hope for a treatment; and in the meantime her medicine is not too unpleasant. It was worthwhile going to the iatréion.

The physician, too, is gratified. He may not have spelled out the diagnosis in modern terms (chronic bronchitis on bronchiectasis with recurrent bronchopneumonia), but this is not at all his concern, for almost anybody can tell what is going on right now. What counts most is to be able to anticipate what is going to happen—*prognosis* rather than diagnosis. In his eyes, he should be congratulated for making what he calls a good prognosis; good, that is, primarily for his ego. Today's physicians behave somewhat alike when they speak of a good diagnosis after having discovered a hidden cancer.

To understand the peculiar lack of interest in diagnosis in ancient Greece, remember also that disease, in general, was always viewed as the same: an imbalance. The author of *On Breaths* goes so far as to say, "Of all diseases the fashion is the same, only the seat varies."[160] The satisfaction of a beautiful diagnosis was therefore minimized, and the iatrós replaced it with a "beautiful prognosis." Here is a rather shocking example: "If convulsions do appear, death is likely, and there is a chance for a beautiful prognosis."[161]

As to the curving nails and swelling fingertips, they belong to the category of strange but true: they are common effects of chronic lung disease. Although theories abound,[162] on the whole the phenomenon is not understood much better today than in the days of the iatréion. French clinicians still record it as *hippocratisme digital.*

Note also that the iatrós has been able to recognize the presence of fluid bubbling in the bronchi by placing his ear on the chest. But what can he be hearing that is *boiling like vinegar?* Other readings have been proposed for this passage, such as "smelling like vinegar"[163] or "seething like sour wine,"[164] which is chemically impossible; none improves the meaning. The answer is probably the simplest. It occurred to me one day that it might help to pour some vinegar into a pan and heat it. As it started to boil, it produced a very special rushing, crackling noise, quite unlike that of boiling water, and comparing very well with the sound heard over a lung when fluid obstructs the finest bronchi, a sound called "fine moist râles" in modern terminology. The iatrós was familiar with the procedure of boiling vinegar, a common step in preparing drugs and plasters.[165]

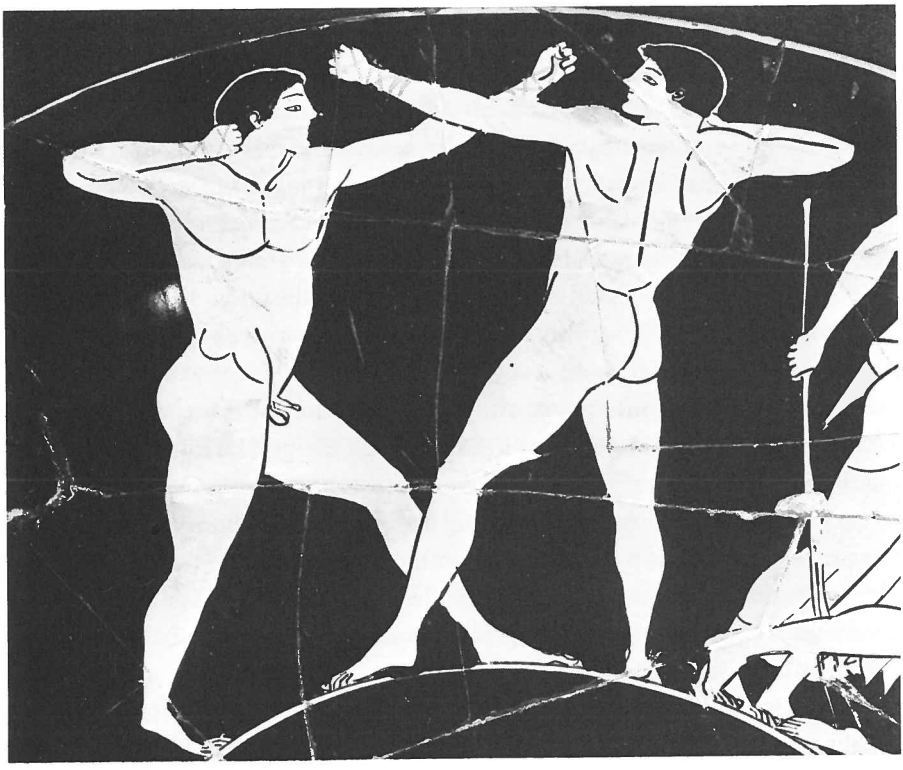
Patient No. 9: Punches in the Head

Ἰατρός

The next patient looks like a nightmare: a giant, with scarcely any face, just a bloody mess of black eyes, swollen ears, and a broken nose. This is the new breed of professional boxer.[166]

Boxing had degenerated by 400 B.C. In the old days it had been a game like all others, practiced by gallant young amateurs whose fists were protected by soft leather thongs (Fig. 4.29). Then over-competition bred professionalism, which spoiled the game.[167] Boxing was taken over by huge brutes, "pothunters," who wandered from city to city in search of a bloody fight to the finish (Fig. 4.29). They wore a new kind of sharp, cutting gloves called *sphái-*

4.29 Greek boxing scenes. *Below:* These sporty young men wearing soft leather thongs about 490 B.C. are amateurs. The aim is typically at the head. *Right:* Later boxing scene, about 336 B.C. The athletes have changed to the professional type: heavyweights, wearing vicious cutting gloves (*sphâirai*).

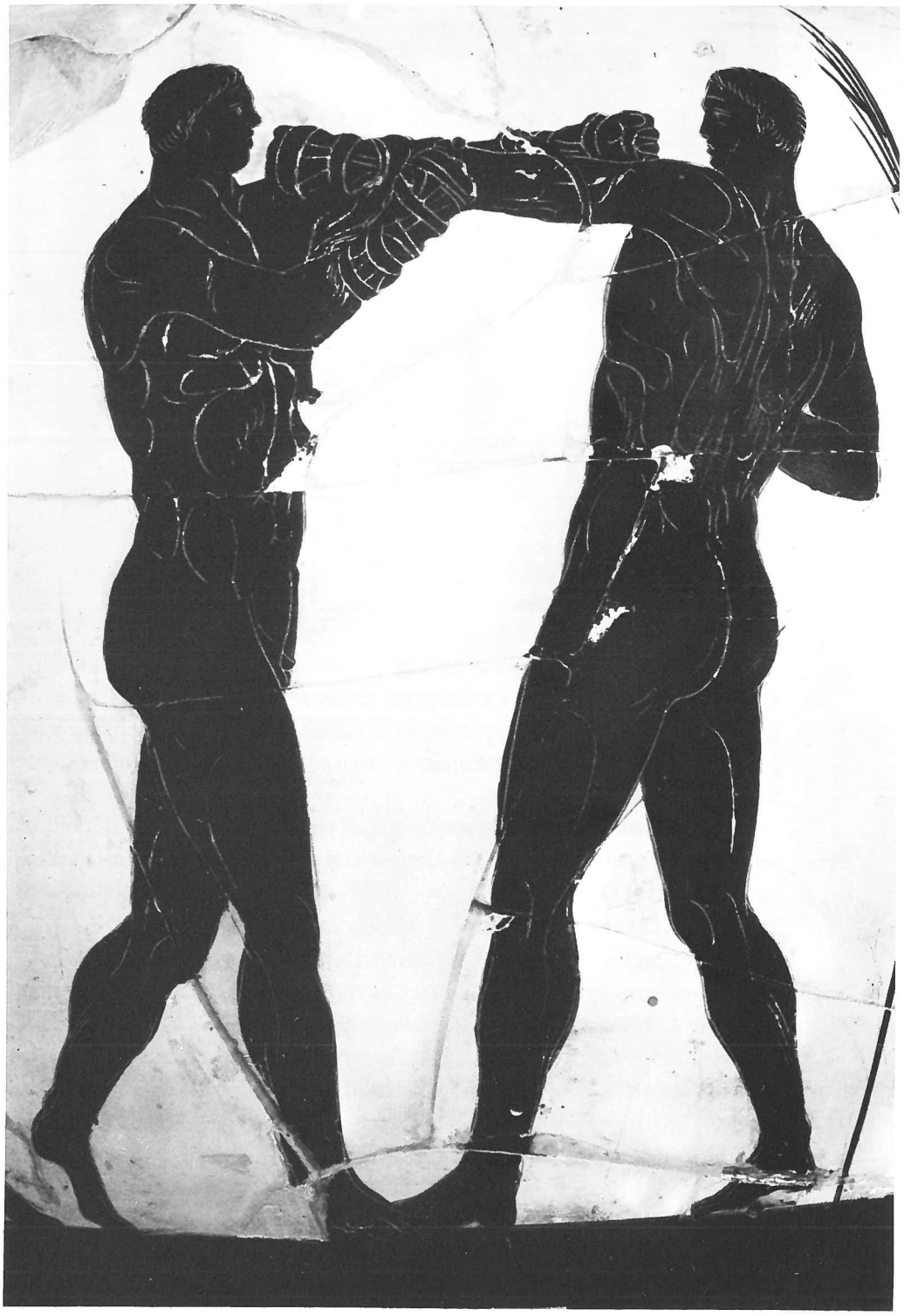


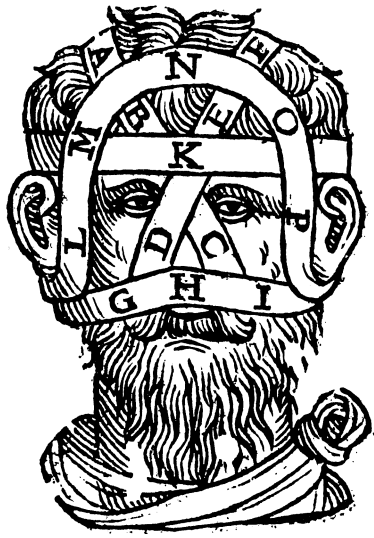
rai: no less a man than Plato had just recommended them for use in his ideal state, as part of the people's training for "the greatest of contests," war.[168]

The iatrós feels very much at ease before this patient. He knows that the ugly sight actually corresponds to a rather benign situation.[169] Complications are unlikely, and soon the monster's face will be improved by an elegant bandage (Fig. 4.30). This type of client must have been quite common, for it is discussed in considerable detail in one Hippocratic book.[170]

Ἰατρός

A good wash with wine shows, under the wound, a break in the nasal bone. With a special bronze spatula introduced into a nostril, the depressed fragment is raised, while fingers help from outside, pushing downward. "I am glad you came just after the fight," the iatrós might say; "Later it would have been more difficult to reduce the fracture. To hold up the bridge of your nose, I will now slip into your nostril a little roll of soft leather, containing fluff scraped off a linen towel.[171] It may bother you a little, but it does not smell. Once, having nothing else at hand, I stuffed in a piece of sheep lung. Now the two ends of the bone are aligned, but they will not stay in place unless you work for it. You will have to hold it in place yourself, if you have the will and the patience. No physician is worth your own two index fingers, held naturally on each side of the nose as long as possible, preferably until the bone has set. If you cannot do this yourself, ask the help of a child or a





4.30 Bandages for the nose, like this one, were the most spectacular types: "Those who practice dexterity without judgement look forward to meeting with a case of fractured nose, that they may apply the bandage. For a day or two, then, the physician glories in his performance, and the patient . . . is well pleased, but speedily . . . he complains of the incumbrance."

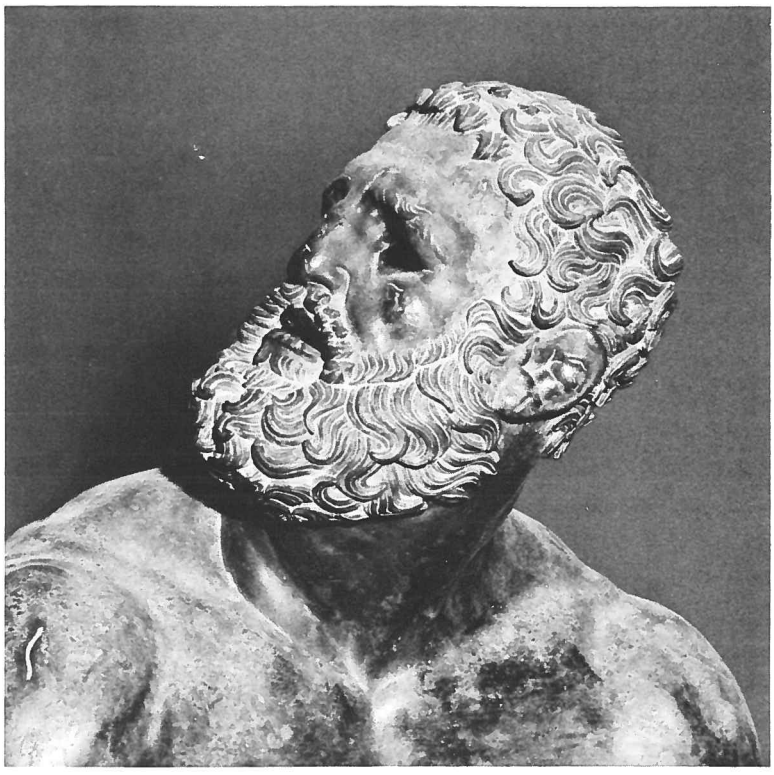
woman, for the fingers ought to be soft. But I know you will find it difficult. *Although men would give a great price to escape being deformed, at the same time they will not pay attention or take care unless they experience pain or fear death.* Anyway, straight or crooked, the parts will be consolidated in about ten days."

On the wound is placed a sticky plaster of wheat, *kómmi* (gum), and an aromatic resin, held in place by a cloth. This is a sticky mixture, but not stiff enough to serve as a support.

Next come the crumpled, or as we now say, cauliflower ears (Fig. 4.31).[172] Ears were a prime target in Greek boxing. Despite the covers (*amphotídes*) sometimes worn in practice,[173] broken ears recur often in Greek and Roman literature as a badge of the athlete. Aristophanes even coined the term *oto-kátaxis,* "ear-breaker," for boxer.[174] When Athens was occupied by the well-trained Laconians, some citizens advertised their political sympathies by adopting Spartan tastes and took to boxing, so that in Plato's time "the fellows with broken ears" came to mean "the sympathizers" or "Laconizers."[175]

Ἰατρός

"As to your ears," the iatrós might continue, "almost anything I could do would make matters worse. *It is sometimes a good remedy to apply nothing at all, and this is true not only for the ears.* Even a bandage would hurt. Later on, if pus forms, I may have to cut, and maybe even burn a hole in the ear with the cautery, though that would leave you with one ear smaller than the other. In the meantime we will work at preventing suppuration: take this purge, which will remove matters from below; and if you know how to vomit easily, I will also purge you from above with the mild method called *syrmaism,* according to which you load your stomach with a large amount of salt, water, and radishes, then throw it up.[176] After that you can go home, and do not sleep on your ears."



4.31 Head of a professional boxer, with injuries to the nose and cheeks and a typical "cauliflower ear." Hellenistic, first century B.C.

Note that the physician does not bother to examine the rest of the body. There was no need to do so, because Greek boxers—for some strange reason—aimed only at the head (Fig. 4.29).[177]

Patient No. 10: Stripes

The last patient is a taciturn slave named Xanthias because of his blond hair.[178] He comes from far-away Scythia and speaks little Greek; but once he has bared his back, there is not much need for words. It is a cruel sight: his skin is crisscrossed with sores from a whipping.[179] One of them looks particularly bad—red, hot, and swollen. This vicious infection draws a frown even from the detached iatrós.

