MEDICINA NEI SECOLI 32/3 (2020) 833-890
Journal of History of Medicine and Medical Humanities

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SURGICAL TREATMENT OF THE BREAST FROM THE HIPPOCRATICS TO THE RENAISSANCE

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SUMMARY

This contribution aims to survey maladies of the female (and occasionally male) breast requiring surgical intervention from Greco-Roman (hereafter classical) times through the Middle Ages. My survey is based on a selection of authors I consider most representative. Special attention will be given to the instruments and paraphernalia used in therapy and, when convenient, to appropriate pharmaceutical applications employed in conjunction. My investigation finds that in the main the same maladies (e.g. menstrual issues, various ulcers and growths) were treated throughout this period with the same or similar therapies and with basically the same equipment. However, medieval sources do occasionally attest conditions not mentioned in classical sources (e.g. inverted nipples) and sometimes employ new names for the equipment used.

Aside from what one might call 'pseudo surgical' procedures, such as cauterization of the right breast of female children by Sauromatians to allow for more efficient use of weaponry[1], the first relevant historical reference to surgical treatment of a breast is found in Herodotus' *Historia* (3.133-134). The pertinent episode occurs in his account of Democedes of Croton, a renowned physician of the late 6th - early 5th century BCE. According to Herodotus, Atossa, wife of Great King Darius of Persia, was beset with a 'growth' (φῦμα) on her breast. When it had burst and was spreading, she sent for Democedes,

Key words: Cancer - *Apostema* - *Antispasis* - Surgical instruments - Trotula

who cured her. Herodotus is not specific in naming the condition, but an abscess/ulcer fits the language he uses. As we will soon see, mammary abscess may frequently be the issue lying behind the term ἀπόστημα/*apostema* (pl. *apostemata*) in the surgical texts consulted in this essay. As to Democedes' cure, no details are given. The sources cited in this study attest lancing and medication as the standard surgical procedures[2].

The *Hippocratic Corpus* offers little in the way of surgical interventions on the breast. All known to me involve cupping, the process used even into modern times whereby a cupping vessel (σικύα in Greek, *cucurbita* in Latin) is heated and then applied to the afflicted part. As the cup cools, the resultant vacuum produces a pulling action. The *Corpus* makes it clear that size, weight, and contour varied to regulate a cup's drawing power; for example, the larger the cup, the more draw[3].

Sometimes an incision was made prior to the application of the cup, a process called scarification; if there was no incision the cup was called in Greek 'light' (*kouphe*, κουφή-αί; for medieval testimony cf., e.g., William of Saliceto III.4: *cufa seu ventosa… sine incisione*). The Hippocratic and subsequent sources referenced in this essay are all of the latter type, unless otherwise indicated. At *Aphorisms*, Jones 5.50 and *Epidemics*, Smith 2.6.16 we are told to fasten a large cup to one or both breasts to restrain menstruation (καταμήνια, ἐπιμήνια ἴσχειν). *Diseases of Women*, Littré 8.110.38-41 seems to represent a more detailed treatment of the same or some similar condition. The text is in part incomprehensible and probably corrupt; but it is clear that 'white, reddish or red flux' is to be treated by cups applied, not to, but below the breasts, sometimes on the left, sometimes on the right. Technically, this procedure has nothing to do with a malady of the breasts themselves, but the breasts are used as a staging area for the cure.

Once anchored in the *Hippocratic Corpus*, cupping of the breasts for heavy periods and 'flux' (perhaps intermittent bleeding or dis-

charge, if not actual menstruation) is an intervention regularly repeated by later authorities who provide further details. These prominent figures include: [Aulus] Cornelius Celsus, contemporary of the emperor Tiberius, Galen of Pergamon, physician to Marcus Aurelius, Oribasius of Pergamon, physician to Julian the Apostate, Alexander of Tralles, a sixth century practitioner sometimes referred to by modern doctors as 'the third Hippocrates', Aëtius of Amida, contemporary of the Emperor Justinian and perhaps a practitioner in his court and, finally, Paul of Aegina, a somewhat murkier figure of the 7th century[4].

Celsus merely repeats the injunction to make the application under the breasts (*sub mammis*) in the event of excessive menstruation causing harm (*si purgatio nimia… nocet* 4.27.1D)[5]. Although Galen ascribes his views to [Hippocrates], he provides details not found in the *Corpus* as we now have it. In various passages he favors placement of a large cup(s) under, to, or alongside (ὑπό, πρός, παρά) the breasts where, he thinks, vessels in common (κοινὰ ἀγγεῖα) connect the chest to the uterus. The cups, in Galen's view, promote through these vessels what he calls 'revulsion' or *antispasis* (ἀντισπᾶσις), that is, attraction in an opposite direction. In other words application of a large cup(s), by pulling/attracting the uterus (and presumably its contents) upward, reduces excessive or unwanted discharge and the danger of fainting, which is likely what Celsus is referring to as 'causing harm'[6]. By the same token, menstrual flow can be prompted by fixing cups to the pubic and groin areas.

Galen's account is echoed by: Alexander of Tralles (*Fevers*, 1.339.18, τοῖς τιτθοῖς εἴωθαμεν ἐπιβαλεῖν σικύας), Oribasius (*Coll. Med.*, 8.19.3, παρὰ τοὺς τιτθούς), Aëtius (5.106.3, παρὰ τοὺς τιτθούς) and Paul (3.62.2.14, ὑπὸ τοὺς τιτθούς)[7]. Alexander and Aëtius also echo Galen in stating that excessive discharge causes fainting (λειποθυμία). All other classical texts dealing with cupping of the breast area are concerned with proper and efficient lactation for

nursing infants. Oribasius mentions the intervention in two passages. The first and most extensive (*Coll. Med. Lib. Inc.*, 31) may reflect the views of Oriabasius himself[8]; the other (*Coll. Med. Lib. Inc.*, 32) he excerpted from the works of Mnesitheus of Cyzicus[9]. Both passages focus on the proper qualities, physical and moral, of a wet nurse, her proper regimen, production of the most desirable milk and, of course, remedies for inferior or deficient production. At 31.28-29 we learn that the latter can be remedied by diet, medication, exercise, manual massage (ἀνατρίβειν), and irritation (ἐρεθίζειν) of the chest and breasts. 'In some cases', Oribasius adds, 'application (location unspecified) of a cup can provide what is needed'[10]. Mnesitheus' remedy is similar but, after medicating, he prescribes a cup along each breast (προσβάλλειν σικύαν καθ' ἑκάτερον τόπον τῶν μαστῶν…). Neither passage explains how cupping achieves 'what is needed (τὸ δέον)'. Most likely the idea again has to do with *antispasis*, or attracting abundant milk into the breasts.

One problem associated with cupping and, in particular, with cupping of the breasts is the vacuum causing the cup to adhere. If applied with a great deal of heat, it might be too strong for comfort, or even to remove. The remedy, of course, was to reduce, or if necessary, to break the vacuum. This might be done by applying to the cup a sponge dipped in hot water, by inserting a spatula probe between the lip of the cup and the bodily surface or, more radically, by drilling a hole in the cup. Sensitivity to this issue is expressed by medieval authorities as well[11].

We today possess nine, perhaps ten specimens of the 'Hippocratic' cup and around two dozen others dating to the Roman Empire (Figg. 1 & 2). All are of copper alloy, though other less preferable materials are attested in the literature (silver, glass, horn, even wood). Several still sport the rings for suspending or removing them (as Fig. 2), and many exhibit traces of their erstwhile presence. About half of them were excavated from graves; the rest were found at sites like Pompeii,

with at least one extracted from the sea[12]. The pre-Roman models are characterized by a less angular profile at the shoulder as opposed to sharper accentuation in the case of their Imperial counterparts[13]. Cups also appear on reliefs and coins. Representations include three of the 'Hippocratic' type shown suspended in the background on a relief now in the Antikenmuseum, Basel, while illustrations of the Roman type include two flanking a box of scalpels on the base of a Roman dedication in the Athens Museum and one on a base, also Roman, honoring a certain Jason in the British Museum[14]. The Basel relief and six Hippocratic specimens from a grave at Ialysos are datable to ca. 500 B.C., establishing the earliest chronology of the pre-Roman type.

In addition to the cups themselves, a spatula probe and a drill have also been mentioned in connection with their removal. The former were ubiquitous all over the Roman Empire and served mainly domestic purposes (Fig. 6)[15]. Drill bits are rare and no specimen of the standard straight type, so familiar now, has ever been authenticated as ancient. On the other hand, over half dozen of the bows to drive bits mounted on chucks are preserved (Fig. 7). This type is likely only a smaller version of the bow drills used by carpenters and stone workers[16].

A couple of side notes re lactation treated with parasurgical items in Oribasius. In *Coll. Med. Lib. Inc.*, 32, 15-16, Mnesitheus massages the breasts and ties just above them a soft *lemniscus* or fillet (μαλακῷ λημνίσκῳ)[17]. This allows the attending healer to apply gentle pressure promoting greater flow of milk. While it is unclear whether the fillet encircles the breasts at their base or the chest just above them, pressuring by fillet appears to represent an approach that is the opposite of *antispasis*. Among approaches for reducing breasts excessively enlarged by the flow of milk is application of a sheet of papyrus (χάρτη) medicated with cumin and brine (Oribasius, *Ecl. Med.*, 141.1).

For similar conditions creating swelling and discomfort, we may consult several passages excerpted from earlier authorities by Aëtius. These occur in book 16, which deals with gynecological issues, such as caked breasts and clotting of milk producing swelling (35- 36 Zervos; 34-36 Cornarius), inflammation (37 Zervos & Cornarius [from Philumenus[18]]), and sclerotic inflammation of the breast (38 Zervos & Cornarius [also from Philumenus]). For clotting with swelling a clean sponge soaked in oxykraton (sour wine and water) or a poultice of ground dates mixed with leavened bread and oxykraton may be bound on and applied with gentle pressure[19]. Inflammation and sclerotic inflammation are combatted with plasters, their most intriguing ingredient being the collected residue of a tub in which only men have bathed. We will see such conditions reoccur in medieval sources.

It is odd that we hear of virtually no lesions of the breast in the *Hippocratic Corpus*, let alone any involving surgery. The sole exception is a reference to breast cancer at *Epidemics*, Smith 7.5.101, a passage repeated at *Epidemics*, Smith 7.7.116.

> *A woman at Abdera had breast cancer (*καρκίνωμα ἐγένετο περὶ τὸ στῆθος*). A bloody fluid flowed from her nipple. When the flow stopped she died.*

Here we find only the detached observation so characteristic of much of *Epidemics* with no indication that breast cancer was treated at all, let alone treated surgically in the fifth and fourth centuries BCE. But abscesses, fistulas, cysts and other growths in and on the breast that we hear of in post Hippocratic sources there must have been, even if these conditions are not named.

Of later authorities writing in Greek, Aëtius presents us with the richest trove of breast conditions requiring the use of instruments such as surgical knives, probes and cauteries. These occur in book 16 in the context of the other breast conditions mentioned above.

At chapter 39 (Zervos & Cornarius) we come to mammary abscess[20] (*ἀπόστημα ἐν μαστοῖς*) which, he says, develops when inflammation and sclerosis cannot be arrested by plasters previously recommended. This requires surgical, i.e., more radical intervention. The operation consists of incision of the pus pocket, which Aëtius refers to as 'rotted tissue' (*σεσηπότα σώματα)*. Other parts of the breast may be cut around without fear. However, particular care should be exercised around the nipple, where the incision should be made in a semilunar form (ἐκτεμνέθω μηνοειδεῖ περιαιρέσει) but sufficiently deep to reach the base of the pocket[21]. Such an incision preserves the natural appearance of the nipple and avoids future problems with lactation. Interestingly, we learn that, if the surgery is performed on males, they too appreciate cosmetic preservation of the nipple, one of the few times we hear of breast surgery involving men.

Post surgical treatment involves plasters topped with a wine soaked sponge. A certain Magistrianus[22] is cited for his special plaster: earthworms (*γῆς ἔντερα*) mixed with barley meal. It is most important not to load the wound with excessive tents (*motoi*/*μοτοί*). This can lead to fistula/sinus (*σύριγξ*), which is the subject of the next chapter (40 Zervos & Cornarius), excerpted from the work of the famous surgeon Leonides of Alexandria[23]. We will find similar wariness over heavy dressings/tents resurfacing in medieval authorities.

