en s'exclamant: *Plutôt voir le turban turc au milieu de la capitale que la mitre latine.*

En avril 1453 Mehmet II met le siège devant la ville. Constantin XI se battit héroïquement et préféra mourir que se rendre. La ville tomba le 29 mai et fut abandonnée au meurtre et au pillage trois jours durant. C'en était fini de l'empire byzantin fondé par le Grand Constantin.

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Articoli/*Articles*

THE SURGICAL INSTRUMENTARIUM OF LEON IATROSOPHISTES

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SUMMARY

This study examines the surgical operations in the ninth century treatise Synopsis of the Medical Art *authored by Leon Iatrosophistes, with particular attention to the instruments required. It is argued here on the basis of this and other relevant Byzantine texts that the surgeons of the Middle and Late Byzantine Periods had available most, if not all, of the instruments employed in the Roman Empire and the Early Byzantine Period. Based on these findings, it is also maintained that the state of the surgical art throughout Byzantine times remained more or less at the same level of expertise.*

The object of this paper is to ascertain what kind of surgical instruments were used by Byzantine physicians. While the emphasis throughout is on the Middle Byzantine Period, and in particular on the ninth century, the conclusions reached probably apply to the Late Byzantine Period as well. The task is not easy because material evidence for Byzantine surgery from the seventh century on is very hard to come by. In stark contrast to the Roman Empire, surviving Byzantine objects identifiable as instruments used for surgical or pharmaceutical purposes are few. And, to make matters worse, the true functions and/or dates of many of those so identified are uncertain[1]. The reason for the lack of material evidence is mainly due to a change in burial customs: whereas Romans from the first through the fifth centuries frequently buried dead physicians with some or all of their *instrumentaria,* Byzantines did not. Moreover, sealed settlement sites like Pompeii, in which so many marvelous tools were

Key words: Byzantine Surgery – Instruments – Leon Iatrosophistes

buried by the eruption of Mt. Vesuvius, are rare in any period of human history. So, the rich sources for the material evidence that helps enormously in reconstructing the surgical practices of the Roman Empire simply do not exist for any period of the Byzantine Era.

In contrast, the literary evidence for Byzantine surgery is abundant. But, unfortunately, the most important treatises were composed between the fourth and the first half of the seventh century; for it is in this time period that Oribasius, Aetius, and Paul of Aegina were at work. Subsequently, there are no sources as informative. There are of course important medical writers after 650, such as Theophanes Nonnus or Chrysobalantes (tenth century), Michael Psellus (eleventh century), Symeon Seth (eleventh century), and John Actuarius (fourteenth century). They, however, tell us little about surgical procedures other than cupping, bloodletting and purging. Of great interest are a series of surviving lists containing mainly Greek names of surgical instruments and paraphernalia (hereafter, *Lists*). These were composed between the 9th and the 15th centuries and occur in both Greek and Latin transcription. I have made much of these documents in the past, proposing that, if lists of such tools were being created, then the instruments itemized and, by implication, the operations for which they were intended must have been being performed at the time *Lists* were made, i.e. during the Middle and Late Byzantine periods[2]. This view has been questioned. It has been pointed out that *Lists* in Latin transcription are transmitted with other Latin works of an elementary nature on medicine; thus it is argued that the original compilation, whence *Lists* descend, may have been directed toward the education of beginning students. If so, *Lists* are merely bookish catalogues of instruments used in an earlier age and cannot be used to shed light on the surgery of their own time[3].

We encounter a similar difficulty in attempting to bring to bear the works of earlier authors that were available in Middle Byzantine times. The patriarch Photius in his famous *Bibliotheca* composed in the ninth century remarks upon the writings of Paul, Oribasius, and Aetius, with emphasis on the latter two[4]. He praises Aetius in particular, the study of whom he highly recommends to those interested in the practical applications of the medical art, including surgery[5]. Also about this time one Nicetas assembled in a splendid manuscript a series of surgical extracts from classical and Early Byzantine authorities[6]. All of these surgical sources were clearly available to readers. But the question is, to what degree were the operations described in them actually practiced. Indeed, in his lengthy description of Aetius' work, Photius gives the impression that many devotes of medicine in his time were interested more in theory than application. So one could argue that, like *Lists*, the surgical chapters of Oribasius, Aetius, Paul and the writings of the celebrated surgeons of the Roman Empire on whom they often depend (e.g. Leonides, Antyllus, Archigenes), even though there to be consulted, were more the object of antiquarian interest than the basis for the surgical procedures of the times.

Conceding for the moment that these particular literary sources cannot be brought to bear on surgical practices after ca. 650, and, acknowledging that the material remains are of little consequence, on what basis can we form any impression of the state of the surgical art during the Middle and Late Byzantine periods? Fortunately, one treatise has been transmitted which allows us to gain at least a partial picture of the situation towards the end of the Issaurian dynasty in the 9th century. This is the Σύνοψις τῆς Ἰατρικῆς or *Synopsis of the Medical Art* (hereafter *Synopsis*) composed by one Leon, an *Iatrosophistes* or Professor of Medicine contemporary with the Emperor Theophilus (829-842)[7].

Leon's *Synopsis* is hardly a meaty, detailed treatise of the type composed by his predecessors Oribasius, Aetius and Paul. Their works occupy volumes when edited or translated through the medium of the modern book, while the whole of Leon's tract amounts to a mere 70 pages of Greek in the only modern edition, that of F. Z. Ermerins[8]. However, although Leon offers only a brief summary, he devotes a noticeable portion of his work to surgery, and his language makes it clear that the procedures he describes are actually used. While his account falls far short of the more than one hundred operations in Paul's sixth book, he nonetheless briefly describes or alludes to about 40 procedures. Whatever Leon's shortcomings, he is, surgically speaking, the

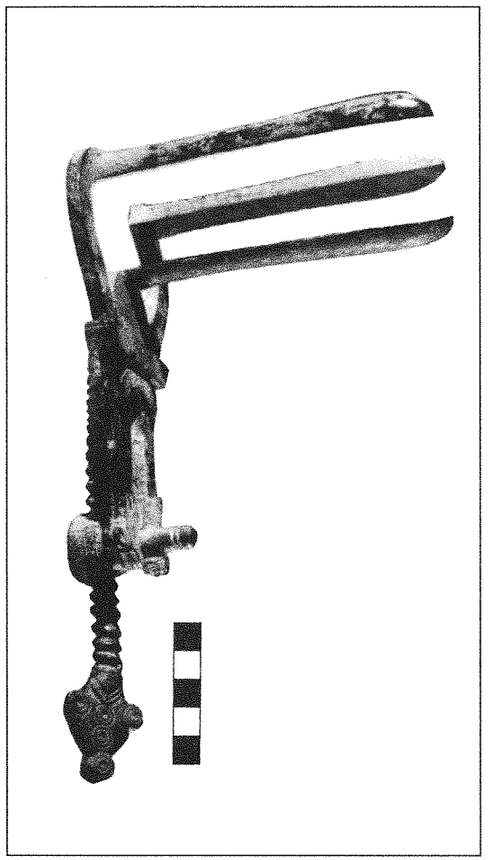

Fig. 1 - Uterine speculum thought to be Byzantine: Wellcome Museum (Science Museum), Phot. Mus. MS 231.

only flower in a desert after Paul. And of course, he represents the only uncontroversial source of information about surgical tools at the onset of the Middle Byzantine Period. For this reason the surgical passages in Leon are essential to our quest.

First a few general remarks about Leon's *Synopsis* that bear on this essay. In the preface we learn that Leon composed *Synopsis* at the repeated requests of a certain George (clearly a student of Leon's) who wanted the tract as a memory aid (ὑπομνήσεως ἕνεκα). As George asked only for a brief treatment of the medical art (διὰ βραχέων), Leon designed *Synopsis* to treat matters succinctly. But he also aimed to be clear and to include everything he considered important. *Synopsis* is reminiscent of some of its antecedents in that it is generally organized *a capite ad calcem* over the course of its seven books[9]. Also reminiscent of his Early Byzantine predecessors is Leon's inclination to depend on classical authorities. One difference is that, for the sake of brevity, these masters are not quoted *verbatim*, the procedure fol-

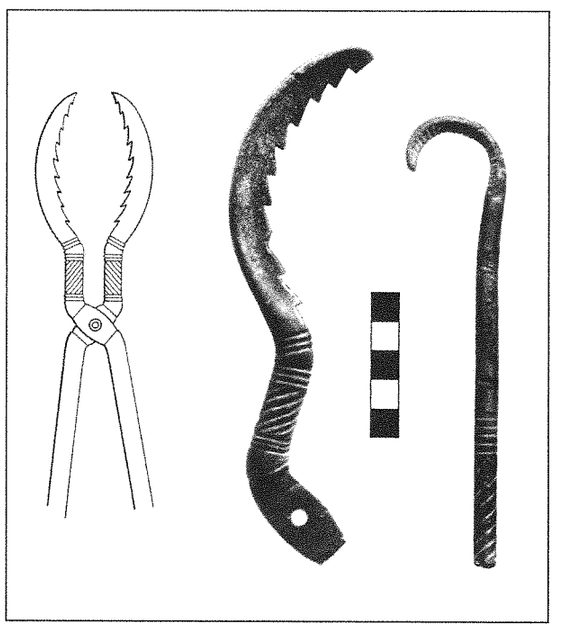

Fig. 2 - Remnant of cranioclast and birthing/lithotomy hook thought to be Byzantine: after Meyer-Steineg, 1912, Taf. 6 and fig. 1.

lowed by Paul, Aetius and Oribasius, but are merely cited. Leon most often refers to Hippocrates and Galen but he also mentiones, if infrequently, other authorities like Archigenes, one of the celebrated Roman physician/surgeons often quoted by earlier Byzantines[10]. It is therefore clear, pace Photius, that a ninth century practitioner might have more than an antiquarian interest in the works of his predecessors.

