¹⁰⁵ A second and more detailed analysis of the Norwich collection of stones was conducted by Yelloly and was included in the study of various aspects of the Norwich stones which he presented to the Royal Society in 1829 and 1830;⁸⁵ he was aided in making this chemical analysis by William Prout and Michael Faraday at the Royal Institution.

It is not profitable to consider in detail the results of Yelloly's findings and other early chemical analyses of urinary tract stones, for in a number of respects chemical studies have been shown to be unsatisfactory and at times erroneous by revealing

¹⁰³ W. Prout, *An Inquiry into the Nature and Treatment of Gravel, Calculus and other Diseases*, London, Baldwin, Craddock & Joy, 1821. See also W. R. Brock, 'The life and work of William Prout', *Med. Hist.*, 1965, 9, 101-26.

¹⁰⁴ The analysis of Reeve's collection, together with letters from Henry, Wollaston and other eminent chemists of the day have disappeared but were in the Norfolk and Norwich Hospital museum in 1900 (Sir P. Eade, op. cit. in fn. 90, pp. 158-59). Henry Reeve (1780-1814), of Suffolk birth, was a pupil of Philip Meadows Martineau at Norwich before completing his studies at Edinburgh. He was a contributor to the early numbers of the *Edinburgh Review* and the *Edinburgh Medical and Surgical Journal* and founded the Norwich Philosophical Society. He was physician to the Norfolk and Norwich Hospital from 1808 until his death at the age of 34 years, Munk's Roll.

¹⁰⁵ W. H. Wollaston, 'On cystic oxide, a new species of urinary calculus', *Phil. Trans. R. Soc.*, 1810, 100, 223-30. See also P. D. Griffiths, R. Huntsman, and C. G. A. Thomas, 'The first cystine stone?', *Brit. med. J.*, 1964, 1, 53.

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supposed chemical constituents which are found to be non-existent by modern analytical methods and in other ways.¹⁰⁶ Modern methods of analysing urinary tract stones employ the techniques of mineralogy, including the use of the polarizing (petrographic) microscope and X-ray diffraction methods. A recent study of bladder stones from a number of collections, including that at Norwich, has been carried out using crystallographic methods by Lonsdale and her colleagues at University College, London.¹⁰⁷ The results of this analysis of the Norwich stones have been given in a series of papers by Lonsdale's group;¹⁰⁸ they broadly confirm a number of Yelloly's findings, such that uric acid was the main constituent of the adult stones, but reveal a number of different and additional results. It is only possible to make reference to the findings of this important work but among the most interesting has been that analysis of the stones from Norfolk children of two centuries past has proved similar to that of stones removed from children of the twentieth century in Thailand, Turkey and India, countries where areas exist in which bladder stone is still endemic.

THE NORWICH SURGEONS AND THEIR OPERATIONS FOR STONE

In Table 4 are shown the names of the twenty-four surgeons to the Norfolk and Norwich Hospital who performed operations for bladder stone between 1772–1909; the number of operations which each surgeon performed and the years between which they were undertaken are included in the table.¹⁰⁹ Those who performed the greatest number of operations, with the figure for each surgeon's number shown in parenthesis after his name, were William Cadge [240], William Donne [173], Philip Meadows Martineau [149], Edward Rigby [106] and William Dalrymple [90]. These men, together with John Green Crosse [52], merit short biographical notes for they were the leading surgeons of the Norwich School of Lithotomy.

William Donne (1746–1804) was one of the first surgeons appointed to the hospital in 1771. He came of a Welsh family that had farmed in Norfolk since the fourteenth century¹¹⁰ and before his appointment to the hospital practised in Dereham where his skill as a lithotomist had attracted the attention of many, including Benjamin Gooch.¹¹¹ Donne performed most of the early lithotomies at the hospital, the total number being 173, for which he had a mortality of 1:7. Nothing is known of his medical training and he is not known to have written any papers. He is said to have

¹⁰⁶ E. L. Prien, and E. L. Prien, jr., 'Composition and structure of urinary stone', *Amer. J. med.*, 1968, 45, 654–72.

¹⁰⁷ Half specimens from 86 of the bladder stones from the 1772–1909 Norwich collection together with fifty bladder stones and seventy renal stones from the personal collection of J. M. Ridley Thomas between 1932–61 were examined. See also J. M. R. Thomas, 'Vesical calculus in Norfolk', *Brit. J. Urol.*, 1949, 21, 1–4.

¹⁰⁸ K. Lonsdale and P. Mason, 'Uric acid, uric acid dihydrate, and urates in urinary calculi, ancient and modern', *Science*, 1966, 152, 1511–12; K. Lonsdale, 'Human stones', *Science*, 1968, 159, 1199–1207; K. Lonsdale, 'The formation of urinary calculi', *Brit. J. Hosp. Med.*, 1968, 1, 243–6; K. Lonsdale, D. J. Sutor, and S. Wooley, 'Composition of urinary calculi by X-ray diffraction. Collected data from various localities. I. Norwich (England) and district, 1773–1961', *Brit. J. Urol.*, 1968, 40, 33–6.

¹⁰⁹ The operations were carried out by men who were usually full surgeons at the hospital, for until the latter half of the nineteenth century no assistant surgeon was allowed to perform a 'capital operation' (which included lithotomy) unless a full surgeon was not available.

¹¹⁰ C. B. Johnson, *William Bodham Donne and his Friends*, London, Methuen, 1905, pp. x-xi.

¹¹¹ The house in which Donne lived at Dereham still stands; he was buried in Dereham parish church, see N. Boston, and E. Puddy, *Dereham, the Biography of a Country Town*, Dereham, G. A. Codeby, 1952, pp. 162, 181.

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Table 4

The Surgeons who operated for stone at the Norfolk and Norwich Hospital, between 1772–1909, with a table of the years during which their operations were performed and the total number of operations (Total=1,488).