In dealing with mammary fistula Leonides leans to milder measures. In particular he favors a plaster he calls 'the black one made of darnel (= *lolium temulentum*)', for which an extensive list of ingredients is provided. This is to be applied on a tuft of wool, care being taken to avoid contact with the nipple. Should the black plaster fail to dry up the fistula, Leonides then resorts to surgery. First the fistulous canal must be explored with a probe (*διὰ πυρῆνος μήλης*) to determine its depth and nature. It may then be opened by incision and any tissue that is hard, callous, and unnatural must be cut out. More plaster is then applied to promote desiccation and a scar.

The next malady, also copied from Leonides (41 Zervos; 42 Cornarius) is a corroding canker or ulcer called *phagedenic* (*τὸ φαγεδαινικὸν ἕλκος*). This type differs from a malignant growth in that it tends to be superficial and its edges are not stiff; nor does it feature a network of supporting blood vessels. Though Leonides says phagedenic lesions react well to medication, he recommends immediate recourse to surgery as the simple and safer approach. Basically the operation consists of excision of the indurated margins (*τετυλωμένα χείλη*) of the lesion and then application of fired cauteries to arrest bleeding before the application of corrosive medication.

As noted, the Hippocratics, so far as we know, did not treat cancer of the breast surgically. The earliest source for this approach is Celsus who, in a wide ranging section on cancers in various parts of the body, lists the female breast as a susceptible area (5.28.2A-E). He notes two stages, the first called by the Greeks *cacoethes*, the second *carcinoma*. The first can be attacked with caustic medication (*medicamentis adurentibus*), cautery (*ferro*) and knife (*scalpello*), but the second is inevitably fatal and admits only of palliative care. Celsus also warns that only the very experienced can distinguish the two stages. In general his approach is characterized by a caution that will be echoed by his successors, classical and medieval, in their treatments of mammary cancer.

First to consider is Galen. In addressing Glaucon, he says he has seen many cases involving the breast. As in our time, he feels most confident of a cure when the cancer is in its earliest stages and can be treated with medicaments, in particular those compounded of metals. Advanced tumors can only be attacked surgically but at great risk. If the tumor is cut around and excised, there is danger of immediate hemorrhage. This can be staunched by ligation but that, in turn, provokes other issues. If on the other had we choose to cauterize the roots of the disease, here again there is great danger of damaging nearby vital parts[24].

Paul of Aegina has a short chapter (6.45) on cancer, observing, as had Galen, that it occurs in particular in the female breast (*ὡς μάλιστα κατὰ…τοὺς μαστοὺς ἐπὶ γυναικῶν*). Some practitioners, he says, simply eliminate the tumor with cauteries, others amputate the entire breast and then cauterize[25]. His own general feelings seem to reflect the wariness of Celsus and Galen: 'even when operated on, it gets worse, sometimes with ulceration'[26].

We now return to Aëtius, whose views on breast cancer, are based on lengthy excerpts from the writings of Archigenes of Apamea[27] and Leonides. Topics of discussion in chapter 42 Zervos (43 Cornarius) include: derivation of the name, division into cancers that ulcerate, and those that do not (also called hidden), features of non-ulcerating cancers of the breast (deeply seated, spreading, linked to supporting blood vessels, changing colors, harder in appearance than to the touch, and painful), and features of ulcerating cancers (constantly expanding and descending, exuding foul secretions, painful and worsening under medication and surgery). In chapter 43 Zervos (44 Cornarius) we are told that cancers extending into the chest (*τὰ συμφυῆ τῷ θώρακι καρκινώματα*) are incurable because of the danger of hemorrhage during surgery and the impossibility of completely extirpating the disease. On the other hand, cancers along the surface of the breast (*τὰ δε κατὰ τὸ ἄκρον τοῦ τιτθοῦ*) can be cured.

Having dealt with these issues, Aëtius now brings us to an actual surgery, the verbatim account of the procedure followed by Leonides (44 Zervos; 45 Cornarius).

> *I usually operate in cases where the tumors do not extend into the chest. The procedure is as follows. When the patient has been placed on her back, I incise the healthy area of the breast above the tumor and then cauterize the incision until scabs form and the bleeding is stanched. Then I incise again, marking out the area as I cut deeply into the breast, and again I cauterize. I do this quite often, incising and then cauterizing to stanch the*

> *bleeding. This way the bleeding is not dangerous. After the excision is complete, I again cauterize the entire area until it is desiccated. I apply the cauteries the first and second time to check the bleeding, but the last time, after the tumor has been excised, for the complete cure of the disease.*

It is important to note that Leonides, as Paul and Galen, only excises the tumor, not the entire breast.

Post operative parasurgical gear is detailed in chapter 45 Zervos (46 Cornarius), perhaps also dependent on Leonides. Required are strips of linen (ὀθόνια) soaked in water or milk (mother's or donkey's) to hold plasters and *motoi* of lint or cloth, themselves sometimes medicated. The latter might in turn be anchored in place by a truss of cloth called a *motophulax* (μοτοφύλαξ)[28].

The final condition of interest described in Aëtius 16 is indurated breast (σκιρρωθεὶς μαστός), excerpted briefly from Leonides (49 Zervos; 50 Cornarius). At issue here is a hard and heavy tumor causing pain by pulling down on the breast. If the hardening extends to the chest, Leonides discourages surgery. If the tumor is only superficial or even extends half way into the breast, amputation of the diseased part is possible without cauterization, because hemorrhage is not a concern.

If we now turn to the instruments, i.e., the knives, probes and cauteries attested as deployed to perform the operations we have described, we encounter a problem we did not have to face in the case of cupping. This is that, though cups may vary somewhat from one another in size or shape, they remain substantially the same in terms of form. On the other hand, when we treat surgical knives, probes and cauteries, formal differences abound, as shown by the variety of names applied in classical surgical sources and the variety of surviving specimens to which we can link these names.

Take for example cauteries. In the written sources we hear of cauteries assuming the forms of razors, styli, spatulas, tubes, triangles, half moons, needles, tridents, olives, knives, nails, bricks, lentils and the

letter gamma, plus natural substances like ignited fungi[29]. The problem is that in the sources focusing on the breast, no specific cautery is mentioned; just the general terms for the instrument, *ferrum* and *kau(s)ter/kau(s)terion (καυ(σ)τήρ/καυ(σ)τήριον*). Other than that we only find the verb *καίειν/kaiein* ('to burn'), its compounds, and the verbal noun for 'burning' (*καῦσις*).

So too in the case of surgical knives and probes. With respect to the former there are over a dozen names for surgical knives in the Greek literature, with recovered specimens perhaps representing as many as nine of them (Fig. 8). No specific knife, or even the general term usually rendered as 'scalpel', *smile* (*σμίλη*) and its diminutives, is to be found in the passages of interest. All we have to go on are verbs and verbal nouns that can be translated as 'cut', 'cut out', 'cut around', 'excise'/'amputate', etc., or a scattering of nouns designating the concrete result of these actions.

This forces us to guess as to the appropriate cautery or knife needed for breast surgeries. When, for example, Leonides cuts directly into the breast to remove a cancerous tumor, knives with pointed straight blades might have appealed most to him (Fig. 8.2)[30], whereas for cutting around the margins of a phagedenic ulcer he might have seen blades shaped like a raven's beak as more functional (Fig. 8.4).

The situation changes when we shift to consideration of fistula; for we find in the literature two and possibly three special knives for treatment. Not surprisingly they went by the name *suringotomon* (συριγγοτόμον) or 'fistula cutter'. As we are occupied with the breast, we may immediately dismiss a sickle shaped model deployed solely for anal fistula[31].

Most attractive is a second type described by Galen (*De Meth. Med.*, 10.415K). Oddly, Galen describes this model, not in treatment of fistula but for enlarging a wound through which intestine and/or *omentum* have prolapsed, so that the protruding part(s) can be restored to their proper position. That it mounted blades sharp only on one side

and dull on the point is shown by his observation that 'two sided knives or those sharp at the point are to be avoided in every way'[32]. This variety of *surringotomon* might be represented by survivals featuring a dull point and one cutting edge (Fig. 8.6-7).

Another possibility is a *spathion surringotomon* (σπαθίον συριγγοτόμον) excerpted from Leonides by Paul[33]. When confronted by a blind fistula, Leonides says he forces a probe into its orifice after its exposure by dilation. He adds: 'using its shaft as a block or director, let the whole fistula be divided by a *hemispathion* or by the *spathion suringotomon*'[34]. *Hemispathion* or 'half spatula' sounds very much like the commonly excavated knife-blade called 'breast shaped' or 'bellied' in antiquity and sometimes type 'D' nowadays (Fig. 8.1.)[35]. The same form appears in medieval manuscripts (Fig. 13; similar is Guy de Chauliac's knife for anal fistula in Fig. 4). *Spathion suringotomon* may, therefore, be just another name Leonides used of an *hemispathion* when it was applied to surgery for fistula; or he may have had a fully spatulate blade in mind, like the unique specimen lately extracted from the marvelous House of the Surgeon at Rimini shown in Fig. 8.5[36]. As Leonides is used as a source for treatment of fistula by Aëtius and Paul, I should like to think both are drawing on that section of his work that dealt with mammary as well as other types of fistula, and that he used one or the other of these knives for fistula affecting the breast.

In some instances a knife might also function as a cautery, in that surgical blades were in the main of iron/steel, the preferred material for cauteries. In fact, cauteries are regularly referred to as *sideria* or 'irons' in the *Hippocratic Corpus*[37]. Cauteries might be heated to varying temperatures, some operations requiring the instrument to be fired 'red hot' (*διάπυρος*, διαφανής), such as those used by Leonides in treating phagedenic lesions. This explains the preference for iron which, as opposed to copper alloy, can take high heat without melting.

As iron is prone to degrade, most classical and medieval tools designed exclusively for cauterization have been lost[38]. Clearly recognizable surviving classical cauteries include: a circular specimen in Baltimore from Colophon (Fig. 9), a set of three semi-circular models in the Naples Museum from Pompeii, a rather similar type combined with a lancet in Mainz from Asia Minor (Fig. 6), a lunated cautery in Bingen, and a small spatulate model in the British Museum said to be from Italy. One of the pieces in Naples is of iron as are those in Mainz, the British Museum, and Bingen; the others are of copper alloy[39].

A quick glance at the cautery types named above reveals none directed specifically to phagedenic ulcer and cancer, the two disorders featured so far in this essay where cauteries are required. As the purpose of cauterization in these cases was to staunch bleeding and to destroy diseased tissue over a comparatively wide area[40], a broader model, such as the specimen figured in the Colophon instrumentarium, those in Naples, and the one from Asia Minor in Mainz seem more appropriate[41]. Staunching bleeding and eliminating tumor and ulcer should also require cauteries fired 'red hot' (therefore of iron) and, in the case of Leonides' multiple attempts to arrest bleeding and eliminate a cancerous breast tumor, a series of cauteries may have been prepared and then applied in sequence, as in the medieval intervention for respiratory issues shown on Fig. 11[42]. And because metal cauteries heated red hot were obviously also a danger to the operating surgeon, Leonides probably wrapped them in rags for safe manipulation, as did Galen[43]. Traces of mineralized wood on the specimen in the British Museum shows that a cautery might also be thrust into or come equipped with an insulating handle of wood[44]. We may see such a wooden handle protecting the hand of the medieval operator in Fig. 13.

With probes, for which the generic Greek and Latin names were repectively *mele* (*μήλη*) and *specillum*, we are somewhat better off.

We are still confronted with multiple names for multiple types[45]. But characteristic of all versions is a straight shaft, and, in many instances, termination at one end in an enlargement, which may be global or elongated in shape (e.g., on the spatula probe in Fig. 6). The Greek name for this feature is *puren (πυρήν)*, usually rendered as 'olivary enlargement'[46]. It is this enlargement that Leonides applies in tracking and penetrating the canal of a mammary fistula before excising calloused and other extraneous tissue[47]. Since the *puren* was found on many probe types, Leonides may have used one terminating at its opposing end with a scoop, a spoon, the model mounting a *puren* at both ends of the shaft (now generally called *dipyrene*: *διπύρηνος μήλη*) or, conveniently, with a blade like the knife shown in Fig. 8.5.
Though the female breast is the focus of our interest, it may not be too much of a distraction to interject a surgery for reduction of the male breast in cases where an excess of fat in the area (*gynecomastia*) creates the impression of unmanliness. The operation is described by Paul (6.46) and is strictly cosmetic, much as his surgeries for mutilated ears and lips (6.26) and restoration of the foreskin (6.53). In the case of the breast, lunated incisions are required. If the patient is disfigured by breasts which swelled when he reached puberty but then remained unnaturally swollen as time went on, one incision should be made below the breast, the skin contracted by dissecting some of it away, and the incision sutured. If the breast is pendulous and flabby, like a woman's, two lunated incisions running parallel and at a small interval apart are to be made at its upper level. The ends of the uppermost (and longer) incision should comprehend the lower, their respective ends meeting. The skin and fat between are then to be dissected away and the wound sutured. If not enough excess is removed, the procedure may be repeated.
Again, though cutting is involved, no particular knife is specified. One supposes that a straight blade, sharp on one side and at the point would do nicely (e.g. Fig. 8.2). Whatever blade might be chosen,

since this intervention involved removal of fat by dissection, it might with profit be mounted on a handle terminating in the leaf-shaped element common on many classical surgical knives (Fig. 8.1-4, 6-7). This feature is regarded as designed for that very purpose. We note the convenience of having a blade and dissector available on the same tool when both functions are needed in the same surgery.