Ἰατρός

"One of your sores, Xanthias," he might explain, "has gone into a state of orgasm.[180] I will cool it down for you with a plaster of boiled celery,[181] and then you will take a purge." There are finesses in this little talk that unfortunately are lost on Xanthias. "Orgasm" was a medical term perhaps more congenial than inflammation; it was also applied to the turgid state of ripening fruit, and it required immediate purging.[182]

The wild celery, too, left Xanthias indifferent. To Greek ears it would have had a noble ring, like laurel. It would have recalled the winners of the Isthmic and Nemean games, who were crowned with celery.[183] "He needs celery" meant "he is in danger," for *sélinon* was also used for chaplets to hang

over tombs. It also gave the name to the lovely city of Selinunte and to its river (Fig. 4.32).

The cool celery plaster will have to be renewed as often as possible, because once warm, it is supposed to be harmful.[184] This happens to be an exception: the usual injunction is to keep wounds warm, but it is allowable to cool them down when they are inflamed.

The other sores call for a different approach. The iatrós reaches for a pot of whitish, greasy ointment; and while he spreads this soothing paste onto the back of Xanthias, he explains: "After all, you are lucky, because sores can go four ways: deeper by gnawing into the body, outward by building new flesh, sideways by becoming larger, or inward by becoming smaller. All but one of your sores are moving inward, which is the natural way of healing."[185] Here is the formula of the salve he applies:

Goat grease
Swine grease
Oil
Frankincense
} add zinc oxide[186]

Note again the frankincense, *libanotós*. The salve is in fact a perfumed zinc oxide ointment, fit for twentieth century use. Greasy applications such as this one were kept for clean wounds near healing.[187] They were supposed to make the flesh grow, and so strong was the belief that it required a special verb, *sarcophyésai* or "making-the-flesh-grow."[188]

Nature was doing it, of course, in those days as well as today; but some still think *they* are doing it. They can use a verb from the Oxford dictionary: *to incarn*.

Wounds As Diseases: Hippocratic Theory

The gist of these ten cases is that Hippocrates scored 50 percent on the two basic questions about wounds, questions now too elementary to ask: should a wound be allowed to bleed, and should a wound give pus? The answer in both cases was a shaky yes and no, after a lot of thinking.

It was a peculiar, or shall I say non-ripe way of thinking, typical of the time. While the Greeks had been training their bodies for the Olympic Games ever since 776 B.C., [189] their mental gymnastics began to gather momentum only with the first great philosopher, Thales of Miletos, around 600 B.C., barely a century before the birth of Hippocrates. In the Golden Age, logic was still a new technique and little understood, so that a Greek might well accept for a fact what we would instantly recognize as an hypothesis.[190]

Ἰατρός

The word *hypothesis* itself occurs for the first time in the Hippocratic book *On Ancient Medicine*, a book in which the author, possibly Hippocrates himself, starts out with an argument against hypotheses and in the same breath sets forth a new one of his own.[191] Testing by experiment was not felt to be a necessity. The few experiments worthy of the name in the Hippocratic books are mostly analogies with irrelevant facts, which are

4.32 Wild celery (*sélinon*) was a wound drug and a noble plant. Here it appears on two coins from Selinunte, c.467 and 520 B.C., where it still grows. Enlarged about four times.

themselves not necessarily correct. An example: water coming from melted ice or snow is unhealthy, having lost its lightest parts. Proof: in winter, measure an amount of water; let it freeze; the next day thaw it, and you will find a good deal less.[192]

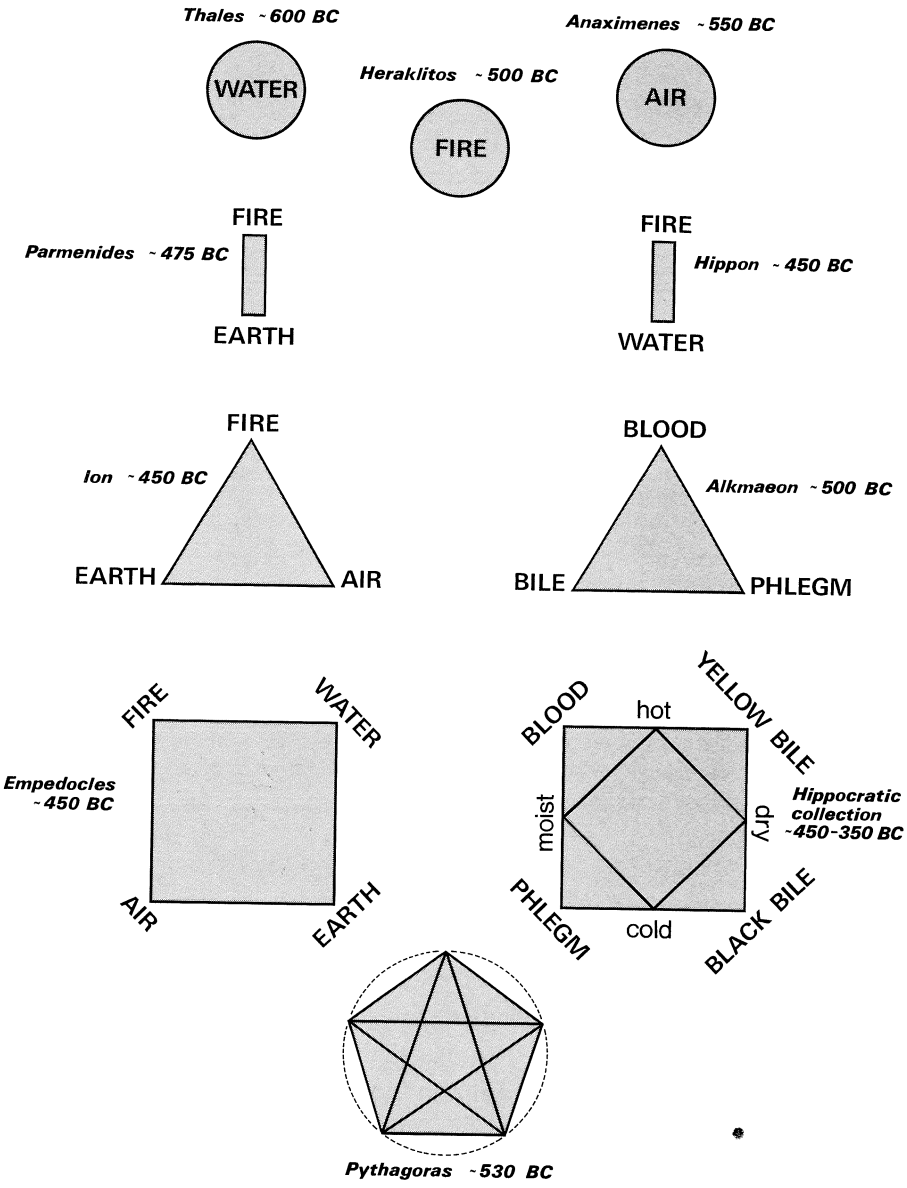
I mention this to explain the feeling of frustration that may come from the following few pages of medical theory. Intelligence without method could not lead far; the results might be rational, but not scientific. Indeed, Greek medicine, great as it was as an art, was a failure as a science.[193] The Hippocratic books are usually at their lowest when they would be scientific; their peaks are abstract thoughts. One of the loftiest is the very definition of thought: utterly Greek, it extends the idea of exercise from the body to the soul: "Thought is the soul's walk abroad" ("La réflexion est l'exercice de l'âme").[194]

Impressed as they were by the possibilities of the "soul's walk," the Greek physicians studied disease primarily by giving it a lot of thought. Nobody expressed this better than Charles Daremberg: "they tried to explain Nature while shutting their eyes."[195]

The result was an overall, synthetic, but wholly imaginary theory of disease, in which the basic disturbance, and therefore the treatment, was always of the same kind, even in the case of a wound.[196] The reasoning went about as follows. In nature everything is balanced. "Too much" or "too little" causes an imbalance, which is disease. The actual components of the body that may go out of balance are the celebrated four humors: blood, phlegm, yellow bile, and black bile. In the normal body these humors are harmoniously mixed; disease ensues if they are mixed in the wrong proportions, or if they become unmixed. Something like it happens when the Scythians shake milk in a pot, and the part that they call "butter" gathers on top;[197] or when one adds the juice of the fig tree to milk, and the curdle separates out.[198] How these four particular principles were chosen by the Greeks is not clear, and even the origin of the theory is uncertain, except that it was just one of the many schemes that the Greeks had been devising since roughly 600 B.C. in their quest for fundamental laws and symmetries. Nowadays, these schemes look naive and worthless (Fig. 4.33); but we must beware of taking them too lightly, for they may mean more than at first appears. The pentagram of Pythagoras, for instance (Fig. 4.33 bottom), which became the secret pass-sign and symbol of the Pythagorean sect, contains the geometry of the golden section, the secret aesthetic formula of Greek architecture, which was rediscovered only during the Renaissance.[199]

Ἰατρός

As to the scheme of the four humors, its success suggests that it was perfectly suited to the needs of mankind. Its fourfold symmetry had the appeal of an order that could also embrace the whole of nature: the four humors could be made to fit the four seasons,[200] four winds, four states of matter, four tastes, four temperaments (the word means "blends") with all the temperaments in between. There was no truth to speak of in the scheme, but it could serve as a framework for many truths. So it stood as the basic theory of medicine for over two millennia, and slowly grew to swallow the entire macrocosm—including, when their time came, the Four Apostles.[201]

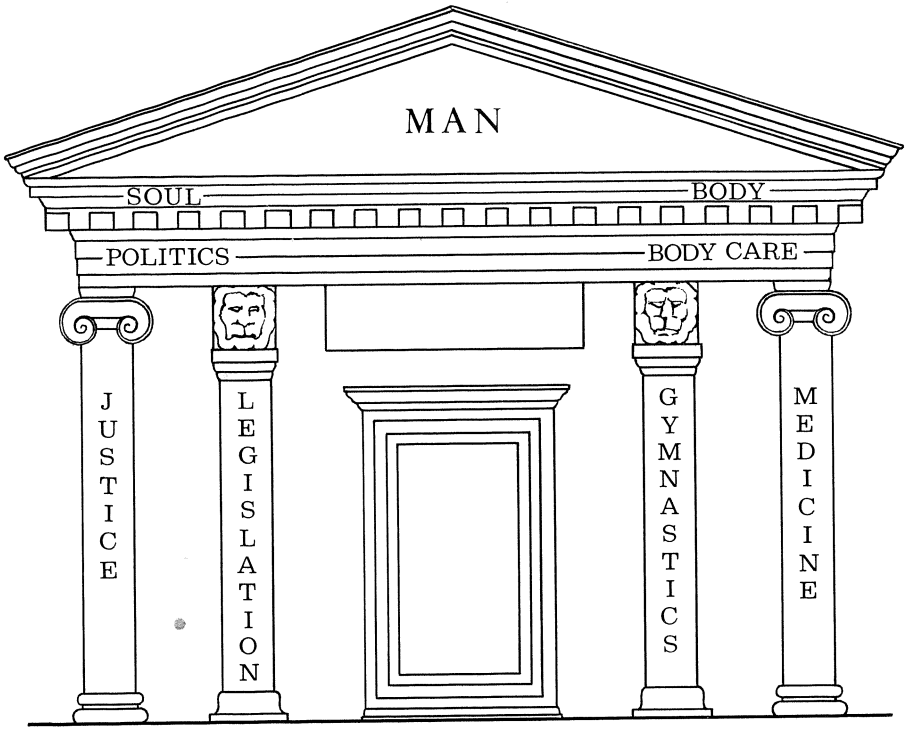


4.33 The search for universal laws and symmetries in Greek philosophy and medicine, during the two centuries in which Hippocrates lived.

Greek aesthetics had a penchant for fourfold symmetries. Law is to gymnastics, says Socrates, what justice is to medicine: almost a credo of the Greek physician (Fig. 4.34).[202] Ἰατρός

Thanks to the theory of the four humors, any pain or lump could be explained as a "distemper" or disharmony of the blend, the likeliest humors to misbehave being phlegm and bile. The treatment followed logically. It was the triple, indefensible commandment:

Bleed, to get rid of bad humors.
Starve, to prevent new ones from forming.
Purge, to get rid of the rest, "from above and from below," or from any other exit.



4.34 Another fourfold symmetry, explained by Socrates. The scheme shows the importance of gymnastics for the Greeks, its position relative to medicine, and the parallel between medicine and justice.

Nobody seemed to worry that the good humors might go out with the bad ones.

There were other theories as well; we are less informed about them, perhaps because they were less popular. One maintained that sickness is due to undigested "residues";[203] another, that all diseases are due to "breaths" or winds, a concept that we shall find also in India and China. In practice, however, the treatment must have been similar, whatever the school of thought of the physician.

All this is well known; but there is a forgotten part of the story, equally interesting, which explains how disease happens at the microscopic level.[204] Of course, the Greeks had no such instrument as a microscope, but they had a much more powerful and dangerous one: "what escapes the sight of the eyes can be seized with the sight of the mind."[205] The result was a story so well knit that it would be acceptable even today to many a layman.

Ἰατρός

Imagine, to begin, the soft parts of the body as they were conceived at the time: a solid mass called flesh, penetrated by the very fine roots of a dead-end plumbing system, the small veins (*phlébia*, "venules"). So there were at least three things that could go wrong: the blood, the venules, and the flesh.[206]

Of the three, blood was regarded as the worst offender, because it was liable to spill out easily and therefore to "stagnate." This was supposed to be dangerous, because one of the key propositions in Greek medicine maintained that stagnating blood will decay.

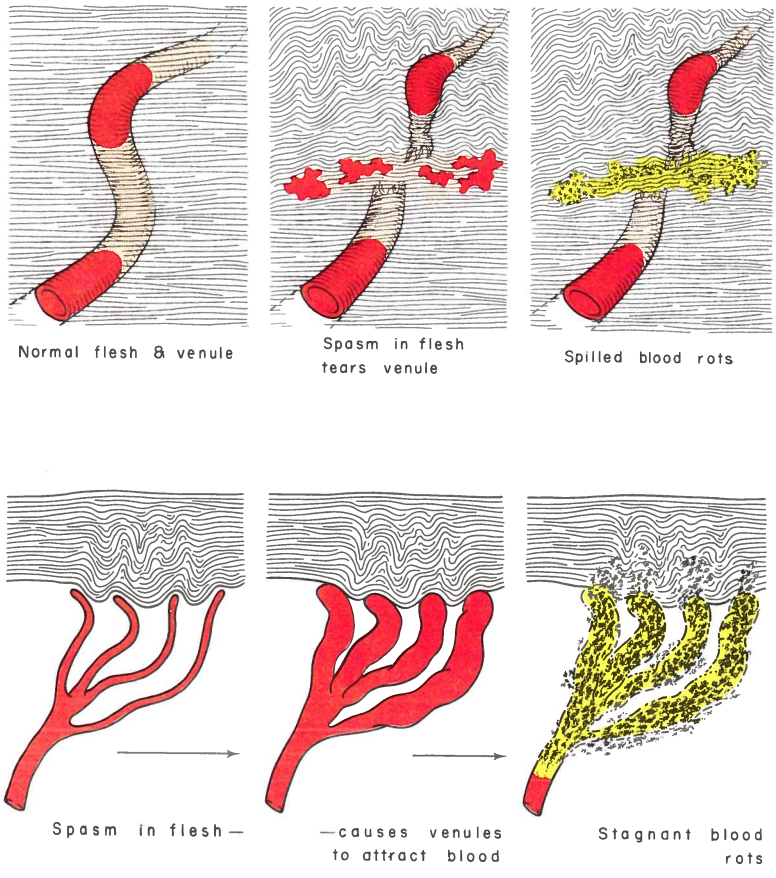


Plate 4.1 The mechanics of disease as seen with the Greek "eye of the mind." The basic theme is that spilled blood decays. In one case (above) the trouble starts with a "spasm in the flesh," which makes the venules burst. In another case (below) a spasm in the flesh "attracts" too much blood in the venules, with the same result.

