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THE HIPPOCRATIC SURGICAL INSTRUMENTARIUM A STUDY IN NOMENCLATURE

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SUMMARY

Precisely what surgical tools were available to Greek surgeons in the fifth and fourth centuries BCE? In the absence of material survivals we must depend mainly on descriptions of instruments and their use in the Hippocratic Corpus to answer this question. We can also speculate on why so few Hippocratic instruments come down to us in contrast to the relative abundance of survivals from the Roman Empire.

The purpose of this study is to detail precisely what surgical instruments were available to the Hippocratic physician and what he used these instruments for. It does not include para-surgical items such as splints, bandages, morters, pestles and crockery used as containers or for mixing; nor does it deal with devices, such as ladders and specially constructed "beds", used as instruments of reduction. Rather, it concentrates on the everyday tools of the trade kept in the surgery or carried on the road by itinerants. By "Hippocratic" I mean those tools likely to have been available to fifth and fourth century Greek physicians/surgeons. J. S. Milne, whose learned study of Greco-Roman surgical tools is still the norm, simply combined together the instruments and paraphernalia of all periods in each of his chapters on the various typologies[1]. Furthermore, his study provided only a selection of Hippocratic texts, thus ignoring the full range of applications to which Hippocratic instruments were put. It therefore would be useful to detail

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separately what was available to the practitioners of the fifth and fourth centuries BCE, so that we may better appreciate, not only the operations Hippocratics were capable of performing, but also to provide a basis for appreciating the advancements, both in tools and their application, that were made subsequently in the Hellenistic and Roman worlds[2].

The *Hippocratic Corpus* is rich in the names of instruments as well as in descriptions of their shapes and functions. This contrasts sharply with the dearth of material survivals from the period in which the bulk of the *Corpus* was written; hence the central role in this study of texts and the names they contain. In fact, the only instruments currently available that can be recognized as "Hippocratic" are a number of bleeding cups which, so far as is known, were all recovered from graves. Graves, of course are our chief material sounce for the instruments used by Greco-Roman practitioners[3]. However, graves containing tools are in the main confined chronologically to the period of the Roman Empire; only then, it seems did it become the norm for a deceased physician to be buried with some or all of his instrumentarium. Still, in basic respects most Hippocratic instruments will not have differed appreciably from their Roman successors: a forceps is, after all, a forceps, and a bleeding cup a bleeding cup. Consequently, in the absence of Hippocratic originals I have used Roman types for purposes of illustration whenever I considered this desirable.

We may begin with a few generalities about the Hippocratic *instrumentarium* gleaned from the surviving *Corpus* of Hippocratic writings. The author of *Physician* 2 stresses that all instruments should be well fitted for their use in size, weight, and fineness, and that copper alloy should be used only for them as opposed to other surgical gear. From *Use of Liquids* 1 we learn that potable water is best for instruments of iron and copper alloy (ποτὸν-σιδηρίοισι καὶ χαλκείοισι κράτιστον-). These passages are particulalry valuable, not just for information on how Hippocratic instruments were kept clean (and perhaps ritualisically pure) but as attesting to the primary materials of which they were made. The only testimonium to storage of the tools is found in *Decorum* 8.10-13 where the physi-

cian is urged to have at hand a portable carrying case of the simpler type called *parexodos* (παρέξοδος ἡ λιτοτέρη- - -ἡ διὰ χειρέων) for making his rounds (πρὸς τὰς ἀποδημίας). *Decorum* may be a later work[4], but clearly instruments permanently at hand were every bit as valuable to the Hippocratic as to his successors and were, therefore, properly stored in the more elaborate cases that are presupposed in this passage. Likewise, it is very much in keeping with the world of *Epidemics* that some tools were ready packed in simple containers for work away from "the office." The term *parexodos* or "that brought away on the road" is an appropriate name for just such a traveling kit.

Bleeding cups

We may begin with a basic Hippocratic instrument, one frequently attested to in the texts of the *Corpus* and the sole type of which we have indisputable pre-Roman survivals: the bleeding cup or *sikua* (σικύα)[5]. Altogether nine speciments survive, six from Ialysos, Rhodes, and one each from Thebes, Corinth, and Tanagra respectively, the last three all housed in the National Museum,

Fig. 1 – Bleeding cup found at Thebes: Nat. Mus. Athens L 349a; L. 14.8 cm.

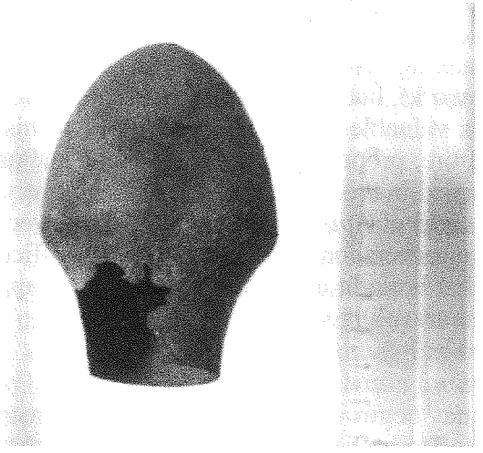

Fig. 2 – Bleeding cup found at Corinth: Nat. Mus. Athens L 349b; L. 9.1 cm.

Fig. 3 – Bleeding cup found at Tanagra: Nat. Mus. Athens 7596; L. 14. cm.

Athens (Figg. 1-3)[6]. All were extracted from graves[7]. The pre-Roman models feature a less angular profile at the shoulder in contrast to the sharper accentuation of their Imperial counterparts[8]. There are also three cups with similar features depicted on a relief now in the Antikenmuseum, Basle[9]. This and the six specimens from the grave at Ialysos, all dating ca. 500 B.C. constitute the earliest examples of the pre-Roman type. Contemporary with the historical Hippocrates are the cups depicted in the well known clinical scene on a red figure vessel now in Paris[10].

Along with the applications of the bleeding cup, the *Corpus* makes it clear that its size and contour varied to regulate its drawing power[11]. The draw was created by the vacuum that resulted from the cooling of the previously heated cup. The function of the cup was to facilitate bleeding or to stimulate an area of the body, often as a way of promoting equilibrium to correct the imbalance causing the disease. The following passages attest to the application of one or more cups and to the situations in which they were used.

At *Ulcers 27.1* the physician is enjoined to be sure a wound is fully drained of blood/fluid when cupping. If applying a cup to the knee area, the physician should have the patient stand.

Cupping and bleeding for ophthalmia and similar complaints are mentioned in passing at *Sight 9.4.*

Places in *Man 12.5* and *Epidemics 2.6.24.1* recommend fastening a cup behind the opposite ear in cases of ear infection, while *Crises 59.1* enjoins us to place a cup to *"whichever of the parts above are in pain"* for headache.

Affections 4.14 recommends fixing two cups to the back of the head with concommitent bleeding after shaving the area in cases of swollen uvula (gargareon).

Diseases 2.26.8 &11 and *2.27.4* direct the physician to apply a cup to the first vertabra of the neck in treating acute sore throat, while *Diseases 2.55.29* recommends placing it under the shoulder blade with incision of the veins in the arms in treating erysipelas of the lung.

Joints 48.21 and *Instruments of Reduction 38.17* mention attempts by some physicians to reduce a depressed vertabra with

a large cup, an operation highly disapproved of in both passages. Cupping at an unspecified location to relieve sciatica is attested to in *Places in Man 22.1* and *4* and *Epidemics 4.1.20.30*, while cupping with bleeding of the ham for sciatica arising from blood is noted in *Internal Affections 51.53*. To these procedures we many add cupping to relieve pain in hip and groin *(Epidemics 5.1.8.3)*. *Internal Affections 21.33* advises application of a cup to the loins and slitting the widest vessels of the scrotum in disease arising from phlegm. The same treatise recommends cupping for swelling of joints consequent on typhus (41.19)
Other passages of interest have to do with female conditions. *Aphorisms 5.50.1* and *Epidemics 2.6.16.1* recommend a large cup applied to one or both breasts to control menstruation. *Diseases of Women 110.37-41* is in part incomprehensible and, therefore, probably corrupt. However it seems to represent a more detailed treatment of the same or some similar condition. Here cups are applied below the breasts, sometimes on the left, sometimes on the right, without bleeding, in treating "red flow" (ῥόος ἐρυθρὸς). *Nature of Woman 5.17*, repeated by *Diseases of Women 144.20 & 248.16* advise (in the wake of other remedies) that the largest possible cup be fastened to the hip to remedy prolapse of the uterus. Finally, uterine moles are treated with a cup to the flanks along with copious bleeding in *Diseases of Women 71.22 and 233.22*

Cutting and puncturing instruments

In situations requiring an instrument for incising or lancing, the preferred Hippocratic designation is simply the general term for "knife": *machaira* (μάχαιρα) or *machairis* (μαχαιρίς) but generally the diminutive μαχαίριον. Other than the indistinct knife poised for blood letting in the hand of the surgeon shown on the Paris vase mentioned above there are no material survivals; we thus have only nomenclature to go on. That employed leads to the conclusion that the "scalpel" or "phlebotome" in the Hippocratic *instrumentarium* amounted to no more than a suitable everyday knife employed in household or shop. In contrast, the surgical literature of the Roman Empire features the technical term *smile* (σμίλη), and numerous

examples survive in surgical kits of the period (Bliquez - Jackson). We do once find *smile* in the *Hippocratic Corpus* (*Diseases* 2.36. 4) but, like *machaira/is*, *smile* was merely a general term in Hippocrates' time; so too were the terms *sideros* (σίδηρος) and its diminutive σιδήριον ("iron," "instrument/blade of iron") which also occasionally appear (see *LSJ* ss.vv.)[12]. In what follows we will find many instances in which the Hippocratic physician/surgeon makes use of items ordinarily intended for other purposes, as opposed to those specifically designed for medical and pharmaceutical purposes[13] on still other occasions he may himself make, or get made, gear for a particular purpose. This tendency to improvise at the time of an operation, as opposed to having instruments permanently available, may have further implications. These will be discussed at the conclusion of this essay.

