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CUTTING FOR STONE: ROMAN LITHOTOMY INSTRUMENTS IN THE MUSEO NAZIONALE ROMANO

RALPH JACKSON
The British Museum, London, UK

SUMMARY

Bladder stones, one of the scourges of the past, have been recorded as far back as 6,500 BC. Lithotomy was famously proscribed in the Hippocratic Oath, but it was certainly being undertaken in Hellenistic Alexandria by the 3rd century BC. However, the earliest surviving description of the operation is that of Celsus in the early 1st century AD, while identifiable instrumentation currently dates between the 2nd and early 5th century AD. Finds from Rimini, Marcianopolis, Ephesus and Cyrene illustrate how widespread the operation was at the time of the Roman Empire, but the majority of lithotomy instruments, of which those in the Museo Nazionale Romano are an important part, have been discovered in Rome itself, doubtless a reflection of the size of the city's medical 'market'.

'On this point, however, the experience of time has concluded that the disease causing the sharpest agony is strangury from stone in the bladder'. (Pliny, Naturalis Historia 25, 7, 23).

Bladder stones

Pliny's assertion that bladder stone was the most painful disease may have been challenged by those suffering from a number of other intensely painful conditions without access to effective pain-killers. However, the force of his comment remains, namely that strangury,

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which prevents or impedes the passing of urine, must have caused many in antiquity 'the sharpest agony'. Its prevalence cannot be precisely gauged, but as a symptom of various urinary disorders and a frequent side-effect of stone in the urinary bladder (vesical calculus), it may have been a relatively common affliction.

Pliny's lay view is complemented by the slightly earlier and much fuller medical account of the condition given by Cornelius Celsus: "Sometimes we are compelled to draw off the urine by hand when it is not passed naturally; either because in an old man the passage has collapsed, or because a stone, or a blood clot of some sort has formed an obstruction within it; but even a slight inflammation often prevents natural evacuation; and this treatment is needed not only for men but sometimes also for women." (Celsus *De medicina* 7, 26, 1A. Trans. Spencer 1938. Also Fischer 1984). In response a specialised instrument had been developed, the catheter, whose invention was attributed to Erasistratus (Caelius Aurelianus *De morbis chronicis* 2, 1, 13). Some four centuries later Pseudo-Galen gave a clear and succinct description of the male catheter of his day, its indication for use and its manipulation: "When urine is not passed on account of excessive dilation of the bladder so that it cannot contract, we draw off the urine with a catheter. Therefore an instrument like the Roman letter S is let down into the bladder by the urethra." (Ps.-Galen *Introductio* 13 (XIV 751K.). Trans. Milne 1907, 143). The method of preparing, inserting and guiding the catheter through the urethra to the bladder is given at greater length by Paul (Paulus Aegineta 6. 59), while Celsus' description adds further details of the instrumentation: "For this purpose bronze tubes are made, and the surgeon must have three ready for males and two for females in order that they may be suitable for every body, large and small. Those for males should be: the longest, fifteen finger-breadths in length, the medium twelve, the shortest nine; for females, the longer nine, the shorter six. They ought to be a little curved, but more so for men, and they should be very smooth and neither too large nor too small."

(Celsus *De medicina* 7, 26, 1A-B. Trans. Spencer 1938). The existence of graded sets is implicit, too, in Paul's account: "Wherefore, taking a catheter proportionate to the age and sex we prepare the instrument for use." (Paulus Aegineta 6. 59. Trans. Adams 1846).

The nine complete surviving catheters - seven male, two female - from 'Italy' (Jackson 1986, 126-7, Fig. 3 nos.20-22), Herculaneum (Bliquez 1994, 168-9, no. 235), Colophon (Caton 1914, 116, Pl. XI, nos. 20-21), Neuss (Simpson 1977, 563, Fig 1, no. 11) and Carnuntum (Krug 1992, 155-6, nos. 7-8) correspond well to these descriptions and conform to Celsus' graded sizes (Jackson 1986, 147-151. Jackson 1990, Fig. 6, nos. 1-3. Jackson 1997, Fig. 9, nos. 1-3). They are finely-crafted slender bronze tubes, S-shaped for males, J-shaped for females, with an immaculately smooth surface, and a small aperture behind the tapered rounded tip (Fig. 1). They would have functioned very effectively in draining the bladder and also, as a clyster, in irrigating the bladder. However, as advocated by Rufus of Ephesus and Soranus, they might also have been used as a sound to dislodge a stone impacted in the urethra or blocking the neck of the bladder, in other words as an alternative or a preliminary to lithotomy (Milne 1907, 145. Sideras 1977. Soranus *Gynaecia* 4, 7). Celsus does not mention this procedure, but as a prelude to his account of lithotomy he describes the removal of an impacted stone in the urethra using an earscoop or a lithotomy scoop or, failing that, by means of a longitudinal incision in the penis (Celsus *De medicina* 7, 26, 1C). Removal of a stone lodged in the urethra near the glans is also described by the surgeon Philagrius (Aetius 11.5.88-94 Zervos), who used a narrow scoop probe (*κυαθίσκος*) and forceps for the manipulation (Bliquez 2003, 326). A constant thread in these accounts is the attempt to resolve urinary bladder conditions without surgery and above all to undertake lithotomy only as a last resort.