To turn to our main concern, surgical instruments, Leon unfortunately specifies only eleven in all, and rarely does he describe any tool. The reason clearly is his wish to be succinct. So, he often provides no more detail than that a particular condition is corrected by cutting (ἐκτέμνομεν) or bleeding (φλεβοτομοῦμεν) or, even more vaguely, simply *by surgery* (διὰ χειρουργίας). This means that one is often forced to speculate on the surgical procedure and, especially, on the actual instruments used. The most obvious way for us to proceed is to have recourse to other sources to fill in the picture in Leon. A few are contemporary with or postdate Leon. But special emphasis will of necessity be placed on the replete tracts of earlier authorities, Paul in particular, where the instruments used are detailed. As we have just seen, Leon himself refers George to earlier authorities; hence the justification for relating texts like Paul's to his silences. Admittedly, this method assumes that Leon generally followed the practices of his predecessors when he did not openly oppose them (see below).

Clearly, the Byzantines admired and desired fine instruments. The clergyman George Tornices, for example, remarks on *marvelous and well suited instruments* used for dissection in his time (mid twelfth century)[11]. Since Byzantine survivals are few and since the instruments Tornices so admired surely retained the basic design of their classical forbears, most of the illustrations provided in this essay are of tools made and used between the first and fourth centuries ACE. In some cases, the instruments used by Byzantines *may even have been* those in service during the Roman Empire. At Corinth, for example, a scalpel handle shaped like a bust of Heracles is said to have been extracted from a tenth to twelfth century context[12]. Four specimens of this type of scalpel were excavated in Pompeii (Fig. 3); therefore they

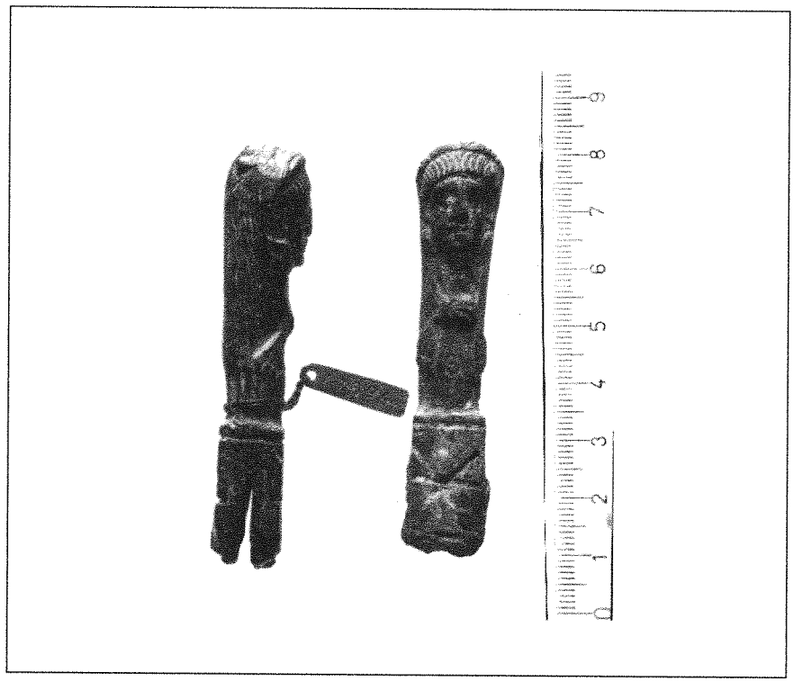

Fig. 3 - Scalpel handle in the image of Hercules, Pompeii: Phot. RGZM L1036/2.

were made in or before 79 ACE[13]. I know of no specimens later than the first century, save for the one from Corinth. If the context in which it was found is accurate, this Heracles handle may have been in use for a millennium or more[14]!

Leon's least interesting book from a surgical perspective is his first. There in 21 clipped chapters he treats of various types of fever, a condition affecting the entire body. Only once does he mention a surgical procedure. In cases of unremittent or continuous fever he follows the directives of Galen and recommends phlebotomy or bloodletting (I.3). But he says absolutely nothing about where or how much blood is to be drawn. For

that the reader needs to refer to the details provided by Galen in *De methodo medendi* (10.287 et *passim* Kühn). We see from the outset how Leon deals only with what he considers essential.

As Leon proceeds *a capite ad calcem*, he deals in the second book with various physical and psychological conditions related to the head. Students of surgery will be especially interested in what he has to say about headache. Ordinary headache can, like fever, be treated by phlebotomy (1). Here at least Leon identifies the humero cephalic vein as the vessel to be opened and specifies the phlebotome (φλεβοτόμον) as the instrument to be used. There is also a reference to the phlebotome in the twelfth century *Typikon* or *Constitution* (hereafter *Typikon*) of the Pantocrator Monastery in Constantinople[15]. There we find enumerated the instruments to be stocked and kept in good condition in its hospital by an official known as the *sharpener* or ἀκονητής. The phlebotome in classical times may have assumed the form of a lancet but, since so few instruments of this shape survive, and, since recommendations for phlebotomy are so frequent in earlier texts (note that there are five in Leon), it is likely that the name was often applied to the ordinary scalpel[16]. That was likely the case in Leon's time as well.

For inveterate (probably migraine) headache more radical steps have to be taken if one resorts to surgery: angiology, arteriotomy, and *periskyphismos* (2). Here Leon's succinctness is particularly remarkable because these are harsh and relatively complex interventions about which no information other than their names are given.

Angiology involved division of the temporal blood vessels. According to Paul (6.5 Heiberg), an incision had to be made, the wound separated with sharp hooks (ἄγκιστρα), the vessels isolated with dissectors (ἐξυμενιστῆρες), raised with a blunt hook (τυφλάγκιστρον), and tied off with linen ligatures passed under them with a needle (βελόνη). The vessels were then opened with a phlebotome and emptied out. In arteriotomy Paul states that the back of the head was shaved, the arteries behind the ears marked out and the vessel cut into until the blood sprang *per saltum* (6.4). In *periskyphismos*, after the hair above the forehead was shaved, an incision was made across the shaved area

from the temples so that the bone was exposed. The wound was kept open with tents and pledgets and the bone scraped to encourage incarnation. The object, according to Paul, was to create a thick scar which, it was believed, would constrict the vessels whose defluxions promoted the pain (6.7). Paul does not mention specific instruments for the latter two operations but obviously a razor and phlebotome or scalpel are called for in each, and probably a retractor for the latter.

Leon also states in chapter 2 that a cautery can be applied along the forehead (καυτῆρα κατὰ τοῦ βρέγματος) to treat headache. In his treatment of angiology Paul reports that some, instead of cutting, burn the temporal veins with cauteries shaped like olive pits (πυρηνοειδῆ καυτήρια), probably simply the bulbous terminations found on the end of the common *spatula* or at the termini of the probe called *dipyrene* (Fig. 5, 2nd row)[17]. This or some other fine cautery must be the type Leon has in mind.

In cases of *hemicrania* or inveterate headache over half of the head, the same interventions are recommended (3).

Finally, in chapter 15 Leon deals with a parasurgical treatment for amnesia. One needs to shave (δεῖ ξυρᾶν) the head and apply a plaster. Thus, we find indirect testimony to the use of the razor in Leon[18].