Although the Hippocratic "scalpel" is designated mainly by only one name, it is clear that different blades were required for the various surgeries performed. This is in fact explicitly stated in *Physician* 6.1 and 9 as well as indicated by the adjectives applied to scalpels and their blades in the *Corpus*. A blade may be pointed or broad (τοῖς δὲ μαχαιρίοις ὀξέσι τε χρῆσθαι καὶ πλατέσιν....), sharp or extremely sharp (ὀξύ, ὀξυτάτῳ, ὀξυβελέϊ), extremely sharp and fine (ὀξυτάτοισιώ καὶ λεπτοτάτοισι), curved and not too narrow at the tip (καμπύλοις ἐξ ἄκρου μὴ λίην στενοῖς), more curved than straight (καμπυλώτερον...ἢ ἰθύτερον), and shaped like a woman's breast (στηθοειδέϊ)[14]. The point of the blade is called τὸ ἄκρον. The following are relevant passages.
Diseases 2.30.7-9 attests to excision of tubercules "with a knife" (μαχαιρίῳ) in cases of tonsillitis.

Diseases 2.47.63-4, the famous passage on empyema, directs the physician to access the pus pocket by cutting first through the skin between the ribs with a breast shaped knife (στηθοειδέϊ μαχαιρίδι) and then to puncture the pocket with a sharp one (ὀξυβελέϊ) after wrapping its blade about the length of a thumb nail below the point (τὸ ἄκρον τῆς μαχαιρίδος) with a bit of cloth[15].

Other passages detailing puncturing and incising include *Affections* 4.17 where swollen uvula is lanced μαχαιρίῳ and *Places*

in Man 25.2 and *Internal Affections* 22.27 (Potter) where dropsy is relieved μαχαιρίοις and ὀξέῃ τῇ μαχαίρῃ respectively. At *Diseases* 2.36.4, nasal polyp is accessed by splitting the nose "with a knife" (σμίλῃ).

Passages attesting to bleeding are *Physician* 7.21, where curved knives not too narrow at the point (μαχαιρίοις δὲ τοῖς καμπύλοις ἐξ ἄκρου μὴ λίην στενοῖς) are recommended as a general rule, and *Ulcers* 24.10 where swellings of the feet should be incised with blades/knives "as sharp and fine as possible" (ὡς ὀξυτάτοισι σιδηρίοισι καὶ λεπτοτάτοισι).

Shifting to gynaecological treatises, several passages describe opening the head or torso of and dismembering a fetus. *Diseases of Women* 70.4 requires that the operation be performed μαχαιρίῳ 70.4 (cf. *Excision of the Embryo* 1.11) and, more specifically, at 70.25 that the knife be more curved than straight (τὸ μαχαίριον--- καμπυλώτερον ἔστω ἢ ἰθύτερον).

There are in addition numerous references to incision or lancing without mention of the knife employed. These have mainly to do with blood letting and need not be specified here. One remarkable exception is the sole Hippocratic testimonium to the operation for bladder stone in *Oath* 17-18[16]. Unfortunately, no further details are provided.

Only twice do we find mention of special purpose knives. In treating acute sore throat (*Diseases* 2.28) the practitioner is instructed to attach a sharp blade to a ring and strike the epiglottis (σιδήριον ὀξὺ προσδησάμενος πρὸς τὸν δάκτυλον τύψαι); and, for purposes of dismembering a fetus a "claw" (ὄνυξ) mounted on the thumb is employed, this apparently also attached to a ring (*Superfetation* 7.5)[17]. The ring knife applied in the first case is clearly created on the spur of the moment, and nothing in the language of *Superfetation* compells us to believe that the second was a regularly used tool either.

There are three passages in the Hippocratic Corpus attesting to the use of needles for surgical purposes. The first occurs in *Internal Affections* 41.19 in connection with swelling of the knees in typhus. In this situation the practitioner is told to pierce the knees with the point of a triangular needle or *akis* (κέντρῳ

ἀκίδος τριγώνου). This *akis* looks like a specialty item designed for surgery. In the other two cases it appears that ordinary household needles are employed for surgical or parasurgical purposes. In the *Appendix to Regimen in Acute Diseases* 61-62 the text is sometimes difficult to interpret, but it is clear that the author recommends using a needle or *belone* (βελόνη) to encompass the haemorrhoids and the papillary growths of trichiasis with stitches for purposes of removal by strangulation. Finally, in *Superfetation* 6-12, where forceable removal of secundines is the topic, a *raphion* (ῥαφίον)[18] or common needle for stitching is used to puncture a water filled sack on which a newborn has been placed. Since the umbilical cord of the baby has not yet been cut, the afterbirth is gently withdrawn as the water drains off and the child slowly descends on the sack.

Cauteries

Throughout the *Hippocratic Corpus* there are many conditions for which the practitioner is urged "to burn" (καίειν); that is, to apply a cautery, even though this intervention was recognized as the most radical of all[19]. Later the names derived from καίειν, *kauter* (καυτήρ), its diminutive *kauterion* (καυτήριον) and, less frequently *kauster/kausterion* (καυστήρ/καυστήριον), were commonly applied to this instrument by Imperial authorities. However, the preferred term throughout the Corpus is *siderion* (σιδήριον) or "little instrument of iron", a name which is used of other surgical tools as well, such as elevators and, as we have seen, of cutting instruments. We once encounter *kausterion* in *Sight* 3.1-9; but there the term seems to refer to the very act of cauterization, as opposed to the instrument. There may also be one instance of *kauster*, this in *Haemorrhoids* 6; however, the reading is disputed and *kauter* may in fact have been written originally[20]. Whichever reading is correct, it does not designate a cautery but a reed-like tube through which the actual cautery is run.

As with knives we again encounter various types which are distinguished by modifying adjectives. Thus cauterizing irons are said to be fine (λεπτῷ), thick (παχέσι), not thick nor excessively

rounded but long (μὴ παχέσι, μηδὲ λίην φαλακροῖσιν, ἀλλὰ προμήκεσι), wedge shaped (σφηνίσκους), and a span long, thick as a probe, and terminating in the form of an obol (σπιθαμιαῖα τὸ μέγεθος, πάχος δὲ ὡσεὶ μήλης παχείης· ἐξ ἄκρου δὲ κατακάμψαι· καὶ ἐπὶ τῷ ἄκρῳ πλατὺ ἔστω ὡς ἐπὶ ὀβολοῦ μικροῦ). As the name *siderion* implies, most of the time the Hippocratic cautery was composed of iron, iron being a most effective conductor of heat, especially in cases where the instrument was required to be red hot (διαφανέα). However, there are copper alloy survivals from the Roman period, and there is no need to suppose that this was not sometimes the case with Hippocratic models[21]. Nor can we preclude the use of other instruments like knives and probes as cauterizing tools. As we consider the applications of the cautery in those passages where the instrument is actually mentioned (as opposed to general references to burning), particularly noteworthy are the frequent injunctions in the middle voice that the surgeon should "make/prepare for himself" or "get made/prepared" the appropriate type of cautery or, as they are often used in quantity, the appropriate cauteries necessary. This again supports the contention that the Hippocratic often made himself or had prepared, by e.g. a smith, what he needed as it was needed. We should also note that in several cases natural substances were used rather than cauteries of metal. These included, for cure of liver disease, tree fungi (μύκησι) and, once, shafts of boxwood shaped like spindles[22]. As to actual therapy, the treatise *Haemorrhoids* several times recommends preparation of specified cauteries for burning piles, including the obol shaped types (2)[23] and the type passed through the reed-like tube (6)[24]. Yet a third method is dessication by passing cauteries over piles without actually making contact (5). A protective tube or *surinx* (σύριγξ) appears again in *Diseases* 2.34.3 where the subject is treatment of nasal polyp[25]. Wedge shaped models are to be fashioned for burning the temporal vessels in treatment of disease of the head (*Diseases* 2.12.44)[26] and thick types transferring heat through oiled sponges for blistering the occipital vessels of the head in dealing with

visionary problems (*Sight* 3.1-9)[27]. Turning to the treatise *Internal Affections*, the application of unspecified cauteries in addition to fungi are recommended for treating kidney disease (18.27-29), dropsies arising from the liver and spleen (24.23; 25.16), and sciatica (51.51). Finally, there is the well known (and unfortunate) injunction in *Joints* 11-17 to toughen up shoulders prone to dislocation by raising the skin near the armpit and twice passing through it "irons … not thick nor too rounded but long"[28]. Some sort of probe called *hypaleiptron* (see below) is then thrust through the two openings and a fine cautery pushed down from above until it intersects the *hupaleiptron*. The idea is that the resulting scarification will firm up the area and keep the humerus from slipping out of joint.