Today, vesical calculus usually occurs in young males in poor agricultural environments (Roberts and Cox 2003, 85.). In antiquity, too, it may have been related principally to diet – it has been shown to be associated with an excessively farinaceous or vegetarian diet (Aufderheide and Rodríguez-Martin 1998, 284) - and specifically to nutritional deficiencies (Makler 1980. Steinbock 1989). Spencer, in his 1938 edition of Celsus' *De medicina*, commented on the prevalence of the condition "among schoolboys then as it continued to be in this country up to within living memory", and noted that the occurrence of bladder stone in this group then declined steeply with the substitution of tea for 'small beer' (Spencer 1938, 426b). But no clear-cut single cause has been determined and recent clinical

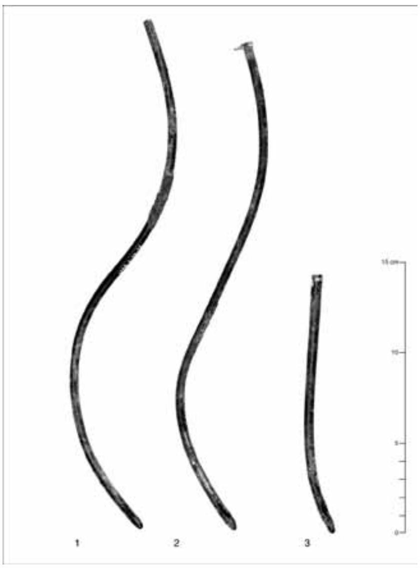

Fig. 1. - Roman bronze catheters, male (1-2) and female (3), part of a set of instruments from Italy in the British Museum, London (Inv. 1968,0626.24-26). Scale 1:2. *Photo © British Museum*.

Fig. 2. - A set of Roman bronze lithotomy instruments from the Rome region in the Museum of Classical Archaeology, Cambridge (Inv. 167-76). 8-10 broken, 4 lacking its handle, 2-3 lacking their iron blades. Scale 2:3. *Photo © Ralph Jackson*.

studies tend towards a multifactorial explanation (Beckett *et al.* 2008, 400). The basic mechanism, if not the exact cause(s), is clear enough: solutes from urine are precipitated in the bladder, growth occurs through crystal aggregation around a nucleus and the stone generally consists of a mixture of crystalline mineral phases and an organic matrix (Sperrin and Rogers 1998). However, the aetiology of stone formation, too, is complex and, "like trends in stone incidence within a population, trends in stone composition have been linked to factors such as geographical areas, diet and social status" (Beckett *et al.* 2008, 401).

Bladder stones are one of the very few surviving identifiable traces of disease sited in soft tissue, though they can be overlooked in all but the most careful excavation of human remains. The earliest recorded case is from an adult female burial in a cave near Trapani, Sicily dated to around 6,500 BC (D'Alessio *et al.* 2005, 127). In Britain, Roman period bladder stones have been found with three inhumations and one cremation burial at Baldock, Hertfordshire and with a late 3rd century AD cremation burial in London (Roberts and Cox 2003, 143). The latter, found with a cremation of an older adult of unknown sex, comprised about half of a small calcified mass, with concentric-layered internal structure, measuring 4.8 x 5.9 mm and weighing 0.2 g (Conheeney 2000, 275-6).

Lithotomy

Perhaps the most famous stone – because he recorded it – was that suffered by Samuel Pepys. Some six centimetres in diameter (the size of a Real Tennis ball), it was successfully removed by the surgeon Thomas Hollyer on 26th March 1658. Pepys rejoiced in his good fortune, both retaining the stone as a keepsake (he records that he had a case made for it) and marking each anniversary of the event with a thanksgiving and celebratory dinner. He had good reason to be thankful: not only did he survive but he was not made incontinent, a frequent consequence of lithotomy at the time, though it would seem he did receive an unintended vasectomy (Bennion 1979, 76, 280). The exact form of Pepys' operation is not known, but as an adult it would not have been the Celsian operation, though, with the re-discovery of manuscripts of Celsus, that operation was still current (known as the 'Apparatus Minor' or 'Petit Appareil') and was to remain in use down to modern times, for example in India where it was still being practised at the turn of the 20th century (J.P.Blandy *in litt.*). As the direct personal experiences of a pre-modern lithotomy patient, Pepys account is invaluable but sadly has no ancient counterpart. Similarly lacking in antiquity is any kind of statistical information, though it is interesting to refer to those given by William Cheselden who, a few generations after Pepys, famously reduced the duration of lithotomy from one hour to one minute. His 1740 report on 213 patients he cut for stone in St. Thomas's Hospital reveals that 105 were aged ten or under of which only three died (Tröhler 2003). But Cheselden appears to have been exceptional and a much higher mortality rate was recorded by other practitioners (Künzl 2002b, 74). By the Roman Imperial period there had been centuries of treatment in the Classical World for stone in the urinary bladder, though how often lithotomy occurred and with how much success, is not known, and no account of the operation earlier than that of Celsus survives. Certainly, however, in the 3rd century BC several Greek stone-quarrying terms had already been appropriated to become part of the technical nomenclature associated with the resolution of vesical calculus: the Alexandrian surgeon Ammonius, who invented the technique of breaking up a large bladder stone to facilitate safe removal, earned the nick-name 'stone-cutter' (λιθότομος *lithotomos*) (Celsus *De med.* 7, prooemium 3; 7, 26, 3B). The seriousness of lithotomy and its potentially high mortality rate were underlined by its inclusion in the Hippocratic *Oath*: "I will not use the knife, not even on sufferers from the stone, but I will give way to men who are skilled in this craft." (*Oath* 4.628-32L = *CMG* I, 1, pp. 4-5 Heib. Trans. Longrigg 1998, 101). Irrespective of whether lithotomy or surgery in general was to be left to those 'skilled in this craft', it is evident that lithotomy epitomised hazardous surgery, and in the ancient world it was to remain one of the very few elective surgical interventions in the abdomen. An effective but dangerous operation, requiring skill and audacity, which promised a patient relief from an intensely painful condition was conducive to 'specialisation', but neither texts nor instruments survive to illuminate lithotomy in the Hellenistic era. However, with the development (and survival) of purpose-made instrumentation from the 1st century AD on, concurrent with the clear surgical descriptions of Celsus, it has been possible to identify examples of the specific and distinctive instruments used in lithotomy in the Roman Imperial period.