Book Three treats diseases of the eyes. The first ophthamological condition for which a surgical cure is cited is *chalazion* (10), a tumor of the eyelid resembling a hailstone (*chalaza*). Leon recommends without preference two procedures: either cutting the growth out (ἐκτέμνομεν), or strangling it with a thread until it separates (ἀπολινοῦμεν). The Greek name for the latter operation, *apolinosis*, indicates that a linen thread (λίνον) was usually employed. Paul (6.16) details the instruments required if the choice is to cut. Whether the growth is situated on the interior or the exterior of the lid, he makes a transverse incision with a scalpel (σμιλίον) and extracts its contents with an ear scoop (μηλωτίς). In the next chapter (11) Leon also prescribes excision or *apolinosis* for a similar condition called *krithe*. Further on, in chapter 32, he notes that some dare to employ *apolinosis* in treating *staphyloma*, even though it is incurable (ἔστι δὲ ἀνίατον τὸ πάθος). The ancients applied the name

staphyloma to several distinct ophthalmological disorders but all were characterized by a grape like bulge on the eyeball. This, as Leon observes, made shutting the eye difficult. Celsus (7.7.11 Spencer), pseudo Galen (19.435 Kühn), Aetius (7.36.37 Olivieri), and Paul (6.19) all attack the bulge by passing through it two threads on a needle. They then tightly tie off the bulge with the threads, thus cutting through and excising it. Paul states that, while sight cannot be restored, the operation is performed to remedy deformity. The loss of eyesight may account for Leon assertion that *staphyloma* is *incurable*. His choice of the term dare/venture (τολμῶσι) of those who attempt a surgical cure indicates that he himself did not favor the operation. As one reads through Leon's seven books, one gains the distinct impression that he is less adventuresome than other surgeons, both earlier and contemporary. Similarly in Book Four, he recommends against surgical intervention for *prosphysis* and *symphysis*, or adhesion of the eyelids to the eye or to one another (21). Here too, however, he shows by his opposition that other surgeons do operate for these conditions.

Owing to the lack of modern sanitation in the past, *ophthalmia* with resultant *trichiasis* (ingrown eyelashes irritating the eye) was a frequent complaint. It was doubtless no less a problem in Leon's time, and we find him recommending in chapter 14 some of the same surgical remedies as his predecessors. But here again Leon treats a complex surgery in the briefest way. *We undertake*, he says, *the simple incision* (ἁπλοτομία), *and the upper* (ἀναρραφική) *and lower* (καταρραφική). Again, we appeal to Paul to fill in the picture (6.8&11). In his account, based on Leonidas, the eyelid is raised and a series of shallow incisions made along its inner surface. These result in an area shaped like a myrtle leaf enclosing the offending hairs and redundant skin. The enclosed area of tissue is then transfixed by a sharp hook, peeled away, and the edges of the incision sutured together. When the incisions are made to the upper eyelid, it is designated as *anarrhaphike* or *upper*; when it is administered to the lower eyelid, it is designated as *katarrhaphike* or *lower*. Essential to this operation is a special little scalpel which Paul terms ἀναρραφικὸν σμιλίον. Another surgical remedy cited

by Paul requires griping the redundant skin with a *forceps for seizing the eyelid* (βλεφαροκάτοχον μύδιον) and removing it with a small scalpel (σμιλίον). I submit that this procedure, which involves only one incision, lies behind Leon's term ἁπλοτομία. Whether the forceps recommended by Paul in the second operation was anything more than a small version of the ordinary dentated surgical forceps cannot be determined, given the present state of our knowledge. But in all probability the surgical scalpel used in both of the procedures cited in Paul is the same. A small scalpel with a fine blade would be appropriate in both situations and a diminutive octagonal handled model frequently found in Roman graves has been proposed as the type (Fig. 5, bottom row, 2nd group from left)[19]. Leon does not indicate here that he has a special instrument in mind but, ironically, he tips his hand in his fourth book (5). There, dealing with an entirely different matter, *parulis* or gum boil, he provides one of his rare references to the actual instrument used: *some divide them with an eyelid knife* (βλεφαροτόμον). The *blepharotomon* of the ninth century and the *anarrhaphikon smilion* of the Roman Empire/Early Byzantine Period will hardly be other than the same instrument.

Leon is less reticent in dealing with *pterygium*, a thin unnatural growth extending like a wing (hence its name) over the eye from the great *canthus* to the *corona* (20). He says that the operation (πτερυγοτομία) is carried out *by applying a horsehair with a needle and thus sawing it*. Paul helps us make sense of these terse directives (6.18). He raises the *pterygium* with a slightly bent sharp hook (ἄγκιστρον μικροκαμπές), passes the horsehair and a linen thread through it with a slightly bent needle, binds and raises the *pterygium* with the thread, then saws it off on the *corona* side with the hair. Paul then proceeds to excise the base of the growth with the knife used in the suture operation for *trichiasis* (ἀναρραφικὸν σμιλίον)[20]. As we have already seen, Leon had such a specialty knife available in his time.

From improper treatment of *pterygium* or some other cause arises *encanthis*, a small reddish excrescence on the large *canthus*. Celsus raises it with a sharp hook and pares it away with a

scalpel (7.7.5). He emphasizes that the surgeon must be exceedingly careful not to damage the angle of the eye (*diligenter temperata manu*). Leon echoes this concern (εὐφυῶς τέμνοντες), though he provides no other information on the surgery (18).

Earlier writers frequently refer to *fistula lacrimalis* (a condition which they call *aegilops* or goat's eye), a fistulous abscess between the large *canthus* and the nose[21]. According to Paul (6.22), we should dissect out the diseased channel if the abscess has burst; if it has not, we should lay it open to the bone. If the bone is healthy, it should be scraped; if the bone is carious, it should be cauterized with *aegilops* cauteries (αἰγιλωπικὰ καυτήρια). This *aegilops* cautery Paul equates with the olivary type (πυρηνοειδὲς καυτήριον) he recommends for angiology. Some, he says, after clearing the flesh, use a trephine or drill (τρύπανον) to bore a drainage passage into the nose, but he himself is content with cauterization. Celsus too declines to drill into the bones of the nose for drainage purposes (7.7.7). Leon's characteristically brief account (22) reads evasively, as though he is inexperienced with the operation or wishes to shift the responsibility to other parties. He says only that *some* (τινες) cauterize and trephine the bone of the nose. But he does again specify an instrument, the *fistula* cautery (συριγγιακὸς καυτήρ). This surely is the cautery referred to by Paul. The name συριγγιακὸς καυτήρ is unique to Leon.

The only other eye condition Leon treats with fire is paralysis (17). This, he explains, is relaxation of the eyelid, such that the eye cannot be opened. The disorder is caused by cold and is therefore countered *by warming agents, such as by fire* (φλογί). One's first thought is that cauterization is meant. However, earlier authorities who deal with paralysis direct us to apply heated bleeding cups to the occiput of the head[22]. This is most likely what Leon means by φλογί.

In chapters 40 and 41 Leon deals with *ektropion* and *hyatids*, both of which he simply says are treated through surgery (διὰ χειρουργίας). So once more we consult Leon's predecessors for details. Celsus, like Leon, defines *ektropion* as eversion of the eyelid, the lower in particular (7.7.10). It arises, he says, from maltreatment of a previous condition resulting in a deficiency of

eyelid tissue or from old age which makes the eyelid droop. If the former is the cause, he corrects the condition by making at the edge of the eyelid an incision in the form of a crescent, with its horns directed toward the jaw; he then permanently separates its edges, thus creating more eyelid once the wound has healed. If *ektropion* is occasioned by old age, he burns with a fine cautery (*tenui ferramento*) the part that droops in an effort to stabilize the eyelid by the resultant scarification. Unfortunately, because he is so brief, we cannot tell if Leon had both situations in mind. In the case of hyatids, fatty cysts of the eyelid, both Celsus (7.7.1) and Paul (6.14) pressure them with the fingers of one hand, expose them with a scalpel or phlebotome, and then extract them with the fingers of the other hand. This was likely the process for Leon who agrees with Paul and Celsus that hyatids afflicted children in particular.

In Book Four Leon tackles diseases of the nose, mouth and throat, before working his way down to the chest. The only nasal condition for which he prescribes surgery is polyp (2). This, he says, can either be excised with the polyp knife (τῷ πολυποτόμῳ σπαθίῳ) or sawed through with a length of *esparto* (τῷ σπαρτίῳ). The mention of a specific instrument in Leon is always a special occasion but, to get an accurate sense of the polyp knife, we have to consult earlier authorities. Paul gives the most detail (6.25). He describes the instrument as having a blade shaped like a myrtle leaf on one side and a small scoop on the other. One cuts away the polyp with the blade and, if any bits remain, they can be scraped out with the scoop. Like Leon, Paul also saws away polyp, but he prefers to do so with a knotted linen thread introduced into the nose by an eyed probe (6.25). Other tools employed by Paul are a rugine to scrape away remnants and a leaden tube (purpose unclear). Leon mentions none of these, and the name by which he identifies the polyp knife occurs nowhere else[23].

Leon's excision of *parulis* with the eyelid knife has already been treated above. The two other surgeries of the mouth and throat occurring in Book Four are tonsillectomy (6) and uvulectomy (8). The usual procedure for the former was to pierce and position the tonsil with a sharp hook and to cut it out with a

scalpel (Celsus 7.12.2). Paul, however attests in addition to a tongue depressor (γλωσσοκάτοχον) and to a special set of knives (ἀγκυλοτόμα) curved in opposite directions, one for the right and one for the left hand of the operator (6.30). Leon mentions no instruments, but he will hardly have done without a scalpel for tonsillectomy, and a hook or at least a forceps to position the tonsil will also have been required. Only Paul mentions the special curved knives, so their use may never have been widespread.