Surgeon	Years	No. of Operations	Surgeon	Years	No. of Operations
W. Donne	1772–1800	173	G. W. W. Firth	1849–1878	58
W. Palgrave	1772–1775	5	W. P. Nichols	1850–1872	75
J. Alderson	1772–1791	69	A. Dalrymple	1852	2
E. Rigby	1790–1814	106	W. Cadge	1857–1895	240
P. M. Martineau	1793–1828	149	T. W. Crosse	1858–1887	77
E. Colman	1803–1812	44	C. Williams	1873–1906	73
W. Bond	1813–1826	45	M. Beverley	1879–1892	21
W. Dalrymple	1815–1838	90	S. H. Burton	1890–1909	57
J. G. Crosse	1826–1849	52	H. S. Robinson	1890–1904	37
H. Carter	1830	2	D. D. Day	1896–1909	16
B. H. Norgate	1831–1857	57	Sir H. A. Ballance	1898–1909	14
J. G. Johnson	1838–1847	10	E. W. Everett	1907–1909	6

been a reserved and nervous man and could not sleep on the night before he had to perform a 'serious operation'. Many of his contemporaries and successors on the surgical staff of the hospital spoke of his skill as a lithotomist as did Astley Cooper who saw him operate when a pupil at the Norfolk and Norwich Hospital and wrote 'it was at the Norfolk and Norwich Hospital that I first saw Mr. Donne operate [for stone] in a masterly manner and it was this which inspired me with a strong impression of the utility of surgery and led me to embark on it as my profession.'¹

Edward Rigby (1747–1822) was appointed assistant surgeon at the early age of twenty-four years when the hospital first opened and served it as surgeon and physician for forty-nine years. A man of great ability and many interests he was born in Leicestershire and first came to Norwich at the age of fifteen years as an apprentice to David Martineau.¹¹² In 1775 Rigby published a book that first proposed the division of uterine haemorrhage into two groups, accidental and unavoidable, and described their different treatment.¹¹³ This volume was widely acclaimed, had three English editions and was translated into French and Italian. As a physician Rigby wrote of Peruvian bark in the treatment of intermittent fevers and as a surgeon performed 106 lithotomies at the Norfolk and Norwich Hospital.¹¹⁴ He also farmed, wrote

¹¹² David Martineau was surgeon to the Norwich Board of Guardians in the early eighteenth century; he was a relative of Rigby's mother and the father of Philip Meadows Martineau.

¹¹³ E. Rigby, *An Essay on the Uterine Haemorrhage, which precedes the Delivery of the full-grown Foetus; illustrated with Cases*, London, J. Johnson, 1775.

¹¹⁴ Astley Cooper was one of his pupils at the Norfolk and Norwich Hospital, see A. Batty Shaw, op. cit. in fn. 1. His son, Edward Rigby junior (1804–60) was the leading London obstetrician of

A. Batty Shaw

papers on agricultural topics such as the mangel wurzel and the economy of the small farm, and as has been mentioned played a prominent part in the cultural and civic life of the Norwich of his day.¹¹⁵

In 1777 Philip Meadows Martineau (1752–1829) joined Donne and Rigby on the staff of the hospital.¹¹⁶ He was a descendant of a Huguenot family that settled in Norwich on the revocation of the Edict of Nantes in 1685. Many members of the family were surgeons, including his father David Martineau to whom Edward Rigby was apprenticed. After studying at Edinburgh, Martineau was apprenticed to Donne at Dereham for three years so there were close links between Donne, Rigby and Martineau before 1777. With his strong family tradition of surgery, early apprenticeship to Donne and innate ability, Martineau became one of the most distinguished lithotomists of his day.¹¹⁷ Astley Cooper said of him that ‘no surgeon in London, I am certain, can boast of similar success [at lithotomy]’² and in Paris he was spoken of as ‘le lithotomiste le plus éminent et le plus heureux de son époque’.¹¹⁸ Martineau performed 149 lithotomies at the hospital with a mortality of 1:8 and in 1821 when senior surgeon to the hospital described before the Medical and Chirurgical Society of London his modifications upon Cheselden’s technique for lateral lithotomy which became known as ‘the Norwich operation for stone’.¹¹⁹

In 1812, twelve years before Martineau’s retirement from the staff William Dalrymple (1772–1847) a man of Scottish descent who was born and educated in Norwich joined him as surgeon. Dalrymple studied at Guy’s and St. Thomas’s Hospitals under Astley Cooper and Henry Cline;¹²⁰ he then returned to practise in Norwich and performed ninety lithotomies during his twenty-seven years on the staff of the hospital. He was a surgeon of ability but his career was hampered in later life by a nervous temperament. One of his house-surgeons, Edward Copeman, records how he resembled Donne in this respect when he wrote that ‘I have often heard him [Dalrymple] say that he was not able to sleep the night before he had to perform a lithotomy; although in such cases his success was great’.¹²¹ Dalrymple gave to the hospital in 1844 his private collection of pathological specimens; this formed the nucleus of the hospital’s first pathological museum.¹²²

his day and played a leading role with Astley Cooper, Alexander Marcet and John Yelloly in founding the Medico-Chirurgical Society, now the Royal Society of Medicine; in recognition of this contribution the portraits of these four men hang in the Council room of the Society’s house.

¹¹⁵ For further biographical details of Edward Rigby see *D.N.B.*, 48, 301, and J. G. Crosse, *A Memoir of the Life of Edward Rigby, M.D.*, Norwich, Burks and Kinnebrook, 1821.

¹¹⁶ Like Rigby, Martineau played a prominent role in the cultural life of Norwich. There is a tablet to his memory in the Octagon Chapel, Norwich and Martineau Lane, Norwich, which ran near his home at Bracondale was named after him; the ‘lane’ now forms part of the outer ring road of Norwich.

¹¹⁷ P. M. Martineau, *A Memoir*, Norwich, Mercury Office, 1831.

¹¹⁸ J. Civiale, *op. cit.* in fn. 5, p. 882.

¹¹⁹ P. M. Martineau, ‘On lithotomy’, *Med.-chir. Trans.*, 1821, 11, 402–13.

¹²⁰ See *D.N.B.*, 13, 426–7 for biographical details of William Dalrymple.