Also, for this surgery needles and thread for suturing would be required. Eyed needles of bronze or brass are not infrequently found in classical surgical kits. These usually went by the names βελόνη (*belone*) in Greek, and *acus* in Latin. They are described in the literature as varying in degrees of shape and sharpness (fine, bent, etc.). Material for suturing of course does not survive. However, there is ample testimony in the literature to the use of wool, sinew, dried gut and silk, even human and animal hair. In general, it seems wool was preferred for suturing/stitching[48].

We now move on to tracing operations on the breast by medieval surgeons who inherited the classical tradition. Other than the brief treatment of cupping for menstruation in the texts of Leon Iatrosophist and Joannes Actuarius, middle and later Byzantine medical sources have little to say about surgery on the breast[49]. Michael Psellus (*De Medicina* 1305) attests in passing to breast cancer, but without further details[50].

In contrast to the Byzantines, the best written sources involving the breast are grounded in the European West, especially in Italy and France. Western authorities, of course, were indebted to the Arabs who preceded them, such as Razis and Avicenna, and in surgery especially to Albucasis (Abū al-Qāsim Khalaf ibn al-Abbās al-Zahrāwī, 936–1013). These individuals were also heirs to the same classical tradition, in the case of Albucasis often repeating Paul of Aegina almost word for word. In this essay I concentrate mainly on the more important European authors writing in Latin from roughly the 11th to the 14th centuries. The relationship between these surgeons/writ-

ers is close, many being the student of a predecessor. Consequently, there is a great deal of repetition as one moves from one to another; for that reason not all of the major names need be fully considered.

As the focus here is on the female breast, it is appropriate to consult first the compendium of three treatises on female diseases and conditions known collectively as the *Trotula*. Apparently originating separately in 12th century Salerno, the three treatises are believed to have been brought together before 1200 by an anonymous compiler[51]. Those female conditions necessitating surgical intervention on the breast are found in the first two, *Liber de Sinthomatibus Mulierum* or 'Book on the Conditions of Women' (*SM*) and *De Curis mulierum* or 'On Treatments for Women' (*CM*). Here we find issues and remedies with which we are already well acquainted. The first (*SM* [35], pp. 82-83) is menstruation in excess[52], for which the traditional classical application of heated cups (*ventose ignite*) is prescribed to draw the blood upward[53]. In classical sources cups were placed on, under, and alongside the breasts[54]. The *Trotula* may include all these locations with its general stipulation *inter mammillas*. Among pharmaceutical remedies the Trotula recommends [36] vaginal insertion of a pessary of plantain juice.

SM [35] also provides the preferred medieval Latin term for cupping vessel: *ventosa*. It seems *ventosa* was used as an adjective in classical Latin. So Juvenal (*Satires*, 14.58), who apparently applied it to *cucurbita*, the classical term in Latin, to designate the sucking sound made when the *cucurbita* was removed[55]. Isidore of Seville (7th century) reinforces this speculation by referring to a *guva* (= *kouphe)* as 'that which by Latins is called by its likeness [to a gourd] *cucurbita*, [and] by its hiss, *ventosa*'[56]. *Ventosa* then became the standard in Romance languages.

The appearance of the cups applied in the *Trotula* and, probably, by most of the medieval masters that follow depends on illustrations preserved in the manuscript tradition, especially that of Albucasis

(II.96). In terms of form these basically represent the classical bulbous type of copper alloy, though some are more cylindrical (Fig. 3). Several such cups appear among a miscellany of texts in a cupping scene preserved in a 15th century manuscript in the British Library (Figg. 4 & 5)[57]. These are especially relevant because, as in classical sources, two are applied under the breasts of a female patient (though by another female). It is likely that a menstrual problem is involved, as a third cup is applied to the groin. Albucasis also advertises a model unattested in classical sources. This type is traversed by a rod or cross-piece to support a lighted wick or candle, seemingly to warm the afflicted part and create a vacuum (Fig. 3). Albucasis describes it as featuring in addition a small hole over which a finger was placed upon application and lifted when the vacuum was to be broken and the cup removed.

The other relevant section of the *Trotula* has first to do with another situation familiar in the classical and Islamic traditions, mammary *apostema*/abscess (*CM* [201], pp. 148-149)[58]. The approach here is to bring the lesion to a head and thereby force it to rupture and drain. As in Aëtius' anonymous source, plasters are preferred and, if ineffective, then recourse is had to incision *cum flebotomo*. Unlike Aëtius, the *Trotula* says nothing about the care needed when incising near the nipple, but instead exhibits more concern for draining the pocket. We are told that the pus has to be released slowly in the beginning, 'lest by sudden evacuation *something bad* results (*ne subita evacatione malum fiat*)'. The treatment is then completed by applying linen smeared with egg yolk two or three times a day. In the classical tradition sudden draining of an empyema or dropsy was regarded as dangerous[59]. The same concern surely lies behind the caution expressed here in the *Trotula*.

As classical authorities like Leonides knew (Aëtius, 16.40 Zervos & Cornarius), mammary abscess might result in a fistulous canal. This complication is also noted in the next section of the chapter ([202],

pp. 201-202). The *Trotula* first directs the operator to insure there is a fistula by tracking the suspect area 'with a probe' (*cum tenta*). If a fistula has developed, remedies (including black hellebore) are applied to encourage cleansing and mortification. After that the area can be treated like any wound/lesion (*vulnus*). Apparently, the Trotula does not envisage opening the fistula by cutting.

We find two tools expressly mentioned in the *Trotula*'s directives for mammary abscess and fistula. The name *flebotomon-um* is merely a transliteration of the Greek φλεβοτόμον. Though the name reflects bloodletting as the primary function of the instrument, other uses, as here, are attested in classical sources. Those same classical sources also suggest that a *flebotomon* was usually only the common Greco-Roman scalpel handle with leaf shaped dissector attached to an appropriate blade (Fig. 8)[60]. Such handles are not known in the medieval west[61]; the handle and blade of the knife mentioned here might have resembled one of those shown in Figg. 4, 10, 13 or 17.

The name *tenta*, for what is clearly a probe[62], is unknown in classical sources. The form *tenta* must derive from the verb *tento/tempto* in the sense of 'touch', 'make trial of'. In classical sources any fine straight shaft of metal, wood or bone, even a finger or stalk of garlic, could be employed as a probe, whether specifically designed as such or not. Some sort of shaft is surely at issue with the *Trotula*'s *tenta*.

We now turn to a sequence of treatises dating from the 12th to the 14th centuries. In contrast to the female focus of the *Trotula*, these are all general works on medicine/surgery. Nonetheless, we find here and there in each most of the mammary conditions with which we are already familiar.

The first in the series, often regarded as seminal, is the *Practica Chirurgiae*, or 'Practice of Surgery', a compilation issued around 1170 or 1180 under the name of Roger Frugard, a native of Parma. The *Practica* was then expanded by Roger's student and fellow native of Parma, Roland Cappelluti around 1240[63]. Relevant to this

survey are three chapters in Book Three (In: *Collectio Salernitana*, II, p. 481) [64].

III.31 deals with mammary cancer[65]. If the breast is hard and dark and burns, Roger maintains cure by extirpation/excision is not possible. But if only part of the breast is affected, he tells us to apply first a corrosive powder of asphodels and emollients (i.e. corrosives) and then try to excise the diseased part (*vel etiam incisione*)[66]. To these directives Roland adds an involved recipe for a corrosive powder that he regards as useful for destroying both cancers and fistulas.

In III.32 we are told that *apostemata* are caused by *amenorrhea*[67]. In this case Roger recommends the application of non corrosive emollients such as malva and acanthus. When the abscess ripens and comes to a head, he tells us to lance it (*incide*) and then insert what he calls 'a long tailed drain' (*stuellum* [also *tasta*] *caudatum,*) to evacuate the pus. An early14th century French translation of the *Practica* illustrates these conditions in two panels (Figg.12 a & b) showing a physician (Roger?) facing two standing female patients, one displaying her right, the other her left breast for treatment. Valls and Sudhoff take the first to represent cancer, the second abscess. The object held by the physician is a salve container (*Salbenbüchse*) [68].

Lastly, III.33 deals with inverted nipples (*caput mammillae interius deducitur*), which may occur in primiparas and recently delivered mothers. This is a serious condition, for it prevents the newborn from nursing. The remedy is to apply a *cuffa* over the nipple to retract it[69]. This *cuffa* is clearly a sucking device, therefore a kind of cup, something like, if not actually the *ventosa* applied by Guy de Chauliac for the same problem (see below)[70]. The name *cuffa* (sometimes *cupha* [*Coll. Salern.* II, pp. 530, 606], sometimes *scufa* [*Coll. Salern.* II, p. 199]), like *guva*, surely derives from the Greek adjective *kouphe*, or 'light'. As noted above, a 'light cup' did not involve scarification, a procedure unnecessary in dealing with an inverted nipple.

To perform the surgeries needed for the conditions treated by Roger cups, knives and a drain are required. The cup for inverted nipples was likely the bulbous type well known to Greco-Roman authorities (Fig. 5). Models of copper alloy and glass are mentioned in the 14th century by Guy de Chauliac (see below), but he cites for this information Albucasis who wrote centuries earlier[71]. Glass may, in fact, have been the general preference of medieval surgeons. Guy clearly preferred it for cupping involving heat[72] and his predecessor, Henri de Mondeville (also see below), actually defined *ventosa* as 'a vessel of glass': *Ventosa est vas vitreum, rotundum, planum, habens strictum orificium, fundum amplum* (III.1.4 Pagel p. 385). When we come to the grand 16th century surgical compendium of Lorenz Heister, only a glass type is shown, which Heister illustrates as preferred in Germany in his time: *Delineatur cucurbitula vitrea qualis hodie in Germania ut plurimum…adhiberi solet*[73]. As noted earlier, classical and Islamic authorities mention glass models. However, they did not prefer them because, they maintained, glass types did not take heat well and risked breaking[74]. It may be that improved methods of producing glass account for a medieval leaning in favor of cups of that material. Another incentive will have been the transparency of glass, allowing for easy assessment of the amount of blood drawn in the event of scarification. In any case, the preference for glass, beginning in the Middle Ages, will account for the preferred modern term 'cupping glass.'

Unfortunately, as many medieval authorities, Roger does not describe the type of scalpel he prefers for cancers and *apostemata*. By chance, however, a Trinity College Cambridge manuscript supplies, among 50 drawings illustrating an Anglo-Norman translation of a portion of Roger's *Chirurgia* (perhaps early 13th century), several featuring pointed razors/knives with a relatively straight blade sharp on its underside (Fig. 10) [75]. The type would be eminently suitable for excising breast cancer and resembles quite closely the blade favored for this condition in the 17th century by J. Scultetus (Fig. 17).

By 'long tailed drain' Roger means a longer than usual piece of cloth to pack the incision[76]. He explains that the 'long tail' keeps the drain from getting lost and permits easy retraction, something usually achieved in classical sources for suppositories and pledgets by attaching a thread[77].

I pass over Bruno da Langoborgo/Longobucco, the authority next in line, because he says nothing about mammary conditions. Still his *Chirurgia Magna* of 1253 provides details on surgeries of interest, e.g. on fistula, that could equally apply to breasts. It will, therefore, be reasonable to refer to these details when appropriate.

We come next to Theodoric Borgognoni (1205 – 1296/8), whose *Cyrurgia*, or *Chirurgia* appeared around 1265[78].

In the third of the four books of his treatise Theodoric covers familiar subjects, specifically chapters directed to *apostema* (III.11), fistula (III.1), and cancer (III.7). The first two treat these conditions generally without specifically involving the breast[79]. But they are worth dwelling on because they feature a number of processes and instruments (actual or assumed) which, presumably, would be employed for mammary *apostemata* and fistula, as well as for other afflicted areas. Furthermore, save for the *Trotula* before, few of the medieval authorities after Theodoric deal specifically with mammary fistula[80].