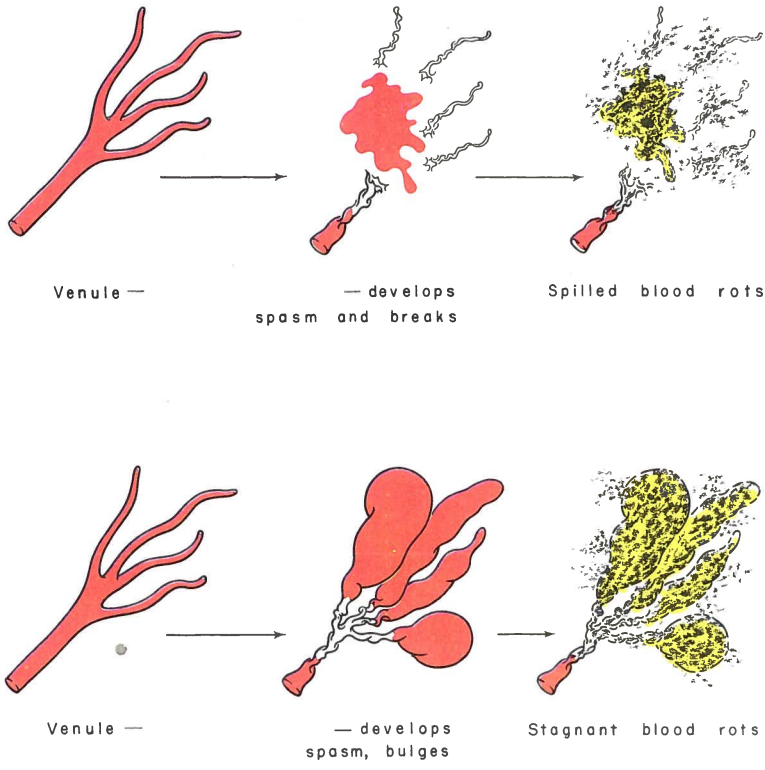


Plate 4.2 "Spasms in venules." A spastic venule can either tear itself apart and spill out its content (above) or trap the blood into a pocket, whence it seeps out and decays (below).

There was an easy comparison here (though never stated) with the fresh water of a brook and the smelly water of a marsh. Blood was not thought to "circulate," of course, but it was supposed to move back and forth in some obscure fashion; if spilled out, it would have to stagnate. In decaying, it might even become pus.[207] Galen, writing five hundred years later, was not sure that he could accept a full transformation of blood to pus, but the decay of spilled blood was "certain."[208] The ounce of truth here is that blood clots left in a wound do tend to become pastures for bacteria, and thereby induce pus.

The second possible source of disease was the flesh. If irritated, it could undergo spasms. Spasms covered a large family of symptoms, ranging from shivering to cramps to convulsions and tetanus: the Greek craving for synthesis could not fail to see them all in the same light.[209] The stated causes of spasm were cold,[210] excessive bleeding,[211] and drastic purging with hellebore,[212] which did throw people into agonizing convulsions. When the flesh went into spasm, it could either attract blood out of the venules[213] or simply squeeze it out, whereupon the "out-veined" blood would decay (Plate 4.1).[214] Therefore, spasms were an important mechanism of disease. In pleurisy, for example, "the chill is considered to be the cause and the beginning of the disease."[215]

The third possible site of disease were the venules. They could spill out their blood by several mechanisms, either by sheer fatigue[216] or by falling into a spasm themselves. A convulsing venule could either tear itself apart and bleed,[217] or trap the blood into a sort of cul-de-sac, whence it would seep out and decay (Plate 4.2).[218] Chills after a wound were thought to come from the vessels,[219] presumably because the exposed vessels caught cold and convulsed.

I mention these apparently wild theories because the venules were too small to see except with the *gnómes ópsei*, "the sight of the mind." Yet one part of the guess was exceedingly good. Small vessels do have spasms, and in 1969 the electron microscope showed that irritated venules do, in a sense, tear themselves apart (Fig. 4.35).[220]

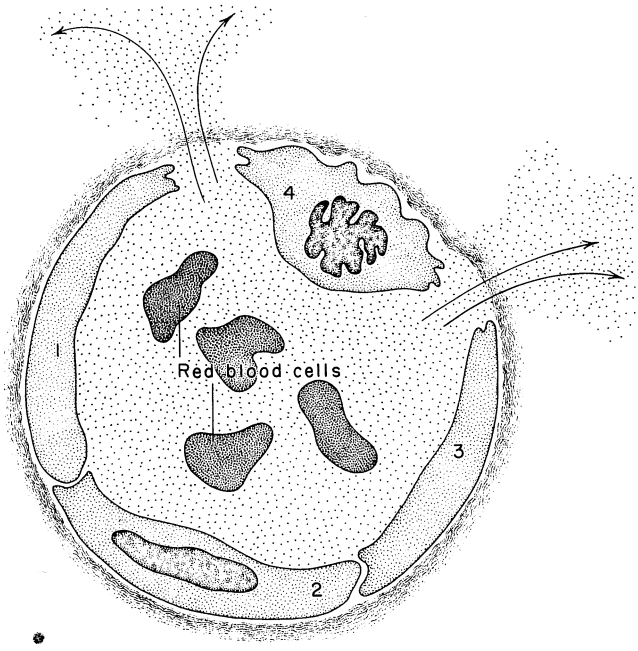
Now apply all this to a wound. Normally the flesh is kept warm under the skin. Once exposed to the outer world, however, it is bound to catch cold and suffer:

> Wounds love warmth; naturally, because they exist under shelter; and naturally they suffer from the opposite; and naturally the veins too, which live in warmth.[221]

Ἰατρός

> The bones, the teeth, the tendons have cold as an enemy, warmth as a friend; because it is from these parts that come the spasms, the tetanus, the feverish chills, that the cold induces, that heat removes.[222]

From this comes the refrain about keeping wounds warm.[223] If chilled, the parts *around* the wound will develop spasms, attract blood, become soaked with it, and decay. The beauty of this thought (corruption originates *around* the wound), however wrong it may sound today, is that it shows how the Greeks struggled to explain the mechanism of what we call infection—or in their terms, corruption. They could have no idea that the cause was



4.35 "Spasm in a venule" as it really occurs. This drawing shows a microscopic vein, in cross section and enlarged about 5000 times, as it would appear in the electron microscope. The inner surface of the vessel is lined with flat cells (1–4) applied against a supporting membrane. Chemical agents, such as histamine, cause some of these cells to contract (top right) and pull away from each other, thereby creating gaps through which fluid escapes. The escaping fluid causes the swelling typical of inflammation.

something deposited on the surface of the wound. Therefore, using their principle that "stagnating blood decays," they rationalized that the trouble had to arise all around the wound: *blood was attracted there, and turned into pus.* This thought is stated or hinted many times in the Collection; for instance, "all wounds draw their inflammation and swelling from the surrounding parts, because of the blood flowing into them."[224] The mistake here is that the inflamed surrounding parts are not *causing* any trouble to the wound; they are suffering from infection just as much as the wound itself, indeed they are fighting it off *with the help of the blood.* But if we accept the Greek way of thinking, at this point the absurd conclusion becomes perfectly rational:

Ἰατρός

Bleed the wound

either by encouraging its hemorrhage, or by slitting an appropriate vein elsewhere. "In every recent wound . . . it is expedient to cause blood to flow from it abundantly, and as may seem seasonable; for thus will the wound and the adjacent parts be less attacked with inflammation . . . When the blood flows they become drier and less in size, as being thus dried up. Indeed what prevents the healing . . . is the decay of the blood."[225]

This notion of drying up the wound explains also the dangerous practice of bandaging tightly, as well as the ultimate aberration: "and in a word, the greater the wound, the more severe and protracted should the regimen be."[226]

All this must have been on the mind of the Hippocratic author (or was it the master himself?) who dropped the loaded remark: "The wound, I believe, is a disease."[227]

Pus or No Pus

A key fact about wounds in ancient Greece is hidden in the very word for wound: *hélkos*. It just cannot be translated accurately. The title of the treatise about wounds, *Perí Helkón*, is translated by Adams *On Ulcers* and by Littré *On Wounds*. Both are right, for the word *hélkos* covers both situations.[228] Today this is shocking, because we associate the notion of ulcer with delayed healing and the foul look of infection; but in ancient Greece that was precisely what happened to most wounds. There was no need to make a distinction. It is even more shocking that this was still largely true for both translators, Adams and Littré, who lived during the first half of the nineteenth century. The situation had been summed up a short time earlier by a commentator who failed "to recognize any difference between wounds and ulcers, except that which was contributed by time."[229]

Infection being almost inevitable, and therefore almost "natural," the Greek physician had ambivalent feelings about pus: it could not be something entirely bad. Sometimes he took it as corrupted blood, and as such it was definitely bad: this was the turbid and smelly variety which he called *ichór*.[230] But other times he interpreted it more benevolently as phlegm, "ripened" by a process of "coction," *pepsis*, never clearly defined, which I visualize rather like the ripening of Camembert. This kind of pus was odorless; it flowed "pure and white," and it was a good omen.[231] Something to hope for.

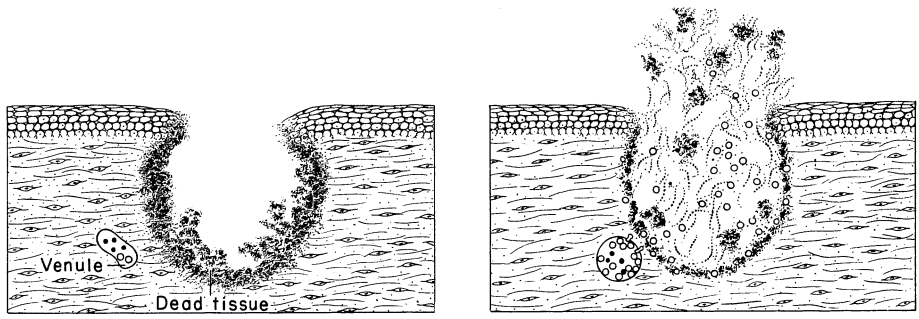
Today, of course, the meaning of the two kinds of pus is obvious: severe infection versus more benign infection. But the Greeks, mistaking the benign infection for the "good and natural" course of events, did their best to encourage it: a fatal mistake, which survived as surgical gospel until the nineteenth century. Not until Lord Lister did it become apparent that encouraging "good and laudable pus" was playing the game of the bacteria. In defense of the iatrós, I must say that he had several reasons for believing that pus was a good thing; and there is some deceptive truth in each of his reasons.

Ἰατρός

First, patients with white and "pure" pus had a better prognosis than those with "bad" pus. This is true.

Second, in a bruised wound suppuration helps because it cleans out the dead tissue.[232] This is defensible. Bits of dead or doomed tissue prevent the wound from closing. Modern surgeons prefer to pick them out, by a painstaking operation called toilette or débridement of the wound. The Greeks cut out the major pieces[233] and let the pus destroy the rest—a cunning use of natural processes (Fig. 4.36).

Third, "if swellings do not appear on severe wounds, it is a great evil."[234] This is true: in a wound, total absence of swelling and pus *may* mean that the



4.36 *Left:* A bruised wound. Before its margins can join again, the dead, bruised tissue (black) must be removed, either by natural processes or by surgery. If such a wound becomes infected (*right*) the dead tissue can be removed incidentally by the pus: that is, by the white blood cells (small circles) that have swarmed in to destroy the bacteria. This cleaning operation was a practical, but dangerous use of wound infection in ancient Greece.

body is incapable of defense. By the shaky logic of the iatrós, this proposition could be restated: "no pus is bad, so pus is good."

Fourth, the Greeks believed that "good, white pus" actually prevented more dangerous complications.[235] This, too, was the result of their peculiar logic; it was somewhat like arguing that foggy weather prevents rainy weather. You have either one or the other. Nowadays one would say that "white pus" is the least of evils.

Fifth and last, the concept of "good pus" was necessary to fill a slot in current medical theory. There had to be a process whereby bad humors could be eliminated, by "ripening" and a final "setting aside," *apóstasis* (hence the ancient English term *apostem* for "abscess").[236]

Still, despite these arguments in favor of pus, the Greeks could not fail to notice that many wounds healed perfectly well without suppuration. Therefore, every wound posed a dilemma: was it one that could heal directly, or one that should be "helped" to suppurate?

It is generally easier to help infection than to fight it. I suspect that the iatrós was more successful in the first task. His decision depended on the presence of bruised tissue. If there was any, he tried to clean it out "by taking the wound rapidly through suppuration."[237] A typical drug placed on the wound for that purpose was:

Ἰατρός

Wool as greasy as can be procured,
dip it in very little water,
add ⅓ wine
} boil to good consistency[238]

I would not be surprised if greasy wool, stuffed in a wound, did indeed help it to suppurate. Note that this "taking the wound through suppuration" was to be done "rapidly." The recommendation to keep wounds open and oozing for a long time to extend the supposed drainage of bad humors was a later aberration; it is never advised in the Hippocratic Collection. However, it is already

mentioned in a fragment by Diokles of Karystos, a younger contemporary of Hippocrates, as "making the wound last" after dog bites.[239]

To prevent suppuration, there was that special set of drugs called enhemes, used especially on fresh wounds. Several enhemes were dry powders to be sprinkled on the wound. They could be washed off with vinegar or wine. Here are four:[240]

Lead oxide (*flower of silver*)

Lead metal powdered together with
Zinc oxide (*? ashes from Cyprus*)[241]

Copper oxide, black (*copper scales*)
Copper sulphate (*chalcitis*)[242]

Alum

These powders are crude antiseptics, in that they kill bacteria at the price of killing tissue cells[243] (some also carry the danger of lead poisoning). Specific antibacterial weapons would not come until the twentieth century.