In cases of an inflamed *uvula* (the small appendage suspended from the soft palate; σταφυλή in Greek) Leon recommends amputation (σταφυλοτομία) or burning with what he calls a *cold cautery* (ψυχρῷ καυτῆρι). Uvulectomy is often met with in classical and Early Byzantine writers. As in tonsillectomy, the inflamed *uvula* is seized, positioned, and excised in whole or in part. A common forceps could be used to grip it, but there was also a special model for the purpose, the *staphylagra* (σταφυλάγρα). Over 20 specimens of what is believed to be the type have been recovered. Paul (6.31) also recommends a uvula knife or σταφυλοτόμον for the operation, perhaps a scalpel with a curved blade on the order of the tonsilltome, conceivably the same instrument. However, he also allows for the eyelid knife (ἀναρραφικὸν σμιλίον). In fact any small scalpel will have been suitable. Since several knives could be employed, it is impossible to determine which Leon might have used. Indeed, he never mentions any type of surgical blade in the entire treatise. As an alternative to excision, the uvula could be destroyed with caustics. These were administered by the *staphylokaustes* (σταφυλοκαύστης), a special forceps with spoon shaped jaws to hold the caustic and at the same time embrace the uvula. Several examples of the caustic forceps have been identified. Here we may be able to probe deeper into Leon's narrative: when he refers to burning with a cold cautery, the caustic forceps is likely what he has in mind[24].

Leon moves on to disorders of the chest, two of which require surgical attention. In chapter 18 after describing conditions resulting in bloody vomit or mucous/sputum he directs George to bleed the patient; or, if the situation is particularly severe, *cut spherically* (σφαιροτόμησον). We are quite familiar with ordinary phlebotomy but the verb σφαιροτομεῖν (literally *cut spherically*)

is otherwise unattested. The term surely indicates a method of bleeding, but it is unclear just what is entailed[25]. In any case the present context favors remedies that reduce the supply of blood. If cupping is at issue, this is the first instance of it in *Synopsis*. There are three recommendations for cupping in Book 6, though none involves the verb σφαιροτομεῖν. Phlebotomy is also prescribed for pleuritis in chapter 19.

Book Five treats of diseases of the abdomen and rectum. For dysentery (9), teinismos or inflammation of the rectum resulting in diarrhoia (12), and colic or blockage of the large intestine (13), Leon orders various clysters with the same formulaic expression: δεῖ κλύζειν. Administration of an enema or a douche is at best a parasurgical operation, but it involved a sophisticated clyster pipe attached to a bladder. These pipes, some of them perforated along their sides (Fig. 4), have been recovered in locations where classical surgeons worked (Pompeii in particular), making it clear that they were administered by medical personnel[26]. Since the modern apparatus requires plastic or latex materials only developed in recent times, Leon surely employed the classical model.

In earlier manuals we find treatment for hemorrhoids from the Hippocratic Corpus on. In the Hippocratic treatise *De haemorrhoidibus* they are burnt with cauteries shaped like an obol at the terminus[27]. Later authorities like Paul (6.79) offer remedies varying from *apolinosis* to the procedures used in uvulectomy: strangulation with the *staphylagra* (though a common toothed forceps would do) before excision with the scalpel or burning with caustics delivered in the *staphylocaustes*. Leon (18) says nothing of burning to remedy the condition, referring only to cutting or *apolinosis* (δεῖ τέμνειν ἢ ἀπολινοῦν). Leon identifies the hemorrhoids as ἐξοχάδες the term for external hemorrhoids in earlier authors. The actual word hemorrhoids (αἱμορροίδες) he reserves for bleeding veins inside the anus, by which he must be referring to internal hemorrhoids (ἐσοχάδες in Paul). In case of the latter he recommends only *apolinosis* (11).

Another condition that Leon attacks with *apolinosis* as well as cutting is rectal fistula (19). An account of this complaint can be found in just about any earlier author interested in surgical

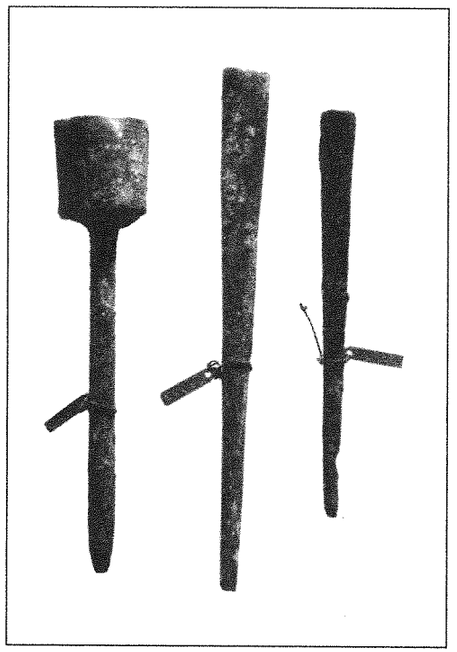

Fig. 4 - Clyster tubes, Pompeii: Phot. RGZM L1037/4.

cures. The earliest occurs in the Hippocratic tract *De fistulis* where we hear of both remedies[28]. *Apolinosis* in the case of fistula involves a somewhat different process than the one used for hemorrhoids, *chalazia*, etc. Rather than wrap the thread around tissue and excise by applying sudden pressure, the thread is passed through the fistula with an eyed probe and knotted tightly enough to cut gradually into its extremities. The thread (or a replacement thread) is kept in place until the fistula is opened completely and can be attacked with medication. If cutting is the method of treatment selected, then the fistula is opened by running a probe into the it to serve as a director or block along which the surgeon draws a scalpel. By Galen's time a special fistula knife called συριγγοτόμον had been created. No example

has ever been recovered, but the descriptions of the instrument in Galen (10.415 Kühn) and Paul (6.78) are complete enough to show that it consisted of a falciform blade, sharp only on one side, that was drawn through the fistula, thus dividing it. This is precisely the instrument specified by Leon who, in one of his few expansive moments, specifies that we should *cut with the instrument called falciform* (τέμνειν τῷ δρεπανοειδεῖ λεγομένῳ ὀργάνῳ). In order to access the fistula Hippocrates and Paul both call for dilation of the anal-rectal passage with a *speculum*. This goes by various names: κατοπτήρ (Hippocrates); τὸ μικρὸν διόπτριον, ὁ ἑδροδιαστολεύς, and διαστολεύς (Paul 6.78). Leon of course mentions no such instrument but such *specula* were surely available in his time (see below).

Two situations at the end of Book Five call for application of the cautery. The first is what Leon calls *hardening of the spleen* (22). This he says is difficult to cure but treatment may be attempted through drugs, perspirants, and through cauteries (διὰ καυτήρων). This is the only occasion on which Leon uses the term cautery in the plural, which one may interpret as indicating several applications of the instrument. This is reminiscent of Paul's chapter on burning over the spleen (6.48), where he relates that some stretch the skin over the spleen with sharp hooks and then burn through the raised tissue three times with a small cautery (μακρὸν καυτήριον) to form six eschars. The cautery in question is probably no more than a fine straight piece or iron, or the olivary terminus of a slender probe such as those on the *dipyrene* or *spatula*. Some such cautery and process must be what Leon has in mind[29]. The second disease so treated is *elephantiasis*, by which Leon probably means leprosy (25). This disease too is almost incurable but cauterization of the forehead helps. Here Leon uses the same formula as he did in dealing with inveterate headache: καυτὴρ κατὰ τοῦ βρέγματος (2.2). There he probably had the olivary cautery in mind; there is no evidence what type he envisages here.

With Book Six we move on to afflictions of the urogenital tract. The first requiring a surgical instrument is *ischuria* (4). Leon attributes inability to urinate to a stone, blood clot, or some other impediment in the bladder. Whatever the cause,

the condition is to be relieved by insertion of a catheter[30]. The process of lubricating and manipulating the catheter is described by several authorities, including Celsus (7.26.1) and Paul (6.59), both of whom also describe the characteristic S-shape assumed by the male version and the shorter female type with its gradual curve. We also find the catheter among the instruments tended by the ἀκονητής of the Pantokrator hospital; thus we have testimony to its existence in the twelfth century as well.

Leon now turns to a series of four inguinal/scrotal hernias. The first two, *buboncele* (10) and *enterocele* (11), involve rupture or stretching of the peritoneum, allowing the intestine to descend into the scrotal sack. *Buboncele* is in fact *enterocele* in an early stage. Leon blithely says of the former that it is to be treated with a support (ἐπίδεσμος) and by burning (διὰ καύσεως), and of the latter that it cannot be cured without an operation (ἄνευ δὲ χειρουργίας οὐκ ἐνδέχεται ἰασιν). But he gives no further details.