Depending on factors such as their type and size Theodoric remedies *apostemata,* by: A. cupping in the initial stages for purposes of *antispasis*[81]; B. phlebotomy in the initial stages for the same reason[82]; C. mild scarification if the tumor is of various content[83]; and D. incision/lancing to break the pus pocket[84].

Of particular interest is Theodoric's treatment of an *apostema* called *colpus*, a type of subcutaneous sinus/pocket (*quasi sinus pendens*). Here he supplies a rich passage relating to instruments for injection. In this case one should wash out the pocket with hydromel 'injected by a syringe or some similar instrument' (*inijciendo cum syringe vel aliquo simili instrumento*). A pig's bladder can also be employed,

'providing that its neck has been properly prepared, as stated in the chapter on fistula' (*vel inijcias cum vesica porcina, collo vesicae ad inijciendo preparato*). Unfortunately, Theodoric's chapter on fistula, at least as preserved, contains nothing about pig's bladders. By *syrinx* Theodoric must be referring here to a traditional injector/*clyster*. This consisted of a tube bound to a bag or animal bladder (Fig. 14)[85]. Models equipped with a pig's bladder, are indeed amply attested in classical and Islamic sources and such are known as well to medieval authorities like Guy de Chauliac[86]. The *syrinx* mentioned in Theodoric's chapter on fistula (see below) will be basically the same device. But what does Theodoric have in mind by referring to 'some similar instrument' for irrigating *colpus*? If this alternative is genuinely distinct, a piston driven syringe might be meant. Such syringes are best exemplified by the so called *puoulkos* invented by Heron of Alexandria (1st cent.) and employed by Galen (Fig. 15) [87]. A similar, if cruder, injector/syringe going by various names was probably known to classical surgeons and certainly, for treatment of bladder stones, to Albucasis (II.6 & II.49) and through him to Bruno (*Ars Chirurgica* II.1, p. 129, *quod dicitur syrinx*). This type involved a tube with a plunger pushing a rolled piece of cloth or a bit of sponge[88]. With these antecedents available to Theodoric, a piston driven syringe might well have found its way into his instrumentarium[89].

When it comes to fistula, the first priority for Theodoric, as for his antecedents, is to understand the depth, direction and complexity of the fistulous canal. To this end he says it should first be cleared by irrigation several times with appropriate water (e.g. ash, sea, or salted) and then probed. If necessary one can inject a *clyster* (*si non vales cum alio* [*sc. modo*]*, saltem clysteribus*). The desired probe should be of lead (*tenta plumbea*) to insure flexibility, a requirement going back as far as the Hippocratic treatise *Fistulas* 4 (Potter). If the opening of the canal is small, Theodoric directs the operator to enlarge it with a cutting instrument (*cum incisorio elargetur*); or, if the patient

fears the knife (*ferrum*), with a probe[90] of heart wood (*aut cum tenta de medulla sambuci*), or a stalk of elder (*vel stipatis medete*) or, better yet, with the pith of reed (*quae melior est, id est de canna syrici*). Then he should dry out and necrotize the canal with a sharp medication smeared on lint (*medicamen acutum in licinijs involutum*). Vinegar should be added to make the medication runny enough to penetrate to the fistula's base and through its branches. Should the fistula be merely subcutaneous and not deep, the surgeon should first run a wooden probe (*intromissa prius tenta lignea*) to its base and fully open the canal (*secetur usque ad finem*). Then the corrupt tissue should be eliminated with a razor (*auferatur cum novacula caro putrida et corrupta*), or sharp medication (*administra medicamem acutum*), or a cautery (*cauterizetur*), described as the ultimate remedy (*ultimum remedium*). Finally, Theodoric warns against being deceived by the depth of the fistulous canal and failing of its complete elimination[91].

We may add a few additional details from Bruno's chapter on fistula (*Ars Chirurgica*, I.15 pp. 111-114; Hall pp. 108-111), which closely follows Theodoric's. He too sees cauterization as the most successful treatment, but only as a last resort. For probing he will use even brass or silver models (*oportet…ut accipias tentam auricalici vel argenti*; see Fig. 18 for cauteries of precious metal). In cure by incision he makes it clear that the wooden probe is used as a director for the scalpel (*intromissa prius tenta lignea…*[*fistula*] *secetur usque ad ultimum ipsius ita ut ipsa tenta liberetur et auferatur cum novacula caro putrida…*).

Citing Avicenna, Theodoric asserts (III.7) that cancer is an *apostema* arising from hot black bile (*apostema ex melancholia adusta materia cholerica*). It occurs, he says, especially in the breasts of women experiencing *amenorrhea* (*praecipue in mamillis mulierum quae non purgantur naturaliter*). Early detection and treatment allows for a cure (*cancer quanto antiquior, tanto peior*). Approaches include diet, purg-

es, phlebotomy and stimulation of the menses, the latter if the lady be under the age of fifty[92]. A more adventuresome surgical approach is described in III.6, where we are told a cancer arising from factors like a hot *apostema* or wound, can be exposed by incision and burnt away in fleshy places (therefore presumably breasts), where veins and muscles do not present an obstacle[93]. If the cancer is well established, various oral medications, poultices and purges may be tried to dissolve and expel it. If, after these remedies, the body suffers from excess (*si corpus sit pletoricum*), then let it be bled (*fiat phlebotomia*); if that is not the case, a cup should be placed on the most proximate source (*ponatur ventosa in proximo fonte*, sc. *cancri*). If the area reddens or is inflamed, leeches can be applied (*ponantur sanguisugae*).

The approaches described by Theodoric and Bruno in these chapters require knives, probes of various materials, cauteries, cupping vessels, a standard *clyster* mechanism consisting of a tube attached to a bladder and, possibly, a piston driven syringe for irrigation.

We may note in addition parasurgical items, especially in Theodoric's chapter on fistula. These include a mortar and spatula for mixing plaster (*mortarium, spatula*), treated new sponge (*noua spongia*) and a shears/scissors (*forfex*)[94].

Curiously, the one chapter of the *Cyrurgia* specifically directed to the breast turns out to focus again on male pecks which are flabby and therefore effeminate. Theodoric's description of the operation (III.32) is basically a rephrase of the accounts of it in Paul and Bruno (*Ars Chirurgica* II.8, p. 124: *De nacta* [= *lipoma*] *et de inflatione quae apparet in mamillis quorundam hominum*). It is interesting that this particular surgery had also attracted the attention of Islamic authorities, chief among them Albucasis (II.47), who follows closely Paul's account. The manuscripts of Albucasis also provide illustration how both the single and double cuts should look.

I note in passing that the male breast is also the focus of cauterization for maladies of the chest (such as breathing difficulties and

liver disease) in a series of illustrated manuscripts in Latin and *Landessprachen* collected by Karl Sudhoff [95]. The citations from these manuscripts refer to points of cauterization *super mamillas et sub mamillis*. The illustrations occasionally also involve, or appear to involve, females (Fig. 10). The required cautery is round (*cum rotundo*).

A contemporary of Roland, William of Saliceto[96] (1210–1277) completed his *Grand Surgery* or *Chirurgia Magna* a bit later in 1275. Five books plus an appendix make up William's opus. Of interest to us re the female breast are three chapters in the first book. The first two deal respectively with the familiar issues of *apostemata* (I.33) and cancer (I.34). The third (I.35), treats such conditions of the breast as caking, overflow lactation and stringy exudation from the nipples (*De lacte coagulato et superfluiditate pilosa in mamilla*). Some of these conditions we have already seen in Aëtius 16**.** They are mainly combatted with topical applications. William's strictly surgical concern is that bad milk may result in pus and an *apostema*, in which case incision and draining are called for[97].

In confronting *apostemata* William distinguishes two types, the hot (*calidum*) and the cold (*frigidum)*; i.e., those that are red and inflamed as opposed to those that are not. Most attention is given to the hot type, on which I will focus exclusively in William and his successors, as the cold type involves little beyond topical applications. William's object in treatment is either to resolve the infection or, as usual with his predecessors, to bring it to a head (*resolvertur aut maturabitur*). He recommends, first, bleeding from the cephalic vein on the side opposite the infected breast (*patiens phlebotometur de cephalica contrariae manus*), if the condition of the patient allows; if not, the practitioner can apply cups to the shoulders after scarification (*scarificetur in spathulis cum ventosis*). The theory of *antispasis* may lie behind these directives, phlebotomy and cups with scarification pulling the elements of the infection to one place. Fomentations,

and plasters may also be used. At this point the pus pocket may be lanced with an incision of appropriate dimensions by a phlebotome or a razor (*tunc facta sanie aperiatur cum phlebotomo vel rasorio*) and, as we have heard before, its contents drained at a rate commensurate with the general condition of the patient. Subsequent hemorrhage and discomfort are treated with appropriate pharmaceuticals used also in treating *apostema* of the armpit.

As noted, William's views on mammary cancer are set down in I.34 (*De scroffulis, duritie et cancro in mamillis*) which, as its title shows, deals also with 'scrofules' and 'induration'[98]. For these problems he recommends purges and medicaments described in previous chapters (i.e. I.23 & 26). As to cancers, he outlines two approaches. One he calls 'mild' (*cura blanditiva*) because it favors diet, purges and topical application of oils containing analgesics, like *mandragora*, opium and *hyoscyamus niger* (henbane). The alternative approach is reminiscent of his ancient predecessor, Leonides: surgical amputation with an especially sharp knife (*membrum incidatur totum cum tota aegritudine cum ferro incidente optime*) followed by cauterization to check the hemorrhage (*deinde cauterizetur locus cum ferro ignito*). Application of pharmaceuticals called 'mondificants (cleansers), incarnatives (promoting new tissue) and consolidatives' (causing tissue to adhere) that he has recorded in previous chapters complete the intervention. To his credit William clearly prefers the 'mild' or palliative treatment, even though he admits it is no cure. Radical mastectomy he properly regards as extremely difficult to execute. And, even if one could perform it successfully, as there is no cure for an advanced cancer, he does not recommend it. The honest surgeon, he says, should avoid meddling with it[99].

As to the instruments used for *apostema* and cancer, William adds little to what we have heard so far. To the cups and phlebotome required for abscesses, he also allows for a razor. The knife/scalpel used for mastectomy must be 'perfectly honed' (*ferrum incidens op-*

time) and the cautery fired red hot (*ferrum ignitum*, but also *cauterium* elsewhere in the chapter), no surprise in either case.

The focus now switches from Italy to France as we come next to William's student Lanfranc of Milan (ca. 1250–1306), variously called Guido Lanfranchi, Lanfranco or Alanfrancus[100]. He too produced a *Chirurgia Magna* in five books in 1296, distinguished from the opus of his master by its full title *Practica quae Dicitur Ars Completa Totius Chirurgiae*.

We proceed immediately to III.3.5, where Lanfranc treats diseases of the breast, including excessive fatness and size (*De aegritudinibus mamillarum, scilicit pinguitudine, et magnitudine praeter naturum*). Though his chapter heading covers a lot of ground, Lanfranc is concerned in the main with *apostemata*. The influence of his master, William, can be seen in a number of details. Like William, Lanfranc recognizes two distinct types: hot and cold. And, like William, for the hot type he prescribes cupping of the shoulders (*ventosatio in spatulis*) and phlebotomy, though his preference is to open the basilic as opposed to the cephalic vein[101], and he does not specify on which side of the infected breast. However, he adds, if the cause of the abscess is *amenorrhea*, the bleed should be from the saphenous vein[102]; i.e., the long subcutaneous vein in the leg. Similarly, when the *apostema* comes to a head, it should be lanced, drained and cleansed[103]. Lanfranc cites an Hippocratic aphorism (Jones 5.40) in support of his view that failure to do so can result in insanity[104]. Should this occur, the remedy is to shave the lady's head, strengthen it with applications (*caput radas et conforta caput*) and regulate diet. At this point he tacks on a specific case in which his advice was ignored to the detriment of a female patient. Unlike William, Lanfranc is vehemently sensitive about the placement of a pledget or suppository (*tenta, villus*) in the wound, particularly a long heavy one[105]. An overload of tents, he argues, will distend the breast, resulting in pain and a lengthier convalescence.

The name of the instrument used for lancing, *sagittella*, suggests a small puncturing instrument shaped like an arrow[106]. An illustration of a lancet shaped like an arrow head and labeled *sagittellum* can be found in the margin of the earliest of the manuscripts of Roger Frugard[107]. See Fig. 6 for a fine classical model.