Probes

Mention of the *hupaleiptron* (ὑπάλειπτρον) brings us to the category of probing instruments. As in all Greco-Roman surgical texts, the predominent term in the *Hippocratic Corpus* is *mele* (μήλη). Though it is never made explicit, one assumes that ordinarily the *mele* was composed of metal and that the metal was usually copper alloy. As we have seen from *Liquids* 1, copper alloy was a primary material for Hippocratic instruments, and continued to be the basic material used in Roman times, as is clear from the many surviving instrumentaria of the period, including the various probe types found in them. However, on the few occasions in the *Corpus* when we do have a specific metal assigned to a probe, it is either tin or lead (see below). Of course other materials like the shafts of wood and the plumes of feathers used by the physicians of the Empire could certainly have been deployed as probes in Hippocrates' time. And, in fact, one several times finds a feather being used to support a swab (*Diseases of Women* 126.6-12; 244.9-12), while once a garlic stalk (φῦσιγξ) is utilized for probing a fistula (*Fistulas* 3). On occasions we even hear of a finger employed for purposes of dilating the cervix (*Nature of Woman* 35.23-25; 37.7-12; 39.6-9; *Diseases of Women* 60.20-27; 157.1-15). Very little information is given as to size and shape. In the main the

Hippocratic *mele* seems to have been any serviceable shaft of metal. As we are told in *Diseases of Women* that the tip of a clyster pipe should be "smooth like that of a *mele*",[29] we have to conclude that usually at least one terminus must have been rounded. As noted above in *Haemorrhoids* 1 we are also once directed to secure cauteries as thick as a thick *mele* (μήλης παχείης)[30]. Otherwise, the physician is directed to use a notched *mele,* or (several times) one perforated with an eye, like a needle; and once he is told to make a series graduated in size and hollow at one end (μήλας--- ὄπισθεν κοίλας) so as to admit a handle. These types will be discussed momentarily. Though some Hippocratic probes must have mounted a spatula or a spoon, that is not easy to demonstrate because terms like *spathomele* (σπαθομήλη), so familiar later, do not occur in the *Corpus* as transmitted to us. Galen does declare in his *Hippocratic Glossary* that *spathomele* was meant by "*flat mele*" and likewise by "*rotound mele*," terms contained in texts in the *Corpus* that we no longer have[31]. However, one suspects that Galen is only guessing what lay behind these names when he does an about face elsewhere and asserts that the phrase "the flat of a *mele*," also mentioned in a text not transmitted, must in this instance refer to a type of "ophthalmic spoon"[32]. Common functions of the *mele* included simple probing and administration of medicaments[33]. It was also employed as a director or block; for example, in opening a fistula by providing support and direction for a knife after being inserted into a fistulous canal (*Fistulas* 5). Similarly, a *mele* might also serve as backing for a knife in enlarging an ulcerous lesion (*Ulcers* 10.17). We find in addition one reference to its use in pressuring vessels for more effective blood letting (*Ulcers* 24.11).

A milder treatment for fistula, was called by later authorities *apolinosis*[34]. In this process strands of linen twisted into a cord with a horse hair were drawn through the fistulous canal by an eyed tin (therefore flexible) *mele* gotten up for the purpose (ποιησάμενος μήλην κασσιτερίνην ἐπ' ἄκρου τετρημένην). The ends of the cord were then knotted tightly, so that the cord put pressure on the terminal openings of the fistula. As the cord gently cut its way into the fistula on both sides, it was tightened,

fresh cord being fastened to the more durable horse hair and introduced as necessary until the canal had been entirely opened and made subject to medication (*Fistulas* 4).

Otherwise, we frequently encounter the *mele* in dealing with female conditions. In particular, we hear a great deal about application of the *mele* for dilation of the cervix. What seems to be involved in each case is simply a plain rod of appropriate length and thickness.

The following Hippocratic gynaecological texts employ the *mele* in probing and dilating operations, usually with the object of administering medicaments, for: indurated womb (*Nature of Woman* 37.7-12; *Diseases of Women* 156.1-15); hydrops or watery discharge of the womb (*Diseases of Women* 60.20-27 and *Nature of Woman* 35.23-25, where a tin model is to be made up for the purpose); closure of the womb (*Nature of Woman* 39.6-9); and induration and closure of same (*Diseases of Women* 228.7). Likewise we find the *mele* useful for: application of a sternutator in cases of hysteria (*Diseases of Women* 126. 6-12); application of beaver testicle and white wine positioned on a wool swab to encourage pregnancy (*Diseases of Women* 221.35); medicating a womb inclined to miscarriage (*Diseases of Women* 238.8-17; *Superfetation* 27.11-15); and opening a cervix blocked by *poros*, a stone-like callous (*Diseases of Women* 244.6-15). In the latter case, the "*mele*" is no more than a bunch of fine soft feathers dipped in rose oil. In some instances the cervix was dilated gradually for medication by introducing a series of tin or lead *melai*, each succeding one thicker than the former and hollow at one end so as to admit a wooden handle before being deployed. We encounter this operation twice in more or less the same language in recommendations for promoting conception (*Diseases of Women* 217.23-39; *Superfetation* 29.22-39). We hear again of the same procedure at *Diseases of Women* 221.9-18 where, however, the number of probes to be inserted is given as precisely five and the probes themselves are not called *melai* but "drawn pieces of lead 3.5 inches long"[35]. A further variation occurs at *Diseases of Women* 157.1-15. Here, when a "sclerotic cervix" has been softened by

soothing medications, a series of three graduated raw linen tents or *motoi* (μοτοί), themselves medicated, are inserted for dilation, the last measuring the length of the small finger and ca. 3.5 inches wide. Wooden dilators too were employed. In a lengthy passage (*Diseases of Women* 133.80-135) prescribing measures for redirecting a displaced uterus to its proper position and promoting menstruation, the treatment requires in part insertion of six graduated probes into the previously fumigated cervix. This time the probes are called *prostheta* and *daidia* (προσθετά; δαιδία). These are round, pointed at each terminus, and measure ca. 4.2 inches in length. The largest of the set is to be as thick as the index finger and smaller at one terminus than at the other. As these dilator/probes were of pine wood, there is concern that they should not be marred by splinters and should be lubricated with fat to facilitate their insertion. It is clear from the text that these *prostheta/daidia* were not a permanent item in the tool box but were produced on site for the purpose at hand. The same is surely true for the single probe/dilator called *molubdion* (μολύβδιον) or "little piece of lead" inserted before and after fumigation at *Diseases of Women* 11.50-52 in preparation for coitus. Also to be associated with dilation is the *mele diastomotris* (μήλη διαστομωτρίς). The name surfaces only in Galen's *Hippocratic Glossary* (92 and 122), meaning again that it occurred in a Hippocratic treatise now lost to us but not to him. Galen equates *mele diastomotris* with *mele diatellousa* (μήλη διαστέλλουσα) and *diastoleus* (διαστολεύς), terms used by him and other Greek authors of the Empire to designate a rectal/vaginal speculum (see below). Perhaps for this reason Milne took the *mele diastomotris* to be a special type of uterine dilator. But, as no such dilator is recognizable among surviving instruments and as both Hippocrates and later authorities[36] refer to penetration of the cervix with an ordinary probe, that is, a *mele* or its equivalent, the term *mele diastomotris* may be no more than a fancy name coined by a Hippocratic for a μήλη employed in this manner[37]. This brings us to *rhabdos* (ῥάβδος) and *atraktos* (ἄτρακτος), names designating rod-like objects that are several times substituted for *mele*. These

were hardly medical terms, the former being applied to all sorts of rod-like objects from walking sticks to fishing poles, the latter usually designating a spindle or (in poetry) an arrow. Only simple probes must be meant. In discussing the Hippocratic use of these terms we may cite first two well known passages in *Diseases*, the subject of which is nasal polyp. The polyp can be torn away and drawn into the mouth, either by drawing a ball of sponge attached to a linen cord through the affected nasal passage (2.33.1-13), or by looping a noose of gut attached to a linen cord over the polyp and pulling it off that way (2.35.1-11). In the latter case the noose is set around the polyp with a notched probe (μήλῃ τῇ ἐντετμημένῃ). As with the eyed tin *mele* mentioned above in connection with fistula, the cords attached to the ball and noose are both introduced and brought to the back of the throat with an eyed *rhabdos* of tin (ῥάβδον---κασσιτερίνην λεπτὴν ἐκ τοῦ ἑτέρου κύαρ ἔχουσαν) through which they have been threaded. To facilitate drawing the lines the operator is to pass them over a forked/cloven object or *khele* (χηλή) used as a fulcrum[38]. As the term *khele* was used to designate the notch of an arrow, a wooden shaft featuring a shallow notch with dulled edges comes readily to mind[39].

Likewise in dealing with female conditions we once find the diminutive of *rhabdos* used instead of *mele*, in this case a wool wrapped ῥαβδίον to administer black hellebore to expel a dead fetus (*Diseases of Women* 91.18). Also mounting a woolen swab to clean sputum from throat in cases of acute sore throat is a *rhabdos* of flexible myrtle twig mentioned in *Diseases* 2.26.

Sight 4 provides the one testimonium to *atraktos*. There we find a bit of wool wound around an *atraktos* for curetting the eyelid.

We may now return to *hupaleiptron*, the term with which we began this section[40]. We find deployment of the instrument in gynecological operations such as dilation of a tightly constricted cervix (*Diseases of Women* 163.1-9) and probing an infected womb in preparation for administration of a klyster (*Superfetation* 28.1-6)[41]. A thick model is recommended for reseting a broken nose (*Joints* 37.5) and a fine one, as noted above, to limit the amount of burning by cauteries in the famous

passage on treatment of dislocated shoulder in *Joints* (11.26). Except for the references to "thickness" or "thinness" Hippocrates gives no details as to the appearence of the *hupaleiptron*. This would seem to explain the ambiguity about it later. Galen, for example, clearly took his cue, not from anything he found in Hippocrates, but from the kindred verb ὑπαλείφω or "annoint." Thus, he interprets the *hypaleiptron* as "anything that can annoint, such as probes (*melai*), spatula probes and dipyrenes, all of these having rounded heads at the end[42]; "or again as," a little plate for annointing the eyes." Erotian complicates the picture while expanding it, allowing for the *melotis* (a type of spoon probe so named in Romans sources) as well as the *mele* (1.97.2-3). Clearly no one knew precisely what *hupaleiptron* meant and this opened the way to a range of possibilities. Whatever the Hippocratic physician regarded as an *hupaleiptron*, all we can say for certain is that its operations in the *Hippocratic Corpus* require no more than a plain rod of varying thickness. Note, for example, that in two passages treating closure of the womb in much the same language, *Diseases of Women* 163.1-9 easily substitutes an *hupaleiptron* for the ordinary *mele* employed in *Nature of Woman* 39.6-9. So, we should be cautious. When later authorities like Galen and Erotian equate the *hupaleiptron* with spoon probes, spatulas and instruments "having rounded heads at the end"- surely a reference to the olivary enlargements commonly found on Roman probe types but a feature never mentioned in the Hippocratic Corpus - they are probably simply guessing, and are basing their conjectures on the probes of their own time[43]. Finally, *mele ischure* (μήλη ἰσχυρή) or "strong/powerful *mele*" is yet another term that we know only through the *Hippocratic Glossary* compiled by Galen (122.12). It too is briefly defined without further comment as a "wound probe" or *traumatike mele* (τραυματικὴ μήλη). The form of the *traumatike mele* can be gleaned from the extensive treatment of missle caused wounds provided by early Byzantine authorities like Oribasius and Paul who follows him. They tell us in almost identical language that the latter can be removed "with bone levers or the scoop of a wound probe[44]." The name used for wound probe by

these authorities is not *mele* but *melotis* and its variant form *melotris*, the term used without modifyers to designate the Roman spoon probe just mentioned. But, even with this information we cannot be sure that the Hippocratic instrument was a type of sturdy spoon. Nothing precludes that, but it is just as possible the Hippocratic *mele ischure* took the form of some type of lever, and the fact is that levers are attested to in the *Corpus*. That brings us to instruments used for bone surgery.