Other enhemes were moist, like this one, which must also have had antiseptic properties:[244]

White vinegar, strong
Honey
Alum from Egypt
Sodium carbonate, roasted (*nitron*)
Bile, a little
} boil together

Note that two of these five ingredients came from Egypt; a third, honey, was an Egyptian favorite. Another antiseptic enheme based on honey is recommended after various operations on the nose:

Honey
Copper oxide, red (*flower of copper*)
} boil together[245]

The fascination with copper, used in so many forms, may also betray Egyptian influence; it will carry over into Roman medicine. Some copper compounds existed in nature (remember malachite and chrysocolla, sources of the Egyptian *wadi*); others could be prepared fairly easily. The mines of Cyprus, famous since the third millennium B.C.,[246] supplied the metal in such large amounts that the island itself, Kypros, gave its name to copper. Cyprus was also a source of zinc. Its zinc ores, heated in water, produced zinc carbonates and hydrosilicates, called "cadmian earth" or simply cadmia. When the mixture was stirred with a reed (calamus), these hydrosilicates stuck to it; hence the name "calamine," which is still applied to zinc lotions. Cadmia, when heated, gave off a vapor of zinc oxide, which condensed on the wall of the furnace. This was scraped off and called *spodium* ("ash"), another favorite wound drug of antiquity[247]—and a favorite drug of modern dermatology.

Ἰατρός

Wine and Vinegar As Antiseptics

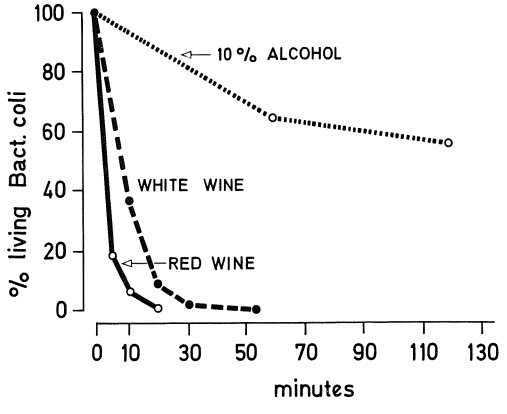
Vinegar owes its sting to acetic acid, which is a powerful antiseptic.[248] A 5 percent solution—about the same strength as in vinegar—was tested recently in Makerere, Uganda, on a series of patients suffering from burns and superficial wounds. Some bacteria proved resistant, but infections with *Pseudomonas* did very well. As expected, the dressings were painful; but the pain did not last.[249] Vinegar is definitely a rational wound-wash.

As for wine, it has been the commonest item in wound treatment since the Greeks. This record alone suggests that there should be something effective in it. The first question to arise is whether this something could be alcohol.

The 9–11 percent concentrations of ethyl alcohol in ordinary wines have very little effect on bacteria. The optimal strength of alcohol-water mixtures against *E. coli* and staphylococci is 70 percent by weight.[250] Yet most experiments with wine as an antiseptic have proven successful (Fig. 4.37). The first were published in 1892 by Alois Pick, an Austrian military doctor. They came in the wake of an epidemic of cholera in Paris, during which a Dr. Rabuteau had noticed that wine drinkers were relatively spared by the disease, and he therefore advised everybody to mix wine into the water.[251] To test this theory, Dr. Pick took cultures of cholera and typhoid bacilli, and added 1 cc of each to each of five flasks containing either water, wine (red or white), or 50–50 water-wine mixtures. In the two flasks with water, the bacteria flourished; whereas the wine, straight or diluted, killed all cholera vibrios within ten or fifteen minutes. Although some of the typhoid bacilli were still alive at that time, they too had disappeared after twenty-four hours. Dr. Pick concluded that during cholera or typhoid epidemics it was advisable to drink water that had been mixed some time earlier with wine.

This forceful, one-page article was followed by many others. Despite the variety of wines and authors, a review of the results in 1951 showed consistent data: wine kills cholera vibrios in 0.5–10 minutes, *E. coli* in 25–60 minutes, and *E. typhi* in 5–240 minutes.[252] Rhine wines, both red and white, kill staphylococci in one hour, or in two if they are diluted with equal amounts

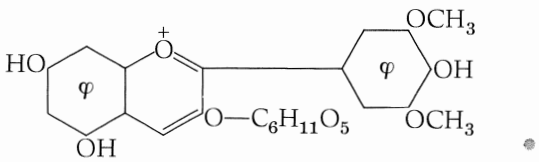
4.37 Bactericidal power of two wines (alcoholic content 9.8 percent); compared with that of 10 percent ethyl alcohol, as tested on the bacterium *E. coli*.



of water.[253] In Bordeaux, Prof. Ribéreau-Gayon found his strain of staphylococci so sensitive that he had to dilute the wine in order to obtain any bacterial growth after fifteen minutes.[254]

This long list should be convincing enough; but I resorted once again to my bacteriological friends for first-hand confirmation, using Greek wine. Two samples of white wine—one resinated, one not—were obtained from a farmer in Crete; they were tested against bacterial cultures on agar plates, by the "center well" method that had also been used to test copper compounds. Both wines behaved as if they contained an antibacterial substance, yet this could not be the 10 percent alcohol, because tests with the latter proved to have no effect. Thereafter, four bottles of red wine were sacrificed to science: a Chianti, a Beaujolais, a Dôle du Valais, and a Rioja from Spain. Samples were infected with *Staphylococcus aureus, Streptococcus pyogenes, E. coli, Proteus mirabilis,* and *Pseudomonas aeruginosa.* After six hours no live bacteria could be recovered, except a few staphylococci, but they too failed to grow after twelve hours.[255]

The antiseptic power of wine is no myth. Since it cannot depend on alcohol alone—in fact, it persists when the alcohol is removed[256]—it was thought for some time that it depended on a mutual reinforcement between alcohol and the organic acids of which wine is rich.[257] Recent studies from Bordeaux have taken an entirely new departure. They pin down the mechanism to the anthocyanes, a subgroup in the large group of polyphenols present in wine.[258] The most important member of this group of compounds, as regards antibacterial effects, is also the principal pigment of red wines, malvoside or oenoside; there is a colorless equivalent for white wines (Fig. 4.38). This pigment is al-



4.38 A relative of phenol, the historic antiseptic—in wine: malvoside or oenoside, a polyphenol.

ready present in the grapes, but combined with a carbohydrate and thus not antiseptic; during alcoholic fermentation it splits free and becomes activated. This hydrolytic cleavage cannot take place unless the solution is acid; but all the steps in the sequence work out as if prearranged, because wine is very acid. The average pH for red wines is 3.6, which is also the degree of acidity that corresponds to optimal solubility of the red pigment.[259] One would therefore expect the bactericidal power of wine to increase with age; and so it does, in unison with the behavior of the pigment, as shown in the following tabulation. The bactericidal index was obtained by finding the maximum dilution of wine in water that would kill a given strain of *E. coli* in no more than ten minutes but no less than five minutes. For example, an index of 17 means that the maximum active dilution was $1/17$:[260]

Ἰατρός

Age of wine	*Bactericidal index (dilution factor)*
Fermented must	0
Wine of same year	11
3-year wine	14
4 " "	16
5 " "	16
6 " "	16
9 " "	19
10 " "	19
14 " "	17
23 " "	16
29 " "	16
36 " "	16
46 " "	12
56 " "	9
82 " "	6

The effect of wine is thus truly bactericidal, not bacteriostatic. Red and white wines are about equal in this respect. Most effective are the strong southern wines like port, among which the palm goes to a Greek wine from Samos, which kills *E. coli* within three minutes.[261] Other polyphenols in wine may help, but their concentration is small.[262] It is pleasing to know that the bacteria are killed by substances really present in native wine, not by the sulfurous anhydride that is now almost universally added to prevent acetic fermentation.[263]

So the Greeks were quite right to pour wine into wounds and over dressings. Wine has to be used generously, however, because its power is short-lived: the active principles are rapidly bound and inactivated by proteins,[264] which explains why wine is not currently sold with first-aid kits.

By cleansing wounds with wine the Greeks were actually disinfecting them with a poly*phenol*, a more complex version of Lister's phenol—the pioneer drug of antiseptic surgery. And the polyphenol of wine, malvoside—weight for weight and tested on *E. coli*—*is 33 times more powerful than phenol.*[265]

The Reverse of the Coin: Cures That Made Matters Worse

Ἰατρός

All in all, Greek care for the wound itself probably did little harm and some good. It is quite another story when one comes to the general treatments, aimed at "helping the wound" more indirectly. They range from bad to hair-raising. Imagine cutting the veins of a patient who has already half bled to death through his wound, plus the combined effects of enemas, purges, and vomiting, plus the side effects of poisoning with hellebore, and all of this on a starvation diet. These were times when medicine worked for evolution.

Hellebore alone could claim a long chapter in the history of human err-

or. Even the name applies to two wholly unrelated plants: "black" hellebore, which is now identified with *Helleborus*, better known as Christmas rose (Fig. 4.39), and "white" hellebore, which is *Veratrum* (Fig. 4.40).[266] All they have in common is an almost perverse endowment with poisonous principles, so irritating that they will do something wherever applied. Armed with roots of either kind of hellebore, the iatrós could raise blisters; evoke sneezing, vomiting, and diarrhea; induce delirium, muscular cramps, asphyxia; even cause the heart to stop. Scientifically these effects are fascinating, but too dangerous to be harnessed.

In essence: both hellebores tend to kill, but before doing so, they have a few side effects, including nausea and diarrhea—which is all that the Greek physician really wanted. One might as well shoot a gun blindly in order to enjoy the noise and the smell. It is no wonder that some patients chose the wrong effects, convulsed, and died.[267] The saving grace of hellebore was that it caused vomiting so fast that the patient stood a chance of getting rid of it before absorbing a lethal dose.[268] In the words of Herophilos the Alexandrian, it behaved "like a powerful general: it sets up a great stir inside, and then gets out with the first."[269]

Having survived the hellebore, the patient had to contend with his diet. The attending physician made a strong point about it, for the proper choice of food was supposed to be the foundation of the medical art.[270] Normal food, for the sick, was supposed to be as bad as the food of wild beasts would be for normal human beings.[271] The safest item was a sort of watered-down porridge, barley slops, with much ado about the proper dilution. There was a whole book about it, surnamed *The Ptisan*.[272] It is often said that the ancient Greeks recognized the importance of diet, which is true; but whatever diet they prescribed was unwholesome even for the healthy. They thought that there was something wrong with almost every vegetable; fruit was even worse; the safest foods were meat and cereals. This expensive regimen retained its authority for a couple of millennia. Many of those who could afford it certainly headed toward vitamin deficiency.[273]

And finally, the Greeks thought they could help a wound to heal also by working on it locally with whole families of drugs: *sarcotics* to make flesh grow, *epispastics* to attract humors, *catheretics* to excite the tissues, *mundifiers* to clean sordid ulcers, *emollients* to produce supple scars, and so on. With the exception of a few antiseptics, all this was wishful thinking. But so intense was the wish, so true was the need, and so great the authority of Hippocrates, that the use of such drugs lasted until World War I. They should have died out about 1920. Some are still for sale.

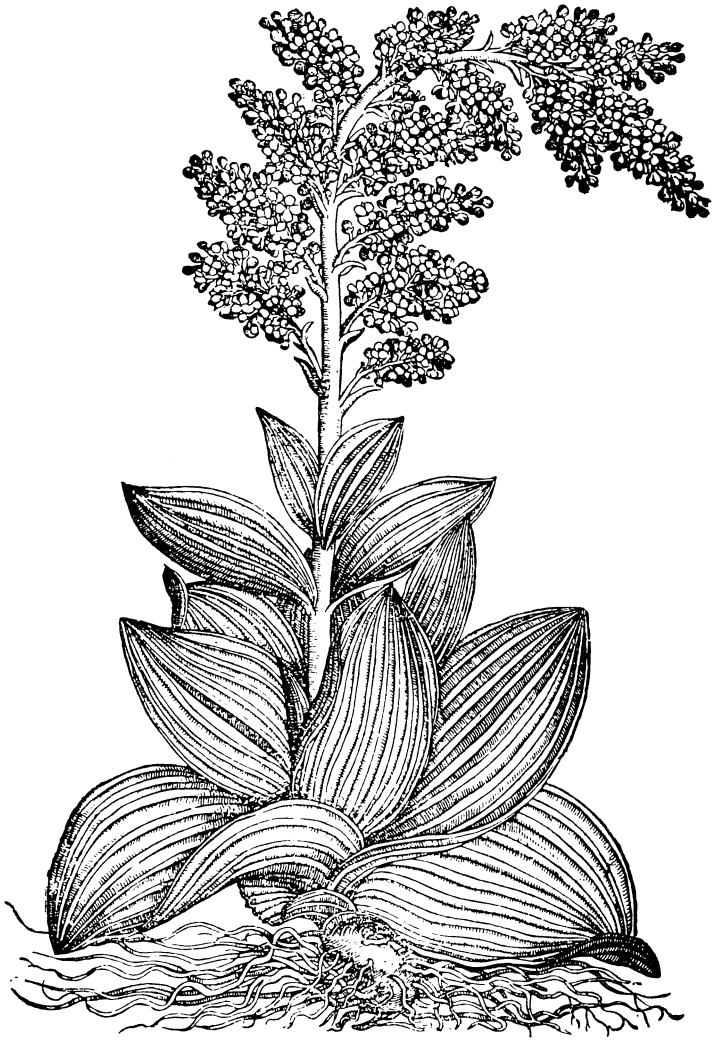
Ἰατρός

This is a thorny subject. People want to be healed, and industry has responded with healing drugs and salves. Some are even advertised in French as *cicatrisants* or "scar-inducers." Yet I am not aware of a single substance that can make a wound heal faster. In experimental animals it is possible to improve certain properties of the wound, such as its tensile strength; but a proven, reliable accelerator of wound healing is not yet available.[274]

Dell'Elleboro nero. Cap. CLIII.

LO ELLEBORO nero ſi chiama Melampodio: percioche ſi dice, che Melampo paſtore di capre fu il primo, che purgò, & ſanò con eſſo le figliuole di Preto diuentate furioſe. Produce le frondi uerdi, ſimili à quelle del platano, ma minori, & quaſi ſimili à quelle dello ſphondilio, ruuidette, piu nere, & aſſai piu intagliate. Produce il fuſto aſpro: & i fiori, che nel bianco porporeggiano, racemoſi: & il ſeme ſimile al cnico, il quale chiamano in Anticira ſeſamoide, & uſanlo per le purgationi. Le radici ha l'elleboro nero ſottili, & nere, le quali hanno origine da un capo quaſi ſimile alla cipolla, delle quali è l'uſo. Naſce nelle colline, & luoghi aſpri, & ſecchi. Il piu ualoroſo è quello, che ſi porta da gli infraſcritti luoghi, come d'Anticira, doue naſce il nero ueramente eccellentiſſimo. Debbeſi eleggere quello, che è ben carnoſo, & ben pieno, che ha poca midol-

4.39 Black hellebore (Christmas rose, a Ranunculacea), the all-purpose drug of the Greeks. It produced centuries of diarrhea and vomiting, some deaths, and presumably no cures. The plant is about one foot high.



4.40 White hellebore (*Veratrum*, a Liliacea), another favorite Greek drug. A much taller plant and quite unrelated to black hellebore, it too is loaded with poisons.