Lanfranc says little about cancer in this chapter, just that he seems to find its cause in cool material which, if dark and hard, should not be treated with hot remedies, lest the result be a cancer[108]. In the event of actual cancer, like William and other predecessors, Lanfranc considers mastectomy a futile endeavor (*labor vanus*). In fact he frankly admits that, although through God's grace his expertise is sufficient to deal with *apostemata* and ulcers, he never has been able to cure a cancer[109]. He also condemns those fools (*stolidi*) who extirpate *glandulae*, by which he may mean William's 'scrofules and indurations', perhaps fibrocystic mastopathy and its benign masses[110].

Mammary ulcers are treated like other types, with diet, various pharmaceutical applications and phlebotomy at unspecified points[111].

Next Lanfranc raises again the issue of inverted nipples. His remedy is to substitute for the heated *cuffa* prescribed by Roger an acorn shell smeared with pitch or resin (*cupula glandis*), heated and bound to the nipple[112]. There is a curious addition to this remedy. If the acorn shell treatment does not work, Lanfranc recommends creation of a *sycia* (*fac fieri syciam*) proportioned to fit over the nipple. This is then fired (*cum igne*) to create the vacuum for retraction. The term *sycia* closely resembles the usual Greek term for bleeding cup *sikya* (σικύα, also σικυία). If this is what Lanfranc means, one wonders why he avoids *ventosa*, the usual term for cup, which he uses elsewhere (e.g. II.3.5, *ventosa cum igne*) and the one used by his successor Guy de Chauliac for this situation (see below). The answer may be that he viewed this retracting device as especially small, created on the spot, and differing significantly in purpose. Since it was distinct from the usual *ventosa*, he chose another name for it, viewing

the Greek term for bleeding cup, however he knew it, as kindred and suitable.

As reflected in the chapter's title, Lanfranc, again discusses reduction of effeminately large breasts in males. But he also deals with the same condition in young women (*virgines*), a situation that he asserts is unbecoming (*non decet*). His treatment is a mild one, based completely on solutions or plasters featuring vinegar laced with the shavings of whetstones (*lapides cum quibus acuuntur cultelli*), heated and bound on loosely. He claims this application will prevent enlargement and even promote reduction[113].

Milk caked breast also makes a brief appearance in this chapter. Ointment and plaster are again the remedies brought to bear[114].

We will not be shocked to see mammary *apostemata* again receiving the attention of the most important French master after Lanfranc, his pupil Henri de Mondeville (ca. 1260 – 1316), whose by now familiar title, *Cyrurgia*, appeared in 1312.

Henri's chapter on the subject, *De cura apostematum communium mammillarum* (III.2.18, Pagel pp. 496-498, esp. p. 497) commences with the usual division into hot/warm and cool/cold types. The characteristics of each and their underlying causes are treated at length before we come to actual treatment of the hot, which is, basically, reflective of Henri's antecedents, especially Lanfranc. He again orders bleeding from the cephalic vein on the hand opposite the affected breast. If that is not an option, cups (*ventosae*) are to be fixed on the shoulders, but also on the buttocks and the back. If the cause is *amenorrhea*, he recommends bleeding from the saphenous vein (III.1.3, Pagel, p. 366). Recommendations for diet and topical applications follow; and, if the infection is unresolved and comes to a head, the surgeon, as usual, is urged to release the pus gradually (*sanies hujusmodi apostematis non debet violeter educi nec tota simul et semel extrah*i). The incision should be made at a lower point in the swelling (*in loco ipsius* [*sc. apostematis*] *magis dependenti*[115]. In keeping with

Lanfranc, Henri insists long drains should be avoided (*numquam imponatur hujusmodi apostematibus longa tenta*). Post surgical treatment involves irrigation with honey water, and cleansing the wound with wine of myrrh. If these directives do not result in a cure, then, as with Lanfranc, the Hippocratic aphorism (Jones 5.40) re madness is invoked as a reason for shaving the lady's head, anointing with oil of roses and vinegar and applying a diet suited to fever[116].

Like many of his predecessors, Henri (III.1.4, Pagel, pp. 384, 386) recommends *antispasis* by cupping of the breasts for heavy menses and nosebleed. He, however, favors placement under the breasts (*super radicibus mammillarum ad restringendum fluxum*). In this case the breasts had to be elevated for the purpose: *quandocunque ventosa ponitur sub mammillis, eleventur sursum, si dependeant donec recte sibi sub radicibus ipsarum possit poni et infigi*.

A misfortune for the focus of this survey was Henri's inability, due to poor health, to write III.3. This would have contained a section on *Diseases of the Breast*. It is calculated that he planned at least fifteen topics[117], many of them familiar from his predecessors. These included cosmetic issues like *gynecomastia*, excessively large breasts in females, their faulty development (in a girl), and even unwanted hair at the nipple. He also intended to treat such problems in lactation as engorgement, pain, caseation, and clotted milk. Of greatest interest, of course, would have been what he had to say about ulceration, cancer, fistula, scrofula or other masses, and retracted nipple. We can at least recover some of his pharmaceutical recommendations for excessively large breasts in females at III.1.13 (Pagel, p. 404). These include *terra sigillata* and clays mixed with vinegar bound on for three days. But, considering the involved treatment of the topics that Henri did finish, he would likely have dealt with these issues more extensively than did any of his antecedents.

Finally, we come to Guy de Chauliac or Guigo De Caulhiaco (ca. 1300 – 25 July 1368), who lived through the Great Plague and who

is regarded as marking, with his summary of all that came before him, the chronological terminus of medieval medicine.

Unsurprisingly, Guy's *Inventarium sive Chirurgia Magna* (ca. 1363) includes conditions with which we are by now quite familiar at II.2.5 (McVaugh-Ogden, Vol. I, pp. 121-122). Following Lanfranc and Henri he classifies *apostemata*, as usual, as hot and cold and attributes their cause especially to *amenorrhea*, which itself is to be treated by provoking menstruation and bleeding from the saphenous veins (*provocacio eorundem* [sc. *menstruorum*] *atque flebotomia sophenarum*). He expands on Henri's warning, based on Hippocratic aphorism Jones 5.40, that *amenorrhea* leads to madness by noting that Lanfranc had seen such a case. However, he himself has not (*ego autem numquam vidi*) and notes that Galen too had never observed one[118].

Should induration, arising from a cold *apostema*, result in cancer, Guy, again following Lanfranc, advises against radical mastectomy and recommends only palliative care, adding that this cautious approach avoids ill reputation (*diffamia*).

To bring hot *apostemata* to maturity, applications like warm/hot rose oil with a bit of vinegar or a combination of water and vinegar can be applied. These may be followed by plasters (one recommended by Avicenna) featuring, for example, bean meal (*farina fabarum*) and sesame and almond oil (*olio sisamino aut amigdalarum*). When mature, Guy maintains the *apostema* should be opened, as Albucasis directs, with a lunate incision at its base (*aperiatur in bassiori loco secundum formam lunarem*)[119]. To avoid discomfort, again following Lanfranc and Henri, he discourages insertion of a large pledget.

When we come to VI.2.5 (McVaugh-Ogden, Vol. I, p. 367) of the *Inventarium*, we find recurrence of a situation treated by Lanfranc and advertised for treatment by Henri, excessively enlarged breasts in young women (*in iuvenculis*). Again, the remedy, here attributed to Galen and Razis, (see McVaugh-Ogden, Vol. II, p. 309) is

application of a band containing substances like vinegar, clay and alum. The same section recalls the lunate incisions to correct excessively effeminate pecks in men, which we can trace back through Lanfranc, Theodoric and Bruno to Paul of Aegina and Arab authorities. Basically Guy repeats Albucasis' account of the operation.

There follows a situation we have encountered in the texts of Roger Frugard and Lanfranc, inverted nipples (*papillus profundatus*) that prevent an infant from suckling[120]. Several of the remedies are familiar. Either the operator can place a heated small cup (*ventosa parva*) over the nipple and retract it with the vacuum created or, as Lanfranc, one can use the heated cap of an acorn (*cupola glandium calefacta*) to the same effect. Novel is the suggestion that one can position a tube (*canula*) on the nipple and create the vacuum by sucking. The type of tube is not specified. Plain tubes of metal occur in classical surgical texts (e.g., Celsus 15.1-2; Paul 6.50.2-3), but a simple section of reed would do just as well. (For use of a tube in sucking, see Aëtius, 6.76.6-10.) Specimens of metal recovered from classical sites and graves appear essentially the same as the models illustrated by Scultetus (see below).

We note in passing the usual application of cups to regulate menstrual flow. With Galen as his source (*In Hippocratis aphorismos commentarii vi*, 17bK.842.6-843.3) Guy recommends large cups below and not on the breasts (VII (*Antidotary*), 1.1, McVaugh-Ogden, Vol. I, p. 400-401). Caked breast or stagnation mastitis (*De coagulacione lactis*). is treated with topical applications. Among them he repeats a plaster (*emplastrum*) touted by Lanfranc (III.3.5) containing these ingredients: grains of pure wheat, barley meal, fenugreek, linseed, root and leaves of marshmallow, and rocket[121].

To round out this essay, I focus briefly for purposes of comparison on one Renaissance treatise, that being the *Armamentarium Chirurgicum* of Johannes Scultetus (Johannes Schulte, 1595-1645). Broadly speaking, Scultetus combines the best aspects of both the

classical and medieval traditions. For example, as the authors of the Hippocratic *Epidemics*, he often describes cases at length and in detail. And, like Galen and his medieval predecessors, he injects himself personally into his case histories[122].

Scultetus' individual case descriptions, called *observationes*, are accompanied by plates (*tabulae*) with good drawings of the instruments deployed plus detailed instruction on their use by way of accompanying explanations (*declarationes*). Since mammillary cancer was treated quite cautiously from Roger thru Guy de Chauliac, Scultetus' account of a radical mastectomy in *Observatio* 52 offers a stark contrast, including his claim that the patient lived.

The case involves one Anna Sibylla, the ca. 47 year old head abbess of a religious community at Ulm. Afflicted with an ulcerated cancer of the left breast, the poor women endured several painful treatments administered by two incompetents[123] before coming under the care of Scultetus. He advised complete amputation (*totius mammae abscisio*) and was given her consent for the surgery. This was performed on 26 June 1641 after administration of an anesthetic or analgesic[124]. *Tabula* XXXVIII = Fig.16 shows the steps described in Scultetus' narrative. His first was to draw at cross angles two thick threads of twisted linen through the base of the breast. The threads were pulled through with two needles, each with a large eye [125]. The needles removed, he then tied together the four ends of the threads and elevated the breast by pulling up on them. Next Scultetus marked out clearly with black ink (*atramento scriptorio*) the base of the breast, thus distinguishing it from the underlying pectoral muscle. At that point the breast was cut through at its base with a quite sharp knife (*acutissimo scalpello*) and, when removed and suspended by the threads, was discovered to weigh 6 pounds. Scultetus completed the operation by 'gently'(*leniter*) staunching the hemorrhage with a fired cautery (*ferammento candente*, *cauterio ignito*). He goes on to say that, after a period of recovery, the abbess left Ulm on 6 October 'in high spirits

and excellent health' (*laetissima et sanissima*). Clearly she survived the surgery. Whether the cancer returned, we will never know.

As stated, we are fortunate in having good drawings of the instruments deployed. Tabula XII, Fig. VIII = Fig. 17 illustrates the eyed needle used to draw the threads of linen and Figg. VI and VII the sharp scalpels for the amputation. These are described as 'two edged with points shaped like myrtle leaves' (*scalpelli ancipites qui ad extremitatem referent foliorum myrti*). *Tabula* XXXVIII depicts the cautery used, a model with a broad branding surface, the type suggested above for the non specified model deployed by Leonides.

Final Remarks

It is received opinion that medieval surgeons did little more than rediscover, especially through Islamic sources translated into Latin, the level of surgery achieved over the course of the Roman Empire. The surgeries discussed in this essay, focused exclusively on the breast, generally bear this out, especially where fistula, *apostema* and cancer are concerned. At the same time our sources supply a few novelties. Note, for example, concern for a situation we do not see in surviving classical sources, inverted nipples, a condition that surely afflicted lactating mothers before the Middle Ages.

With the recovery of classical precedent in medieval surgery also came the tools used to perform it. For breast surgery in particular we have found references to cupping vessels, cutting and puncturing instruments (scalpels, phlebotomes, lancets, razors), cauteries, probes/directors of metal and wood, needles, plain tubes, clysters formed of tubes and bladders and, perhaps, even a piston driven syringe. And accompanying primary tools we find mention of parasurgical items, including spatulas, mortars, sponges, scissors, and tents/drains of cloth. But here too there occur minor novelties: e.g. in the preference for glass cups and in application of devices not mentioned or, at least, not used in the same way in classical sources. I think here of the tiny

cup, acorn shell, and tube to create the vacuum necessary to retract inverted nipples, devices anticipating the modern breast shell. We also find some new or preferred names for standard classical instruments and paraphernalia: *incisorium* for knife, *tenta* for probe as well as tent, *stuellus* for tent, *ventosa, cuffa/cupha/scufa* and *sycia* for bleeding cup, *sagitella-um* for lancet, and *syrinx* for clyster.