In fact, complex surgeries lie behind these brief remarks as an examination of earlier accounts will show. Paul, for example, describes two methods of treatment for *buboncele* (6.66). One involves cutting and suturing, but most of *the moderns*[31], he says, favor burning, the procedure that Leon recommends. First the area to be treated is marked off with black ink in a triangle and a mark placed in its middle. Then nail shaped cauteries (ἡλωτοὶ καυτῆρες) are applied to the mark, after which gamma shaped types (γαμμοειδεῖς) are used to burn the sides. Finally, the whole triangle is leveled with cauteries shaped like tiles or lentils (πλινθωτοὶ ἢ φακωτοί). In all, ten cauteries are used in the operation. In the case of *enterocele*, Paul (6.65) has the damaged *peritoneum* exposed by a blunt hook or flat probe (κοπάριον) after an incision and application of sharp hooks to keep the wound open. If any intestine has descended into the scrotum, it has to be pushed back up into the belly. The *peritoneum* is then sutured with needle and thread in a complex maneuver, and the part of it that becomes superfluous is removed along with the testicle. Some, he says use cauteries in the course of the operation to guard against hemorrhage.

Similarly, in his chapters on hydrocele, which he calls hygrocele (12), and cirsocele (14), Leon tells us no more than that these conditions are treated διὰ χειρουργίας, forcing us again to Paul's accounts to fill in the many details that Leon passes over.

Hydrocele, as its name indicates, is a hernia caused by fluid collecting in the scrotum in or around a membrane called the *tunica vaginalis*. Like *bouboncele* it can be treated by cutting or cauterization. If the former, Paul (6.62) opens the scrotum with a scalpel (σμίλη), retracts the wound with a sharp hook, exposes the hydrocele with the scalpel and a dissector suited to the purpose (ὑδροκηλικῷ κοπαρίῳ), lances the *hydrocele* with a phlebotome, drains the fluid, raises with sharp hooks and excises the *tunica vaginalis* (and also the testicle if necessary), then inserts an olivary probe into the incision and elevates the scrotum so as to make an incision with the point of a scalpel to remove blood and pus. Again though, he says, the moderns cure by cauterization. If this method be followed, then the surgeon is to burn open the scrotum with 10 or 12 gamma shaped cauteries, dissect away intervening tissue with a *spatula* or a blunt hook, access the *tunica vaginalis* with a cautery knife (τῷ μαχαιρωτῷ καυτῆρι, probably just a heated scalpel), evacuate the fluid with the point of a gamma shaped cautery, then stretch and raise the tunica vaginalis with sharp hooks and excise it with the cautery knife.

In the condition known as *cirsocele*, the nutrient vessels of the testicles become vericose. In dealing with *cirsocele* Leon says only that it is treated by surgery (14), so we again have to consult Paul for details. Paul (6.64) follows the usual course of accessing the diseased vessels with a scalpel, retracting with hooks, and dissecting for full exposure. He then proceeds to ligate the vessels, empty their contents, medicate, and allow the affected parts to suppurate away. Paul here follows the first and second century surgeon Leonides, who approves this approach when only a few of the nutrient vessels are affected. When all are in a vericose state, the testicle should also be removed, as it will decay without its blood supply.

After dealing with conditions which affect the genitalia of men, Leon shifts to nine female complaints, all centering on the uterus[32]. Three of these require application of bleeding cups

(παρέχειν/τιθέναι/σικύαν): retention of the menses (16), copious menses (17), and ascent of the womb resulting in suffocation (20). In the first case the cups are fastened at the groins and *hypogastrium*, in the second to the breasts, and in the last to the groins again. While Leon stipulates the areas to be cupped, he does not say whether the cupping should be wet or dry (i.e. with or without scarification). For this and other information we have recourse to the second century authority on gynecology, Soranus, who offers a detailed account of retention (3.2.155-160, Burguière, Gourevitch, Malinas). Among the remedies proposed is phlebotomy and, as a separate procedure, cupping. This, Soranus says, should be done initially without scarification and with a *spatula* probe inserted under the rim of the cups to mitigate their pulling power. If the condition persists, Soranus recommends scarification as well, the cups being placed on the pubic and hypochondriac region, approximating the location prescribed by Leon. Cupping to arrest copious flow is recommended as early as the Hippocratic Corpus[33]. Again, Soranus includes cupping as a remedy, but he gives no further details (3.13.70). For hysterical suffocation we return again to Soranus (3.5.65) who prescribes dry cupping of the groin and pubic regions, the same area stipulated by Leon. Aetius includes both dry and wet cupping in his account[34]. Unless the puzzling directive at 4.18 *cut spherically* has to do with cupping, these are the only references Leon makes to this procedure in his entire treatise.

The one other female condition for which Leon requires surgical intervention is the opening of imperforate vagina by cutting. But this is an operation he leaves to midwives: ...τιτρώσκουσιν αἱ ἰατρῖναι. When we meet with imperforate vagina in Paul (6.72), he directs us to apply the fistula knife, and perhaps sharp hooks in the event the blockage is caused by obstruction rather than adhesion. A speculum may also have to be deployed to gain access. Aetius uses a probe (μηλωτρίδιον) to divide an impediment at the labia; if the problem is further back, he inserts a catheter into the urethra as a guard, punctures the impeding tissue with a lancet (ἐργαλεῖον τὸ λογχιτικόν), puts tension on its remnants with a sharp hook, cuts them out, and eventually inserts a tin tube to prevent adhesions (16.108 Zervos). These passages in Aetius and Paul

give us a good sense of the instruments needed to perform the gynecological surgery that Leon leaves to others.

Before he embarks on his final book Leon announces that he has covered conditions affecting the separate parts of the body. He will now return, as he did with fever in Book One, to those that are found over the entire body.

In Book Seven the first two chapters deal with inflammation (1) and *erysipelas* (2) respectively. In both cases Leon recommends phlebotomy but, as with most of the other conditions requiring this remedy, he does not specify the vessel(s) to be lanced or the amount of blood to be taken. He then proceeds to *skirrhos* (4). This he defines as a painless hard tumor which, when it occurs in the neck, is called *choiras*. We refer to the condition as scrofulous glands or, when occurring in the neck, goiter. *Skirrhos* is to be handled by surgery and burning (διὰ χειρουργίας καὶ καύσεως). Paul (6.35), who treats of *choiras*, says nothing about burning it, but he does incise, retract the wound with sharp hooks as usual, and then dissect out; if the *choiras* is larger, it should itself be raised with sharp hooks and dissected out with careful attention to surrounding nerves and the carotid arteries.

Chapter 6 on abscess rivets attention because Leon again names an instrument. In this case, after ordering an unspecified surgical solution (δεῖ ... χειρουργῆσαι ...), he enjoins us to irrigate (κλύζειν) the wound *through the 'physorion' for wounds* (διὰ τοῦ τραυματικοῦ φυσωρίου). The surgical solution of course would be to cut open and drain the abscess (Paul 6.34). But the question remains, what does Leon mean by τραυματικὸν φυσώριον? This name is not attested to in any other surviving text; but as *physorion* is a diminutive form and, as irrigation is at issue, a small tube is surely what Leon has in mind. And if a tube is at issue, there are two possibilities: either Leon is referring to the standard clyster apparatus consisting of a bladder to contain an injection which passed through an attached tube (see above), or he means some kind of plunger operated syrringe, such as the *pyoulkos* which was used among other things to irrigate cavities[35]. The term φυσώριον surely derives from φυσᾶν: *to puff, blow*. The overtones of inflation and distension conveyed by φυσώριον favor

the bladder/tube arrangement which will have been swollen with the injection prior to its expulsion[36]. There may have been a special version designed especially to wash out wounds and incisions (τραύματα); hence τραυματικὸν φυσώριον.

Later (11&12) Leon cryptically prescribes a surgical cure (διὰ χειρουργίας) for *steatoma* and *atheroma*, tumors/cysts filled with fatty wheaten colored fluid, hence their names. Paul recommends the same procedure for these tumors as he did for *skirrhos* but he cautions us not to spill their contents (6.36).

Acrochordon, a type of wart mounted on a thin neck is handled with the usual brevity by Leon (14): *some*, he says, *cut it or burn it with a cold cautery*. Paul (6.9) stipulates that the cutting be done with a scalpel after the wart has been seized by a *forceps* (σαρκολάβον). Paul says nothing of burning. However, it is a reasonable conjecture that by *cold cautery* Leon again means the caustic forceps as previously in (4.8). Given the elongated shape of the *acrochordon*, it could, like the *uvula*, conveniently be compressed by that instrument with its load of caustics.