Celsus, like his predecessors, was clear about the risks of lithotomy, emphasising that it should only be envisaged 'when it is impossible otherwise to afford relief' and that 'it is most inadvisable to undertake it hastily since it is very dangerous' (*De med.* 7, 26, 2A). Furthermore, he stipulated that the operation was only to be performed in the spring and was only applicable to boys between the ages of nine and fourteen. The reason for the latter restriction is readily explicable, for the success of the first version of the operation he described involved a manipulation that would only be possible before the enlargement of the prostate at puberty. Although hazardous the procedure was straightforward, involving an incision in the perineum – between the scrotum and the anus. The patient lay on his back with his legs drawn up on the lap of a 'strong and well-trained man' who held him securely in that position pressing down on the patient's chest with his shoulders. The practitioner inserted the oiled index and middle finger of his left hand into the rectum and placed his right hand on the lower abdomen (hypogastrium) in order to locate and guide the stone, with great care, down to the neck of the bladder, its arrival there being indicated by a bulge in the perineum. "When the stone has now got there, then the skin over the neck of the bladder next the anus should be incised by a semi-lunar cut, the horns of which point towards the hips; then a little lower down in that part of the incision which is concave, a second cut is to be made under the skin, at a right angle to the first to open up the neck of the bladder until the urinary passage is opened so that the wound is a little larger than the stone." (Celsus *De med*. 7, 26, 2H-I). This last was very important, in order to avoid the agony and hazards of stretching or tearing.

If the stone was small it was to be pushed outwards with the fingers of one hand and seized with those of the other. "If large we must put over the upper part of it the scoop made for the purpose. This is thin at the end, beaten out into a semicircular shape, smooth on the outer side, where it comes into contact with the body, rough on the inner where it touches the stone. The scoop must be rather long, for a short one has not the strength to extract." (Celsus *De med*. 7, 26, 2K). Celsus' account continues with a detailed description of the manipulation of scoop and stone to ensure the stone does not slip out and to enable a successful and safe extraction. Describing this as "the simplest method of operation" he then goes on to explain the technique necessary to deal with a stone that is not just rough but spiny. These, he says, cannot be sought for because the chance of them fatally wounding the bladder is too great. So, patient and practitioner had to wait for the stone to descend naturally to the neck of the bladder, its presence there being disclosed by difficulty in passing water or, in the case of a spiny stone, by the inclusion of blood in the urine. Having very gently ascertained with the fingers the presence of the stone, the incision was to be made with a scalpel. But Celsus observes that the normal scalpel may not be sufficiently strong or well-enough adapted to the demanding requirements of an irregular stone and may result in the need for a second operation. Thus, he says, "Meges made a straight blade, with a wide border on its upper part, semicircular and sharp below. This knife, with its handle grasped between the two fingers, index and middle, and the thumb put upon the back of the blade, was so pressed down that any projection upon the stone might be cut through along with the flesh. By this means it followed that he made one opening of a sufficient size.” (*De med*. 7, 26, 2N-O). The knife attributed to Meges, a celebrated surgeon in Rome in the 1st century BC, has remained elusive, but the suggestion has recently been made that it may be one of the surgical instruments depicted in the famous late 1st century BC/ early 1st century AD marble relief of a doctor in the Berlin Antikensammlung (Krug 2008, 41-3), though an argument might also be made for an instrument from the House of the Surgeon at Pompeii long identified as a phlebotome (Milne 1907, 35-6, Pl. VIII, 3. Bliquez 1994, 122, no. 53).