Bone and tooth instruments

Among the more heavy duty items in the Hippocratic arsenal are the drills and levers/elevators likely suggested, and certainly adapted, from the types employed by carpenters, smiths and stone masons[45]. The Hippocratic surgeon must have employed a plain saw or *prion* (πρίων) because, although he was leery of amputating limbs, he was willing to remove diseased or traumatized digits or a hand or foot[46]. However, all actual Hippocratic references to *prion* designate the crown drill employed for trephining the skull, also termed *prion kharaktos* (πρίων χαρακτός; *Wounds in the Head* 21.21). In his *Hippocratic Glossary* Galen claims that the name *orthoprion* (ὀρθοπρίων) was also applied to the trephine by Hippocrates although, as so often, the term occurs in no surviving Hippocratic treatise[47]. The other Hippocratic term used for saw is *trupanon* (τρύπανον), which covers both the crown drill and simple straight bits. The latter type is attested to in *Internal Affections* 23 where the surgeon drills through rib to drain dropsy with a *trupanon pereterion* (τρυπάνῳ περητηρίῳ); this Galen correctly took to mean "straight pointed"[48].

The Hippocratic descriptions of skull trephining occur in the famous treatise *Wounds in the Head* (21.13-39). The method here is to use crown drills to trephine out a circular piece of skull in consequence of a severe blow to the head if an opening has not already been created by fracture. The idea was to avoid the problems consequent on suppuration at the base of the skull by providing a means of drainage. The recommendation for use of a small trephine (σμικρῷ τρυπάνῳ) on young persons is clear evidence

that the sizes of crown drills varied to meet changing situations. Although later authorities were luke-warm on skull trephining, the fact that the only surviving crown drills date to the time of the Roman Empire indicate that the operation continued to be practiced[49]. Though not mentioned in any Hippocratic text, bows were clearly used to rotate the crown drills as it is recommended that the latter be cooled in water[50]. Only a bow drill could produce that kind of friction and heat. Several specimens of Roman date bear witness to the type[51]. A fifth century Attic red-figure vase by the Gallatin Ptr. showing a carpenter at work illustrates use of the bow drill quite well[52]. The *Epidemics* are rich in accounts of trephination, including trephination of children[53].

We also find several references in *Wounds in the Head* to the *xuster* (ξυστήρ), a scraping instrument (14.15, 25, 48 & 19.26). Milne[54] maintained that this tool was a type of rasp featuring a blade that was fixed at right angles to a shaft and that was drawn toward the operator. But such an instrument type has never emerged from either Roman graves or settlement sites, inclining me to think that no more than a small file or even a sharp edged spoon or strigil is meant[55]. Be that as it may, the *xuster* is recommended for leveling contusions to the skull and for determining the existence and location of fractures. For, as noted, in the absence of fractures trephining was thought necessary.

In the treatise *Fractures* (31.45-70) the surgeon is urged to have prepared or to prepare for himself (χρὴ ποιέεσθαι) levering devices to be used along with extension in reducing compound fracture of the bone. As cauteries and sometimes scalpels, these tools are simply called *sideria* (σιδήρια) or "iron instruments," and are said to be like those used by stone masons. Later in the section the term *mochlos* (μοχλός), the word used to designate the levers used by masons, is substituted for *siderion,* and this becomes the name preferred by Roman authorities. These elevators, we are told, should be prepared in several sizes, each being broader at one end and narrower on the other (τὸ μέν τι πλατύτερον, τὸ δέ τι στενότερον), and they should be strong, so as not to bend. When operating, one should apply the upper side of the lever to the upper bone and the lower side to the lower

bone. If the upper bone is pointed so as not to afford purchase for the lever, a notch should be cut in the bone for that purpose.

In *Joints* (67.7) and *Instruments of Reduction* (33.14) dislocated joints accompanied by wounds are reduced with a μοχλίσκος/*mochliskos* or "little lever." This should be round for internal dislocations and flat for external (τὰ μὲν ἔσω στρογγύλῳ, τὰ δὲ ἔξω πλατεῖ). That this *mochliskos* is the same device as the *siderion/mochlos* recommended in *Fractures* is clear because the author of *Joints* refers back to that work in recommending it (67.1-10).

In his commentary on *Fractures*, Galen expands on the Hippocratic association of the *mochliskos* as the type of tool used by stone masons. He notes that the surgical type is smaller and stresses the need to have a number of elevators available, each differing in length and in the width and thickness of its end (18b 592 5-12K). (For the Roman type see (Bliquez Jackson 1994).

Forceps, retractor

One last instrument should be considered in connection with bone surgery, the *osteologon* (ὀστεολόγον). The name means literally "bone extractor." The *osteologon* must therefore have been an instrument resembling the sturdy plier-like forceps that goes by the name *ostagra* in Roman times[56]. Ironically, the *osteologon* is not attested to in the Hippocratic tracts on bone surgery: its sole mention comes in the third book of *Diseases of Women* (also transmitted under the title *Barrenness*). There it serves to remove the skull fragments of an aborted embryo (249). A similar function was performed by the *ostagra*, of which there are archaeological survivals and which played a much wider role in surgery in the literature of the Roman Empire[57]. It is hard to see how this would not have been the case earlier as well.

Two other relevant names surface in *Physician* 9.1-4: *odontagra* and *staphylagra* (ὀδοντάγρα, σταφυλάγρα). We are told nothing about their applications, just that a neophyte physician needs to be conversent with their use. Their names, ending in - *agra*, indicate that both instruments were forceps (cf. *ostagra*) and were used on teeth (οδοντ-) and the uvula (σταφυλ-) respectively. Surviving Roman forceps types associated with these names are, like the

ostagra, plier-like; the odontagra likewise a heavy duty model[58], the *staphylagra* a lighter model with long handles and serrated spoon-like jaws[59]. Again, these tools had wider application than their names suggest, including weapons extraction, strangulation of haemorrhoids, etc[60]. The Hippocratic models were likely similar in shape and function. It may be, however, that their use emerged only late in the Hippocratic period. *Physician*, the sole pre-Roman witness to their existence, is thought to have been written in the mid to late fourth century[61].

Oddly, the only reference to a less imposing forceps type is to the *labis* (λαβίς), probably no more than a common domestic tweezers. This occurs in *Diseases of Women* in the passage on treating *poros* of the cervix (244.1-17). When other methods fail, one can attempt to pluck away the *poros* "with a very fine *labis*" (λαβίδι ὡς λεπτοτάτῃ). It would seem that, like the *odontagra* and *staphylagra* just discussed, more ordinary forceps of the spring variety were not much employed by the Hippocratics, perhaps because other instruments like probes (used for example to pry up growths), or even fingers, could be substituted[62].

Apparently substitues were also frequently employed for the blunt and sharp hooks commonly cited in the literature of the Empire as useful for retraction. These instruments are readily recognized as well in the archaeological record of the period, particularly in the case of the sharp variety (Bliquez - Jackson 1994). Neither the sharp model called *ankistron* (ἄγκιστρον) nor the blunt type called *tuphlankistron* (τυφλάγκιστρον) is attested to in the *Hippocratic Corpus*. One item that does occur and arouses curiosity is the *ankuromele* (ἀγκυρομήλη) or "anchor probe," a name suggesting a hooked instument. Both Galen (106.19.69.7) and Erotian (51.5) list the term in their *Hippocratic Glossaries*, defining it as the *ankistron* known to them. Once again, unfortunately, *ankuromele* is not a name found in the *Corpus* as we presently have it. Still, if Erotian and Galen equated the *ankuromele* and the *ankistron*, they may have had at least one text in front of them that involved raising tissue, a blood vessel or the like with a hooked retractor. However, the dearth of testimony to retractors in Hippocratic literature, in contrast to the common mention of such instruments later,

makes it doubtful that sharp or blunt retractors were widely used in the fifth and fourth centuries BCE. Occasionally, even in the literature of the Empire we find a forceps or fingers substituted for the sharp hook (pseudo-Dioscorides 2.2.32; Philumenus 1.2.6.8; Orib. 45.10.3). The Hippocratics may have employed fingers as a matter of course.

Gynecological tools

Mention of the *osteologon* and its use in abortion raises the category of instruments used for gynecological purposes. In addition to the probes mentioned above for medication and dilation we encounter several other items.

In extracting a dead and bloated embryo the author of *Diseases of Women* 1.70.1-7 recommends first beheading it with a knife (μαχαιρίῳ) and then breaking up its head with a cranioclast, called in Greek *piestron* (πίεστρον), before plucking out the skull fragments with the *osteologon*. Galen in his *Hippocratic Glossary* twice defines *piestron* as *embruothlastes* (ἐμβρυοθλάστης) or "embryo crusher," the name used for the *piestron* in his time (104.6 and 130.16). He also attributes to Hippocrates the name *thlastes* (θλάστης) for the *piestron*, although it does not occur in the present *Corpus*. Strangely, no surviving post-Hippocratic medical treatise attests to use of the cranioclast or describes its physical appearence. This may be because it not often deployed. Soranus, for example, simply crushes the head of the embryo with his hand (*Gynaecology* 4.11.3). If the head could generally be managed in this efficient and convenient way, that might explain why a special cranioclast was rarely used, hence seldom mentioned in the literature. In any case, the name *piestron* or "squeezing tool" suggests a plier-like apparatus, operating on the same principle as the *osteologon*. The ophthalmologist and collector Theodor Meyer-Steineg secured one element of such an instrument, claiming that it came from Ephesus. It is regarded as of Byzantine date[63]. The piece consists of a curving toothed jaw mounted on a handle. It would have been complimented with a similar member linked with it by a pivot or screw. Although the Meyer-Steineg instrument is much later than Hippocratic times, it gives us a sense what the *piestron* might have looked like.