The Limits of Greek Surgery: Amputation

Ἰατρός

The Hippocratics did not know how to amputate. However, in private practice they had to deal with amputation happening by itself. Poor circulation can lead to gangrene of a whole limb; if the dead part dries up fast enough, bacterial infection is held in check, the tissues become mummified, and they eventually fall off. This process is relatively benign, though horrible to see. The Greeks called it "blackening" (*melasmós*). Here is what they did about it:

> With regard to the gangrene of fleshy parts . . . when the forearm and leg drop off, the patients readily recover . . . Those parts of the body which are below the

boundaries of the blackening are to be removed at the joint, as soon as they are completely dead and have lost their sensibility; care being taken not to wound any living part; for if the part . . . which is cut off give pain, and if it should prove not be quite dead, there is great danger lest the patient may swoon away from the pain, and such swoonings often are immediately fatal [*the swooning was called* lipothymia, *literally "soul-leaving"; it was rather the effect of blood loss*]. I have known of the thigh-bones . . . to drop off on the eightieth day; the parts below the knee were separated at the knee on the twentieth day, and as I thought, too early for it appeared to me that this should be done more guardedly.[275]

In another case, "the bones of the leg . . . separated at its middle on the sixtieth day."[275] The account concludes that "such cases . . . are more formidable to look at than to treat . . . for they come to a crisis for themselves; only the diet must be attended to . . . and the body is to be placed in the proper positions."[276]

In essence, the iatrós just stands by while the limb slowly drops off, and nature has time to plug the large vessels, by a beautiful, built-in mechanism. He helps now and then by removing bits of dead tissue, but he will not even saw off the dead bone, which, as explained in the text, sometimes sticks out alone long after the flesh has gone. His wise, conservative attitude was justified: he did not have the know-how, and nature usually did.

Links with Egyptian Medicine

Wound care in ancient Greece was based on ten salient techniques (Plate 4.3). When these are compared with their counterparts in the Smith papyrus, it turns out that the two basic Egyptian methods are not being used by the Hippocratics. The slab of fresh meat is reserved for very special situations (a piece of meat bigger than the big toe, six fingers long, treated with oil of roses, etc., and attached to a thread, went to soothe ulcers of the matrix[277]); the honey-and-grease ointment has disappeared, and honey alone is rarely used.[278]

However, several drugs came from Egypt, and some Egyptian ideas must have traveled with them. Among the materials specifically mentioned as Egyptian are nitron, alum, perfumes, thread, and leather.[279] A heritage of ideas is more difficult to prove, but certainly present.[280] The Hippocratic texts constantly refer to humors that "fix" themselves somewhere in the body and cause disease processes, such as suppuration.[281] The Ebers papyrus had spoken of fixation 1200 years earlier.[282] Even the *ukhedu* may have crossed the Mediterranean; some scholars see it hinted in the theory whereby disease is caused by "undigested residues."[283] The Greeks would amply repay their Egyptian medical heritage by founding Alexandria of Egypt, which became a beacon of medical science.

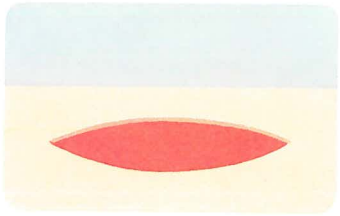
Ἰατρός

Authentic Clinical Histories

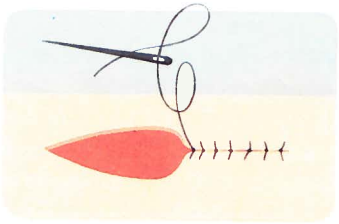
We are now more ready to appreciate a very unusual gift of history: original notes about Greek patients. Although there are no complete clinical

Plate 4.3 Basic procedures of Hippocratic wound care. Whether the sutures were continuous, in separate stitches, or of both kinds, is not known. One obscure passage suggests that both kinds of stitches *may* have been used on the ends of the bandages. It is often claimed that Hippocrates wisely recommended applying poultices *around* the wound, but this was not always the case. See also next page.

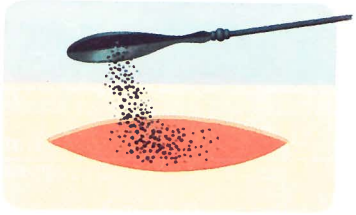
wound washed
(or dressing soaked)
with cold wine, warm
wine, or vinegar



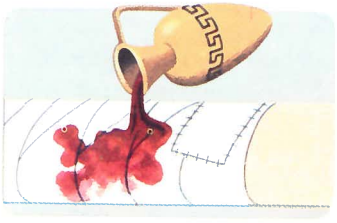
wound left
without dressing



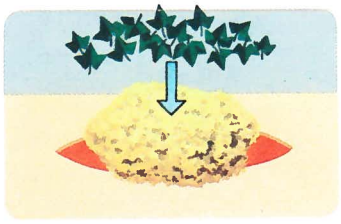
suture



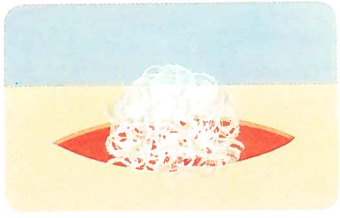
sprinkled with dry
enhemes (antiseptics)



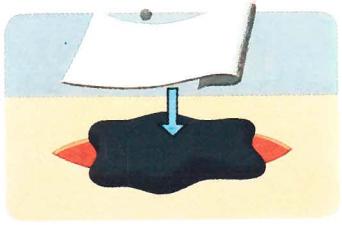
bandage soaked
with wine
(its end is stitched)



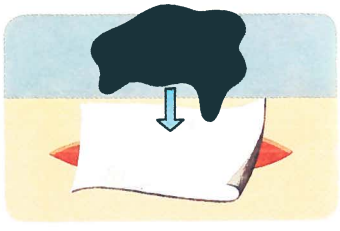
sponge, soaked in
oil and wine,
covered with leaves



wool, soaked in
oil and wine



poultice on wound,
then linen pad
soaked in vinegar



linen pad soaked in oil
and wine on wound,
then poultice

poultice around wound
(recommended for suppuration)

histories of the time, there do exist several sets of short notes that traveling physicians took during their *epidemics* or "visits abroad" to various islands and cities of the Greek world. These epidemics make up seven books of the Hippocratic Collection. Most of them read like personal memos, jotted down in haste; the iatrós recorded only a few facts that he thought to be especially important and probably never meant them to be published in this form. At times one wonders why they were preserved at all.

I have chosen some cases dealing with wounds from Books IV and V. The author may not be Hippocrates himself, because the style is not so elaborate as in Books I and III, traditionally believed to be from the hand of the master. As a result, none of these cases, so far as I know, has been considered worthy of an English translation. Yet the text is gripping for its ability to convey the essential and for its obvious interest in truth. We shall use these notes as a practical seminar in Greek pathology, in which we will try to guess what the iatrós had in mind when he chose to record a given fact.[284]

Billos had been wounded in the back; much air came out of the wound, with noise; he bled; he was treated with enhemes and healed.

The same happened to Dyslytas.[285]

Survival from war wounds such as these must have encouraged physicians to cut their way into the chest.

Aristippos was hit high in the abdomen by a powerful and dangerous arrow. Terrible belly pains. Soon there was inflammation. He did not void from below; he retched; dark bile; and when he vomited he seemed relieved; but a little later the terrible pains returned. Abdomen like in ileus [*intestinal paralysis*]; heat, thirst. He died within the seven days.[286]

Clinically this must be a perforation of the stomach or colon, with peritonitis resulting in intestinal paralysis. Note the implications between the lines: not voiding is bad; vomiting helps. Another undercurrent is evident in the "seven days"; there is a whole Hippocratic book called *On Sevens*.[287] This emphasis reflects the preoccupation with detecting patterns of events in time, patterns that may help future prognoses.

The man of Aenos, in Delos, wounded by a javelin in the back, on the left side, the wound was not painful.

On the third day, sharp pain in the belly; no stools; an enema in the night brought some feces. The pain did not relent.

On the fourth day it was in the loins and invaded the pubis and belly. He could not stay still. He threw up some dark bilious matter; eyes like those of people who faint.

After five days he died; there was a little heat [*fever*].[288]

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Probably another intestinal perforation, this time from the rear, ending in peritonitis. Note again the preoccupation with "days," and the standard treatment of wounds by voiding the intestine.

At Larissa, a man was wounded from behind by a broad lance held in the hands; the point came through under the navel, a long path. Livid, swollen. After the wound he felt at first a sharp pain, and the belly swelled up. The next day this patient was given a purge; he passed some bloody stools and died. It seemed that something was wrong with his intestine, and that blood filled the abdomen.[289]

Again a penetrating abdominal wound, but here the internal bleeding takes its toll before the peritonitis. "It seemed that his intestines were unwell," reads the text literally. To judge from the bloody stools, the intestines are perforated. The purge given under these conditions may have been the coup de grâce.

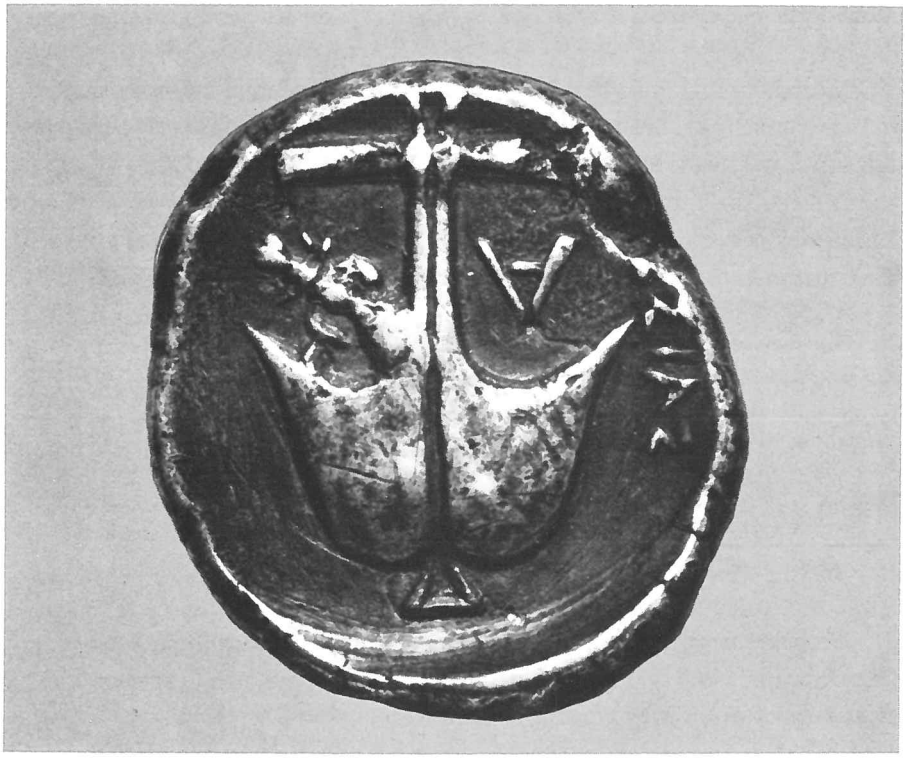
The following cases show that purging and inducing vomit belonged practically to first aid. To understand the first case, note the shape of Greek anchors at that time (Fig. 4.41).

In Salamina, the man who fell on the anchor was wounded in the belly. He suffered a lot. He took a potion and could not evacuate, neither from below, nor by vomiting.

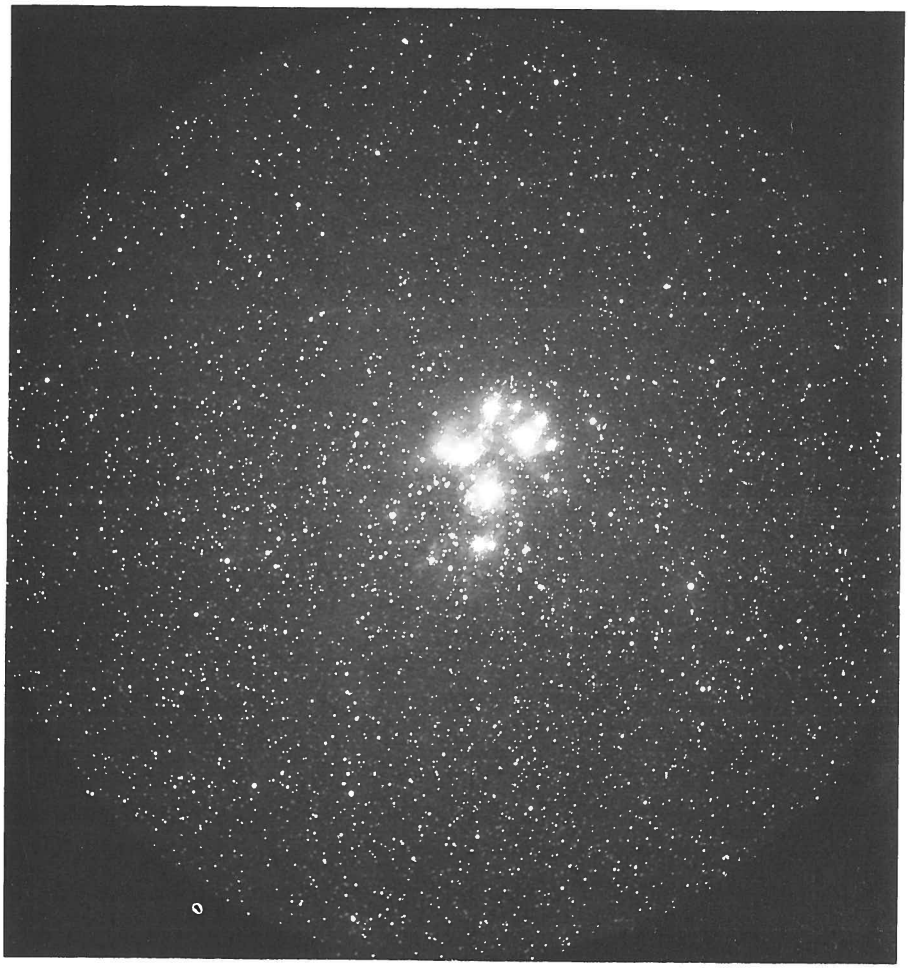
The woman who cut her own throat was choking. She was given a purge much too late; it did loosen the belly.

The woman slave. A potion made her evacuate little from above, with choking, but a lot from below. She died in the night; she was a barbarian.[290]

4.41 An anchor from the time of Hippocrates. This shape, which was relatively new, may explain the case of the "man of Salamina" who fell on an anchor and was wounded in the belly. Greek coin, c.400 B.C.



Ἰατρός



4.42 In trying to explain disease, the Greeks took into consideration even the stars, such as the Pleiades. Here they are today, minus one cluster that has faded away since the time of Hippocrates.

The last case, not a wound, shows the mental workings of the iatrós. His closing remark is not xenophobic; he is trying to find explanations by putting things together, including the fact that this particular woman, who reacted in this particular way, was a barbarian.

What were the relevant facts to put together? The dilemma was overpowering:

Ἰατρός

> Even for good physicians . . . it is difficult to work out, with insight, the right paths: [*a patient may have*] a pointed head, a flat nose, a hooked nose, a bilious nature, he may vomit with difficulty, or be atrabilious, or young, or having led a heedless life—it is difficult to put all these different things together into one sense.[291]

One important factor in any illness could be the weather. A good clinical history included a *katástasis* or "constitution" of the weather and stars at the time of illness.[292] Here is a brief example related to surgery (Fig. 4.42).