¹²¹ E. Copeman, *Brief History of the Norfolk and Norwich Hospital with a few Biographical Observations on the late W. Dalrymple and J. G. Crosse, Esq.*, Norwich, Jarrold, 1865, p. 67.

¹²² Sir P. Eade, *op. cit.* in fn. 90, p. 84. Dalrymple gave evidence on behalf of Bransby Cooper in the celebrated case in 1828 when Bransby Cooper of Guy’s Hospital accused Thomas Wakley, editor of the *Lancet*, of libellous remarks which he had printed concerning a patient who died after undergoing a lithotomy by Bransby Cooper. Dalrymple said that ‘he saw no indication of lack of skill on the part of the operator’, ‘Cooper and Wakley, Court of King’s Bench’, *Lancet*, 1828, 1, 372. The small stone which caused the controversy can still be seen in the Gordon Museum, Guy’s Hospital.

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John Green Crosse (1790–1850), appointed to the surgical staff of the hospital in 1823, records that he first used to hold the urethral staff for Martineau at lithotomies; in the same way Martineau had assisted Donne and these two examples illustrate how the art of lithotomy at Norwich was handed on from one generation to the next. The son of a Suffolk yeoman, Crosse studied in London, Dublin and Paris before settling in Norwich. In 1833 he was awarded the Jacksonian Prize of the Royal College of Surgeons of England for an essay on ‘The Formation, Constituents and Extraction of the Urinary Calculus’, based on a study of the records of bladder stone at the Norfolk and Norwich Hospital together with an account of his own experiences and findings. Though Crosse was one of the most able of the Norwich surgeons during the nineteenth century he only performed fifty-two lithotomies during his twenty-five years on the surgical staff of the hospital. This was due to his appointment as surgeon being in the main parallel with that of Edward Lubbock as physician. Lubbock, with his partner Gibson, deprived the hospital of many stone cases which should properly have been operated upon by Crosse and the surgeons contemporary with him. Crosse’s Jacksonian Essay published in 1835, was the surgical counterpart of Yelloly’s papers of 1829 and 1830;¹²³ among its features was a bibliography of over 2,700 references, the longest list that has been found in any British work on urinary calculus.¹²³ Crosse was a man of great intellectual and surgical ability and his industry was prodigious. For his contributions to surgery he was elected a Fellow of the Royal Society and a full account of his life and times, based on personal diaries and case-books, has been written by his grand-daughter, Dr. V. M. Crosse.¹²⁴

The last of the Norwich surgeons to merit special mention is William Cadge (1822–1903) who like Donne was the son of a Norfolk farming family. Cadge studied at University College Hospital and after qualification became the private assistant to Robert Liston. In 1850 he was appointed assistant surgeon to University College Hospital but after two years had to resign his appointment because of ill health. He returned to his native county and in 1854 was appointed to the staff of the Norfolk and Norwich Hospital where the treatment of bladder stone occupied his main surgical attention. He gave an address on this subject to the meeting of the British Medical Association at Norwich in 1874¹²⁵ and it was the theme of the Hunterian lectures which he delivered before the Royal College of Surgeons of England in 1886;¹²⁶ frequent reference to both these works has been made in this essay. Cadge operated on 240 cases of stone at the hospital, the largest number for any one surgeon, and during the same period, 1854–95, operated on at least 144 further cases in private practice as revealed by the stone specimens in the Cadge cabinet at the hospital.⁹³ His biographer described him as ‘*facile princeps* among the East Anglian surgeons of

¹²³ J. G. Crosse, *A Treatise on the Formation, Constituents and Extraction of the Urinary Calculus; being the Essay for which the Jacksonian Prize for the Year 1833 was awarded by the Royal College of Surgeons in London*, London, J. Churchill, 1835.

¹²⁴ W. M. Crosse, *A Surgeon in the Early Nineteenth Century. The Life and Times of John Green Crosse, M.D., F.R.C.S., F.R.S., 1790–1850*, Edinburgh and London, E. & S. Livingstone, 1968. See also Plarr’s *Lives of the Fellows of the Royal College of Surgeons of England*, 1, 182–4.

¹²⁵ W. Cadge, *op. cit.* in fn. 61, pp. 207–12.

¹²⁶ W. Cadge, ‘Lectures on the surgical treatment of stone in the bladder’, *Brit. med. J.*, 1886, i, 1149–54, 1205–10, ii, 1–6.

his generation.¹²⁷

Other surgeons of the Norwich School of Lithotomy were Charles Williams (1829–1907) who wrote on Norwich surgical history,^{19,21,45} a review of the Norwich bladder stones up to 1870¹²⁸ and three short papers on different aspects of the surgery of bladder stone;^{72,129} Thomas William Crosse (1826–1892) son of John Green Crosse, performed 77 stone operations between 1858–87; Donald Day (1858–1937), renowned for his speed as an operator, wrote a paper when house-surgeon to the hospital in 1886 on the recurrence rate of stone after lateral lithotomy;¹³⁰ space does not allow an account of the others. Most of the Norwich lithotomists lived in St. Giles, Norwich, a street of imposing Georgian houses where Eade has identified the numbers of the houses in which each surgeon lived.¹³¹

The operative procedures that were carried out for the removal of bladder stones are given in Table 5 and Figure 3. Though several procedures were employed, it will be seen that 1,125 out of the 1,488 cases (75 per cent) were dealt with by the operation of lateral lithotomy, so Norwich was truly ‘a school of lithotomy’. Lateral lithotomy was carried out by the technique described by Cheselden with minor modifications such as those of Martineau.¹¹⁹ In 1936 Sir D’Arcy Power wrote of lateral lithotomy as an operation which ‘occupied a prominence in surgery which has seldom been held by any other operation before or since . . . it would be attended by all members of the surgical staff of the hospital . . . it was the show test of a successful surgeon . . . the end was glorious, a surgical feat amounting almost to legerdemain’.¹³² This description conveys the spirit in which lithotomy was performed at Norwich and described in the writings of its surgeons.