Lithotomy instruments

While some instruments have defied unequivocal identification there has been a conspicuous success with Celsus’ lithotomy scoop (*uncus*). The link between that scoop, the combined scoop and knife described by Rufus of Ephesus (*De renum et vesicae morbis* 9, 9-10) and surviving instrumentation, was made by Ernst Künzl, who recognised the distinctive roughened scoop terminals in a kit of instruments in the Cambridge Museum of Classical Archaeology (Inv. nos. 167 – 176) and in a larger instrumentarium, from Asia Minor, in the Römisch-Germanisches Zentralmuseum (RGZM) in Mainz (Künzl 1983). Künzl was also aware of other potential lithotomy instruments in a large, but at that time unpublished, find from Marcianopolis (Devnja), Bulgaria (Minchev 1983). Subsequently, more details have emerged of all three sets: the Cambridge kit was donated to the Museum of Classical Archaeology in 1921/2, having been found in Italy in the late 19th century, and is believed to have come from a tomb in the Roman Campagna (Jackson 1986, 142, fn 80); the Mainz set is now thought likely to have been a grave find from Ephesus (Künzl 2002a, 12-20, A1-A36); and illustrations of five lithotomy instruments in the Marcianopolis find – from a house burnt down in the late 4th or early 5th century AD - are now available (Kirova 2002, 74-9, Fig. 3). Additional examples of lithotomy instruments have also come to light, either from excavations - a scoop in the astonishing Rimini *domus* 'del chirurgo' find (Jackson 2003, Fig. 2. Jackson 2009, 84-5, Pl. 2. Ortalli 2009); via the antiquity market - a combined scoop and knife said to be from the Lower Danube region (Künzl 2002a, C1); or in existing collections – two further examples of the combined scoop and knife, one from Cyrene (Jackson forthcoming) and one in the Wellcome Collection in the Science Museum, London (Inv. no. A622584). More particularly, in 1991, through the kindness of Professor La Regina, I was able to study the medical instruments in the collections of the Museo Nazionale Romano (MNR), where I found several lithotomy scoops and related instruments. Although still not numerous there are now sufficient lithotomy instruments to provide a fuller understanding of the equipment potentially available to those Roman practitioners who cut for stone.

Furthermore, although the modest sample size precludes firm conclusions on their dating and distribution, the locations of the provenanced examples appear meaningful in terms of the intensity of medical activity: it is hardly surprising to find that the largest number of lithotomy instruments, including the most complete set (Cambridge, 2nd century AD), comes from Rome (Fig. 2); and it may be more than coincidence that the sub-set of lithotomy instruments in the large instrumentarium from Asia Minor (mid-3rd century AD) is linked to Ephesus (Fig. 3), a great and prosperous city, the home of Soranus and Rufus, and the setting for annual medical contests in the 2nd and 3rd centuries AD; while the lithotomy instruments from Rimini (mid-3rd century AD) (Fig. 4, 1) and Marcianopolis (late 4th/ early 5th century AD) are components of very extensive sets of instruments, the date of which in each case coincides with periods of prosperity of the towns. It is possible to suggest that in all these places the combination of population density, wealth and high level of medical activity enabled, encouraged and sustained surgical specialisation, including lithotomy.

Most critical and instructive of the finds is that from Rome in Cambridge (Fig. 2), probably dating to the 2nd century AD, for it is not only clearly a belonging set and one that is probably complete but also one in which all the instruments by design or incorporation appear to have been intended exclusively for lithotomy: it is the instrumenta-

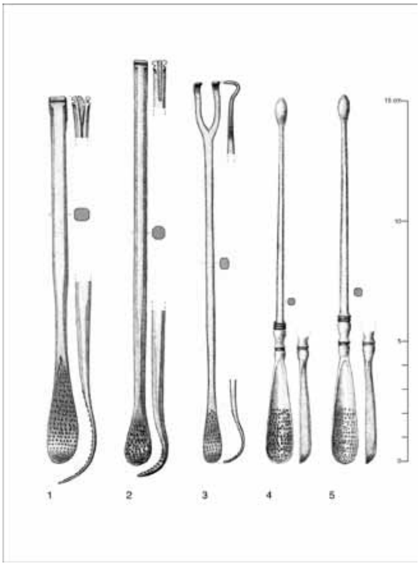

Fig. 3 - Roman bronze lithotomy scoops, part of a set of instruments from Asia Minor (Ephesus) in the Römisch-Germanisches Zentralmuseum, Mainz (Inv. O.37829-34). 1-2 lack their iron blades. Scale 2:3. *Images courtesy of Ernst Künzl and RGZM.*

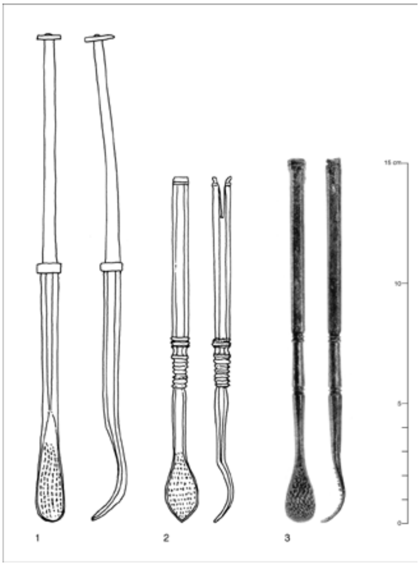

Fig. 4 - Roman bronze lithotomy scoops from 1) Rimini (Museo della Città), 2) Cyrene (Cyrene Museum), 3) Lower Danube region? (RGZM, inv. O.42217). 1 lacks its handle, 2-3 lack their iron blade. Scale 2:3. *Drawing 2 after Jim Thorn. Image 3 courtesy of Ernst Künzl and RGZM.*

tion of a Roman lithotomist, the λιθοτόμος in Galen's list of medical specialists (*De partibus artis medicativae* 2-3. Baader 1967, 233-4). The Cambridge set allows the recognition of instruments utilised in lithotomy beyond those with the distinctive roughened scoop, and it has formed the basis for the following classification of types.