> About the time when the Pleiades set, the son of Metróphantos—wounded in the head with a shard (*óstrakon*) by another child—had fever. It was the twelfth day.

[*The reason:*] while washing himself, he hurt the edge of the wound, and caught cold. Soon the lips of the wound swelled up, and all around it the skin became thin. He was promptly trepanned. No pus came out, nor was there any relief. Pus seemed to form near the left ear (the wound was on that side). But then this abscess did not form, and the left shoulder filled up fast with pus. He died about the twenty-fourth day.[293]

This was a deadly infection spreading downward from a relatively minor wound of the head. The implications: maybe the stars had something to do with the malignant course, but the wound definitely caught cold. And disappointingly, the crown drill (Fig. 4.43) found no pus; perhaps there was some difficulty in the formation of pus (this is, indeed, the case in certain very severe infections).

Another patient taken away by infection:

The man of Malia, a loaded wagon passed over his chest and broke his ribs. After some time pus formed, low on his side. Cauterized below the spleen, and carrying a wound dressed with a tent, he went on for ten months. An opening appeared going from both sides into the epiploon [*a membrane inside the belly*] and leading, through a corrupt passage, from the open skin to the kidneys and bones.

It had not been recognized that this man's body was of bilious habit; and there was corruption in the body as well as in the disease: advanced corruption of the epiploon and other flesh, to be eliminated at once by means of a dry drug, while the man still had some strength. In fact, moist means, far from helping him, made the corruption worse. Moisture being retained by the tents, he was taken by shivering and fever; the corruption advanced; there dripped a putrid, blackish, stinking matter, of the same kind that flowed out before the beginning of the treatment; it did not come easily. It was recognized that the main disease was farther than beneath the skin. Even if all had been done in the best possible manner, it seemed that he could not have been saved. Diarrhea took him.[294]

Treatment poor; insight and honesty great. The bizarre notion that not only the body but the disease itself had become corrupt may be a way of

4.43 The crown drill (*prión*), sometimes used on the skull instead of the pointed drill (*trýpanon*). About one-half actual size.

saying that the course had become "malignant." The "dry drugs" are the antiseptic enhemes.

Several histories relate to osteomyelitis in children—a reminder of what life can be like without antibiotics. Patches of bare bone, exposed by infection, were so common that they had a special name, now forgotten: *psíloma*, "a bareness":

The child of Phile, who had the bone laid bare in his forehead, had fever on the ninth day; the bone became livid; he died.

The same happened to the child of Phanias and to the child of Euergetes. The bone becomes livid, there is fever, the skin comes off the bone, and no pus appears.[295]

The cases of osteomyelitis reappear in *Epidemics VII*, slightly modified, and with this addition:

Trepanation brought out of the bone itself a thin ichor, serous, yellowish, stinking, deadly. In such cases vomiting may also occur, and spasms towards the end, and sometimes loud cries, and sometimes paralysis, on the left if the wound is on the right, on the right if it is on the left.

The child of Theodoros exposed himself to the sun on the ninth day. Fever came on the tenth day from a bareness of the bone which was, as one might say, nothing at all. During the fever the part became livid, the skin came off; many loud cries; on the twenty-second day the belly swelled up, especially toward the hypochondria; on the twenty-third he died . . .

The child of Isagoras was wounded in the back of the head, the bone was injured and became livid on the fifth day. He was healed, and the bone did not slough off.[296]

The next, appalling case of osteomyelitis can scarcely be the result of just a caries and infection; bad nutrition may well have interfered:[297]

At Cardias, the son of Metrodoros, after a toothache, had gangrene of the jaw; terrible overgrowth of flesh on his gums; he gave a moderate amount of pus; the molar teeth and the jaw fell out.[297]

But infection was unpredictable, then as now (Fig. 4.44):

The cobbler, while piercing a sole, stabbed his thigh with the awl, above the knee, to the depth of about a finger.

No blood came out and the wound closed fast, but the whole thigh swelled up, and the swelling gained the groin and the flank. This man died on the third day.

Ἰατρός

But the one who was wounded by an arrow in the groin, and whom we saw ourselves, was saved most unexpectedly: because neither was the point extracted (it was lying too deep) nor was there any hemorrhage worth mentioning, nor inflammation, nor lameness. When we departed he still had the point, and that was after six years. It was thought that it lay between the tendons, and that no vein or artery had been severed.[298]

Note the unbiased report. The first man had a typical stab wound with practically no bleeding, and died, which fits the writer's scheme of things,

4.44 "The cobbler, while piercing a sole, stabbed his thigh . . ."

since bleeding helps. But he also tells that the second healed beautifully, though his hemorrhage "was not worth mentioning." The passage is also remarkable as being the only one, as far as I can ascertain, in which arteries and veins are clearly mentioned in a proper anatomical context[298] (the tendons, however, are still called *neura;* to this day some are called apo*neuro*ses).

The next case is a war wound with something strange about it:

Ἰατρός

> Tychon, at the siege of Datos, was hit in the chest by a catapult, and after a while he was taken by convulsive laughter. It seemed to me that the physician who drew out the shaft left a piece of the lance in the diaphragm. Because he was in pain, the physician gave him an enema and a purge. He went through the first night very uncomfortably. When day came it seemed to the physician and to the others that he was better.
>
> Prognosis: with spasm developing, he will die promptly.
>
> The following night he was in pain and could not sleep; he lay mostly on his belly. On the morning of the third day he was seized by spasm and died.[299]

To the writer this case was important because he had observed, or believed he had observed, a strange kind of laughter (Littré rendered it as *rire plein de trouble*). It also seemed to him that a piece of the missile (Fig. 4.45) had been left in the *diaphrágma.* The diaphragm, also called *phrénes,* was

currently thought to be the site of the soul and probably also of laughter (*phrenítis* meant "madness," hence the modern words *phrenetic* and *frantic*). This belief was certainly held five hundred years later when Pliny wrote his *Natural History:* "To this membrane unquestionably is due the subtilty of the intellect; it consequently has no flesh, but is of a spare sinewy substance. In it also is the chief seat of merriment, a fact that is gathered chiefly from tickling the arm-pits to which it rises . . . On this account there have been cases in battle and in gladiatorial shows of death caused by piercing the diaphragm that has been accompanied by laughter."[300] In the Hippocratic books, opinions vary. One book maintains that the diaphragm can scarcely be the seat of the soul, because . . . it has no hollowness in which to receive the good and the bad; but in another book the diaphragm can become delirious.[301] As the question remained open, it was worthwhile remarking that a piece of lance stuck in the diaphragm was associated with strange laughter.

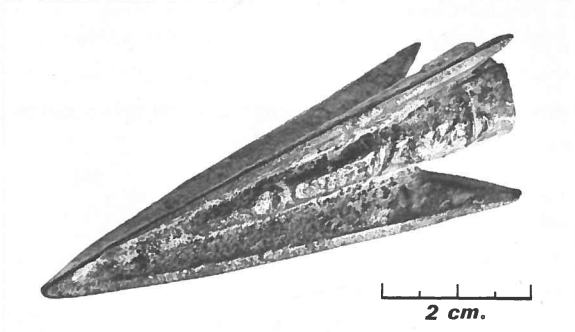
The "spasms" in this case are possibly terminal convulsions, but in the next cases the spasms tell a more precise story:

> The one who was hit by a sharp arrow in the back a little below the neck had a wound that seemed barely worth mentioning, because it did not go deep. But before long, after the arrow was pulled out, he was arched back by convulsions like those of opisthotonos; and the jaws locked; and if he took some fluid into the mouth and tried to swallow it, it came back through the nostrils; and the other signs became worse, and on the second day he died.[302]

This must be tetanus, with its typical symptoms, opisthotonos (Fig. 4.46)[303] and "lock-jaw." Between the wound and the first symptoms, the incubation period is on the average six to seven days; an incubation period of one day, though not unheard of, is extremely rare. Hence, death "on the second day" should rather be understood as "on the second day since the onset of spasms." This also applies to the next two cases:

> The watchman of the big ship had the index and lower bone of the right hand crushed by the anchor. Inflammation developed, gangrene, and fever. He was purged from below, moderately; heat and pain mild; a bit of the finger came off. After the seventh day there came some pus, of passable quality. After this [*he complained*] of the tongue, he said he could not pronounce all [*words*].
>
> Prognosis: opisthotonos will come.

4.45 A tricuspid spearpoint, probably fired from a machine. About 348 B.C. Ἰατρός



4.46 Opisthotonos ("the backward spasm") and lockjaw, the terrifying symptoms of tetanus. For the Greeks, spasms in general were diseases, not symptoms; the simplest was shivering.

The jaws began to come tightly against each other, then the neck [*was taken*]. The third day the whole body arched back in a spasm, with sweat. On the sixth day after the prognosis he died.

Telephanes, son of Harpalos and of the freedwoman, sprained his thumb.[304] It became inflamed and painful. And after this was over he went to the country. When he returned he had pains in the loins; he took a bath; during the night the jaws locked, and opisthotonos appeared; his spittle was frothy and could scarcely come through the teeth; he died on the third day.[305]

Peace to the watchman, he surely died of tetanus. As to Telephanes, it may seem strange that he caught tetanus by a simple sprain; but modern statistics allow it. In some series, less than half of the cases have a visible injury of the skin.[306] Besides, in another book the case of Telephanes is written up again, and that time he "hurt" and most likely "pricked" his thumb.[307]

Tetanus could also be the doctor's fault:

Thrinon, son of Damon, had a wound at the ankle near the tendon, already mundified; it was irritated by a drug, and he came to die with opisthotonos.[308]

The spores of tetanus thrive in the feces of domestic animals. A clean folk, with plenty of animals and no soap, was well qualified to hand down the name of *tetanus*, "the stretches," and of *opisthotonos*, "the backward spasm."

Ἰατρός

The iatrós tended all these wounds the best he could. In the back of his mind, however, he knew that he was not alone. Witness these two thoughts, recorded in the *Epidemics:*

Nature, without instruction or knowledge, does what is necessary.
Natures are the physicians of diseases.[309]

The word for nature was *physis.* There is this message in the word *physician.*

The Drakon

When all else had failed; when the wound simply refused to heal, and no iatrós in town could think of a new and different plaster; when Gorgias had carried the arrowhead in his lung for a year and a half and filled sixty-seven pots of pus[310] and nobody could help him—there was still one hope: the temple of Asklepios. It was called the Asklepieion. Asklepios, the patron god of physicians (his name was Latinized as Aesculapius), did some healing of his own; and since his mortal pupils were loathe to take on a hopeless case,[311] his practice must have been a large one. It was an aid, not a competition, for official medicine. There is no evidence that the lay physicians ever objected to the assistance offered at the Asklepieia;[312] and besides, doctors have always welcomed help in hopeless cases. The two approaches were basically different, and could be well integrated in a society in which patient and physician alike firmly believed in the existence of the gods, with physicians themselves offering sacrifices to Asklepios.[313] "Prayer indeed is good—is written in a Hippocratic book—but while calling on the gods one must oneself lend a hand."[314] And in another book: "The gods are the real physicians, though people do not think so."[315]

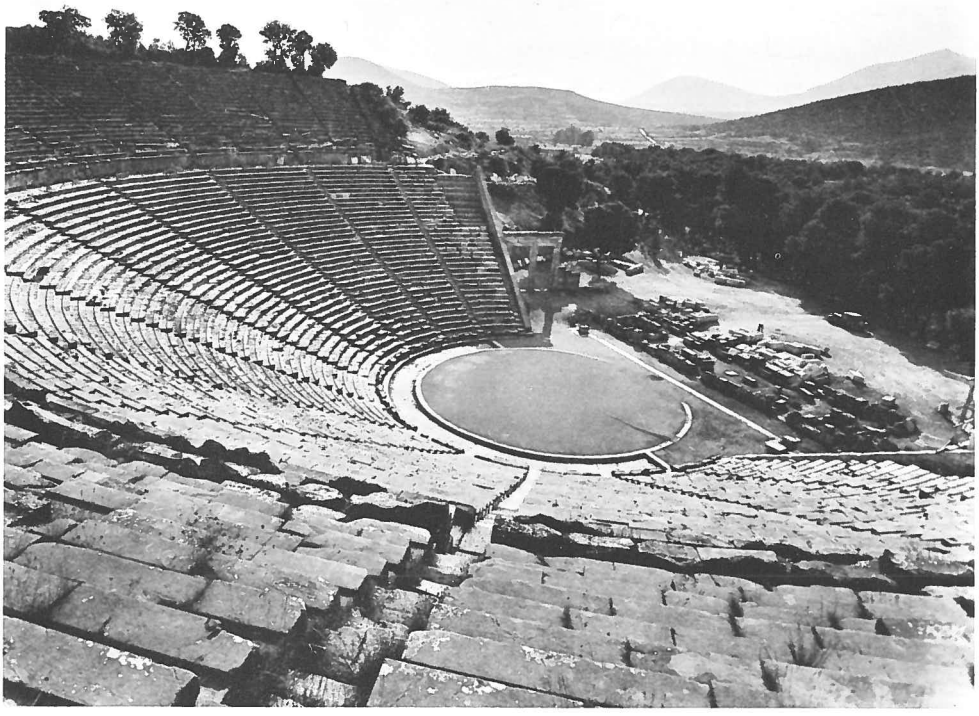
The crowd of hapless beings who flocked to the temples of Asklepios knew that there would be no knife, no cautery to fear. The ritual would be simple: relax on the holy grounds, take in the beauty of the surroundings, listen to the hymns, and wait for the night.[316] Then each patient would be required to lie down in the sacred hall called the *ábaton* ("place of no walking") and wait for the god to appear and give advice in a dream. The priests would assist, receive a small gift for the god (perhaps a cheese cake or a votive tablet), and maybe act as guides to the amenities that came with the temple: the baths, the theater (Fig. 4.47). But all the medical gestures would be up to the god.

The god appeared sometimes in person, sometimes in the disguise of his sacred animals, the snakes and the dogs, which were tended in the temple.[317] Where were these creatures kept? How did they reach the patients? What did the sacred hall look like? Unfortunately, no artist has left us a picture, although at least one hundred shrines of Asklepios existed in ancient Greece.[318] But the priest saw to it that the results were recorded.