Unfortunately, we cannot be more specific about the tools deployed for the surgeries we have reviewed. This is disappointing, given that generally speaking we are fairly well informed about both classical and medieval instrumentation. For the former there exists an abundance of tools recovered from houses, baths, shipwrecks and, especially, burials over the course of the Roman Empire, along with literature replete with names and descriptions of various tools[126]. In contrast, few actual medieval instruments survive. On the other hand we are compensated by ample depictions of them in the manuscript tradition[127]. In spite of this reasonably good picture, when it comes to the precise nature of a knife or cautery type for, say, mammary cancer as dealt with by Leonides, William or Lanfranc, we have nowhere near the precise detail and quality of illustration we enjoy later with Scultetus. The one exception may be the special knife types called *surringotomon* for treatment of fistula, as attested in classical and, if rarely, medieval sources[128]. However, these are never mentioned in connection with the breast; nor do they really need to be applied in other cases of fistula[129]. An ordinary straight or bellied scalpel like those in Fig. 8 might do just as well. We can be most precise, I think, in concluding for both periods that the cups, tube and bladder driven clysters (Fig. 14), tubes/*cannulae* (Fig. 17), and lancets shaped like arrow heads (Fig. 6) attested for mammary conditions from classical through medieval times were pretty consistent in form. Likewise, the preferred scalpel/razor and the cautery used as a hemostat in extirpating breast cancer, if and when extirpation was performed, most likely involved the types recovered at Colophon and illustrated by Scultetus (Figg. 9, 16 & 17). This is probably as far as we can go.

Fig. 1. Cupping vessel, Thebes. Ht. 14.8 cm. Ca. 500 BCE

Fig. 2. Cupping vessels, Pompeii. Ht. of largest (with ring) 13 cm

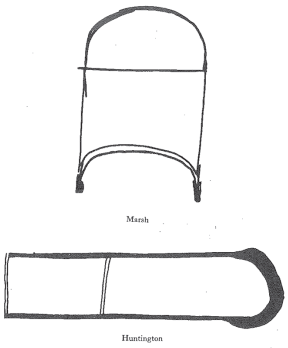

Fig. 3. Cups described by Albucasis, as reproduced by Spink from Bodleian Library, *Oxford Mss. Marsh 54*, 1271-2 and *Huntington 156*. 1465-6 CE

Fig. 4. Cupping scene (copied from a manuscript of Guy de Chauliac), *BL, Sloane Ms 6, f. 177v*, British Museum. Among relevant instruments, lower rt. are a knife and three cauteries for anal fistula. 15th century. As edited by Alexander Hollmann

Fig. 5. Detail of *BL, Sloane Ms 6, f. 177v*, British Museum

Fig. 6. Spatula probe, lancet-cautery combination, allegedly from Ephesus. L. of spatula 15.2 cm. 1st half, 3rd cent. CE. Römisch-Germanisches Zentral Museum, Mainz. 0.37850

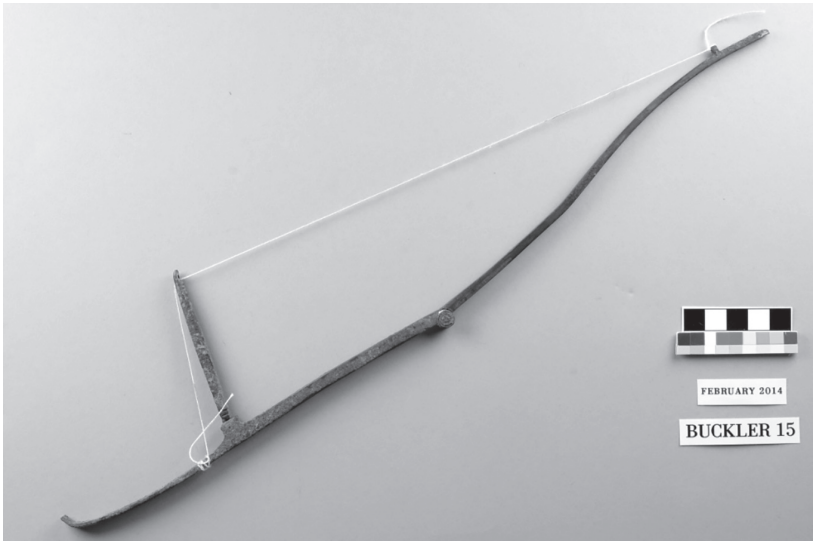

Fig. 7. Drill bow, allegedly from Colophon. Johns Hopkins Archaeological Museum, Inv. Buckler 15. L. 39 cm. 1st – 2nd century

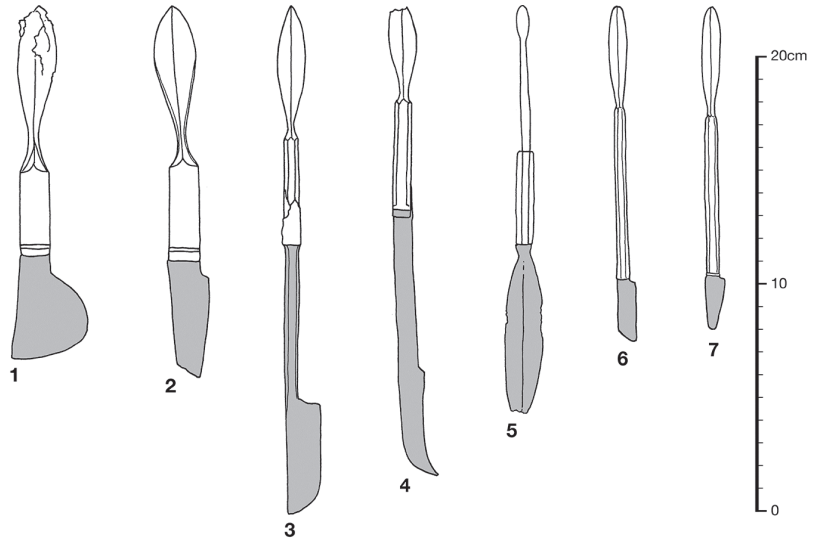

Fig. 8. Scalpel types, Domus 'del chirurgo,' Rimini. 3rd century. Drawings by Ralph Jackson

Fig. 9. Cautery, allegedly from Colophon. Johns Hopkins Archaeological Museum, Inv. Buckler 16. L. 16.8 cm. 1st – 2nd century

Fig. 10. Cranial intervention. After *Trinity College, Cambridge, Ms. 0.1.20*. 13th century. Drawn by Alexander Hollmann

Fig. 11. Cauterization. After *MS Plut. 73.41, f. 122, Biblioteca Laurentiana*, *Florence*. 9th – 10th cent. Drawn by Alexander Hollmann

Fig.12a. Mammary cancer. After *BL Ms. Sloane 1977*, British Museum. 14th century. Edited and drawn by Alexander Hollmann

Fig. 12b. Mammary abscess. After *BL Ms. Sloane 1977*, British Museum. 14th century. Drawn by Alexander Hollmann

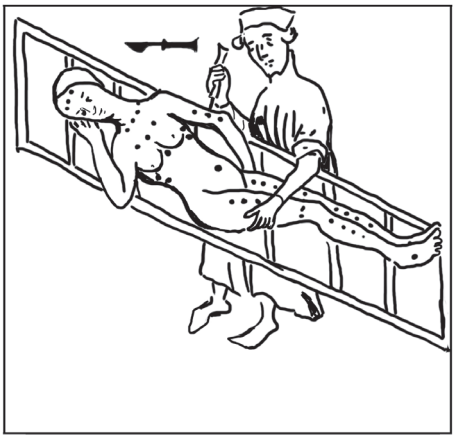

Fig. 13. Cauterization. After *Laudianus Miscellaneus 724 Bl. 3r Oxford*. 14th century. Drawn by Alexander Hollmann

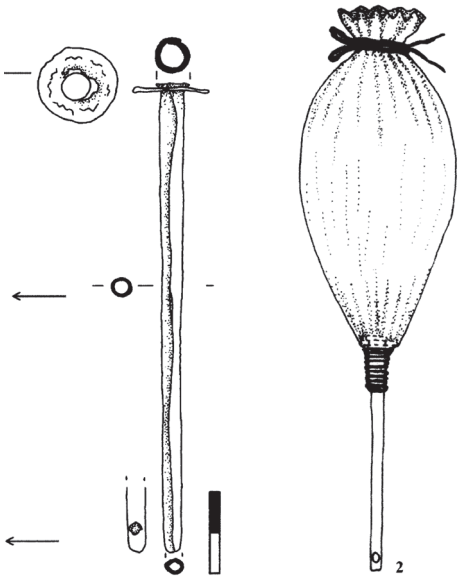

Fig. 14. Cannula, perhaps also clyster tube, Allianoi (Turkey). L. 11.5 cm. Late 1st to mid 3rd century

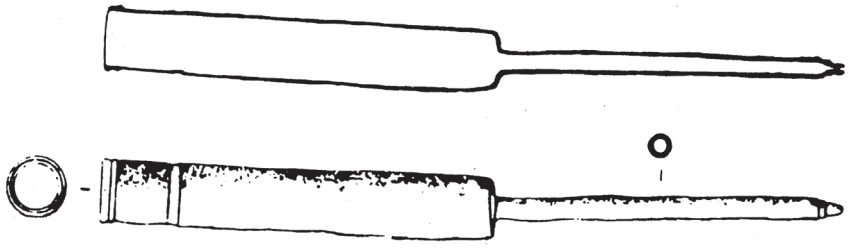

Fig. 15. Injection tube, likely *puoulkos*, Nea Paphos. L. 20.2 cm. Mid 2nd - early 3rd century

Fig. 16. Scultetus' illustration of mastectomy in his *Armamentarium chirurgicum*. Photo University of Washington

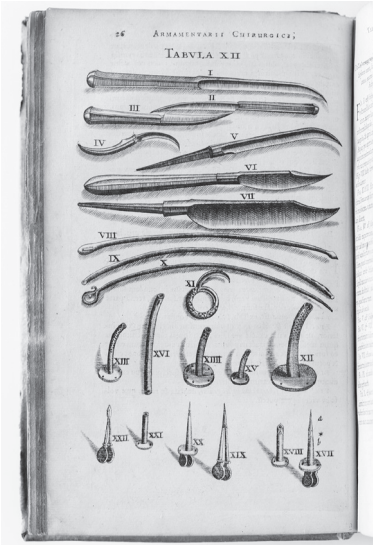

Fig. 17. Scultetus' illustration of knives and tubes, *Armamentarium chirurgicum*. Photo University of Washington

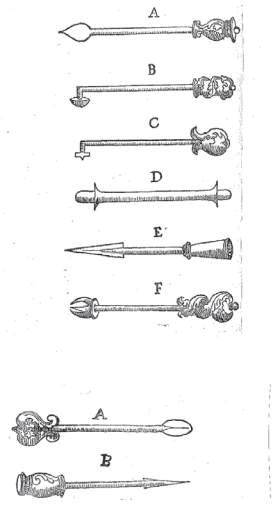

Fig. 18. Cauteries advertised by William of Saliceto. The two lower models labeled A & B are of gold or silver. After Pifteau.