Lithotomy scoop (Fig. 2, 4; Fig. 4, 1; Fig. 5, 1-2)

The most distinctive and diagnostic component of lithotomy instruments is the roughened scoop which, according to Celsus, was semicircular, with a smooth outer convex face and a roughened inner concave face, and was mounted on a long handle. Five closely similar examples answering that description are now known: three from Rome (Künzl 1983, Taf. 63, no. 3. MNR, below, nos. 1 and 2), one from Rimini (Jackson 2009, Fig. 2, no. 22) and one from Marcianopolis (Kirova 2002, Fig. 3, no. 4), the distribution and proportion of which mirrors that for the whole sample of lithotomy instruments. They are robust bi-partite copper-alloy instruments ranging in length from 205 mm to 225 mm. All evidently once had an organic (probably wooden) handle, now lacking, secured on a sturdy rectangular-sectioned rod. The two examples from the MNR and that from Rimini retain a terminal washer which braced the end of the handle, while the split end of the handle rod on the MNR examples is a feature also seen on the distorted instrument from Marcianopolis. The handle is divided from the functional part of the instrument by a decorative moulding. This comprises a simple rectangular collar on the Rimini example, but a more ornate finely-cut ring-and-baluster motif on three others - one of the MNR scoops, that in the Cambridge Museum and that from Marcianopolis - and an even more extensive disc and candy-twist moulding on the second MNR scoop.

In all examples the scoop is set at the end of a stout, lightly tapered stem, its surface smoothed and angles softened in order to minimise the possibility of tissue damage. The scoop itself, remarkably consistent between examples, is curved, thick and ovoid, with a lightly ridged smooth convex outer face, a roughened rasp-like concave inner face and rounded tip and sides. The roughened surface comprises a series of lines of tiny pits and sharp peaks created by repeat strikings of a fine punch (square-tipped in the case of the Cambridge set) at an angle to the surface of the scoop. Thus, the instrument combined grip and strength with a carefully-finished external surface to maximise the chance of a safe removal of the stone.

Scoop probe adapted for lithotomy (Fig. 3, 4-5)

Just two instruments of this type are currently known, both in the Asia Minor/ Ephesus set at the RGZM (Künzl 2002a, A13, A14), length 152mm and 154 mm. They are examples of the standard multi-purpose copper-alloy scoop probe (*cyathiscus*/ *κυαθίσκος*), frequently found in Roman surgical kits, which combine an olivary-tipped probe with a slender elongated scoop. However they differ from the norm because about two-thirds of the internal surface of the scoop at the distal end has a roughened surface formed by the same technique as that used for the lithotomy scoops in the set. The stem of these scoops is much more slender than the handles of the purpose-made lithotomy scoops implying that the adapted instruments were intended to extend the range of manipulations required to resolve a wide variety of different types and size of bladder stone. We should note, however, that these roughened scoop probes might have had additional surgical uses, for Bliquez has observed that they may also correspond to the *κυαθίσκος* that Paul recommended for filing down teeth (Paulus Aegineta 6.28. Bliquez 2003, 328).

Double-ended lithotomy scoop (Fig. 2, 1; Fig. 5, 3)

So far examples of this type are known only from Rome – one in the Cambridge set (Künzl 1983, Taf. 63, no. 2) and three in the MNR (Below, nos. 3-5) – all closely similar in form, and with lengths ranging from 153 mm to 170 mm. Like the lithotomy scoops they are stout copper-alloy instruments with a plain square-sectioned stem, its angles carefully chamfered to present a smooth finish. In each case they combine the same pair of roughened scoops set in opposite planes: at one end a small version of the ovoid roughened scoop, at the other a small thick circular disc with chamfered back, smooth rim and roughened flat interior face.

Combined lithotomy scoop and knife
(Fig. 2, 2-3; Fig. 3, 1-2; Fig. 4, 2-3)

Most numerous of the identifiable lithotomy instruments is a double-ended tool combining a copper-alloy handle and roughened scoop with an iron (or steel) blade (Jackson 1997, Fig. 9, no. 7). Of ten examples, which range in length from 144 mm. to 174 mm., two are from the Rome set in Cambridge (Künzl 1983, Taf. 64, nos. 1 and 2), two from the RGZM Asia Minor/ Ephesus set (Künzl 2002a, A17, A18), three from the Marcianopolis set (Kirova 2002, Fig. 3, nos. 1, 2, 3), one from the 'Lower Danube region' (Künzl 2002a, C1), one from Cyrene (part of a group of nine instruments thought to have come from a tomb in the necropolis – Jackson forthcoming) and one of unknown provenance (ex- Gorga and Capparoni Collections) in the Wellcome Collections of the London Science Museum (Inv. no. A622584). In every case the iron blade is lacking, either broken or corroded away, but the slot socket is of a standard type for securing scalpel blades and the Cyrene and RGZM examples retain the end of the iron tang in the socket. Interestingly, in view of Celsus' comment concerning the need for a strong blade, the slot socket which secured the blade is broken on four of the instruments (Gorga, Cambridge (two), Marcianopolis). As with the other lithotomy instruments the form of the combined scoop and knife is very constant. All comprise a slotted blade socket with simple terminal moulding at one end of a robust handle stem of chamfered square, octagonal or circular cross-section; and, with the exception of the RGZM examples, the scoop and its stem are separated from the handle stem by a slender disc-and –baluster moulding. The shape and proportions of the ovoid roughened scoops varies a little, as does their degree of curvature, and there is one atypical form – the flat inverted triangular shape of one of the Marcianopolis instruments – but that may be due to damage and breakage. The proportionately high number of examples of this type of instrument presumably reflects a preference for it by practitioners of lithotomy as well as the more general Roman predilection for double-ended instruments. Certainly, in a serious operation like lithotomy the time-saving convenience of a combination instrument might well have proved beneficial and it is instructive that it is the instrument mentioned by Rufus.