During the first half of the nineteenth century there was some criticism of lateral lithotomy; it was an operation not without morbidity and mortality especially among those not skilled in its execution, so alternative procedures were introduced. Instead of widening the prostatic urethra with a knife, it was claimed that it could be less dangerously enlarged with a fluid dilator containing mucilage.¹³³ This procedure was termed *lithectasy* or *cystectasy* and was used by Astley Cooper in 1819. But even in Astley Cooper’s skilled hands the operation lasted over forty hours and the operation therefore enjoyed only a short-lived vogue.¹³⁴ Another method, of

¹²⁷ Cadge was a member of the council of the Royal College of Surgeons and gave £15,000 during his lifetime to the first re-building of the Norfolk and Norwich Hospital (Plarr’s *Lives*). After his death a stained-glass window was erected to his memory in Norwich Cathedral; the unveiling ceremony was attended by Sir John Tweedy, P.R.C.S., and surgeons from twenty-two countries, including his lifelong friend and student contemporary at University College Hospital, Lord Lister; ‘The William Cadge memorial window’, *Brit. med. J.*, 1904, ii, 138, 1587–8.

¹²⁸ C. Williams, in: *A System of Surgery*, edited by T. Holmes, 2nd. ed., London, Longmans & Green, 1870, pp. 1063–69, 1079–82.

¹²⁹ C. Williams, ‘Relapse of stone in the bladder after lithotomy’, *Lancet*, 1878, i, 713–14.

Idem., ‘Stone in the bladder in connexion with enlargement of the spleen’, *Lancet*, 1888, ii, 1010–11.

¹³⁰ D. D. Day, ‘On repeated lithotomy’, *Brit. med. J.*, 1886, i, 286–8.

¹³¹ Sir P. Eade, *Some Account of the Parish of St. Giles, Norwich*, Norwich, Jarrold, 1886, pp. 22–33, 344–79. It is a local tradition that these houses were ‘founded on stones extracted from human bladders, a story which deserves to be true even if it is not’, J. Mardle, ‘Our Norfolk doctors’, *Eastern Daily Press*, 18 October 1967.

¹³² Sir D’A. Power, ‘Some bygone operations in surgery. I: Cutting for the stone’, *Brit. J. Surg.*, 1931, 18, 1–5.

¹³³ J. Arnott, ‘Lithectasy, or the extraction of the stone by slow and painless dilatation’, *Lancet*, 1843, ii, 610–13, 650–53. See also R. Willis, *op. cit.* in fn. 62, p. 160–9.

¹³⁴ R. Druitt, *The Surgeon’s vade mecum*, London, Renshaw, 1843, pp. 489–90.

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which Allarton was a strong advocate, was 'a reversal to the Marian operation in modified form'.¹³⁵ The operation never found much favour in London but was widely practised in the provinces for several years.¹³⁶ It was used on thirty-five cases in Norwich between 1858–65, shown in Table 5 as cases of 'modified median lithotomy'. The results of the operation were unsatisfactory at Norwich as elsewhere and the operation fell into disuse.¹³⁸ One final method of lithotomy appears in Table 5, one case of vaginal lithotomy. This operation, of which Benjamin Gooch had been a pioneer, was used by Williams in 1882 for removal of a bladder stone from a woman of sixty-one years and an account of it was published.⁷²

Between 1772–1909 thirty-five cases of bladder stone, almost all in females, were removed by a procedure described in the Norwich registers as 'dilatation and evacuation'. This involved dilatation of the urethra and extraction of the stone by forceps or with the fingers. Yelloly referred to the procedure's early use in England when in 1815 he gave an account of a further case so treated.¹³⁷

The main alternative to lateral lithotomy for the removal of bladder stones during the first half of the nineteenth century was lithotrity and Shelley¹³⁸ and Sir Eric Riches¹³⁹ are among those who have described the ingenious designs of lithotrites which surgeons of the time devised with which to crush bladder stones. In 1832 the Norfolk and Norwich Hospital purchased 'a sett of lithotrity instruments on the recommendation of the surgeons for twenty-two guineas'.¹⁴⁰ Two years later the instruments were first used by William Dalrymple and in the subsequent year Benjamin Norgate treated a second case. But there appears to have been some reluctance by the Norwich surgeons to practise lithotrity and after Norgate's case the procedure was not used again for twenty years. The third lithotrity was performed in 1855 and thereafter the procedure, with litholapaxy after 1878, was used with increasing frequency for the removal of bladder stone as shown in Table 5 and Figure 3. Among the disadvantages of lithotrity to those skilled in lateral lithotomy were that it might require repeated sessions to remove a stone, and that after the procedure fragments might remain in the bladder as foci from which fresh stones would form.¹⁴¹ These

¹³⁵ G. A. Allarton, *Lithotomy Simplified, or a New Method of Operating for Stone in the Bladder*, London, Ash & Flint; Birmingham, Wrightson & Bell, 1854.

Idem., *A Treatise on Modern Median Lithotomy*, London, Renshaw, 1863.

¹³⁶ A. Poland, 'Urinary calculi and lithotomy', in *A System of Surgery*, edited by T. Holmes, 2nd ed., London, Longmans & Green, 1870, pp. 1002–92.

¹³⁷ J. Yelloly, 'Particulars of a case in which a very large calculus was removed from the urethra of a female without operation; with examples of analagous cases', *Med.-chir. Trans.*, 1815, 6, 574–82. The procedure was also known to the ancient Egyptians, see R. Willis, *op. cit.* in fn. 62, pp. 47–52.

¹³⁸ H. S. Shelley, 'Intravesical destruction of bladder stone', *J. Hist. Med. All. Sci.*, 1964, 19, 46–60.

¹³⁹ Sir E. Riches, 'The history of lithotomy and lithotrity', *Ann. Roy. Coll. Surg. Eng.*, 1968, 43, 185–99.

¹⁴⁰ Sir P. Eade, *op. cit.* in fn. 90, p. 76.