The same passage in *Diseases of Women* recommends the *helkuster* (ἑλκυστήρ) or "dragging/pulling tool" for extracting the rest of the fetus. As the instrument has to be attached to the clavicle and then pulled on, sometimes with greater and sometimes with lesser force, there is little doubt that the Hippocratic *helkuster* was a hooked instrument; thus, Galen in the *Hippocratic Glossary* (19.97.9) does not hesitate to equate the *helkuster* with the *embruoulkos* (ἐμβρυουλκός), the sturdy hook used for the purpose in his time. Several examples of the *embruoulkos* recovered in Pompeii surely resemble the Hippocratic tool. Galen also tells us in the same work (19.107.1-4) that another Hippocratic name for this kind of hook was *ikhthue* (ἰχθύη) after its resemblance to the superimposed scales of a fish. This term he found in *Excision of the Fetus* 1.1-15 where the *ikhthue* is fastened to the exposed bones of the baby's hand before traction is made.

While the *embruothlastes* and *embruoulkos* of the Empire were surely manufactured for the purposes indicated by their names ("embryo crusher," "embryo extractor"), the same cannot be said of the *piestron* or the *helkuster*[64]. It is quite possible that, like the *machairion*, these tools were generally used for non-medical purposes.

The same is also likely true of two other knives attested to for dismembering an impacted embryo. In one case a curved knife is thrust into the birth canal with the operator's finger covering its point so as to protect the uterus (*Diseases of Women* 1.70.23-28). This seems no more than an ordinary domestic knife suited to the purpose. A second device in *Superfetation* 7.1-10 is called an *onux* (ὄνυξ) or "claw." It should be worn, we are told, on the middle finger after the hand has been covered with wax, so as to be more easily introduced into the womb. Tertullian may also mention the instrument, apparently calling it an *anuloculter* in *De Anima* (25.4-6), a passage which treats abortion of an impacted embryo as a necessary act of cruelty[65]. As he specifically mentions Hippocrates in the course of treating abortion and the instruments used, he likely has the *onux* in *Superfetation* in mind. There exists no surviving specimen from any period of Greco-Roman antiquity[66].

In *Nature of Woman* 33.42.1-11 thrombi formed on the cervix are

removed by winding a bit of vulture's hide or membrane around a *xustra* (ξύστρα) and then curetting the area. The reference here may be to a small strigil, as the name *xustra* is applied to this instrument of hygene[67]. However, grammarians like Pollux and Phrynicus indicate that *xustra* in the sense of "strigil" is late, the common term for strigil in the time of Hippocrates being *stlengis* (στλεγγίς)[68]. Therefore, the Hippocratic author may simply have some spoon-like scraper in mind, which he kept from unnecessarily irritating the surface of the cervix by covering it with the soft and smooth skin of a large bird.

Tubes

Sometimes female conditions were treated with medicaments delivered via tubes, which leads us to that category of instruments. One of the most arresting is described in *Diseases of Women* 1.222. In cases of ulcerated uterus preventing conception the physician is directed to inject a solution of mare's milk. The douche, which is contained in a sow's bladder is injected through a tube called a *klyster* (κλυστήρ)[69]. This is said to have a smooth solid tip of silver and, after an opening near the tip, a series of openings at intervals along its sides. The patient herself can put the tube in the proper position before the physician makes the injection. As so often, the physician is told "to make the tube for himself" or "to get it made" (ποιησάμενος). In other words it, like other tools and devices used by the Hippocratics, is not ready to hand. The klyster tube is attested to again for uterine lesions at *Diseases of Women* 66.35 and at *Diseases of Women* 179.8 for

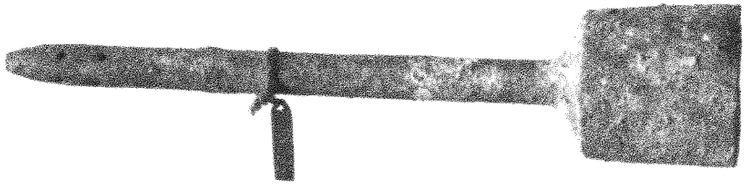

Fig. 4 – Clyster tube, probably recovered in Casa del Medico Nuovo (I); Pompeii: Naples Mus. 78235; L. 15 cm. Photo courtesy of Römisch-Germanisches Zentralmuseum Mainz, no. L1032/11.

uterine "wind" (ἄνεμος). Though no such tube survives from the time of Hippocrates, several copper alloy models retrieved from the ashes of Pompeii closely follow the Hippocratic directives (Fig. 4)[70].

Purging with enemas and douches is a frequently prescribed remedy throughout the *Corpus*. The apparatus employed is seldom described in any detail, in contrast to the device just cited; but any Hippocratic *klyster* surely had to be constructed along the same general lines: that is, made up of a bladder attached to some sort of hollow tube. In one case at *Fistulas* 6.1-5 even the shaft (*surinx*) of a feather is deemed suitable for irrigating a fistula (κλύζειν δὲ πτεροῦ σύριγγα προσδήσας πρὸς κύστιν). The term *surinx* appears again in *Internal Affections* 6.4-5. There erysipelas in the lung is treated with oral medicament instilled into the mouth "through a *surinx*" (διὰ σύριγγος). Very likely here too only a handy natural tube such as a reed is meant.

In general the female treatises are the richest source of references to tubes. These often function as part of a douching apparatus, as above, or as one element of a device for fumigation. Such tubes go by several names, including aulos (αὐλός), literally "pipe" or "flute", its diminutive auliskos (αὐλίσκος), and kalamos (κάλαμος) or "reed". Thus, ileus of the uterus should be irrigated with warm olive oil delivered via a bladder attached to an auliskos (*Diseases of Women* 131.1-8). For various conditions a fumigation apparatus of a clay jug or basket sealed with a plastered wicker lid pierced with a kalamos or an aulos is recommended. These include prolapse of the uterus toward the hip joint (*Diseases of Women* 133.36-62) and promotion of conception (*Diseases of Women* 11.45-50; *Diseases of Women* 221.2 & 34). In some cases the fumigation device is no more than a gourd trimmed at its base and apex, as at *Nature of Woman* 61.1-6, where the mouth of the gourd (τὸ ἄκρον τῆς σικύης) is inserted into the vagina in treatment of strangury, or at *Diseases of Women* 230.8-27, where, in treating sclerotic cervix, the woman seats herself on a wicker chair in order to better engage the aulos of the gourd. Returning to *Diseases of Women* 222, which treats of ulcerated womb and promotion of conception, we again find a gourd (σικυώνη/σικύη) employed as a

fumigating device (35-37)[71]. In one case of displaced uterus, fumigation is proceeded by inflation of the uterus with an auliskos-bladder combination (*Nature of Woman* 14.1-7). Finally inflation of the uterus with an auliskos and bladder (αὐλίσκον προσδήσας πρὸς κύστιν) is prescribed for hysterical suffocation in *Nature of Woman* 14.4[72]. Once more, the devices needed for these operations give the impression of being created at the moment of treatment.

Tube-like instruments designated by the terms *aulos* and *auliskos* are also attested to for conditions other than specifically female disorders. At *Diseases* 3.10.15, for example, *auliskoi* are thrust down the throat in cases of severe sore throat with danger of suffocation. These, we are told, allow the patient to breathe, and also serve to convey fumigation into the nose[73]. At 2.47.43 of the same work an *aulos* is recommended as useful in allowing the patient to inhale a vapor created by dropping heated *ostraka* into a solution of water parsnip, wine and goat or cow's milk in the well known passage on combatting empyema. An *aulos* even proves handy in the inward reduction of a thigh bone displaced at its head. The method is attested to by the author of *Joints* 77.12, though he prefers other procedures. The idea is to inflate with the *aulos* a bladder placed between the previously bound together thighs of the patient. And in *Haemorrhoids* 6, as quoted above, the reed-like tube through which a cautery is passed in destroying piles is termed *auliskos* as well as *kauster* or *kauter*[74].

At *Diseases* 1.6.12 the catheter is referred to as an *auliskos*[75]. Little is said about the instrument other than that the mark of a physician is to know how to insert one into the bladder. Still, this reference arrests attention because catheterization of a male would require an S-shaped model to conform to the contours of the male urethra. Yet, pseudo-Galen associates invention of the S-shaped catheter with Erasistratus of Iulis at a later date (*Introduction or Physician* 14.750 & 788), and this testimonium has been generally accepted[76]. But if the author of *Diseases* 1 is right, pseudo-Galen must be in error. If so, Erasistratus' contribution to the development of the catheter had to involve some other refinement[77].

Returning to the treatise *Diseases* and its directives for empyema,

at 2.47.69 the previously lanced pus pocket is then to be infused with a solution of warm wine and oil through an *auliskos*. In *Affections* 21.1-9 we find ileus being treated by inflating the blocked intestine with an apparatus consisting of a small bag of animal skin attached to an *auliskos* (αὐλίσκον προσδήσας πρὸς ποδεῶνα ἀσκίου) before administration of an enema. The same general remedy is applied to this condition in *Diseases* 3.14, but there a blacksmith's bellows (χαλκευτική φῦσα) is used for inflation prior to the enema[78].