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1. [Hippocrates], Aër, Jones 17 echoed by Galen, In Hipp. Aph. comm., 18a.148 (Kühn, hereafter K). Herodotus (4.117) knows of these warlike Sauromatian women but leaves out their cauterization.
2. The fact that Democedes may have had no instruments at the time (3.131) presents no obstacle to lancing. Any appropriate knife would do, the usual term in Greek for 'scalpel' among practitioners of the period being μαχαίριον ('little knife'). See Bliquez L, The Tools of Asclepius, Surgical Instruments in Greek and Roman Times. Leiden: Brill; 2015. pp. 27-28.
3. See VM, 22.23-26 (Jones), picked up by Galen, In Hipp. Aph. comm., 17b.842K. When I examined an archaic (therefore 'Hippocratic') cup from Thebes (Fig. 1) in May of 2002, I noted that it was considerably heavier than the two other specimens of the same period in the National Museum, Athens.
4. Short up to date biographies of these figures can conveniently be found in alphabetical order in: Keyser PT, Irby Massie GL (eds.), The Encyclopedia of Ancient Natural Scientists. London and New York: Routledge; 2008.
5. He also allows for placement at the groin with scarification (cute incisa).
6. See esp. De meth med., 10.316 and 925-926K. Also Ad Glauc. de meth. med., 11.51 and 54K; De hirudinibus etc., 11.319-20K; Comm. Hipp. Aph., 17b.842K. The theory of antispasis is picked up by Paul, 3.62.2.15 and much later by Guy de Chauliac, VII (Antidotary), 1.2 (McVaugh-Ogden, Vol. I, p. 400).
7. Soranus of Ephesus should probably be noted as well. As a good Methodist, he deals with 'flux' by 'metasyncritic cupping'; i.e., cupping to alter the state of the pores. See Gynaec., 3.13.72. Most likely his cups are applied to the breasts, though he does not specify. For Soranus, see Keyser and Massie, ref. 4.
8. Oribasius also produced a syncopated version of this text in Syn., 5.4.5, copied almost word for word by Paul, 1.4.1.11.
9. Keyser PT, Irby Massie GL (eds.), ref. 4.
10. ταῖς δ᾽ ἂν καὶ σικύα προσβαλλομένη παράσκοι τὸ δέον.
11. E.g., Henri de Mondeville, Cyrurgia, III.I.4 (Pagel, p. 383); Guy de Chauliac, VII (Antidotary), I.2 (McVaugh-Ogden ,Vol. I, p. 402).
12. Bliquez L, ref. 2, pp. 25, 56-63 for details. Wood cups are attested by the great Arab surgical authority, Albucasis (II.96).

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15. Bliquez L, ref. 2, pp. 118-121.
16. Bliquez L, ref. 2, p. 189.
17. A fillet is not what I usually think of as a lemniscus, but that seems the meaning of the term here. Bliquez L, ref. 2, p. 312.
18. Keyser PT, Irby Massie GL (eds.), ref. 4.
19. This recipe for the condition goes back to Soranus of Ephesus, Gynaec., 2.3.
20. The presence of pus suggests an abscess and that is what I generally assume; but the term apostema is more elastic; see note 58 below.
21. So also Oribasius, Coll. Med., 44.5.7, who depends on Antyllus and Heliodorus.
22. Keyser PT, Irby Massie GL (eds.), ref. 4.
23. Keyser PT, Irby Massie GL (eds.), ref. 4.
24. Ad Glauc. de meth. med., 11.140-141K. The passage may not be sound. My understanding of it is influenced in part by the comments of Francis Adams (see under Translations) on Paul 6.45.2; see also De meth. med., 10.979K.
25. Specific applications to dull the pain of the parts cut (desecanda) are given in the Physica Plinii Bambergensis, 67.2.
26. ὅς γε καὶ χειρουργούμενος χεῖρον διατίθεται, ποτὲ δὲ ἑλκούμενος.
27. Keyser PT, Irby Massie GL (eds.), ref. 4.
28. Bliquez L, ref. 2, pp. 319-324, 326-328 for further details on use of these materials.
29. Bliquez L, ref. 2, pp. 166-173 for further references and illustration of these cautery forms.

30. Note that J. Scultetus (see below) figures such a straight knife in his account of mastectomy (Fig. 17).
31. Paul provides the most useful account (6.78). He describes it as having a blade without a handle and shaped like a sickle with a sharp point (τῇ ἀκμῇ τοῦ δρεπάνου), which was drawn through an open fistulous canal to divide it. The type seems rarely used and there are no survivals.
32. τὰ δ᾽ ἀμφήκη τῶν μαχαίρων ἢ κατὰ τὸ πέρας ὀξέα παντὶ τρόπῳ φευκτέα.
33. Also treated in Paul's chapter on anal fistula (6.78.4).
34. ἐπικόπου τε ὄντος τοῦ ἐλάσματος ὅλη διαιρείσθω ἡ σῦριγξ τῷ ἡμισπαθίῳ ἢ σπαθίῳ συριγγοτόμῳ.
35. Galen, Hippocratic Glossary = Linguarum seu dictionum exoletarum Hippocratis explicatio, 140.13K.
36. For fuller treatment of the classical types of suringotomon see Bliquez L, ref. 2, pp. 104-106. The views expressed here re the spathion surringotomon are a revision of those expressed there.
37. Bliquez L, ref. 2, pp. 30-32, 158.
38. Of course, tools of copper alloy primarily intended for other purposes were also used for cauterization. These survive in abundance, including spatulas, the tiny scoops called ligulas, and needles (e.g. Fig. 6).
39. Bliquez L, ref. 2, Figg. 2 & 36 for the Naples and Bingen specimens and Jackson R, A Set of Roman Medical Instruments from Italy. Britannia 1986(17):25 & Fig. 3(25) for the model in the British Museum. The iron model in Naples may now be lost, as I could not find it while working in the National Museum in 1985.
40. As opposed to, e.g., removing offending eyelashes by burning with a dipyrene probe (for which see Paul 6.13.1).
41. Johannes Scultetus figures such a cautery in his account of mastectomy (Fig. 16).
42. As done for lacrimal fistula at Aëtius, 7.88.5-10 and Paul, 6.62.4.
43. οὕτω καὶ τούτων τὰς λαβὰς ἐνελίττω ῥάκεσιν (De simpl. med. temp. ac fac. 12.267K; cf. Aëtius, 2.95.19-23.
44. Jackson R, ref. 39, p. 128(25), 156.
45. Bliquez L, ref. 2, pp. 108-146 for discussion and names.
46. Bliquez L, ref. 2, pp. 113-116.
47. ἀναστέλλειν χρὴ τὴν τῆς σύριγγος ὑποφορὰν διὰ πυρῆνος μήλης…
48. Bliquez L, ref. 2, pp. 147-157 for details.

49. For Leon see Bliquez L, The Surgical Instrumentarium of Leon Iatrosophistes. Med. Secoli 1999;11(2): 291-322, esp. 318. To arrest menses he places cups κατὰ τῶν μαζῶν. Like Galen, he promotes the menses by applying cups to the groin and hypogastrium (6.16). John also applies cups below the breasts to arrest white and red 'fluxes'; De meth. med., 4.8, p. 155 (cucurbitula sub mamillis defixa). A Greek edition of the De methodo medendi has not yet appeared; hence we are still forced to use the Latin translation of Masithius (Venice, 1554).
50. This is not to say that general surgical expertise declined in the Byzantine east. See Bliquez L, Two Lists of Greek Surgical Instruments and the State of Surgery in Byzantine Times. In: Scarborough J (ed.), Symposium on Byzantine Medicine, Dumbarton Oaks Papers. 1984(33). pp. 207-204, esp. 193 and Bliquez L, ref. 49, pp. 291-322, esp. 318.
51. See Green's Preface to her edition and translation of the Trotula as cited under Principal Texts Consulted, p. xii.
52. De nimio fluxu menstrorum.
53. The full remedy reads: et ponantur ventose ignite inter mammillas, ut sanginem superius trahant.
54. So too the anonymous, roughly contemporary to Trotula, Bamberger Surgery (In: Sudhoff K, Beiträge zur geschichte der chirurgie im mittelalter; graphische und textliche untersuchungen in mittelalterlichen handschriften. 2 vols. Leipzig: A. Barth; 1914-1918). Vol. 2, p. 146, 1230-1231: in mulieribus quoque fluxum ventris patientibus sub mamillos posita (ventosa) idem (arresting the flux) facit. For a handy short summary of the place of this treatise in the history of surgery, see Green M, https://remedianetwork.net/2015/10/13/crafting-a-written-science-of-surgery-the-first-european-surgical-texts/ (Accessed 5 June 2018).
55. The name cucurbita is occasionally found in contexts that may designate the classical bleeding cup (e.g., De aegritudinum curatione. In: Collectio Salernitana II, pp. 140, 164-5, 360). But in at least one instance (Glosulae quatuor magistrorum super Chirurgiam Rogerii et Rolandi, also in Collectio Salernitana II, p. 607) it is clear we are literally dealing with a gourd used as such. This compromises the meaning of cucurbita in De aegritudinum curatione.
56. Orig. 4.11: Guva, quae a Latinis a similitudine cucurbita, a suspirio ventosa vocatur. The first attestation to ventosa as a noun is found in Theodorus Priscianus, Euporist. 2 (Logicus), 17 & 87.

57. Sloane MS 6, f. 177v; see Tabanelli M, Tecniche e strumenti chirurgici del XIII e XIV secolo. Firenze: Olschki; 1973. Fig. 83. See also Jones P, Medieval Medicine in Illuminated Manuscripts. London: British Library; Milan, Italy, Centro Tibaldi; 1998. p. 88, Fig. 81. According to Jones the drawings derive from a manuscript of Guy de Chauliac. A similar scene can be found in Sudhoff K, ref. 54, Vol. 2, Taf. IX (32).
58. De apostemate mamillarum. The term apostema, transliterated as aposthem/a (sometimes imposthume or emposthume) generally means any swelling or tumor. Cf. Theodoric Borgognoni III.11: apostema est tumor vel inflatio membri praeter naturam. It need not, therefore, necessarily mean abscess. The range of tumors, swellings, etc. covered by the term apostema in the Middle Ages can best be appreciated by perusing Guy de Chauliac's Chirurgia Magna II.1.1-2 (McVaugh-Ogden, Vol. I, pp. 57-77).
59. This caveat for draining empyema and ascites/dropsy can be traced all the way back to the Hippocratic Aphorisms (Jones 4.6.27). See also Celsus, 7.15.1-2, Paul, 6.50.3, and subsequent medieval authorities like Theodoric (III.33), who drains with a brazen or silver tube, and Guy de Chauliac, II.2.6 (McVaugh-Ogden, Vol. I, p. 126), where he relies on Avicenna.
60. Bliquez L, ref. 2, pp. 84-87.
61. Such handles do appear among the illustrations E. Nicaise included in the second appendix to his French translation of Guy de Chauliac (see Translations). However, these scalpels (Pl. III, 63, 65-68) have nothing to do with Guy or medieval surgery, being recovered in the Pompeian excavations and, therefore, coming to light no earlier than the 18th century.
62. Often in medieval medical texts, tenta, like stuellus, refers instead to a pledget, tent, or suppository: see below, notes 76, 90, 105.
63. The Practica is thought to have first been initially compiled from lecture notes by Roger's students. The titles of Roland's edition include Chirurgia Rogerii cum additionibus Rolandi and Rolandina.
64. Sudhoff K, ref. 54, Vol. 2, pp. 218-19, following manuscripts in Monaco and Florence, prints all three chapters as one (III.28).
65. According to L. Rosenman Roger and his successors seem to be describing true cancer as it applies to the breast. See the cautionary note on p. 85 of his rendering (see Translations).
66. I add Rosenman's exegetic note on this curt narrative in his translation of Roger, p. 120: 'Rather than cut into the mass, the chary surgeon 'ate his way' through the skin and panniculus with corrosives. Or, if the cancer had eroded and ulcerated, the corrosives would act on it. Rare successful ablations have been reported'.

67. Based, he thinks, on the fact that menstrual blood, if not converted to milk, results in induration of breast tissue.
68. Ms. Sloane 1977, Cyrurgie Mestre Rogier de Salerne. Valls H, Studies on Roger Frugardi's Chirurgia. PhD dissertation. Toronto: U. of Toronto; 1995. pp. 208-209; Sudhoff K, ref. 54, Vol. 1, p. 28. Valls adds another version of the cancer scene from Montpellier MS H-89 (Latin). I note also two similar illustrations found on Codex 3, Mss. Latini, Bibliotheek der Rijkuniversiteit, Leiden, a witness to the Chirurgia of Theodoric Borgognoni. These are shown in Lyons A, Petruccelli R, Medicine: an illustrated history. New York: H.N. Abrams; 1978, repr. New York: Abradale Press/Abrams; 1987. pp. 326-327, ills. 490 and 498.
69. apponenda est cuffa super capitellum.
70. Roger uses a cuffa again at III.25 to straighten a fractured rib. Two names for bleeding cup suggest a distinction. But the two seem equated in the text of Roland I.30 preserved in the commentary of the so called 'Four Masters' (Coll. Salern., II p. 676: Cuffa quidem est quod ventosa ferri…) and by William of Saliceto who employs a magna cufa seu ventosa to raise a depressed sternum (Chirurgia Magna, III.4). Nor can size be an issue because we find William of Saliceto also employing a large cuffa (cum cuffa magna) to evert the vagina, a more restricted area, better to see lesions needing intervention; see his Summa Conservationis: Chirurgia. Piacenza, Johannes Petrus de Ferriatis, 1476, I.168.
71. VII (Antidotary), 1.1 (McVaugh-Ogden, Vol. I, p. 399): Est autem ventosa instrumentum pixideum cum orificio stricto et ventre spacioso et secundum Albucasim fiunt ex cornibus et ere atque vitro. I here pass by horns used as cups.
72. VII (Antidotary), 1.1 (McVaugh-Ogden, Vol. I, p. 401: …ventose que apponuntur sunt duorum modorum…quedam sunt de cornu, que applicantur sugiendo; quedam de vitro, que applicantur igniendo… The latter he heats with coarse flax fired with a candle: stuppa sicca carpinata et cum candela incensa inflammatur.
73. Institutiones Chirurgicae, etc. Amstelaedami, Apud Janssonio-Waesbergios, 1739, p. 491, Tab. XII. Fig. 1). The specific cylindrical form illustrated there can be traced no earlier than the 15th century. KÜNZL E, Ventosae cucurbitae romanae? Zu einem angeblich antiken Schröpfkopftypus, Germania 1982;60:513-32.
74. Oribasius, Coll. Med., 7.16.13 and Paul, 6.14.2 (both derived from Antyllus); Albucasis II.96.