¹⁴¹ Lithotrity had an earlier history but its real introduction as a practical procedure was due to the Paris surgeons Civiale, d'Etioles and Heurteloup in the early years of the nineteenth century. Heurteloup left Paris to settle in London and was the first to perform lithotrity in London. In 1833 he was visited in his London home by Crosse of Norwich to learn of the technique; Heurteloup said he had then done two hundred lithotrites, V. M. Crosse, *op. cit.* in fn. 124, p. 140. Sir Henry Thompson of University College Hospital* was the leading British exponent of lithotrity in the nineteenth century; he was an East Anglian, born at Framlingham, Suffolk, was on familiar terms with the Norwich surgeons of his day and presented his specimens from one thousand cases of lithotrity to the Hunterian Museum of the Royal College of Surgeons of England. Thompson's first interests in medicine were aroused by his family's doctor at Framlingham, William Jeaffreson. Jeaffreson not

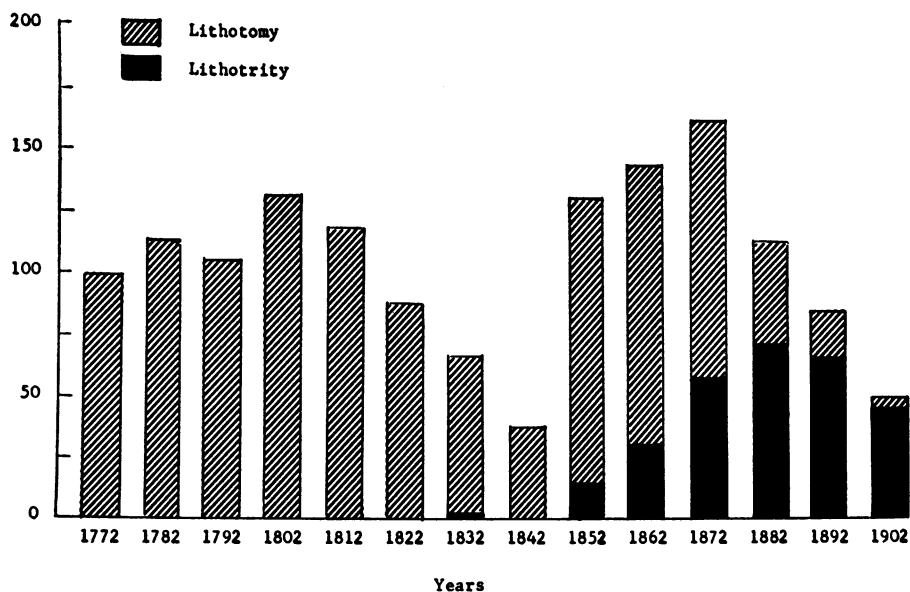


Figure 3

The number of cases of bladder stone treated by lithotomy [1,161] and lithotrity [280] at the Norfolk and Norwich Hospital, shown in decennial periods from 1772–1902. The cases of lithotomy include those treated by lateral, modified median and vaginal lithotomy; those of lithotrity include cases treated by litholapaxy (see also Table 5).

disadvantages were overcome by the procedure of litholapaxy, a term introduced by Bigelow of Boston, Massachusetts in 1878 to describe his operation of crushing and evacuating all the fragments at one sitting under a general anaesthetic. Bigelow modified the lithotrity to enable this to be done and devised an evacuator to wash out the fragments.¹⁴² The Norwich registers only contain records of 'lithotrity' so it is not clear how soon after 1878 litholapaxy was adopted and in which cases it was used; from Cadge's Hunterian lectures of 1886 it is clear that he and his colleagues were then practising litholapaxy.¹⁴⁶ In the absence of a distinction between lithotrity and litholapaxy in the Norwich registers these procedures are shown in the same column in Table 5 and in the same area in Figure 3. In Cadge's lectures of 1886 much time was spent in a discussion of the relative indications and advantages of lithotomy and lithotrity. Twenty-three years earlier in his monograph on *Practical Lithotomy and Lithotrity* Thompson had discussed this same problem.⁷ It was one of the great surgical debating points of the late nineteenth century. Table 5 and Figure 3 show the increased frequency with which lithotrity and litholapaxy were used in the treatment of stone at Norwich between 1853 and 1909. In 1884 Cadge was the first of the Norwich surgeons to remove a bladder stone by suprapubic cystolithotomy; the re-introduction of this operation as a safe and certain surgical procedure for the

only made surgical history in 1836 when he was the first surgeon in England to remove an ovarian cyst with survival of the patient but he was another East Anglian surgeon in a small town skilled in the treatment of bladder stone. He studied lithotrity under Costello and reported his first case of a bladder stone removed by lithotrity—it required thirty-seven sittings—in 1834, see J. A. Shepherd, 'William Jeaffreson (1790–1865): surgical pioneer', *Brit. med. J.*, 1965, ii, 1119–20.

¹⁴² H. J. Bigelow, 'Lithotrity by a single operation', *Amer. J. med. Sci.*, 1878, 75, 117–34.

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Table 5
The operations performed for 1,488 cases of bladder stone at the Norfolk and Norwich Hospital, 1772–1909

YEARS	<i>Lateral Lithotomy</i>	<i>Dilation and Extraction</i>	<i>Lithotripsy and Litholapaxy</i>	<i>Suprapubic Cystolithotomy</i>	<i>Modified Median Lithotomy</i>	<i>Vaginal Lithotomy</i>	TOTAL
1772–1781	99	2	–	–	–	–	101
1782–1791	112	3	–	–	–	–	115
1792–1801	104	5	–	–	–	–	109
1802–1811	127	9	–	–	–	–	136
1812–1821	119	5	–	–	–	–	124
1822–1831	89	3	–	–	–	–	92
1832–1841	66	2	2	–	–	–	70
1842–1851	36	–	–	–	–	–	36
1852–1861	87	2	14	–	25	–	128
1862–1871	104	2	30	–	10	–	146
1872–1881	103	1	61	–	–	–	165
1882–1891	44	–	71	8	–	1	124
1892–1901	32	2	56	1	–	–	91
1902–1909	3	–	46	2	–	–	51
	1,125	36	280	11	35	1	1,488

removal of a bladder stone had been made possible by advances in anaesthesia and antiseptics.¹⁴³ Gradually litholapaxy and suprapubic cystolithotomy usurped the place so long held by lateral lithotomy though it was not until 1904 that Williams, when senior surgeon to the hospital, performed the last recorded lateral lithotomy, an operation which for so long had been the pride and glory of the Norfolk and Norwich Hospital.