In chapter 21 we encounter the operation for stripping varicose veins. Leon merely says *we employ the operation for excision of verices* (κιρσοτομία). So, again it is necessary to refer to Paul (6.82) to understand the full implications of *kirsotomia*. In Paul's account, which deals mainly with varices of the leg, the diseased vein is ligated so as to become distended and marked out in ink. It is then exposed with a scalpel and sharp hooks, teased out with the curved dissectors used for hydrocele (τοῖς ὑδροκηλικοῖς ἐπικαμπέσι κοπαρίοις), raised with a blunt hook, partially emptied with a phlebotome, ligated at its extremes with threads passed under it with a needle, then evacuated of all blood by manual compression and either cut out or allowed to fall off with the ligatures. To these instruments Oribasius adds sharp hooks called κιρσουλκοί that are *just slightly curved and gamma shaped at the bend* (ἄγκιστρα τῶν σφόδρα μικροκαμπῶν, καλουμένων δὲ κιρσουλκῶν, γαμμοειδῆ κατὰ τὴν καμπήν). With these he stretches the tissue over the varix before the incision to access it, and with these he pierces the varix itself prior to excision (*Coll. Med.* 45.18.5, Raeder)

Leon concludes Book Seven with three short chapters on fracture (including compound fracture) and dislocation (24-26). Chapter 24 is particularly interesting. It prescribes for fractures extension and counter extension as well as setting the bone and immobilizing it without, as usual, giving much detail. But here Leon refers George to his *Treatment of Fractures and Joints* (ὡς εἴρηται ἐν τῷ περὶ ἀγμῶν καὶ ἄρθρων). Since there is no such section in *Synopsis* as it now stands, Leon is referring to a portion of the treatise that is missing; or, more likely, he has in mind a separate treatise that has not survived. That may have been where Leon spoke more extensively about surgery on the skull and the rest of the skeleton (see below).

At this point we can summarize our findings. In all there are twelve tools or natural substances used instrumentally that are explicitly named by Leon. These include: bleeding cup (6.16,17&20), phlebotome (2.1), eyelid knife (4.5), polyp knife (4.2), falciform knife for fistula (5.19), cauteries of unspecified type (2.2; 5.22&25; Fig. 5), cautery for fistula (3.22), needle (3.20), small clyster apparatus for washing out lesions (6.6), catheter (6.4), horse hair (3.20) and esparto (4.2).

To these we may add instruments indirectly attested to in *Synopsis* by verbs that reflect the nouns used to designate them: razor (ξυρᾶν, 2.15), linen thread (ἀπολινοῦν, 3.10 *et passim*), small trephine for *aegilops* (τρυπᾶν, 3.22), and clyster apparatus (κλύζειν, 5.9 *et passim*).

Although Leon never mentions the common scalpel by name (Fig. 5), it would have been indispensable in operations requiring cutting: τέμνειν (3.18, *et passim*), ἐκτέμνειν (3.10), τιτρώσκειν (6.21). There is, however, an almost contemporary testimonium to the traditional name for the scalpel (σμίλη) in an hagiographic text[37]. And surely different types of blades were employed by Byzantines of the ninth century as in classical times, even if we cannot here be specific[38].

Other instrument types, while never mentioned, simply had to have been present in Leon's instrumentarium in order for the operations he mentions to have been carried out. The sharp hook (Fig. 5), for example, was needed to keep open incisions made by the scalpel and to position tissue for excision as in

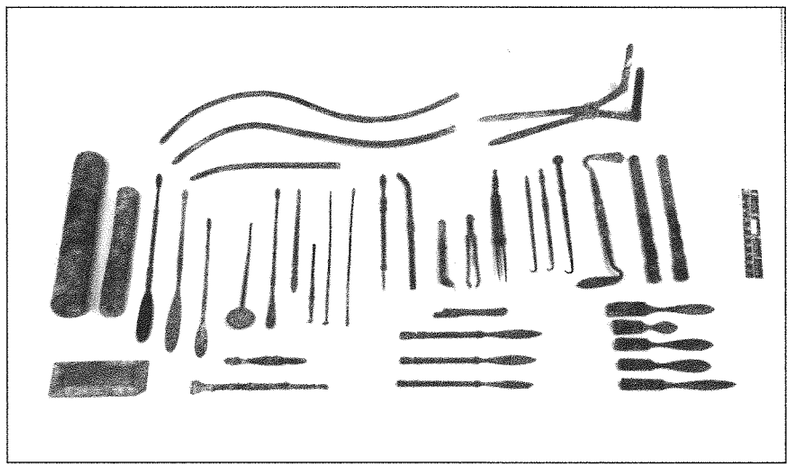

Fig. 5 - Set of Roman surgical instruments from Italy, Phot. Courtesy of the British Museum. Early 1st or 2nd century. Top row: catheters and anal speculum; middle row: 2 cylindrical containers, 3 spatulas, spoon, spoon probe, probe?, 2 ligulas, *dipyrene* probe, cataract needle, needle holder, 3 forceps, 3 sharp hooks, double blunt hook, 2 chisels; bottom row: stone palette, 2 cauteries and a variety of scalpel handles, one with a curette, the rest with leaf shaped dissectors.

pterygiotomy and tonsillectomy (3. 20; 4.6), while the blunt hook/retractor (Fig. 5) and the dissector (Fig. 5) were necessary for exploring lesions, accessing hernias (7.10, 11&12)[39], and exposing and raising blood vessels (7.21). Probes too (Fig. 5) will have been needed for exploratory purposes, the preparation and application of medicaments, and cauterizing. While Leon does not mention specific types, the twelfth century writer Michael Italicus refers to the deft way Michael Pantechnes, physician to the emperor, manipulated the *dipyrene* (ἀμφισμίλη)[40] and *spatula* types (σπαθομήλη), as well as the ear scoop (μηλωτίς)[41]. Michael's testimony indicates that such tools were standard throughout the Byzantine Era. Surely the same was true of the spoons and *ligulae* so commonly used in the Roman Empire for preparation of medicines[42].

Although Leon only mentions a small specialized forceps for work on the eye (3.14), the ordinary dentated forceps must also have been present among his tools (Fig. 5); for example, to grip and position for excision *acrochordon* (6.14), and in the performance of uvulectomy (4.8). He also likely refers to the spoon jawed caustic forceps or *staphylocaustes* when he prescribes use of the *cold cautery* in treatment of *uvula* (4.8) and *acrochordon* (7.14).

As we have seen, the *Typikon* also refers without specification to instruments for the head and stomach. Leon details only a few surgeries on the head in Book One, but later in Book Seven (24) he refers George to his work *On Fractures and Joints*. The title of this work, περὶ ἀγμῶν καὶ ἄρθρων, is reminiscent of the famous Hippocratic treatises on these subjects, in which surgical operations on the skull and limbs require the trephine and elevators[43]. At any rate it is only in this part of *Synopsis* that we find any hint of instruments for tooth and bone surgery as attested to by earlier authors like Celsus, Galen, Oribasius, Aetius, and Paul: the bone forceps, the tooth forceps, the elevator/lever, the trephine/drill, the saw, the file, the hammer/mallet, the chisel (Fig. 5), the rasp, the gouge, and the guard plate for protection of delicate underlying parts (μηνιγγοφύλαξ)[44]. Of these tools the plier like tooth forceps was doubtless available to Leon because it is specifically named in the 12th century *Typikon*. And if the tooth forceps was employed, so too will have been the bone forceps of similar design[45]. Also, Leon's prescription of a small drill for *aegilops* suggests that the larger drills or trephines and the bow mechanisms needed to drive them were also in Leon's repertoire. This is confirmed by references to the trephine, hammer and saw (τρυπάνη, σφῦρα, πρίων) in an account of the slaughter of 20 monks at the Sabas Monastery in the Kidron Valley composed around the turn of the 9th century[46]. We may conclude, therefore, that most, if not all, of the bone instruments used by earlier surgeons were available to Leon and his contemporaries. Finally, Leon's attempts to deal with headache do not include the fearsome operation called *hypospathismos* in which the forehead was divided at intervals and the resultant flaps/sections raised by an elevator called the *hypospathister* (probably only a large *spatula*)[47]. However, Psellus mentions the operation and the elevator in his eleventh century Doctors' Poem[48].

It is a little harder to divine the instruments for the stomach mentioned in the *Typikon*. These might have included the *cannula*, a tube recommended by Paul and others for draining *empyema* and dropsy[49]. Other tube instruments will have included the rectal clyster (Fig. 4), which Leon refers to indirectly, and specialty types like his clyster/syringe for wounds. Mention of a syringe/clyster specifically for wounds should mean, as we would expect in a society preoccupied with war, that other necessary tools like the missile forceps (probably the same as the bone forceps) and the impellent were available for extraction of embedded points[50].

Finally, Leon has little to say of gynecology and nothing of obstetrics because, as we have observed, he prefers to leave these areas to midwives. But other testimonia can be found to supplement Leon. I refer again to Michael Psellus' poem. In his verses he refers to the uterine/vaginal speculum or, as he terms it, δίοπτρον[51]. Many uterine specula survive from the Roman Empire. Aside from one quadrivalve specimen, they are worm driven trivalve types. One particular trivalve now in the Wellcome Museum may actually date from Early Byzantine times (Fig. 1)[52]. If Leon's generation employed the uterine speculum, then the smaller bivalve rectal type (Fig. 5) mentioned so often in earlier sources must also have been present for the fistula and hemorrhoid surgeries he so briefly describes (5.11&19)[53].