75. Trinity College Cambridge MS 0.1.20. The illustrations are reproduced by Hunt T. The Medieval Surgery. Woodbridge, Suffolk, Rochester, NY: Boydell Press; 1992, repr. 1994 and 1999, pp. 37 (head wound), 63 (facial tumors), 79 (ear ache, but surgery uncertain); cf. also 99 (fistula?). These pictures also appear in Sudhoff K, ref. 54, Vol. 1, Taff. V-VII.
76. Cf. e.g. II.1 stuellus de panno immittatur (wounds of neck). Linen cloth is sometimes stipulated: see the Bamberger Surgery, In: Sudhoff K, ref. 54, Vol. 2, p. 140 (95) 1063: stuellos lini duros… ponimus. Such drains/tents might be medicated with substances like lard or egg white, as in Roland's addendum to Roger II.1.B (Coll. Salern. II, p. 454): vel due stuelli fiant de panno et liniantur lardo et intromittantur and to Roger II.2 (Coll. Salern. II, p.455) pannum infusum albumine ovi. Both passages also deal with neck wounds.
77. Bliquez L, ref. 2, p. 311. Use of a retracting thread also is found in medieval authorities; e.g. Guy de Chauliac, III.2.5 (McVaugh-Ogden, Vol. 1, p. 198): tenta…ligata cum filo ut si caderet posset extrahi).
78. Also known as Teodorico dei Borgognoni, and Theodoric of Lucca. He is generally considered the son of Hugh of Lucca whose own views may have been incorporated into Theodoric's treatise.
79. Theodoric does have a chapter (III.20) specifically devoted to apostemata of the breast and penis (De apostematibus mamillarum et virgae), but it is short and involves only topical applications (localia).
80. To Roger's chapter (above) on breast cancer Roland added a recipe for a corrosive powder that he claimed was also effective on fistula; but that is as far as he went. Henri de Mondeville intended to include fistula in a projected chapter on breast diseases for [Tract.] III. [Doctr.] 3, but he only completed the prologue of III.3.
81. in ipso principio (apostema) repercutiendum in contrariam partem trahendum…vel per exercitium in opposito factum vel per ventosam attrahentem.
82. necesse est a principio ut fiat phlebotomia a parte contraria secundum positionem materiae; ab initio phlebotomia in parte oppositiva.
83. quandoque necessaria est scarificatio, praecipue quando apostema est multae materiei; scarificamus locum, non tamen pluribus neque profundis plagis…
84. deinde locum scalpella; maturato ap., ponantur rumpentia, vel secetur sanies…
85. Bliquez L, ref. 2, pp. 208-211.
86. E.g., Galen, Ad Glauc. de meth. med. 11.125K, De comp. med. per gen. 13.499-500K; Albucasis II.83. For Guy see VI.2.7 (McVaugh-Ogden, Vol. 1 p. 384).

87. Bliquez L, ref. 2, pp. 217-218. At least one Greco-Roman specimen of the puoulkos has come down to us. Guy de Chauliac, III.2.5 (McVaugh-Ogden, Vol. 1 p. 199) is familiar with the instrument, surely through Galen.
88. Bliquez L, ref. 2, pp. 214-217 for an argument made for classical authorities. Albucasis and Bruno mention models with tubes of silver or copper alloy.
89. Nicaise (see under Translations, Henri de Mondeville, pp. 514, 689-691) envisaged a piston driven syringe lurking behind the cannula in Guy de Chauliac's application, via Galen, of a powder to the uvula cum cannula aut cum digitis seu cocleari (see Guy VI.2.2, pars 5 McVaugh-Ogden, Vol. 1 p. 362 and Vol. 2 p. 303). The passage in Galen must be De comp. med. sec. loc. 12.984.14-985.8K (Asclepiades). However, all applications there only involve, in addition to fingers and a spoon, just a simple tube/reed (καλαμίς) for insufflation.
90. So translated by Campbell. But Henri de Mondeville (III.2.17, Pagel p. 496) asserts that a tenta of heart wood can be friable (frangibilis) and therefore requires a tail (cauda) for retraction. This may mean that the 'probe'/tenta here is more like packing or a suppository to enlarge and open the canal, in contrast to the lead and wooden tentae used for exploration.
91. Verum oportet ut caveas ne in quantitate profunditatis ipsius decipiaris et diversitatem eius cum cauterio non possis attingere.
92. et mulier si fuerit aetatis congruae, menstrua vehementer provocabis. Quia si quinquagenaria quae patitur, minime hoc facere poteris.
93. si vero cancer in locis carnosis fuit ubi de veins et nervis timendum non sit, usque ad sanam carnem incidatur et accendatur post modum, sicut de fistulis dictum est, curetur.
94. Bliquez L, ref. 2, pp. 263-267 (mortar), 118-123 (spatula), 339-343 (sponge), 107-108 (scissors/shears) for discussion and illustration of classical types.
95. Sudhoff K, ref. 54, Vol. 1, pp. 81-110, esp. 84-85, 89 and Taff. XV-XXXVIIA upper right; also pp. 54-55, 118 and Taf. X.23 (Bodleian Library, Oxford, Laudianus Misc. 724). Tabanelli M, ref. 57, Fig. 55.
96. Properly Guglielmo da Saliceto; other names: Guillaume de Salicet; Latin: Guilielmus de Salicetum
97. si autem tale lac in saniem converteretur… tunc incidatur apostema et sanies extrahatur.
98. These may be fibrocystic disorders; so Rosenman conjectures. See his translation of William, p. 54.
99. (membri abscisio) non videtur mihi bonum nec utile nec honestum medico. Roger, Bruno and Theodoric must have felt the same way as they do not

entertain the subject of radical mastectomy. The Bamberger Surgery (ed. Sudhoff K, ref. 54, Vol. 2) similarly expresses caution: pp. 123, 514-515: cancri qui in mamillis mulierum fuerint per incisionem et cauterium minus curari intelleximus. Albucasis too avoids extirpation of advanced cases, admitting that he has never been successful and knows of no one else who has (II.53).

100. For political reasons Lanfranc was exiled from Milan to France in 1290 where, established in Paris, he became a primary figure in the development of French surgery.
101. phlebotomia de basilica. The former lies on the outer side of the arm, the latter on the inside.
102. vel si esset (sc. apostema) cum retentione menstruorum, ipsorum provocatio vel minutio de saphena (sc. cura est).
103. si vero saniem fecerit (sc. apostema), cum sagittella aperi, et sanie expurgata, cum uno mundificativorum mundifica dicendorum.
104. The aphorism asserts that blood collecting in a woman's breasts signifies madness. Shaving the head is prescribed as a remedy, apparently as the head is regarded as the seat of madness.
105. nec ullo modo ponas ibi tentam grossam nec longam, sicut faciunt stolidi.
106. The term for arrow, sagitta, as used in phlebotomy, goes back at least to the late classical veterinary authority Vegetius (Mulomed. 1.22.4; 1.25.5). It is unclear whether Vegetius had in mind a special knife or an actual arrow.
107. Sudhoff K, ref. 54, Vol. 2, p. 11 and p. 176 = Sudhoff's edition of Roger XXXVII, line 681 [nasal issues] sagitella incidatur. Roger uses the same language in general treatment of apostemata (Coll. Salern. II.5, p. 457). Clearly he too might have lanced a mammary apostema with the sagitella.
108. Si vero materia (sc. frigida) versus duritiem et nigritudinem tenderit vel livorem, tunc medicamina callida valde cave, quoniam locus ille cancrum libenter generat.
109. Quamvis per Dei gratiam satis sciam de curandis apostematibus et ulceribus, nullam tamen de uno cancro curare potui.
110. So Rosenman's view in his translation of Lanfranc, p. 173: sunt etiam multi stolidi qui reperientes in mamillis glandulas nituntur eas extrahere dicentes quod sit caro superflua.
111. For the relevant applications Lanfranc actually refers the reader to III.3.1. There he deals with eye conditions but also has a general section on ulcers.
112. …habeas cupulam glandis vel aliud instrumentum ad eius factum formam et illam terebintha vel pice linias interius et callidum supra capitelum applica et fortiter liga. Albucasis connects nutshells and cups at II.46: 'Sometimes

of this class (cups) small instruments like nutshells are made'. They are to be used only on fleshy places, including breasts. Curiously, the illustration figured with this remark in Ms. Marsh resembles a small rhombus.

113. nam hoc mamillas augumentari prohibit, et augmentatas minuit donec formam recipiant naturalem.
114. lac in mamilla coagulatum propter caliditatem curatur cum olio, rosa et aceto.
115. For this use of dependeo, cf. Guy de Chauliac's remedy for mammillary apostema below. We find dependeo in this sense as far back as Roger's stipulation, re apostemata arising from wounds of neck and throat, that incision of the pus pocket should be made ubi magis dependet (II.5, p. 455 in Coll. Salern. II; Sudhoff reads ubi magis pendet (Sudhoff K, ref. 54, Vol. 2, p. 190 VIII, line 135).
116. tunc prius rasum caput ungatur unguento dicto de oleo rosaceo et aceto …et febricitantis regimen injungatur.
117. I depend here on Rosenman's list (Vol. II, p. 921) based on L.'s stated intentions for III.3 elsewhere in the Cyrurgia.
118. Guy must be thinking of In Hipp. Aph. comm., 17b.832.13-14K.
119. The chapter of Albucasis referred to must be II.40. There Albucasis deals generally with 'tumors'. As he speaks of releasing their pus, 'tumors' surely allows for abscesses. In some cases (unspecified) Albucasis recommends a lunate or curved incision to open them.
120. Given the nature of the cure, papillus profundatus can only mean sunken nipples.
121. Rx mice panis mundi, farine ordei, fenugreci, seminis lini, ana unc. 1; radicis malvavisci, foliorum malve, eruce, ana M 1; colligantur.
122. One recalls, e.g., William of Salecito's lengthy account of a child born with a swollen scalp (I.1) and Lanfranc's tirade against a foolish practitioner (quidam laicus chirurgus) when his advice, based on an Hippocratic aphorism, was ignored to the detriment of a female patient who went mad (III.3.5).
123. Described as a barbitonsor and a balneator.
124. potiuncula ex confect. Alkerm, aquis cordialibus et cinamomi. The bowl held by the physician in Fig. 11 is said to hold, or at least symbolize pain relief. Jones P, ref. 57, p. 77, Fig. 69.
125. duobus acubus quae filum ex lino contortum trahunt.
126. Bliquez L, ref. 2, p. 5.
127. Cited survivals include those in the Museo di Storia della Medicina dell' Università, Roma shown by Tabanelli M, ref. 57, Figg. 53, 93-95. Some of these may be reconstructions. For the manuscript tradition and its attendant

problems, especially with accurate representation: Jones P, ref. 57, esp. pp. 76-94; Hunt T, ref. 75, esp. pp. 37, 79. An example: one notes that classical cauteries are equipped with quite plain handles (e.g., Fig. 9), as generally is the case in medieval illustrations (Figg. 4, 11, 13, 16). This suggests that the gaudy, therefore impractical productions associated with William of Saliceto (Fig. 18) are stylized for show.

128. Albucasis (II.80) knew of this knife through Paul; and Guy de Chauliac (IV.2.7, McVaugh-Ogden, Vol. 1, p. 247) through Albucasis. Their manuscript illustrations differ substantially.
129. Paul in fact admits that even anal fistulas can be treated with ordinary scalpels (6.78.2).

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