THE AETIOLOGY OF NORFOLK BLADDER STONE

The reason for the high incidence of bladder stone in Norfolk was discussed by most writers from the Norwich School and it was logical that the explanation should be sought in some characteristic whereby Norfolk differed from other areas of Great Britain. Crosse felt that the explanation lay in the county's cold dry winds from the north and east which prevail during the winter and spring¹²⁸ and Prout subscribed to a similar view.¹⁰³ Cadge felt that this theory did not account for stone being less prevalent among the inhabitants of the coastal belt of Norfolk than among those

¹⁴³ As a result of Cadge's close friendship with Lister (see fn. 127) antiseptic surgery was introduced at Norwich soon after Lister's discoveries became known.

living inland, for this he had found to be his experience.¹²⁵ Norfolk's geology was examined and the belt of chalk upon which it stands, or the resultant hardness of its water were blamed. Others incriminated the beer which was made from native barley and drunk in large quantities and Cadge thought the main reason was the inadequate supplies of milk in Norfolk.¹²⁵ The factor which attracted most attention was the Norfolk diet. As has been pointed out Norfolk experienced economic depression for a great deal of the period between 1772–1909 and N. Riches is among those who have given a description of the very low standard of living of the Norfolk agricultural workers which resulted.⁸ The poverty of the Norfolk agricultural worker and his diet were particularly well described in 1830 by William England, a doctor who was born in Norfolk and who practised for a time as physician to the Norwich Guardians' Dispensary. England firmly believed that a defective diet explained the high incidence of bladder stone in Norfolk.¹⁴⁴ In addition to its shortage of milk England pointed out that the Norfolk diet contained little cheese, bacon, fats, meat or vegetables and consisted largely of cereal products.¹⁴⁵ Yelloly doubted if a high farinaceous diet was the sole explanation for the high incidence of stone in Norfolk for such a diet was common in other rural areas of England in the early nineteenth century, when he was writing, and such areas did not experience a high incidence of stone.⁸⁵ An inherited diathesis towards bladder stone was another theory put forward and the medical history of the Walpoles and the consanguinity of many Norfolk families were cited as supporting evidence. But when bladder stone disappeared from Norfolk at the beginning of the nineteenth century the climate, water supply and geology of Norfolk did not change and frequent intermarriage between Norfolk families continued. The general standard of living and the people's diet did improve and therefore the explanation of the county's high incidence of stone on the basis of a dietary factor appeared the only one among the early theories put forward that might withstand the test of time. The bladder stones in Norfolk were mainly examples of primary bladder stone, a condition mainly affecting children, known since the dawn of civilization and described in all continents of the world. The Norfolk bladder stones occurred when the condition was endemic throughout Europe and there are no grounds for thinking that their aetiology was different from elsewhere but there must have been a reason why they were more common in Norfolk than in any other British county.

The presence of only fifty-three female cases among the 1,498 stone cases in the Norwich series illustrates the well-known sex difference in the incidence of bladder stone. This has been known since the time of Hippocrates who wrote that 'female children are less liable to stone because the urethra is short and wide and the urine is passed easily . . . in males it is not straight and it is narrow as well'.¹⁴⁶ Conversely the high incidence in boys is brought out by the Norwich figures. Forty per cent

¹⁴⁴ W. England, *Observations on the Functional Disorders of the Kidneys, which give rise to the Formation of Urinary Calculi; with Remarks on their Frequency in the County of Norfolk*, London, Underwood; Norwich, Bacon & Kinnebrook, 1830.

¹⁴⁵ The traditional local dish of a Norfolk dumpling may be described as boiled bread.

¹⁴⁶ This explanation has not been challenged over the succeeding twenty-five centuries but a further explanation given by Hippocrates that 'girls drink more than boys' may not be so generally acceptable. Hippocrates recognized the incidence of bladder stone in children when he described how they 'rub or pull at their private parts because they think that in them lies the cause why they cannot make water', *The Medical Works of Hippocrates*, trans. by J. Chadwick and W. N. Mann, Oxford, Blackwell Scientific Publications, 1950, p. 98.

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(604) occurred in patients, predominantly male, below the age of twenty years and many of the stone cases in the older age groups, where the age denotes that of operation, may be regarded as cases where the stone had first formed in childhood. This point is illustrated by the history of the forty-eight-year-old gardener from Poringland whose bladder stone was removed by Harmer and Gooch in 1746. The gardener had experienced symptoms of stone since infancy and Gooch remarked that he was 'searched and should have been cut' at the age of eight years;⁶⁶ there will have been other examples of bladder stone among the Norwich cases where the stone was present for forty or fifty years before operation was undertaken. The presence of an additional aetiological factor in the older cases is indicated by the bi-modal form which the columns in Figure 2 display with a peak in the 60–70 age group. This second peak reflects the role which prostatic gland enlargement played in the aetiology of the Norwich series of stones. Bladder stones at the present time are mainly encountered in the presence of bladder outflow obstruction, most commonly due to prostatic gland enlargement; it therefore tends to be argued that prostatic gland enlargement was the sole explanation for stones among the older age groups in the past. But the presence of an additional factor, possibly the same factor that produced the high incidence of stone among the young age groups, is strongly suggested by Figure 4 which shows not only the disappearance of bladder stone in children in Norfolk at the beginning of the twentieth century but also a fall in the number of stone cases among patients of all ages. This fall occurred when the population had increased, when medical services had become more generally available and they were of a higher standard. Such argument only applies to the 'hospital class' of pre-1948 patients. Among the higher social classes there again appears to have been a factor, other than prostatic gland enlargement alone, to account for the high incidence of bladder stone in the older age group. The stones differed in composition from those among the 'hospital' patients and the generally-agreed explanation for their high incidence among older men of the upper social classes from the seventeenth to nineteenth centuries is that given by Lonsdale—'a high-protein, unbalanced diet with wrong kinds of drink [water was in any case not safe] and to insufficient exercise. They [the stones] have largely disappeared with the disappearance of gargantuan meals'.¹⁴⁷ Another difference between bladder stone in the 'hospital' class and the upper social classes was that stone 'never' occurred in boys of the upper classes whereas it was so frequent among boys of the 'hospital' class. This cannot be shown from the Norwich figures which refer only to hospital patients but Cadge, with his extensive surgical practice, had only encountered one case of bladder stone in a boy from the upper classes and this boy had always refused to drink milk.¹²⁵