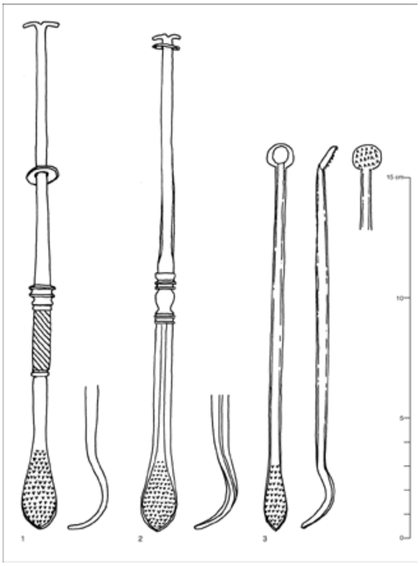

Fig. 5 - Roman bronze lithotomy instruments in the Museo Nazionale Romano (Inv. 65839/1, 65838, 50263/1). 1-2 lack their handles. Scale 2:3.

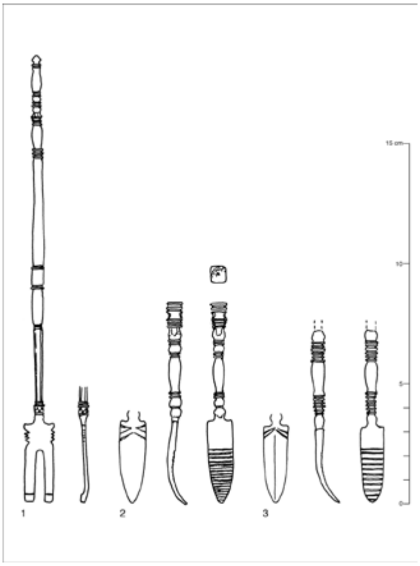

Fig. 6 - Roman bronze surgical instruments in the Museo Nazionale Romano (Inv. 65841, 65817). 2-3 broken. Scale 2:3.

Combined lithotomy scoop and bifurcated blunt hook (Fig. 3, 3)

Just one of these instruments is known, a copper-alloy example 159 mm. long in the RGZM Asia Minor/ Ephesus set (Künzl 2002a, A16). Its handle stem, of chamfered rectangular cross-section, resembles that of the other lithotomy instruments but is narrower – almost as slender as the stem of the scoop probes adapted for lithotomy in the same set. Its roughened scoop, too, of the same form as other lithotomy scoops, is proportionately small and slender. At the other end of the handle stem is a bifurcated blunt hook with curved ends and rounded tips. The roughened scoop denotes this as a lithotomy instrument and it is not hard to imagine that the bifurcated blunt hook would have made another very effective scoop for locating and removing certain varieties of bladder stone.

Bifurcated blunt hook (Fig. 2, 5; Fig. 6, 1)

This type of instrument may have been used more widely than in lithotomy alone, as, for example, in the retraction of skin, tissue and blood vessels. However, its use in lithotomy seems assured, not only in view of the combination of a bifurcated blunt hook with a lithotomy scoop (above), but also because the type is included, in an adapted form, in the Rome set in Cambridge (Künzl 1983, Taf. 64, no. 3). There is also an example in the MNR, part of the same inventory number sequence as the lithotomy scoops (below, no. 7). The length of the Cambridge instrument is 224 mm., that of the MNR instrument 187 mm. Both are of copper alloy and share a similar design and décor: the slender plain circular-sectioned handle stem is flanked by mouldings, with at one end a decorative finial and at the other a tapered stem terminating in a neat moulding at the junction with the bifurcated hook plate. The ends of the hooks of the Cambridge instrument are turned through a right angle. Originally sharp, the hooks were adapted to blunt usage by curling their tips.

The hooks of the MNR instrument, lightly curved in profile, have thickened, blunt, square-ended tips.

Slender ridged lever/ scoop (Fig. 2, 7-8; Fig. 6, 2-3)

There are two examples of this type of instrument in the Rome set in Cambridge (Künzl 1983, Taf. 65, nos. 2-3), implying a connection with lithotomy. If so, it is possible that they were included with the set rather than specifically made as lithotomy instruments. For they closely resemble the type of lever used to elevate fractured bones, as, for example, two copper-alloy instruments from Pompeii (Bliquez 1994, 131, nos. 91-92). However the bone elevators are generally stouter, more robust instruments, usually either single-piece iron tools or iron levers mounted at either end of a copper-alloy handle (Jackson 2005, 110-111 and Fig. 5.2, nos. 2-3). The relatively gracile form of the Cambridge instrument and its comparators closely matches the handle stems of the lithotomy instruments. So, until further evidence emerges we may tentatively associate them with lithotomy, their curved ridged levers adding variety to the wide range of scoops and hooks potentially available for the removal of bladder stones.