Another name for tubes come upon in the *Hippocratic Corpus* is *motos* (μοτός). As is sometimes true of Hippocratic probes, a peculiarity of this name is the frequent stipulation of the material of which it should consist: tin or lead. For example, in the famous passage on empyema (*Diseases* 2.47.62-75; see also 2.60) a tin *motos* is inserted after the pus pocket has been punctured, preliminarily drained, and washed out with an *auliskos*. The purpose of the *motos* in this operation is to complete the drainage of the pocket and to allow the ulcer to heal[79]. It is clearly not meant to be a permanent part of the physician's *instrumentarium* as it is cut off piece by piece as the ulcer knits. In *Diseases* 2.59 we encounter another *motos* of tin, though this one is solid (μοτὸν στερεὸν κασιτέρινον). Its purpose is to prevent adhesians by being positioned in wounds of the ribcage or incisions for empyema. The same motive likely accounts for the creation of a piece of lead (μόλιβδον ποιησάμενος) smeared with honey and placed in the nostril after removal of a polyp (*Diseases* 2.33, 36 & 37). The term *motos* is not used here, but clearly a tube is required. A tube called *motos* is also found in administering to female complaints, in this case a uterus displaced toward the hip bone. As part of the treatment a lead *motos* is fashioned, filled with the kneaded fat of a ewe and inserted to soften the cervix (*Diseases of Women* 133.103-105)[80]. Elsewhere the term is used to designate a tent of linen used in the main as a plug in dealing with various maladies[81]. With *motos* we may include *balanos* (βάλανος). Ordinarily *balanos* designates a plug or pledget of medication; but once it is said to be made of horn (κερατίνη), smeared with fullers earth and inserted rectally in combatting fistula (*Fistulas* 3). In this instance, therefore, the *balanos* must be a tube.

Speculum

Finally: in addition to the aforementioned graduated probes employed in dilation of the cervix, we also hear of a device performing a similar function for treatment of rectal maladies such as fistula and piles. It is referred to solely in *Haemorrhoids* 5 and *Fistulas* 3 where is called *katopter* (κατοπτήρ).

Authorities writing at the time of the Roman Empire amply attest to a rectal dilator of that period to which they gave various names including "small speculum" (μικρὸν διόπτριον)[82]. Included in some

Fig. 5 – Rectal specula: (left) Casa del Medico Nuovo (II), Pompeii; (right) probably Herculaneum: Naples Mus. 116436 and 78031; L. 18 and 15 cm. Photo courtesy of Römisch-Germanisches Zentralmuseum Mainz, L 1032/8.

instrumentaria extracted both from Roman graves and settlement sites is an apparatus consisting of two elements, each featuring a projecting valve and rotating on a pivot (Fig. 5). Altogether eleven specimens survive[83]. The device was operated like a forceps by compression of its handles, which action forced the valves apart. While no Roman source (with perhaps the exception of Celsus[84]) ever describes the instrument, the fact that it is termed "small", in contrast to the larger uterine speculum available to Greco-Roman physicians, and the astonishing resemblance of Roman survivals to modern versions of the rectal speculum make the identification certain[85]. As Galen did not hesitate to identify the imperial terms with the Hippocratic *katopter,* these surviving bivalve dilators have generally been seen as both the Roman and the Hippocratic instrument in question. However, the fact that Celsus only describes but does not name the instrument has prompted the suggestion that it may only have been recently developed, at least in the form assumed by the surviving examples[86]. If so, the Hippocratic *katopter* may have been something else, perhaps only two large spoons, the operator holding one in each hand as he enlarged and examined the rectum. The first century Hippocratic commentator Erotian may have understood *katopter* in this sense when he equated it with a spoon probe[87]. One might also expect to hear of the *katopter* in connection with vaginal and uterine examinations in the Hippocratic gynecological treatises which, however, are silent on the issue[88]. Still, the concept of an instrument consisting of two elements revolving on a pivot was familiar to the Hippocratics who, as we have seen, attest to the tooth forceps, as does Aristotle (*Mech.* 854a17); furthermore the language used in *Haemorrhoids* 5, "when (the *katopter*) is being opened (διοιγόμενος)...", suggests a genuine pivot mounted speculum. The matter is presently irresolvable and underlines the difficulties of treating Hippocratic surgery without the benefit of contemporary instruments to compliment Hippocratic texts. But if the *katopter* was a speculum in the modern sense, it would, being useless for much else, represent along with the bleeding cup one of the few instruments in the Hippocratic arsenal manufactured solely and permanently for surgical applications.

Conclusions

As we have seen, the Hippocratic surgeon attempted to minister to various infections, growths and lesions along the surface of the body and, where accessible, in its orifaces. Thus, in addition to cupping and bleeding, we find him applying or introducing numerous medicaments and solutions with probes and tubes, inserting the catheter, operating on tonsil, polyp, fistula and haemorrhoid with knife, needle, forceps and cautery, and even even cutting into the body to puncture and drain ascitis and empyema. Among his most daring procedures he might deploy drills, levers, saws and rasps to trephine the skull, reduce fractures or perform minor amputations. And, clearly, he was much preoccupied with female complaints, accessing the organs of reproduction with dilators, medicating with probe, pessary and klyster, and even dismembering and extracting a lifeless fetus. Still, anyone interested in the surgical texts of the Roman Empire soon realizes that there are more names for instruments and more adventure some operations attested to in the texts of that period than we find in the *Hippocratic Corpus*. A cursory reading of the sixth book of Paul of Aegina demonstrates this amply. Note, for example, his expressed surprise at the reluctance of Hippocratics to amputate arms and legs (6.121). In contrast, he and the surgeons of the early Empire on whom he depends are prepared to perform lithotomy, mastectomy, major amputations, and surgery for goiter and various hernias, all perhaps made possible by techniques developed in the Hellenistic period for ligating blood vessels[89]. In short, the Hippocratic surgeon was less well equipped and, however admirable his sense of enterprise, less capable. Moreover, not only are fewer tools of the trade attested to in Hippocratic literature but, in contrast to the fine obviously professionally prepared and permanently available instruments extracted from Roman graves, it seems, as we have already observed, that not infrequently the Hippocratic employed items not intended for medical purposes, or even created what he needed on the spot. *Joints* 7 nicely expresses this tendency: "you always have to use whatever is at hand"[90]. Though the surgeon of the

Empire too occasionally used whatever was available, there are many more references to the practice in the Hippocratic tracts. This may help to explain why so few recognizable surgical tools survive from the fifth and fourth centuries BCE. The surviving bleeding cups from graves show that it cannot be because, unlike the physicians of the Empire, Hippocratics were never buried with instruments. On the contrary they clearly sometimes were. So there must be other reasons for their infrequency. One may have been a greater scarcity of metal during the fifth and fourth centuries which, were this the case, would have precluded wasting good metal tools by interring them with a corpse. But this study also suggests another reason. If it was indeed the case that there were fewer tools specifically designed and manufactured for physicians in the fifth and fourth centuries, that may explain, at least in part, why we have nothing recognizably surgical other than the few bleeding cups deposited in graves. It is noteworthy that the *sikua* always takes pride of place on the coinage of Greek cities especially associated with the medical art, and the same applies to votive and grave stones, including the late archaic stone in Basle cited at the beginning of this paper[91]. Its seems, therefore, that the bleeding cup was the one item available in Hippocratic times that was particularly symbolic of the surgical art; hence it was the item of choice for burial purposes when one considered appropriate grave furniture for a deceased physician in those singular instances where a physician was so honored.

BIBLIOGRAPHY AND NOTES

NB: I have throughout used Littre's text of Hippocrates unless otherwise indicated. Citations of Galen are from Kühn's edition. References in the text to BLIQUEZ are to 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 Ralph Jackson. Mainz, Verlag Philipp von Zabern, 1994.

1. MILNE J.S., *Surgical Instruments in Greek and Roman Times*. Oxford, Clarendon Press, 1907. Reprinted: New York, Augustus M. Kelley, 1970.

2. In addition to Milne one might also cite *GURLT E., Geschichte der Chirurgie und ihrer Ausübung. 3 volumes.* Berlin, Hirschwald, 1898. Nachdruck 1965; who has an extensive section on Hippocratic surgery but with emphasis on process rather than instruments. In any case he does not deal at all with female conditions and the tools used in that connection. ZERVOS S., *Les bistouris, les sondes et les curettes chirurgicales d'Hippocrate.* Athens, 1932; should also be mentioned. He certainly does not neglect Hippocratic instruments but, as his title shows, he is only interested in three types. The best attempt to date is that of LOPEZ SALVA M., *Terapia Quirúrgica in el Corpus Hippocraticum: Estudio Léxico del Instrumental.* In: BAADER G. and WINAU R. (ed.), *Die Hippokratischen Epidemien. Theorie-Praxis-Tradition, Verhandlungen des Ve Colloque International Hippocratique.* Sudhoffs Archiv 1989; 27:299-312. But even this effort passes over a number of instruments and misses some references; furthermore, our respective studies differ in focus and detail.
3. Grave finds of the Roman Empire have been collected by KUENZL S. with the collaboration of HASSEL F. J. and KUENZL S., *Medizinische Instrumente aus Sepulkralfunden der römischen Kaiserzeit.* Bonn, In Kommission bei R. Habelt, 1983; Sonderdruck aus den Bonner Jahrbüchern, Bd. 182, 1982.
4. See W.H.S. Jones' remarks in his introduction to *Decorum* in the second volume of the Loeb edition of Hippocrates, 269-271.
5. The name *sikua* was primarily applied to various gourds, the instrument deriving its name from their shape. For use of the former in medicine, see *Epidemics* 7.1.62.11, *Nature of Woman* 62.1-4 and *Diseases of Women* 230.9-10. Galen maintains that Hippocrates also used the term *sikuone* (σικυώνη) for bleeding cup (*Hippocratic Glossary* 137.5-17). This is nowhere apparent in the surviving *Corpus*, save for *Diseases of Women* 222.35-37 where we encounter a *sikuone* of copper (σικυώνην--- χαλκοῦ λευκοῦ). But the passage is corrupt at this point and should not be accepted as a dependable witness. Note the attempts to make sense of the passage in ERMERINS' F. Z. (edition), see also ref. 7 below. Utrecht, 1859-64, vol. 2 pp. 668-9.
6. Two of the Ialysos cups were lost in World War II; BERGER E., *Das Basler Arztrelief: Studien zum griechischen Grab und Votivrelief um 500 v. Chr. und zur vorhippokratischen Medizin.* Mainz, Philip von Zabern, 1970, p. 175. The Tangra specimen once sported a chain, now lost, apparently for suspension and removal. This can be seen in older photos; e.g. Milne, ref. 1, Pl. XXXVIII. A cup with a chain is also attested to among the dedications of the Athenian Asklepieion in the early fourth century BCE (cf I.G. 2, 47, lines 8-9: σικύα μ[εγ]ά[λη] ἀλύσει δεδεμένη).
7. For Ialysos see BERGER E., ref. 6, p. 66; for Thebes, Tanagra and Corinth see LAMBROS K.P.I., *περὶ σικύων καὶ σικυάσεως παρὰ τοῖς ἀρχαίοις.* Mainz, Typ. "Palingenesias" J. Angelopoulou, 1895, pp. 19-20.