The demonstration that a bladder stone consists of uric acid or cystine may be of value in indicating the aetiology of the bladder stone but the chemical analysis of primary bladder stones at Norwich and elsewhere has yielded disappointing results in shedding light as to why primary bladder stone occurs. In the sixty years since the Norwich stone register was closed the aetiology of primary bladder stone has been assiduously studied both experimentally and among patients who live in those parts of India, Turkey, Thailand, etc. where bladder stone remains endemic but still the

¹⁴⁷ K. Lonsdale, 'Human stones', *Science*, 1968, 159, 1202.

cause of primary bladder stone is not known with certainty. All the evidence indicates that primary bladder stone is a distinct disease from 'primary' kidney stone but all stones of the urinary tract share some features in common. The factors concerned in the pathogenesis of urinary tract stones and which relate both to kidney and bladder stones have recently been summarized by Smith as falling into two groups.¹⁴⁸ First 'changes which increase the urinary concentration of constituent crystalloids' and second 'physico-chemical changes conducive to stone formation at normal concentrations of crystalloids'. The first group includes reduction in urine volume and increased excretion of calcium, oxalate cystine, uric acid, xanthine, ammonia (phosphate); the second group includes pH, stone matrix, stasis, foreign bodies and the substances which have been shown to protect against stone formation, magnesium, pyrophosphate, citrate and other normal constituents. Andersen, who has done much work in this field has put forward a hypothesis that primary bladder stone is caused basically by a diet consisting almost exclusively of one cereal.¹⁴⁹ Certainly all the evidence from recent work points to a dietary factor as the cause but it has not proved possible to incriminate the exact dietary deficiency or how its effect is exerted in any experimental or clinical study. An attractive theory is that a dietary deficiency might affect hitherto unrecognized substances in normal urine which are normally inhibitory to the formation or growth of certain urinary tract crystals; these are the 'inhibitor peptides and other normal constituents' included in Smith's second group.¹⁵⁰ Forbes also favours a nutritional cause but remarks that in respect of knowing precisely how this effect is exerted we are 'just about where we were a hundred years ago'.¹⁵¹ On the basis of a nutritional cause for primary bladder stones, Ridley Thomas attributed its disappearance from Norfolk to the improved diet of the Norfolk agricultural worker and his family during the present century¹⁰⁷ though from Figure 4 it would seem that the change was probably taking place from about 1880 onwards during the time of an agricultural depression lasting until 1914. William England's firm belief of 1830¹⁴⁴ that a defective diet was the cause of stone in Norfolk would seem to stand the test of time better than any other explanation and the defect must have been more pronounced in Norfolk to explain why stone was more common there than in any other county in Great Britain.

CONCLUSION

In the history of schools of art, philosophy or literature it may be difficult to assign to them a definite period of years and this was so of the Norwich School of Painting.

¹⁴⁸ L. H. Smith, 'Introduction to symposium on stones', *Amer. J. Med.*, 1968, 45, 649-53. This is an introduction to a symposium on stone formation containing authoritative review articles of the factors enumerated by Smith, *Symposium on Stones*, by various authors. *Amer. J. Med.*, 1968, 45, 649-783. See also A. J. Butt, *Etiologic Factors in Renal Lithiasis*, Springfield, Ill., 1956, pp. 3-47; papers published by Lonsdale and her group, op. cit. in fn. 108; 'Studies of bladder stone in Thailand', by various authors, *Amer. J. clin. Nutr.*, 1967, 20, 1312-68; D. A. Andersen, op. cit. in fn. 149, and 'Patterns of incidence of stones of the urinary tract with special reference to endemic bladder stones', *Urologia (Treviso)*, 1967, 34, 385-402, 'The incidence of urinary calculi', *Hosp. Med.*, 1968, 2, 1024-33, and *Proceedings of the Renal Stone Research Symposium held at Leeds, April 1968*, ed. by A. Hodgkinson and B. E. C. Nordin, London, J. & A. Churchill, 1969.

¹⁴⁹ D. A. Andersen, 'The nutritional significance of primary bladder stones', *Brit. J. Urol.*, 1962, 34, 160-77.

¹⁵⁰ J. E. Howard, and W. C. Thomas, 'Control of crystallisation in urine', *Amer. J. Med.*, 1968, 45, 693-99.

¹⁵¹ A. L. Forbes, 'Stone in the urinary bladder and kidney', *Nat. Acad. Sci. Bull.* (in press).

The Norwich School of Lithotomy

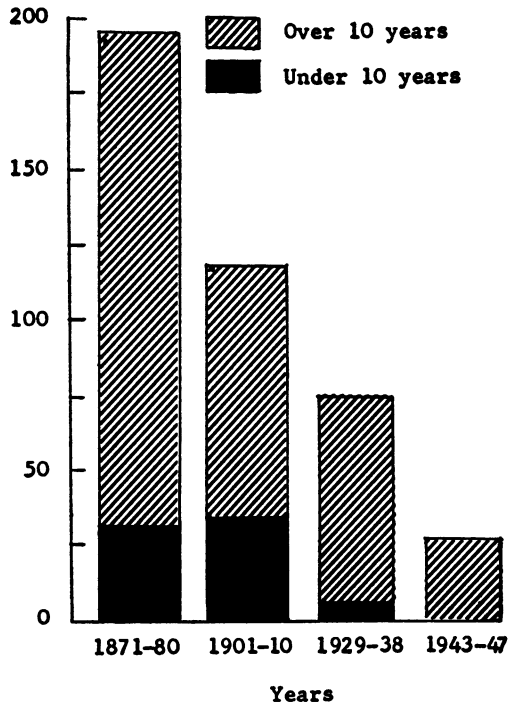


Figure 4

The number of bladder stone cases admitted to the Norfolk and Norwich Hospital during four periods between 1871-1947. The figure is adapted from Figure 4 published by Andersen (149) and based on numbers provided by Ridley Thomas (107).