Psellus also mentions the forceful extraction of a fetus (*embryoulkia*)[54]. Since this was traditionally achieved with a type of stout hook (ἐμβρυουλκός), we may assume that instrument too was always in the Byzantine instrumentarium[55]. A pair of instruments in the Meyer Steineg collection in Leipzig are of interest in this connection, as they are suspected of being Byzantine. One is a sturdy hook roughened on its interior surface. As it resembles in style the other, the remnant of a cranioclast, it has been conjectured that the two tools comprised a birthing set and, that the hook, traditionally interpreted as a lithotomy hook, could also have been used as an embryo hook (Fig. 2)[56].

To sum up: this study of the Σύνοψις τῆς ἰατρικῆς indicates that the surgical instrumentarium of the 9th century was hardly, if at all, inferior to that of the 7th. Even if Leon did not have

access to all of the instruments cited by predecessors like Paul, it is nonetheless clear that those commonly employed in earlier times had to be included in Leon's *instrumentarium* in order for him and his contemporaries to have carried out the operations that he mentions. We should also bear in mind that in many cases ordinary tools can have been substituted for such specialty instruments as paired tonsil knives and the uvula forceps[57]. For example, a suitable scalpel and forceps will have been quite sufficient for tonsillectomy, and uvulectomy. It is also likely that ordinary tools sometimes lie behind fancy names. The γλωσσοκάτοχον or tongue depressor may have been no more than a common *spatula*[58]. And were tile, nail, and gamma shaped cauteries, varix extractors, and dissectors for hydrocele, anything other than the usual cauteries, hooks, spatulas and leaf shaped dissectors on scalpel handles, perhaps of a special size or adapted for a special purpose, if unique at all? Note that Leon himself occasionally comes up with novel terminology for what were probably only well established items[59].

At this point we may ask how surgeons were instructed in the use of the tools. The written sources we have used to expand on Leon (Aetius, Paul, Oribasius, and their Roman sources) were, of course, there to be read and studied. The selection of excerpts collected by Nicetas also must have served some such purpose. While it is true that Photius maintains that readers of medical tracts in his time were more interested in those dealing with theory than application, Leon clearly refers George to earlier literature of a practical nature, as we have seen. We might go this far with Photius: surgery is a technical craft learned by demonstration and imitation as well as from books. Certainly, hands on experience is essential. A number of passages from Patristic literature can be cited that attest to operations performed in public, the attending crowd forming a sort of operating theater[60]. Add also the abundant testimonia we find to the conduct of autopsy from the fourth to the twelfth century and, once, even to an account of vivisection in the eighth century[61]. Occasions like these presented good opportunities for neophytes like George to experience directly human anatomy, the conditions requiring surgery, and the surgical procedures that are described so perfunctorily by Leon.

Finally, a broader question. Did surgical practice in the Middle and Later Byzantine Periods remain at the same level of sophistication as in the Early Byzantine period? There is a temptation to conclude that it did not, in view of the sparse treatment of the subject by Leon (and the even sparser treatment by his successors) in contrast to his predecessors. Yet, even in Leon's *Synopsis* there are indications that more was going on in surgery than he records. As noted, he clearly had something to say about bone surgery, although this has not come down to us. And he alludes to operations he will not perform, on *prosphysis* and synthesis for example, even though he concedes that others attempt surgery for these conditions. Leon's cautious nature may also account for such glaring omissions as lithotomy and couching of the cataract, surgeries treated extensively in earlier sources but that find no place in the chapters of *Synopsis* dealing with the conditions requiring them (7.1; 3.35)[62]. Yet these operations may very well have been performed in his time. In the case of the former we have at least been able to cite a suitable surviving hook as an indication that this operation continued to be performed by Byzantines. But lithotomy was always a risky procedure[63], accordingly one that may not have appealed to Leon. The same may be true of couching the cataract. We can cite too as evidence of the continuing enterprise of Byzantine surgeons, the brief references there are here and there to operations ignored by Leon, such as, laringotomy, *embryoulkia*, and *hypospathismos*, all surgeries mentioned by Psellus[64]. Of particular note is a daring attempt in the 10th century to separate Armenian twins joined at the upper abdomen[65].

These considerations suggest that, in spite of the lack of written literature on the subject between the 8th and the 14th centuries, the surgical art did not decline as the Byzantine Empire advanced in time; or if it did decline, the decline was relatively minor. But, while surgical expertise did not decline seriously, neither did it advance. So we should not be surprised by the dearth of literature on the subject in the Middle and Later Byzantine Periods. Since there was no significant change in the surgery described by the great authorities of the Early Byzantine Period, Oribasius, Aetius, and Paul, there was no point in rewriting their treatises. These and the tracts of their predecessors gave ample literary instruction and were generally available for consultation. Against this background a brief and incomplete synopsis was sufficient to remind Leon's pupil, George, of what was possible[66].

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8. ERMERINS F. Z., *Text in Anecdota Medica Graeca*. Ed. Amsterdam, A.M. Hakkert, 1963 (reprint of Leipzig edition of 1840).
9. As in, e.g., CELSUS and PAUL.
10. 2.15. Leon also cites Logadius (2.1), Philip (1.19;4.19), Constantine (3.20), Severus (3.19), and Faustus, Pasion, and Andron (all 4.19).

11. TORNIKES G. et D., *Lettres et discours*. Paris, Editions du centre national de la recherche scientifique, 1970; *Eulogy of Anna Comnena* 225. 11, lines 12-19.
12. DAVIDSON G., *Corinth, vol. XII, The Minor Objects*. Princeton, American School of Classical Studies at Athens, 1952: no. 1406.
13. BLIQUEZ L. J., *Roman Surgical Instruments and Other Minor Objects in the National Archaeological Museum of Naples, With a Catalogue of the Surgical Instruments in the "Antiquarium" at Pompeii* By: JACKSON R. Mainz, Verlag Philipp von Zabern, 1994, 119 (nos. 40-43). Mr. Abraham Levi of Jeruselem has informed me of yet another example in his possession.
14. See KRUG A., *Blade changes made this possible: Römische Skalpelle, Herstellungstechnische Anmerkungen*. Medizinhistorisches Journal 1993; 28, 1: 93-100.
15. GAUTIER P., *Le Typikon du Christ Sauveur Pantocrator*. Revue des Etudes Byzantines 1974;32:1-145. See esp. p. 105 (lines 1270-1280).
16. For the classical scalpel see Fig. 5 and JACKSON R., *Roman Medical Instruments*. Medicina nei Secoli 1997;9,2:223-248, esp. 229; for possible Byzantine survivals see BLIQUEZ L.J., ref. 1, plates between pp. 192 and 193 and KÜNZL E., ref. 1, 225&227.
17. For these multipurpose instruments, see BLIQUEZ L., JACKSON R., ref. 13, 161-162 (nos. 209-213).
18. See CELSUS (Spencer) 6.4. For the classical razor see RIHA E., with the collaboration of JOOS M., SCHIBLER J., STERN W.B., *Römisches Toilettgerät und medizinische Instrumente aus Augst und Kaiseraugst*. Augst, Römermuseum Augst, 1986= Forschungen in Augst, Bd. 6: 28-30.
19. See KÜNZL E., *Medizinische Instrumente aus Sepulkralfunden der römischen Kaiserzeit*. Unter Mitarbeit von HASSEL F. J. and KÜNZL S., Kunst und Altertum am Rhein 115, Köln und Bonn, 1983, = Bonner Jahrbüchern 1982; 182: 1-131, esp. 102 (Wehringen; JACKSON R., *A Set of Roman Medical Instruments from Italy*. Britannia 1986; 17: 119-167; esp. 132-136.
20. *He adds that some, after raising the pterygium with the thread cut it off the with a knife called a pterigotome* (πτεριγοτόμον)*; in other words this method avoids the sawing operation. The pterygotome must have had a small fine blade like the* anarrhaphikon smilion. For other accounts see CELSUS 7.7.4 and AETIUS (Olivieri) 7.59 and 60.
21. In addition to Paul, CELSUS (7.7.7), ARCHIGENES (apud GALEN, *De compositione medicamentorum secundum locos*, 12.821 Kühn), and AETIUS (7.87) deal with the condition.
22. See AETIUS 7.51
23. Though this name is close to the πολυπικὸν σπαθίον attested to in earlier texts. AETIUS, e.g., uses it to excise thymi (a warty growth) from the female parts (16.117 Zervos).
24. For a full discussion of inflammed uvula and the instruments to treat it, see JACKSON R., *Staphylagra, Staphylocaustes, Uvulectomy and Haemorrhoidectomy: the Roman Instruments and Operations*. In: *From Epidaurus to Salerno*. Symposium held at the European University Centre for the Cultural Heritage, Ravello, April, 1990. = PACT, Journal of the Centro Universitario Europeo per i Beni Culturali 1992; 34: 168-185.
25. So ERMERINS (p. 163): *...nihil aliud significare posse h. l. videtur quam* σίκυα (sic!) προσβάλλειν *seu potius* ἐγχαράσσειν.
26. BLIQUEZ L., JACKSON R., reference 13, 167 (nos. 231-234); BLIQUEZ L., *Two "Sets" of Roman Surgical Tools from the Holy Land*. Saalburg-Jahrbuch 1998; 49: 83-92, esp. 89-92.
27. 6.436 (Littré = Potter, Loeb 8, p. 380).
28. 6.450 (Littré = Potter, Loeb 8, p. 392).