8. KUENZL E., ref. 3, p. 21.
9. BERGER E., ref. 6, pp. 19-23.
10. The name vase of the Clinic Painter, ca. 460 BCE; see BOARDMAN J., *Athenian Red Figure Vases.* The Archaic Period: Toledo, Thames and Hudson, 1975 (rep. Artes Graficas, Toledo,1983), fig. 377.
11. For broad and tapering cups with extra drawing power see *Ancient Medicine* 22.17: ---αἱ σικύαι προσβαλλόμεναι ἐξ εὐρέος ἐς στενώτερον ἐστενωμέναι πρὸς τοῦτο τετεχνέαται, πρὸς τὸ ἕλκειν ἀπὸ τῆς σαρκὸς καὶ ἐπισπᾶσθαι. *Physician* 7. 1-11 is useful in attesting to cups that are not too heavy and have a narrow mouth, moderate belly, and lengthened apex, as well as to cups with a wider mouth. The former allow for a direct draw and the latter for a wider more inclusive draw. My examination of the cup from Thebes (Fig. 1) in May of 2002 revealed that it was appreciably heavier than the other specimens in the National Museum.
12. The sole reference to σίδηρος is the famous Hippocratic aphorism: Ὁκόσα φάρμακα οὐκ ἰᾶται, σίδηρος ἰᾶται· ὅσα σίδηρος οὐκ ἰᾶται, πῦρ ἰᾶται· ὅσα δὲ πῦρ οὐκ ἰᾶται, ταῦτα χρὴ νομίζειν ἀνίατα (*Aphorisms* 7.87.1-3).
13. LOPEZ SALVA M., ref. 2, is particularly good on this point.
14. Galen readily identified the latter type as the common bellied scalpel of his own time. See *Hippocratic Glossary* 120. 9-10: μαχαιρίδι στηθοειδεῖ· τῷ σμιλίῳ ἰατρικῷ γαστρώδει. A relief now in the National Museum, Athens shows Amphiareus operating with what may be the breast shaped type; see ZERVOS S., ref. 2, p. 31; HERZOG R., *Die Wunderheilungen von Epidauos.* Philologus Supp. 22, Heft 3, Leipzig, Dieterich, 1931, plate to left of title page.
15. Evacuation by incision of a pus pocket at the hip is contemplated but not executed in *Epidemics* 6.5.1.
16. There are references to bladder stone here and there in the *Corpus* (e.g. *Nature of Man* 12; *Airs, Waters, Places* 9); but, for any description of a surgical procedure to remove them, we have to wait until the first century ACE. See Celsus (Spencer) 7. 26.
17. ἔχειν δὲ χρὴ πρὸς τὰ τοιαῦτα καὶ ὄνυχα ἐπὶ τῷ δακτύλῳ τῷ μεγάλῳ.
18. Littre reads γραφίῳ, which is accepted by Milne.
19. So the famous aphorism cited above in ref. 12.
20. See Potter's text in vol. VIII of the Loeb edition, p. 386.
21. Naples Museum; see 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 Ralph Jackson. Mainz, Verlag Philipp von Zabern, 1994, nos. 103-104.
22. *Int. Affect.* 28.32-36: καῦσαι χρὴ, ὁκόταν μέγιστον τὸ ἦπαρ γένηται καὶ ἐξεστήκῃ μάλιστα, πυξίνοισιν ἀτράκτοισι, βάπτων ἐς ἔλαιον ζέον, προστιθέναι δὲ ἕως ἄν σοι δοκέῃ καλῶς ἔχειν καὶ κέκαυσθαι εὖ, ἢ μύκησιν ὀκτὼ ἐσχάρας καῦσαι.

23. Παρασκευάσασθαι δὲ κελεύω ἑπτὰ ἢ ὀκτὼ σιδήρια, σπιθαμιαῖα τὸ μέγεθος, πάχος δὲ ὡσεὶ μήλης παχείης.
24. ---καυστῆρα ποιήσασθαι, οἷον καλαμίσκον φραγμίτην· σιδήριον δὲ ἐναρμόσαι καλῶς ἁρμόζον· ἔπειτα τὸν αὐλίσκον ἐνθεὶς ἐς τὴν ἕδρην, διαφαῖνον τὸ σιδήριον καθιέναι---.
25. ἐνθέντα χρὴ σύριγγα καῦσαι σιδηρίοισιν ἢ τρισὶν ἢ τέσσαρσιν:
26. τοῖσι δὲ σιδηρίοισι σφηνίσκους ποιησάμενος, διακαίειν πλαγίας τὰς φλέβας.
27. καίειν παχέσι σιδηρίοισι---.
28. Σιδηρίοισι δὲ χρὴ ταῦτα καίειν, μὴ παχέσι, μηδὲ λίην φαλακροῖσιν ἀλλὰ προμήκεσι (ταχυπορώτερα γὰρ), καὶ τῇ χειρὶ ἐπερείδειν.
29. τὸ μὲν ἄκρον τοῦ κλυστῆρος λεῖον ἔστω, οἷόν περ μήληςτ. *Diseases of Women* 222.14.
30. For full text, see ref. 23.
31. μήλῃ πλατείῃ· τῇ σπαθομήλῃ 122.13; στρογγύλον μήλην· τὴνσπαθομήλν 141.12.
32. 19.122.14: μήλης τῷ πλάτει· τῷ κυαθίσκῳ τῆς ὀφθαλμικῆς μήλης.
33. See *Epidemics* 7.1.8.4 (probe as measuring device); *Diseases* 2.33 (probing a head wound); *Wounds in the Head* 10.10 (to determine nature of skull lesion); *Wounds in the Head* 21.23-34 (testing depth of track of a trephine); and *Coan Prenotions* 404.1 (testing the color of pus).
34. See e.g. Paul of Aegina 6.78.3
35. μολιβδίοισιν ἐληλασμένοις ὀκτω δακτύλοισι πέντε---.
36. For example, Galen and others test for pregnancy by attempting to insert a probe into the mouth of the cervix. Galen's *Natural Faculties* 2.150, *Use of the Parts* 2.897, and Aetius 16.1 are but a few instances.
37. No archaeological survival of any period can be specifically identified as a uterine dilator. MILNE, ref. 1. p. 82, following Védrènes, thought he had a candidate in a straight hollow tube shaped like a serpent that was recovered in Pompeii; but this curious item does not appear to have been found in a surgical context. See BLIQUEZ L.J., ref. 21, p. 3 (O).
38. In treating χηλή in his *Hippocratic Glossary* (19.155.2 & 19.93.4) Galen offers the definition μήλη δίκρους, which does not get us any closer to envisiging exactly what the Hippocratic author has in mind. A small forked instrument has been recovered in a Roman surgical grave at Savaria/Szombathely (KUENZL S., ref. 3, p. 117); and objects of copper alloy survive that might have served in some capacity as eyed probes, KUENZL S., ref. 3, p. 51[18,21].
39. As Milne long ago noted, only a blunt type of notch would be safe to use in this sort of procedure in the back of the throat; MILNE J.S., ref. 1, p. 83.
40. *Hupaleiptron* was probably an exclusively Hippocratic term. Else why would Erotian and Galen have to define it for their contemporaries?
41. Here he calls the instrument μήλην ὑπαλειπτρίδα.

42. Εἰ μὴ δυνατὸν, φησὶν (Hippocrates), εἴη ἐντιθέναι τῇ ῥινὶ τοὺς δακτύλους, ὑπαλείπτρῳ χρηστέον. ὀνομάζει δ' οὕτως, ὡς ἤδη πρόσθεν εἶπον ἅπαν ὅ τι ἂν ὑπαλείψειεν, οἷαίπερ μίλαι τε καὶ σπαθομίλαι καὶ τὰ διαπύρινα κατὰ τὸ πέρας αὐτῶν ἔχοντα ταῦτα πάντα κεφαλὰς περιφερεῖς (*Commentary on Hippocrates' Treatise on Joints* 18a.478); ὑπάλειπτρον· ἐλασμάτιον ᾧ ἄν τις ὑπαλείψαιτο τοὺς ὀφθαλμούς (*Hippocratic Glossary* 19.148.10).
43. For this olivary enlargement or *puren* (πυρήν) see BLIQUEZ L.J, ref. 21, nos.107 -133, 145-183 and 161-213. Not only does the term *puren* never occur in this sense in the Hippocratic Corpus but, to the best of my knowledge, this feature is never found on similar objects of the fifth and fourth centuries BCE.
44. Paul: δί ἀναβολέων ἢ κυαθίσκου τραυματικῆς μηλωτίδος (6.88.9):Oribasius: μετ' ἀναβολέως καὶ τῷ κυαθίσκῳ τῆς τραυματικῆς μηλωτρίδος (*Coll. Med.* 46.11.26, Raeder).
45. *Fractures* 31; so too Galen, *Commentary on Hippocrates' Treatise on Fractures,* 18.593.
46. cf. *Joints* 68.
47. ὀρθοπρίονι· τῇ χοινικίδι, 19.126.15.
48. περητηρίῳ· τρυπάνῳ τῷ εὐθεῖ καὶ ὀξεῖ: ἔστι γὰρ καὶ ἕτερον ἠχοινικίς, 19.129.15.
49. See COMO J., *Das Grab eines römischen Arztes in Bingen*, Germania 1925; 9: 152 -162, esp. p. 160 & Abb. 6 (1-5). See also KUENZL, ref. 3, p. 84 for the specimens recovered at Bingen. Pseudo Galen thought the process abandonned in his day (*Introduction or Physician* 14.783), while Paul noted that it had been condemned by "the moderns," meaning Byzantine authors as early as Oribasius, as is made clear in his Preface to Book 6.
50. *Joints* 21; so too Celsus 8.3.7.
51. For specimens now in Bingen, Baltimore and the British Museum, see CATON R., *Notes on a Group of Medical and Surgical Instruments found near Kolophon.* Jour. Hell. Stud. 1914; 34: 114-118, COMO J., ref. 49, p. 157 & Abb. 2 (19), and KUENZL S., ref. 3, p. 84.
52. BOARDMAN J., ref. 10, fig. 192.
53. The preferred terms are πρίω, πρίσις, οἴγω, ανδ τρυπάω: see *Epidemics* 4.1 and 11; 5.16, 27 and 28; 6.7.4; 7.35.
54. MILNE J.S., ref. 1, pp. 121-122. MAJNO G.,*The Healing Hand.* Cambridge/Mass., London, Harvard University Press, 1975, p. 169; apparently follows him in illustrating the use of the *xuster* in *Wounds in the Head* 14.
55. Files at least are sometimes found in Roman graves; see KUENZL E., ref. 3, pp. 20 & 82(18).
56. KUENZL E., WEBER T., *Das spätantike Grab eines Zahnarztes zu Gadara in der Dekapolis.* Damaszener Mitteilungen 1991; 5: 81-118, plus 7 plates; cf. esp. 102-103 & Taf. 37-39;