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The greater part of the activity that gave the School its character occurred between 1803-33 but the School extended broadly from the end of John Crome's apprenticeship in 1790 to the death of John Joseph Cotman in 1878 and there were both artists who were forerunners of the school and a local tradition for painting persisted after 1878. It is not difficult to ascribe a period of years to the Norwich School of Lithotomy for it has been defined as commencing in 1772 when the Norfolk and Norwich admitted its first patients, and its stone register was begun, and ending in 1909 when the register was discontinued as bladder stone had 'disappeared' from Norfolk. But this School also had its forerunners and a local interest in urological surgery has persisted since and extends to the present day.¹⁵³ Its first forerunners were the seventeenth-century Norfolk surgeons, contemporary with Sir Thomas Browne, and accounts of their operations for stone survive in the Mayor's Court Books of the City of Norwich. They were followed by the Norfolk lithotomists of the early eighteenth century, Harmer, Gooch and others, who in their turn were the teachers of the first lithotomists appointed to the staff of the Norfolk and Norwich Hospital in 1771. From his close associations with the foundation of the hospital and in virtue of being the

¹⁵³ Several general surgeons to the hospital since 1909 have had a special interest in urological surgery, in particular J. M. Ridley Thomas, surgeon to the Norfolk and Norwich Hospital from 1930-64. In 1968 the hospital became among the first district general hospitals in England to have two urological surgeons on its surgical staff.

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most eminent Norfolk surgeon and lithotomist of the early eighteenth century, Gooch may be regarded as the founder of the Norwich School of Lithotomy. Its leading exponents of lithotomy were Donne, Rigby, Martineau, Dalrymple, Crosse and Cadge; among its physicians Yelloly made the most important medical contribution, but there were other physicians and surgeons to the Norfolk and Norwich Hospital who played an important role in the activities of the School and their work should not be forgotten. The Norwich School of Lithotomy arose because bladder stone was a common condition in Norfolk but had it not been for the skill of the Norwich surgeons and the care with which their records and the stones themselves were kept, the Norfolk and Norwich Hospital would not have achieved the reputation that it acquired in the treatment of bladder stone. Sir John Thomson-Walker (1870–1937), urological surgeon to King's College Hospital, wrote in 1934 of this reputation as follows, 'The figures of no other hospital in England could compare with those [at the Norfolk and Norwich Hospital] in the accuracy with which they were compiled, the care with which the details were sifted, or the brilliance of the surgical results they displayed.'¹⁵³

This account cannot be concluded without an expression of sympathy to the Norfolk people of the past for the suffering that they must have endured from bladder stone. Among the many descriptions of the symptoms of bladder stone, Osler considered that no one had described an attack of 'the stone' more graphically than Michel de Montaigne (1533–92) who was himself a sufferer from bladder stone for many years. 'Thou art seen to sweat with pain, to look pale and red, to tremble, to vomit well-nigh to blood, to suffer strange contortions and convulsions, by starts to let tears drop from thine eyes, to urine thick, black and frightful water, or to have it suppressed by some sharp and craggy stone that cruelly pricks and tears thee'.¹⁵⁴ No wonder that the Norfolk people sought relief from such tormenting symptoms, but had it not been for faith in their apothecaries and surgeons and courage to withstand the ordeal of operation, the surgical triumphs of the Norwich lithotomists could not have taken place.

Bladder stone is no longer endemic in Norfolk and the Norwich collection of bladder stones and their registers survive as the memorials of an era that is past. They were displayed at the Annual Meeting of the Royal College of Surgeons of England held at Norwich in the autumn of 1968¹⁵⁵ and it was their demonstration that led to the writing of this essay. In displaying the stones on that occasion and in writing this account of them, the order made by the Governors of the Norfolk and Norwich Hospital in 1773 would thereby seem to have been carried out—that the hospital's bladder stones be kept 'in order to show to strangers and to be referred to occasionally.'⁹⁰

¹⁵³ Sir J. Thomson-Walker, 'Surgery in the early nineteenth century', *Trans. med. Soc. Lond.*, 1934, 57, 1–23.

¹⁵⁴ W. Osler, *The Principles and Practice of Medicine*, Edinburgh and London, Pentland, 1892, p. 767.

¹⁵⁵ R. S. Handley, 'Annual meeting of Fellows and Members', *Ann. Roy. Coll. Surg. Eng.*, 1968, 43, 341–6.

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¹⁵⁶ L. Heister, *A General System of Surgery*, trans. into English from the Latin, 3rd ed., London, W. Innys, 1748, part 2, pp. 101–83; J. Bell, *The Principles of Surgery*, London, Longman, Hurst, Rees & Orme, 1806, vol. 2, pp. 39–142; E. Desnos, *Encyclopédie française d'Urologie*, Paris, 1914, vol. 1, pp. 1–294; J. Swift Joly, *Stone and Calculous Disease of the Urinary Organs*, London, W. Heinemann (Medical Books), 1929. Since submission of the manuscript a short and well-illustrated history of bladder stone by Professor H. Ellis has been published, H. Ellis, *A History of Bladder Stone*, Oxford and Edinburgh, Blackwell Scientific Publications, 1970.

¹⁵⁷ F. Blomefield, *An Essay towards a Topographical History of the County of Norfolk*, London, W. Bulmer, 1805–10, vols. 1–11; *Norwich and its Region*, see fn. 47; *Norwich: the Growth of a City*, see fn. 74.

¹⁵⁸ F. H. Garrison, *An Introduction to the History of Medicine*, 4th ed., Philadelphia and London, W. B. Saunders, 1967.