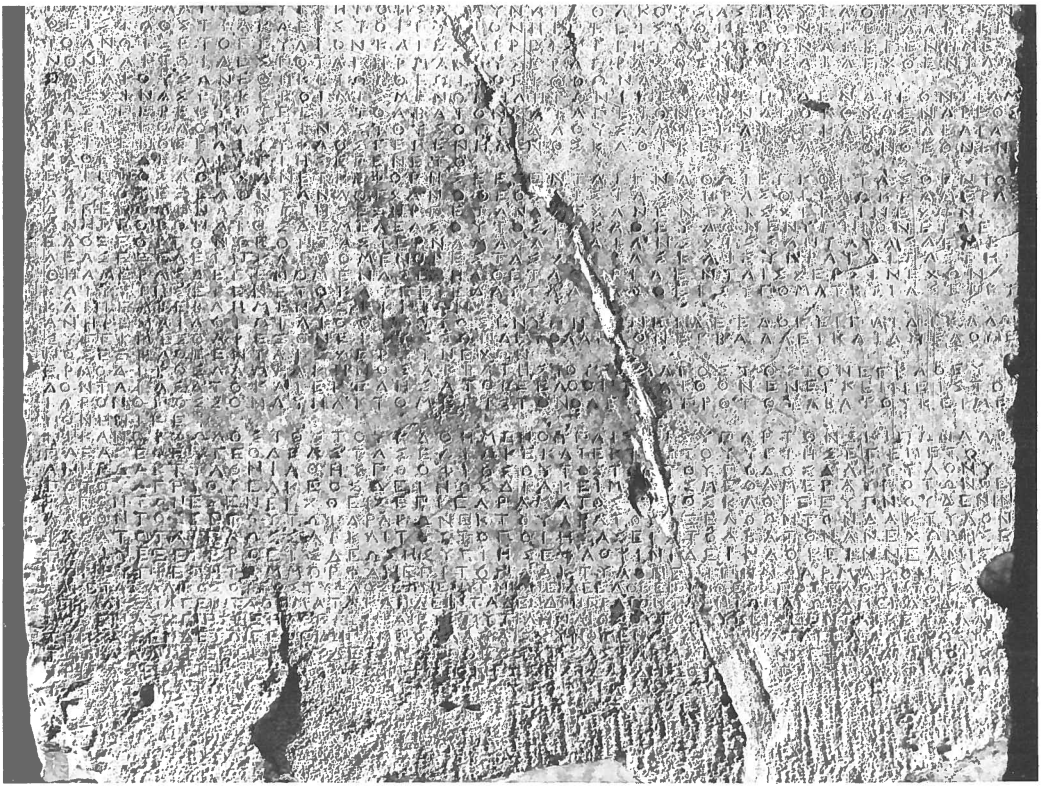
In Epidauros, in the ruins of the most celebrated Asklepieion, a large marble stele was found (Fig. 4.48), together with the remains of three others.[319] It preserves the case histories of seventy patients who came to the temple with a problem and shed it there, plus one who misbehaved toward the god and came away with a problem.[320] One of these cases is that of Gorgias.[321] Written in very simple style, about 350 B.C., with no punctuation or separations between the words, it reads like this (the opening phrase is a title):

Ἰατρός

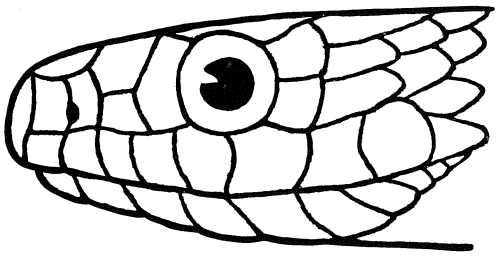
GORGIAS OF HERAKLEIA WITH PUS IN A BATTLE HE HAD BEEN WOUNDED BY AN ARROW IN THE LUNG AND FOR A YEAR AND A HALF HE HAD SUPPURATED SO BADLY THAT HE FILLED SIXTY-SEVEN BASINS WITH PUS WHILE SLEEPING IN THE TEMPLE HE SAW A VISION IT SEEMED TO HIM THE GOD EXTRACTED THE ARROWHEAD FROM HIS LUNG WHEN DAY CAME HE WALKED OUT WELL HOLDING THE ARROWHEAD IN HIS HANDS



4.47 The plays offered in this amphitheater, on the grounds of the temple of Asklepios at Epidauros, were surely of value as psychotherapy.



4.48 Marble stele, found at Epidauros, describing miraculous cures at the Asklepieion. Several of the cures concern wounds. About 350 B.C.



4.49 Head of *Elaphe longissima longissima,* the snake of Asklepios. It is a tree climber and a constrictor, harmless to man.

When Asklepios used a drug, it was a dream drug:[322]

TIMON [*fault in the stone*] WOUNDED BY A SPEAR UNDER HIS EYE WHILE SLEEPING IN THE TEMPLE HE SAW A DREAM IT SEEMED TO HIM THAT THE GOD RUBBED DOWN AN HERB AND POURED IT INTO HIS EYE AND HE BECAME WELL

Asklepios also practiced dream surgery. Note that the pupils of the eye are called "the so-called pupils," as if the readers were assumed to be rather simple-minded laymen:[323]

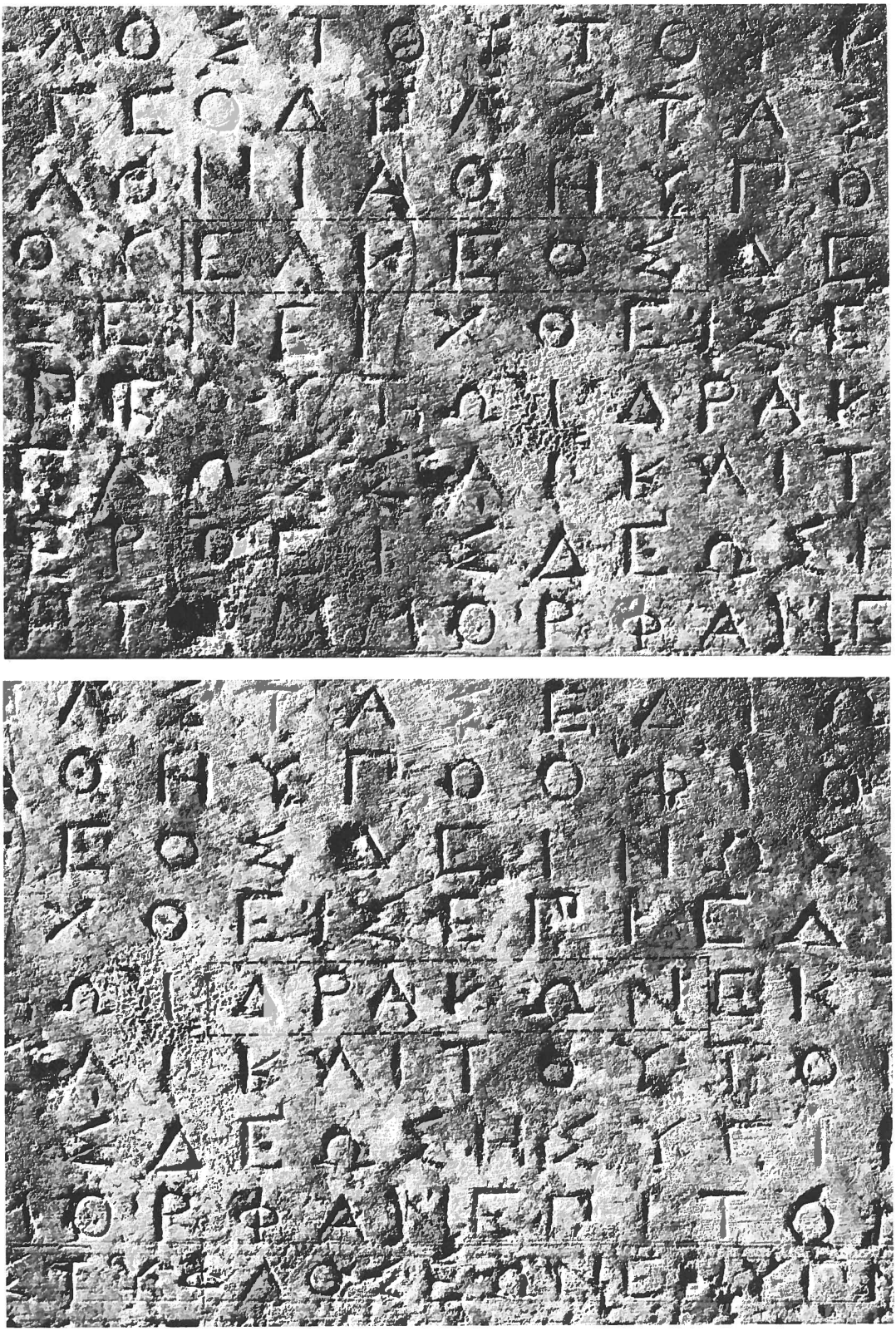
ANTICRATES OF CNIDOS EYES IN A BATTLE HE HAD BEEN HIT BY A SPEAR IN BOTH EYES AND HAD BECOME BLIND AND THE SPEARPOINT HE CARRIED WITH HIM STICKING IN HIS FACE WHILE SLEEPING HE SAW A VISION IT SEEMED TO HIM THAT THE GOD PULLED OUT THE MISSILE AND THEN FITTED INTO HIS EYELIDS AGAIN THE SO-CALLED PUPILS WHEN DAY CAME HE WALKED OUT SOUND

The next patient was lucky enough to receive also the attention of the snake, the *drakon;*[324] his case combines the three main therapeutic themes, the snake, the god, and a drug. Descendants of the healing snake are still quite common: *Elaphe longissima longissima,* Europe's only constrictor, can be five feet long but is quite harmless to man (Fig. 4.49). Its reputation as a healer was tremendous: the Romans imported it from Greece in 291 B.C., even before they had imported a regular Greek physician (Fig. 4.50).[325]

THE MAN WHOSE TOE WAS HEALED BY THE SNAKE THIS MAN MUCH SUFFERING FROM A DREADFUL WOUND OF HIS TOE WAS CARRIED BY DAY ON A STRETCHER BY THE SERVANTS OF THE TEMPLE AND LAID OUT IN THE OPEN AIR AND HE FELL ASLEEP THEREUPON A SNAKE HAVING EMERGED FROM THE ABATON HEALED HIS WOUND WITH ITS TONGUE AND HAVING DONE THAT RETURNED TO THE ABATON WHEN THE MAN UPON WAKING UP FOUND HIMSELF TO BE HEALED HE SAID IT SEEMED AS IF HE HAD HAD THE VISION OF A FAIR YOUNG MAN SPREADING A DRUG ON HIS WOUND

Ἰατρός

The man was rather vague about the facts because he had been asleep, and also was probably blindfolded, just in case. We know this from Aristophanes, who is no believer in the system and tells of patients who peeked from beneath the bandage and saw the servants making off with their goods:[326]



4.50 Details of the text on the stele at Epidauros: this man suffered "of a wound," ΕΛΚΕΟΣ (above, box), and was healed by the touch of "the snake," ΔΡΑΚΩΝ (below, box).

Then, glancing upwards, I behold the priest
Whipping the cheese-cakes and the figs from off
The holy table; thence he coasted round
To every altar, spying what was left.
And everything he found he consecrated
Into a sort of sack.

Anyway, the wound was healed.

After Hippocrates

With respect to the treatment of wounds the Hippocratic legacy left much to be desired. But it would be unfair not to acknowledge the unique insight of those physicians. Their natural ease with the abstract led them to guess a number of rules before the game was ready to be played. They spoke of sepsis[327] without knowing of bacteria, of spasms in vessels that they could not see, of *diuretiká* with no diuretics to speak of. Two millennia later we are still hunting for facts to fit their concepts. The notion of *rheumatism,* although exasperating in its vagueness, remains the title of university courses. Even that ghastly theory of blood, bile, and phlegm was so well adapted to human nature that, instead of dying, it became permanently embedded in our language. When we say that someone is sanguine, or bilious, or melancholic, or phlegmatic, we are still blaming, in turn, each one of the four humors (Fig. 4.51).[328]

In dealing with wounds, the antiseptic enhemes were a discovery, and they caught on. The Greek emphasis on cleanliness and the generous affusions with wine survived with ups and downs. Hemostasis with the tourniquet, though dangerous alone, was a good beginning; but it faded away and was lost for some 1500 years. The surgical drain, like auscultation, was not resuscitated until the nineteenth century.

The tight bandages were a step in the wrong direction. So was the notion of encouraging suppuration, which became standard practice. And worst of all, the three basic general "treatments"—bleeding, starving, and purging—spread like wildfire all over the Western world. In today's jargon one would say that they had been very well sold. Anybody could see how true they were—with the eyes of his mind.

After Hippocrates, the first major advance had to be the ligature of blood vessels. It came soon and was lost again, not to be retrieved until the 1500s. Apart from this, the tale of the wound becomes one long, dull parenthesis, broken by a few bright episodes; the pace will change abruptly in 1865, with Lord Lister and antisepsis. It took that time, some seventy generations, to find out how the body works. Greek philosophy had thrown open the door to the abstract; but to understand the ways of the flesh, a different approach was required: the experimental method. To produce real science, remarks Joly, it is not enough to free oneself of magico-religious concepts; other demons have yet to be conquered, and these will be all the more difficult to exorcise in that their link with reason is closer.[329] Here the iatrós

Ἰατρός

℄ Flegmaticus.
Vnſer complex iſt mit waſſer mer getan
Daruñ wir ſubtilikeit mit mügen lan.

℄ Sanguineus.
℄ Vnſer conplexion ſind von luſtes vil.
Darumb ſeÿ wir hochmütig one 3yl.

℄ Melencolicus.
℄ Vnſer complexion iſt von erden wëych
Darüb ſeÿ wir ſchwärmütigkeyt gleich

℄ Coleticus.
℄ Vnſer complexion iſt gar von feüer
Schlahē vñ kriegen iſt vnſer abentëüer.