One of the Cambridge instruments is complete and double-ended, 200 mm. long, with a long slender handle stem of chamfered rectangular cross-section, a fine central multiple disc-and-baluster moulding, and a curved ridged lever at either end set in opposite planes. One lever is sub-triangular, with a pointed tip, the other tapered rectangular with a square end. Like the other lithotomy scoops their outer convex face is smooth and lightly-keeled while the inner concave face is roughened by a series of parallel cut ridges. The second Cambridge instrument is a single sub-triangular curved ridged lever with a slender multiple disc-and-baluster moulded stem which terminates at a square moulding with a dimple in its end. This feature is paralleled on a near-identical example in the MNR (below, no. 9) and gives the appearance of an instrument with a composite construction – either it was attached to another instrument or it had an organic handle. A second example in the MNR (below, no. 8) is broken across a baluster moulding, perhaps a little short of the end, and the same is true of one in the Museo Archeologico Nazionale, Napoli, which appears subsequently to have been adapted to different usage (Bliquez 1994, 122-3, no. 54). Interestingly, the Naples instrument, from the Borgia collection, is considered to be most likely from Rome (Bliquez 1994, 37, fn. 112), for the other examples, too, share that provenance.

Slender double-ended blunt hook (Fig. 2, 6)

This is another type of instrument which, by its inclusion in the Cambridge set (Künzl 1983, Taf. 65, no.4), appears to be associated with lithotomy. It is 205 mm. long and at each end of the slender handle, beyond a swan's neck loop and set in opposite planes, is a flat plate with blunt tip and sides, one leaf-shaped, the other kite-shaped. The central multiple disc-and-baluster moulding and slender chamfered rectangular cross-section of the handle stem link the Cambridge example stylistically to the double-ended ridged lever and bifurcated blunt hook in the same set (Künzl 1983, Taf. 65, no. 3; Taf 64, no. 3). Significantly, the type is also included in the Marcianopolis instrumentation, a slightly smaller and apparently broken and/ or reworked example, of near-identical form, with a leaf-shaped hook (Kirova 2002, Fig. 3, no. 5).

Like the slender ridged lever/ scoop this type of double-ended hook was probably a dual- or multi-purpose instrument, for it is found quite widely in Roman surgical instrumentation and in a variety of forms. A stout and robust version appears to have been an instrument of bone surgery and may even equate with Celsus' *meningophylax* (Jackson 2005, 111-112 and Fig. 5.2, no. 5). A slenderer type combined a blunt leaf- or kite-shaped hook with a sharp hook (Jackson 1986, 140-143 and Table 1. Jackson 1990, Fig. 2, no. 6),

a combination well-suited to procedures requiring both blunt and sharp retraction, including Celsus' operation for varicose veins (*De med*. 7, 31, 2-3). An idiosyncratic variant in the Rimini instrumentation, which combines a slender kite-shaped hook with a bifurcated hook (tips broken but probably curved and blunt), is perhaps to be associated with the lithotomy scoop in that instrumentation rather than with the tools of bone surgery.
Perhaps the most likely role of these blunt hooks associated with lithotomy instruments was to retract the margin of the perineal incision facilitating the removal of a stone with fingers, scoop or forceps.

Coudée forceps (Fig. 2, 9-10)

The final components of the Rome lithotomy kit in Cambridge are two spring forceps, one complete the other fragmentary. Fortunately, sufficient of the fragmentary example survives to show that it was of similar form to the complete forceps: both are of coudée type, with broad, finely-toothed jaws turned to one side. The complete example (Künzl 1983, Taf. 63, no. 1) is 165 mm. long with a slender moulded handle, straight arms and very carefully-made long hollow jaws with smooth outer rims. One jaw is complete, with twenty finely-cut teeth. The damaged forceps (Künzl 1983, Taf. 65, no. 1) has a short decorative finial, slightly broader arms and a sliding lock-ring.
Toothed forceps of coudée type are widely found throughout the Roman Empire (Jackson 1986, 139. Jackson and Leahy 1990, 272-3, and further examples from Cyrene, Vindonissa and Carnuntum). They were part of the standard repertoire of forceps for general surgery – smooth-jawed fixation forceps, pointed-jawed forceps, toothed fixation forceps and coudée forceps – as exemplified by a pair of double-ended forceps from Asia Minor which combine all four varieties (Künzl 2002b, 51, Abb. 66). However, there is some variation in the precise shape, angle and length of the jaws of coudée forceps and the Cambridge example has the longest and thinnest of

all (25 mm.), with very particular profiling of its edges. It is conceivable that it was specifically made with lithotomy in mind, where it's projecting, smooth-edged, hollow toothed jaws would have been used to good effect in grasping a stone.

Catalogue of lithotomy scoops and related instruments in the collections of the Museo Nazionale Romano, recorded in September 1991.