29. Paul also mentions in the same chapter a τρίαινα or τριαινοειδες καυτήριον invented by Marcellus. But this was probably a virtuoso instrument associated with one individual and never widely used.
30. ... καὶ δεῖ πάλιν τῷ καθετῆρι χρήσασθαι. πάλιν is peculiar, as though Leon had prescribed it previously. But there are no references to catheterization in the rest of the treatise as it now stands.
31. Paul makes clear in his brief preface that by "the moderns" (οἱ νεώτεροι) he means Byzantine authorities as early as Oribasius.
32. Female complaints are headed by a special title: περὶ γυναικείων παθῶν, τῶν περὶ τὴν μήτραν.
33. *De morbis popularibus* 2.16 (Littré = Smith, Loeb 7, p. 86); Aphorisms 5.50 (Littré = Jones, Loeb 4, p. 170).
34. Aetius says dry cups should be well heated for maximum pulling power; if the situation is chronic, there should be scarification, with the cups fastened to the back as well as to the abdomen (16.67 Zervos).
35. BLIQUEZ L., and OLESON J.P., *The Origins, Early History, and Applications of the Pyoulkos* (Syringe). In: *Science et Vie Intellectuelle à Alexandrie (Ier - IIIe Siècle apres J.-C)*; textes édités par ARGOUD G. Publications de l'Université de Saint-Étienne 1994: 83-119.
36. ARISTOPHANES, Ach. 405, and Nub. 405 explicitely relate φυσᾶν to inflation of bladders.
37. PAPDOPOULOS-KERAMEUS A.,'Εξήγησις ἠτοι μαρτύριον τῶν ἁγίων πατέρων ..., Pravoslavnij Palestinskij Sbornik 1907; 19, 3: 1-41, esp. 31-32. For the date see BECK H. G., *Kirche und theologische Literatur im Byzantinischen Reich*. Munchen, Beck, 1959: 507-508.
38. MILNE J. St., For blade types see*: Surgical Instruments in Greek and Roman Times*. Oxford, Clarenden Press, 1907. Reprinted, New York, Augustus M. Kelley, 1970: 24-50.
39. Exclusive of *Lists*, the latest testimonium to these hooks known to me is found in *The Miracles of St. Artemius*, ed. PAPADOPOULOS-KERAMEUS A., *Varia Graeca Sacra*. Petersburg, 1909, 1-75, esp. 36. The date is shortly before 668; see BECK H.G., ref. 37, 464. We find also in this work (p. 73) references to *apolinosis* and surgeons specializing in hernias.
40. Galen equates the two; 2.581 (Kühn).
41. MICHAEL ITALICUS, *Lettres et discours*, ed. GAUTIER P. Paris, Institut Francais d'etudes Byzantines, 1972, Monodie sur Pantechnès, lines 22-23. He also praises Pantechnes' deftness with δεσμοὶ καὶ βρόχοι, by which he probably means bandages/supports and the loops used for apolinosis. For the diverse functions of these instruments see MILNE J. St., ref. 38, 52-61, 63-68.
42. BLIQUEZ L., JACKSON R. , ref. 13, 145-159 (nos. 145-203).
43. See BLIQUEZ L., JACKSON R., *De articulis, De fracturis, De capitis vulneribus*: ref. 13, 131-134 (nos. 91-102).
44. For sources see MILNE J. St., ref. 38, 121-142.
45. For discussion of these instruments see KÜNZL E., WEBER, T., *Das spätantike Grab eines Zahnarztes zu Gadara in der Dekapolis*. Damaszener Mitteilungen 1991; 5: 81-118.
46. PAPDOPOULOS-KERAMEUS A., ref. 37, 507-508; for classical survivals see KÜNZL et alii, ref. 19, 56(19) & 58(1-3).
47. See PAUL 6.6.
48. *Carmen de re medica*. In: *Physici et Medici Graeci Minores*, ed. IDELER I.L. Hakkert, Amsterdam, 1963 (edition of 1841): lines 1334-1335. Psellus confuses the name of the operation with the instrument used to perform it.

49. CELSUS 7.1; PAUL 6.50. BLIQUEZ L., JACKSON R., ref. 13, 169-170 (nos. 236-240).
50. For the missile forceps and the impellent see MILNE J. St., ref. 38, 139,141.
51. Ref. 48, line 1189.
52. LONGFIELD-JONES G.M., *A Graeco-Roman Speculum in the Wellcome Museum*. Medical History 1986; 30: 81-89; KÜNZL, ref. 1, 206-207.
53. See MILNE J. St., ref. 38, 149-50 and JACKSON R., ref. 19, 124-126.
54. Ref., 48, line 1187.
55. CELSUS 7.29, SORANUS 4. 9-11(Ilberg), AETIUS 16. 23 (Zervos), PAUL 6.74.
56. See KÜNZL E., ref. 1, 201-203.
57. See Bliquez' arguments re the survivals from Pompeii. In: BLIQUEZ L., JACKSON R., ref. 13, 70-81.
58. Note the language in which ORIBASIUS (44. 11. 13, derived from Heliodorus) and AETIUS (8. 48) allow either the *spatula* or the *glossokatochon* to be used to depress the tongue in accessing a quinsy. The broad double spatulas in the Naples Museum would make perfect tongue depressors. See BLIQUEZ L., JACKSON R., ref. 13, 144 (nos. 139, 141-142).
59. Unique names include συριγγιακὸς καυτήρ, τραυματικὸν φυσώριον, δρεπανοειδὲς ὄργανον, πολυποτόμον σπαθίον. Lists likewise are filled with names unattested in earlier sources.
60. BLIQUEZ L., ref. 1, 194.
61. The sources have been gathered and discussed by BLIQUEZ L. and KAZHDAN A., *Four Testimonia to Human Dissecton in Byzantine Times*. Bulletin of the History of Medicine 1984; 58: 554-557. See also BROWNING R., *A Further Testimony to Human Dissection in the Byzantine World*. Bulletin of the History of Medicine 1985; 59: 518-520.
62. See e.g. PAUL 6.60 (lithotomy), 6.21 (cataract).
63. Hippocrates, *Iusiurandum*/Oath, lines 22-24 (Jones, Loeb 1, p. 289).
64. Ref. 48: 1186-1189,1334-1336,1348,1363.
65. PENTOGALOS G., LASCARATOS J., A *Surgical Operation Performed on Siamese Twins during the Tenth Century in Byzantium*. Bulletin of the History of Medicine 1984; 58, 99-102.
66. One can already see an effort to *downsize* in Paul who in his Preface explains that his goal is to produce a reduced, therefore handier, treatment of medicine than the huge compilation of Oribasius.

Addendum. In John Zonaras' account of the treatment administered to Alexius I Comnenus (1081-1118) just before his death we hear of a cautery applied to the emperor's stomach. It is said to be bent at its end and is given the name "anker". The instrument sounds similar to the gamma shaped types cited above in treatment of inguinal hernia. Cf. John Zonaras, Historical Epitome [759] 28; ed. T. Buettner-Wobst, Corpus Scriptorum Historiae Byzantinae, Bonn, 1897.

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Articoli/*Articles*

BYZANTINE PHYSICIANS AND THEIR HOSPITALS

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SUMMARY

Byzantine medicine was organized around hospitals. By the eleventh and twelfth centuries, the best physicians of Constantinople treated their patients either in hospitals or in walk-in dispensaries which formed part of the hospital facilities. Byzantine hospitals were thus medical institutions. This article will review the evidence for this conclusion and introduce two new texts dealing with hospitals in Constantinople. The article will close by suggesting avenues for future research, especially regarding hospitals in provincial cities.

Any discussion of Byzantine medicine and its practitioners should recognize that the physicians of the East Roman Empire provided medical care to the sick and injured in a way far different from that of their ancient predecessors. Rather than visiting the private homes of their patients as Greco-Roman doctors had, the best Byzantine physicians treated the gravely ill in hospital wards and those with minor ailments in walk-in dispensaries attached to those same hospitals. In 1985, I published a monographic study of Byzantine hospitals, *The Birth of the Hospital in the Byzantine Empire*, a study which traced the origin and subsequent evolution of this sophisticated system of public health care. A careful reading of the primary sources revealed that by the eleventh and twelfth centuries, these philanthropic hospitals (called *xenones* or *nosokomeia* in medieval Greek) had become the primary organizational units of the Byzantine medical profession in Constantinople and perhaps in other urban centers, the places where doctors met most of their patients and

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