57. MILNE J.S., ref. 1, p. 135.
58. KUENZL E., WEBER T., ref. 56.
59. JACKSON R., *Staphylagra, Staphylocaustes, Uvulectomy and Haemorhoidectomy, the Roman Instruments and Operations.* PACT Journal of the Centro Universitario Europeo per i Beni Culturali 1990; 34: 167-185.
60. MILNE J.S., ref. 1, pp. 97-98.
61. See Potter's summary of the scholarship on this question in his introduction to *Physician* in volume VIII of the Loeb edition, p. 298.
62. As with evulsion of tonsils at *Diseases* 2.30. So too Celsus 7.12.4
63. MEYER-STEINEG T., *Chirurgische Instrumente des Altertums.* Jena, Gustav Fischer, 1912, p. 37 and Taf. VI, 1; KUENZL E., *Spätantike und byzantinische medizinische Instrumente.* PACT Journal of the Centro Universitario Europeo per i Beni Culturali 1990; 34: 202-243.
64. On this point see MAZZINI I., *Embriulcia ed embriotomia: evoluzione e diffusione di due interventi ginecolocici atroci nel mondo antico.* In: VEGETTI M., and GASTALDI S. (ed.), *Studi di storia della medicina antica e medievale in memoria di Paola Manuli.* Firenze, La Nuova Italia 1996, pp. 21-23.
65. The mss. read *anulo cultro* or *cultro anulo*, prompting emendations by Rigaltius (*anulocultro*) and Gelenius (*anulo cultrato*). Milne accepts the former and J. H. Waszink (*Quinti Septimi Florentis Tertulliani De Anima.* Amsterdam, J.M. Meulenhoff, 1947) the latter. Either can be interpreted in the sense of "ring knife". Waszink believes that Tertullian is thinking of the *uncus* used to dismember an embryo in Celsus 7.29. It features a cutting edge: *in interiorem tantum partem per totam aciem exacuitur.*
66. CUEPPERS H. ET AL., *Die Römer an Mosel und Saar. Zeugnisse der Römerzeit in Lothringen, in Luxemburg, im Raum Trier und im Saarland. Ausstellungskatalog.* Mainz am Rhein, Philipp von Zabern, 1983, p. 40 and RIHA E., with the collaboration of JOOS M., J. SCHIBLER M., STERN W. B., *Römisches Toilettgerät und medizinische Instrumente aus Augst und Kaiseraugst.* Augst, Römermuseum Augst, 1986, *Forschungen in Augst*, Bd. 6, p. 83 illustrate blades mounted on a ring in the same plane which some might identify as Roman versions of the Hippocratic type. But in both instances the blade is not hooked in the form of a "claw" and is impractically arranged in any case. To be effective, the blade would have to be positioned perpendicular to the ring.
67. For examples of the fourth century strigil see ROBINSON D.M., *Excavations at Olynthus, pt. X, Metal and Minor Miscellaneous Finds.* Baltimore, Johns Hopkins University Press, 1941, pp. 172-181 & Pll. XXXII-XXXVI; see also DAVIDSON G., *Corinth, vol. XII, The Minor Objects.* Princeton, American School of Classical Studies at Athens, 1952, pp.180-181 & Pll. 81-82.

68. See Ch. A. Lobeck's remarks in his edition of Phrynicus, p. 299.
69. The same term is also used of the liquid injected, along with κλύσμα and κλυσμός.
70. See BLIQUEZ L.J., ref. 21, p. 56 (nos. 231 & 232).
71. As observed above in ref. 5, the passage is untranslatable in part, and therefore corrupt. But it resembles *Diseases of Women* 230. 8-27 closely enough to make clear the general line of treatment.
72. An approach rejected later by Soranus of Ephesus, *Gynaecology* 3.29.2
73. Caelius, following Hippocratic procedure, describes use of the *clysteris auliscus* or *fistula* for fumigating the throat (*Chronic Diseases* 4.3.24-26).
74. See ref. 24 for the text.
75. The term *katheter*/καθετήρ, which was later standard and which one would expect to encounter in Hippocratic writings, does occur, but only once, and then not in the sense of catheter. Rather it is applied to a series of three linen pessaries, also called *mota*/μοτά, annointed with goose fat and inserted to soften sclerotic womb. See *Diseases of Women* 2.157.9 where application of this linen *katheter/motos* is compared to the type of *motos* used in the treatment of empyema, as in *Diseases* 2.47.66.
76. See Marcus Wellman: *RE*, s.v. "Erasistratus;" GURLT E., ref. 2, (1898) vol. one, zweiter Buch, p. 309.
77. Or was it simply that he was remembered for applying the S-shaped catheter in certain situations? So Caelius, *Chronic Diseases* 2.1.13: *praeterea etiam peritioneo paralysi vitiato, ut Erasistratus ait, urina abstinetur et neque excluditur nisi adhibito catheteri.*
78. Caelius Aurelianus, like Soranus, rejects this approach but supplies the Latin terminology for it: *folliculo artis aerariae, ex aerario folliculo* (17.154-156). A tube was likely attached to the bellows; such was the stipulation later by Alexander of Tralles who requires an *auliskos iatrikos* (αὐλίσκος ἰατρικὸς; 2. 363).
79. Drainage for this condition had to be gradual; see *Aphorisms* 7. 37.
80. ὁκόταν δὲ ποιηθῇ ὁ μοτὸς ὁ μολύβδινος. στέατος αὐτὸν ἐμπλῆσαι ὄϊος τετριμμένου---.
81. As above in treating sclerotic cervix at *Diseases of Women* 157.1-15
82. These include διαστολεύς, ἑδροδιαστολεύς (Paul 6.78), and τὸ μικρὸν διόπτριον (Oribasius *Coll. Med.*, 44. 20. 61, Raeder). For the link see Galen 19.110.10.
83. JACKSON R., *Roman bivalve dilatators and Celsus' "instrument like a greek letter-(De med. VII, 5, 2 B).* In: *Le Latin Médical, La Constitution d' un Langue Scientifique, Saint-Étienne.* Publications de L'université de Saint-Étienne, 1991: 101-108, esp. table 1 facing p. 108. To this list add a specimen in the Deutsches Klingenmuseum, Solingen (unpublished; provenience unknown) and one from Valeria, FUENTES DOMINGEZ A., *Instrumentos Romanos de Medicina en el Museo de Cuenca.* Archivo Espanol de Arqueologia 1987; 60: 251-274.

84. Celsus (7.5.2B) remarks on an instrument used in extraction of impacted arrowheads. He gains access to the missile by dilating the wound with a device that he compares to a letter of the Greek alphabet (*"ferramento ad similitudinem facto Graecae litterae"*). Unfortunately, the figure of the letter has dropped out of the text. However, there is strong feeling among scholars that the Greek letter in question was upsilon ("Y"). The shape assumed by the instrument cited above, when its valves are open and its handles completely compressed, is exactly the configuration of upsilon.
85. See for example the rectal specula advertised in *Catalogue of Surgical Instruments of Superior Quality, Biddle and Crowther Inc. 321 Seneca St.,* Seattle, Wa. 1935 (24th ed.), p. 58.
86. JACKSON R., ref. 83.
87. κάτοπτρον: ἡ μηλωτίς. (90. 15). I assume here that κάτοπτρονσ κατοπτήρ.
88. Oribasius and Paul (see citations, note 82 above) state that this type of speculum was also useful for dilation of the female organs, perhaps more so in the case of girls for whom the uterine speculum would be too large.
89. So MAJNO G., ref. 54, p. 328, although Hippocratics are not quite as inept at amputation as he makes out. See also GURLT E., ref. 2, (1898) vol. one, zweiter Buch, p. 293.
90. χρῆσθαι δὲ χρὴ αἰεὶ τούτοισι ἃ ἂν τύχῃ παρεόντα. One also thinks of Herodotos' account of the famous Democedes of Croton who carried on without any instruments at all (3.131).
91. In a few cases a forceps also appears. LAMBROS K.P.I., ref. 7, pp. 15-19 has most illustrations of both; see also PENN R. G., *Aspects of Medicine on Ancient Greek and Roman Coins.* Batsford, London, 1994, pp.141-143. For Ialysos see BERGER E., ref. 6, pp. 19-23.

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