1. Lithotomy scoop (Fig. 5, 1)

Museo Nazionale Romano, Inv. 65839/1
Length 211 mm; Length handle 113 mm.
A robust copper-alloy instrument with metallic brownish patina (cleaned). All four faces of the lightly-chamfered square-sectioned handle rod preserve manufacturing file marks, which would originally have been hidden by the (now missing) wooden or bone handle. One end of the handle was secured by a circular washer (now moved out of position) braced against the split end of the handle rod. The other end butted against a small rectangular plinth and oval 'pillow' moulding followed by a series of fine circular disc-and-candy-twist mouldings. Beyond the mouldings the operative part of the instrument comprises a short thick chamfered stem which tapers, curves and expands to form a curved thick ovoid scoop, with smoothly rounded tip and sides, a median ridge on the smooth convex outer face, and a roughened concave inner face.
Photo neg. nos.: MNR 366833-4R; DAI INR. 85,2260 and 85,2266.
Tabanelli 1958, Tav. XCVI ('Leve romane per ossa').

2. Lithotomy scoop (Fig. 5, 2)

Museo Nazionale Romano, Inv. 65838.
Length 208 mm; Length handle 101 mm.
A robust copper-alloy instrument, condition and handle as no. 1. A finely-made disc-and-baluster moulding separates the handle from

the operative end which consists of a stout, chamfered diamond-sectioned stem which curves and expands to form a curved thick ovoid scoop, with smoothly rounded tip and sides, a median ridge on the smooth convex outer face, and a roughened concave inner face.
Photo neg. nos.: MNR 366831-2R; DAI INR. 85,2260.
Tabanelli 1958, Tav. XCVI ('Leve romane per ossa').

3. Double-ended lithotomy scoop (Fig. 5, 3)

Museo Nazionale Romano, Inv. 50263/1. 'Kircher.' Coll.
Length 160 mm.
A complete copper-alloy instrument, with a dusty mid-green patina lightly accreted with soil in places. The plain stem, with chamfered square cross-section, tapers lightly and evenly from the centre to each end. One terminal is a near-circular, small, thick angled disc, with a smoothly rounded perimeter edge, chamfered convex outer face and roughened flat inner face. The other terminal is a curved slender ovoid scoop, with smoothly rounded tip and sides, a median ridge on the smooth convex outer face, and a roughened concave inner face.

4. Double-ended lithotomy scoop

Museo Nazionale Romano, Inv. 50263/2. 'Kircher.' Coll.
Length 154 mm.
A complete copper-alloy instrument, near-identical to no. 3, but slightly smaller and with less accretion.

5. Double-ended lithotomy scoop

Museo Nazionale Romano, Inv. 65839/2.
Length 170 mm.
A complete copper-alloy instrument, condition as no. 1, of the same form as nos. 3-4. The plain, well-made stem is of chamfered square cross-section, gently tapered both ways from the centre-point. One terminal takes the form of a small, angled, thick circular disc with

smooth perimeter, chamfered convex outer face, and roughened flat inner face. The other terminal, slightly distorted, is a curved elongated ovoid scoop with smooth tip and sides, a median ridge on the smooth convex outer face, and a roughened concave inner face.
Photo neg. nos.: MNR 366587-8R; DAI INR. 85,2260.
Tabanelli 1958, Tav. XCVI ('Leve romane per ossa').

6. Modified spatula probe

Museo Nazionale Romano, Inv. 65840.
Length 141 mm.
A copper-alloy spatula probe, condition as no. 1, of normal form, with carefully-profiled stem, its olivary terminal broken. The oar-shaped spatula has been deliberately and carefully bent to form a smooth strong curve, a modification perhaps intended to adapt it to use as a scoop – it is effectively an un-roughened version of the lithotomy scoops nos. 1-2.
Photo neg. nos.: MNR 366585-6, 366589R; DAI INR. 85,2267.

7. Bifurcated blunt hook (Fig. 6, 1)

Museo Nazionale Romano, Inv. 65841.
Length 187 mm; Width hook plate 11.5 mm.
A complete copper-alloy instrument, condition as no. 1. The slender, finely-crafted stem, with ornate finial, is separated from the hook plate by a neat moulding. The hooks, thickened blunt and square-ended, are lightly curved in profile, perhaps originally more so.
Photo neg. no. DAI INR. 85,2266.

8. Ridged lever/ scoop (Fig. 6, 3)

Museo Nazionale Romano, Inv. 65841.
Length 71.5 mm.
One end of a copper-alloy instrument, condition similar to no. 1. The slender circular-sectioned stem is broken above a series of finely-cut

disc-and-baluster mouldings. The operative part is a slender, curved, elongated shield-shaped lever or scoop, with smooth blunt tip and sides, a median ridge on the outer convex face and a zone of ridged faceting (comprising eleven cut grooves) extending back from the tip on the inner concave face.
Photo neg. no. DAI INR. 85,2260.

9. Ridged lever/ scoop (Fig. 6, 2)

Museo Nazionale Romano, Inv. 65817.
Length 83 mm.
One end of a copper-alloy instrument, condition similar to no. 1, in form nearly identical to no. 8, though slightly larger. The slender, finely-moulded stem is of circular cross-section except at the point of breakage, which is a triple-disc-and-reel moulding of square cross-section. A distinct 'dimple' in the broken face suggests the instrument had a composite construction. The operative part is a slender, curved, elongated shield-shaped lever or scoop, with smooth blunt tip and sides, a smooth convex outer face and a zone of ridged faceting (comprising seventeen cut grooves) extending back from the tip on the inner concave face.
Photo neg. no. DAI INR. 85,2267.

BIBLIOGRAPHY AND NOTES

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Correspondence should be addressed to:

RJackson@thebritishmuseum.ac.uk