4.51 The four temperaments, illustrated in a German calendar about 1480 A.D.

stopped short. His basic science should have begun with anatomy, and he knew some, but he preferred the anatomy of thought. He had freed himself of religion to become the prisoner of philosophy.[330]

Hence it is appropriate to close this chapter with words of wisdom from a Greek philosopher—medical wisdom, which will last as long as men will care for men. In one of Plato's dialogs, a young man—Charmides—complains about a headache. He would like a certain drug; but Socrates explains to him at length that this simple treatment is not adequate. "To treat the head by itself, apart from the body as a whole," he says, "is utter folly." The ideal approach had once been described to him by a Thracian physician:

Ἰατρός

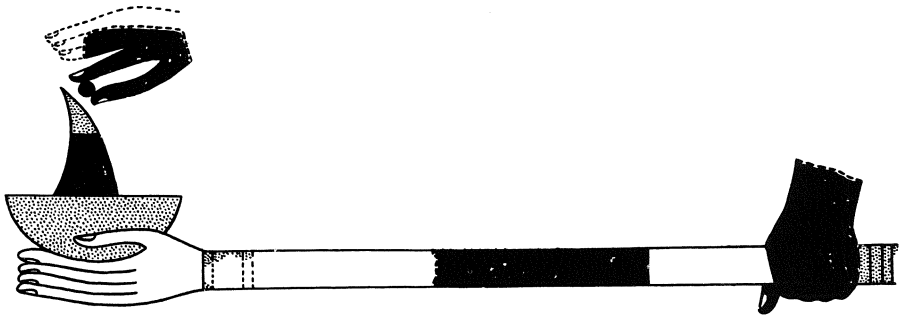
> You ought not to attempt to cure eyes
> Without head,
> Or head without body,
> So you should not treat body
> Without soul.[331]

5 The Perfumes of Arabia

There is a lost fragrance about ancient drugs. A disconcerting fragrance of incense, roses, and cinnamon, which keeps luring the mind out of medicine into the church, the kitchen, and the beauty parlor. But these contrasts are entirely a matter of custom. Our ancestors, who liked to smear themselves with cinnamon oil, might have marveled at cinnamon bread as we would at incense pie.[1] Besides, perfume for them was a far broader concern, with broader implications than it has today. What was good to breathe, or eat, or drink was also good for the gods, for disease, and for wounds. So the Greeks had one lovely word, *arómata,* to cover much of what we would now break down into incense, perfumes, spices, and drugs.[2] Aromata were the zest of life. That is what the Romans meant when they said "my myrrh, my cinnamon" as we would say "my darling."[3]

It is difficult to grasp the importance of perfumes in the history of mankind.[4] More than a luxury, they have been one of the basic necessities of life. In ancient Egypt, around 1180 B.C., laborers on a necropolis went on strike because the food was bad and "we have no ointment."[5] In the Old Testament, "ointment and perfume rejoyce the heart."[6] Good and bad smells have always enjoyed the loftiest associations: Good and Bad, God and the Devil. Part of Alexander's greatness, according to tradition, was his personal fragrance;[7] and I have before me a list of Christian saints who smelled good, either alive or dead: it is thirty-five pages long.[8]

Doubtless these associations have a deep biological meaning, rooted in



5.1 Egyptian censer in the form of a human arm, c.1900 B.C.

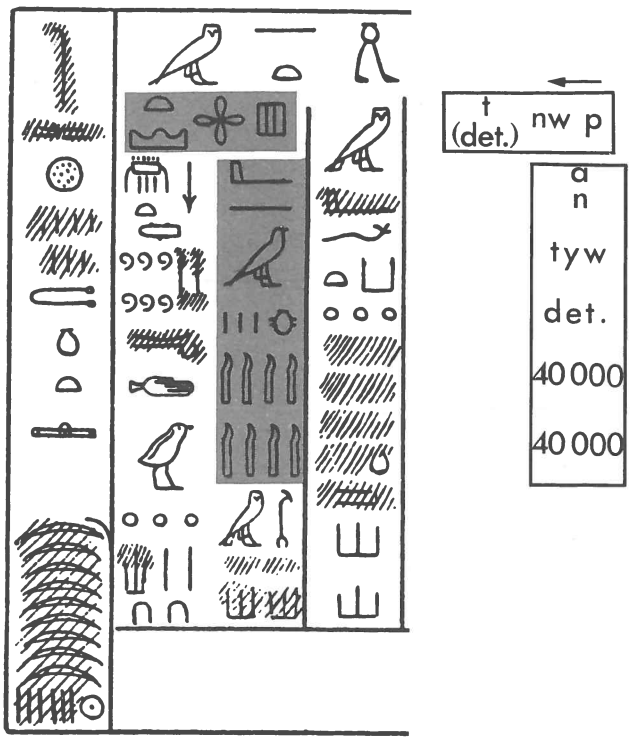
evolution. By recognizing the smell of decay as "bad," we automatically shun danger and death. On the other hand, the sense of smell may have been of help in recognizing plants of medicinal value: substances that have a strong smell are also likely to have a physiological effect. This may have been the manner, for instance, in which the South African natives narrowed down their available nine thousand plant species to perhaps two or three hundred.[9] So the quest for good smells has always been pursued with the intensity of a need. The sense of smell, after all, is not just a luxury: it has a survival value.

The spiritual role of perfumes is bound up with sacrificial fires. It was smoke that carried aloft the fragrance of man's gifts to the gods.[10] In fact, the word perfume comes from *per fumum*, "by smoke."[11] Incense was the perfect gift to the gods, because it was not shared by man, being consumed by fire to the last grain (Fig. 5.1).[12] The smoke of sacrificial fires was regarded as actual food for the gods, who would starve without it.[13] There is a comedy of Aristophanes in which birds stir up trouble by preventing the sacrificial smoke from reaching the heavens; and in a satirical work of the second century A.D. the workshop of Zeus is depicted as a sort of attic, with trapdoors covered by a lid, one of these being reserved for sacrificial smoke.[14]

The first sacrifices of the ancient Greeks, wrote Theophrastos, were fires of aromatic bushes.[15] Eventually the Greeks developed a whole line of aromatic gum-resins, their favorite being obtained from *Pistacia terebinthus*, the turpentine tree; but none of these home products could match Arabian frankincense and myrrh, whose reputation was already at least two thousand years old by the time of classical Greece. An Egyptian inscription from the Fifth Dynasty, about 2500 B.C., records the purchase of "80,000 measures" of myrrh; whatever the measure, this was a lot of myrrh (Fig. 5.2). A thousand years later another Egyptian bas-relief shows that the grains of myrrh, those precious grains that had been gathered one by one, were hoarded in heaps (Fig. 5.3).

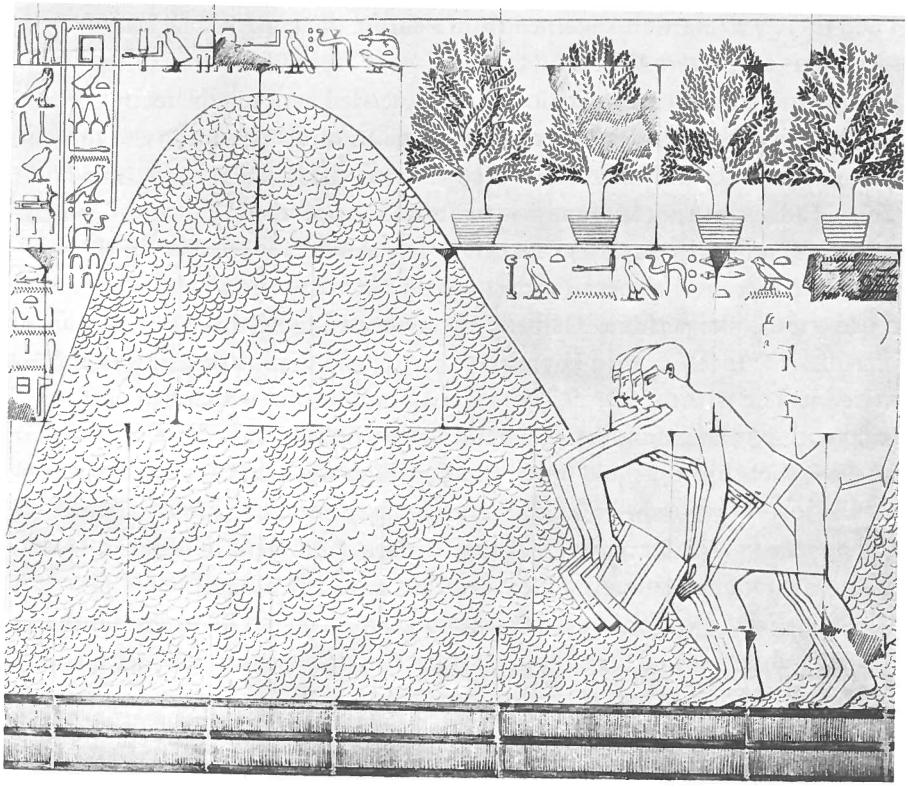
The Perfumes of Antiquity

A few perfumes of antiquity, like musk, were animal products. Of these, the most used in medicine was castoreum, which has nothing to do with



5.2 The earliest reference to myrrh (shaded), about 2500 B.C., when its trade was already on a wholesale scale. The pharaoh Sahurê was importing "Pwnt antyw 80,000": *Pwnt* was probably Somaliland; *antyw* was myrrh.

5.3 About one thousand years later myrrh was still used by shovelfuls at the court of Queen Hatshepswt, as shown by part of a relief commemorating the queen's own expedition to Pwnt, to get myrrh and myrrh trees.

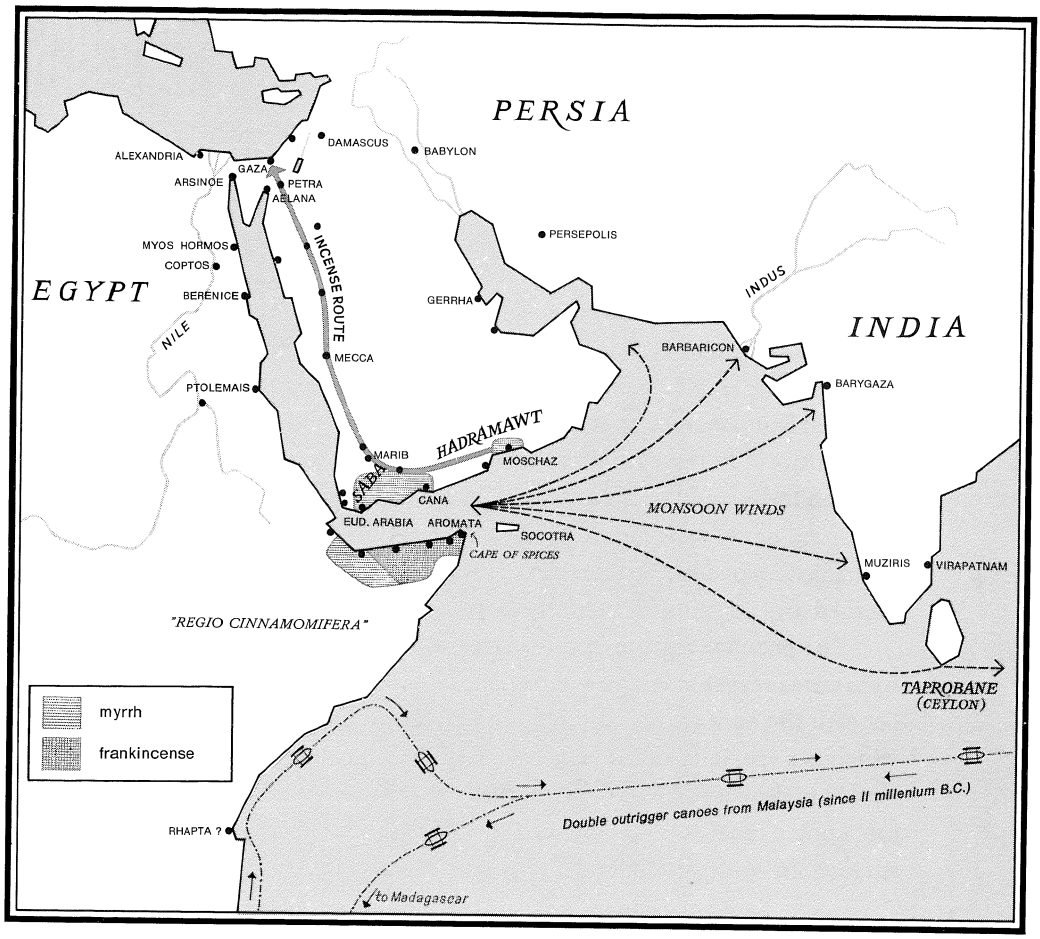


castor oil, being obtained, against all odds, from the rear end of the beaver. According to all ancient treatises on drugs that I have seen, castoreum was obtained from the testicles, but it seems that some information was lost between the beaver and the market: a modern chemical analysis of castoreum specifies that it was extracted from the scent glands, which lie between the anus and the genital organs. It contained, among other aromatic substances, hydro*cinnamic* acid; and it may also be the only animal product known to contain salicin and salicylic acid: aspirin in disguise![16]

Many other perfumes were obtained from herbs; still others were the product of trees, sometimes of wounded trees. Of special importance was (as it still is) the group of substances that ooze out of trees. Some of these trickle straight out of an incision, like blood (though they are not to be confused with sap, which is the real "blood" of the tree); others are pathologic: they develop some time after an injury, as if a "gathering" had formed around a bruise in the bark.[17] Chemically they are highly complex and varied mixtures, which can be broken down into three main groups of components, not all perfumed: *resins,* the sticky materials that are insoluble in water but often soluble in alcohol; *gums,* which are insoluble in alcohol but capable of taking up water to form a mucilage, like gum acacia; and *oleoresins* and *balsams,* the syrupy liquids that contain resin dissolved in volatile oils and are responsible for the perfume, like Mecca balsam or the ooze of the turpentine tree. Balsams also contain a high proportion of *balsamic acids,* which are partially soluble in water.[17]

The whole family of resins, gums, and balsams that were prized in antiquity would be too tedious to review, but even a partial list suggests the variety of the trade. The two most important were frankincense and myrrh. Then there was mastich, obtained from a shrub, the lentisk. The best specimens came from the island of Chios. As it "speedily softens in the mouth, and may be easily masticated and kneaded between the teeth,"[18] I assume it was the principal chewing gum of antiquity. The history of turpentine, queen of resins, would easily fill a volume; the best also came from Chios. Ladanum—not laudanum—was the strangest of all. This resin, which rubbed off onto sheep as they brushed by the plants, was combed off the sheep's fleeces with a special gadget, called *ladanisterium;*[19] not surprisingly it had a musklike perfume. Galbanum, mentioned in Exodus 30:34, was an ingredient of incense; with Hippocrates it dropped to pessaries, in which it shared its fate with incense.[20] There was ammoniacum, which had nothing to do with our ammonia.[21] Pliny mentions, without further details, a resin from a sort of olive tree, sold by the Arabs, which was excellent "for contracting the scars of wounds."[22] Then there were bdellium, two kinds of storax, and opopanax. The black sheep was asafetida, a condiment in India, but definitely not a perfume. And I leave out many, many others.[23]

Nor shall I dwell on the uses of all these aromata; but just consider that the gums were chewed long enough to give the verb *to masticate,* from gum mastich (the Egyptians, however, chewed papyrus[24]). The resins were precious as adhesives, though Pliny, who tends to find reasons for complaint, writes in the first century A.D., "I am ashamed to confess that the chief value



5.4 The home of myrrh and frankincense: a small area, but in a key position. The Roman name of *Regio cinnamomifera* for East Africa proves the success of Arab merchants in hiding the true source of cinnamon, India.

now set on resin is for use as a depilatory for men."[25] The volatile oils were chiefly responsible for the medical uses. When we read that their fragrance is plainly detectable today in some Egyptian mummies,[26] we can begin to understand why the ancients felt so strongly about them, even to the point of fighting pitched battles in defense of a single shrub.[27]

Twice-Happy Arabia and Its Trees

In view of the fame of myrrh and frankincense, it is hardly conceivable that they came, as they still do, from a very small corner of the world: part of the South Arabian coast—the main source—and the Horn of Africa just opposite (Fig. 5.4). That is where the right trees have chosen to grow:[28] two genera belonging to the family of Burseraceae.

In Greek and Roman times, Arabia was a shifting mosaic of small states, including the Biblical Saba, strung around the desert.[29] It was about 950 B.C. when the Queen of Saba paid her famous visit to Solomon, third king of Israel. Although the precise motives of her trip are not recorded, it certainly included commercial interests, and tradition relates it to the incense trade.[30]

Saba itself was the main producer of myrrh; most of the incense came from the kingdom of Hadramawt, farther east (Fig. 5.4).[31] Until the first century A.D., part of the precious harvest found its way to the southern harbors to be shipped as far as India; but the supplies for the Mediterranean countries went mainly overland, heading north by the Incense Route.[32] The caravans threaded their way through the various states, paying duties all along, so that by the time they reached their destination, the price of a camel load had soared.[33]

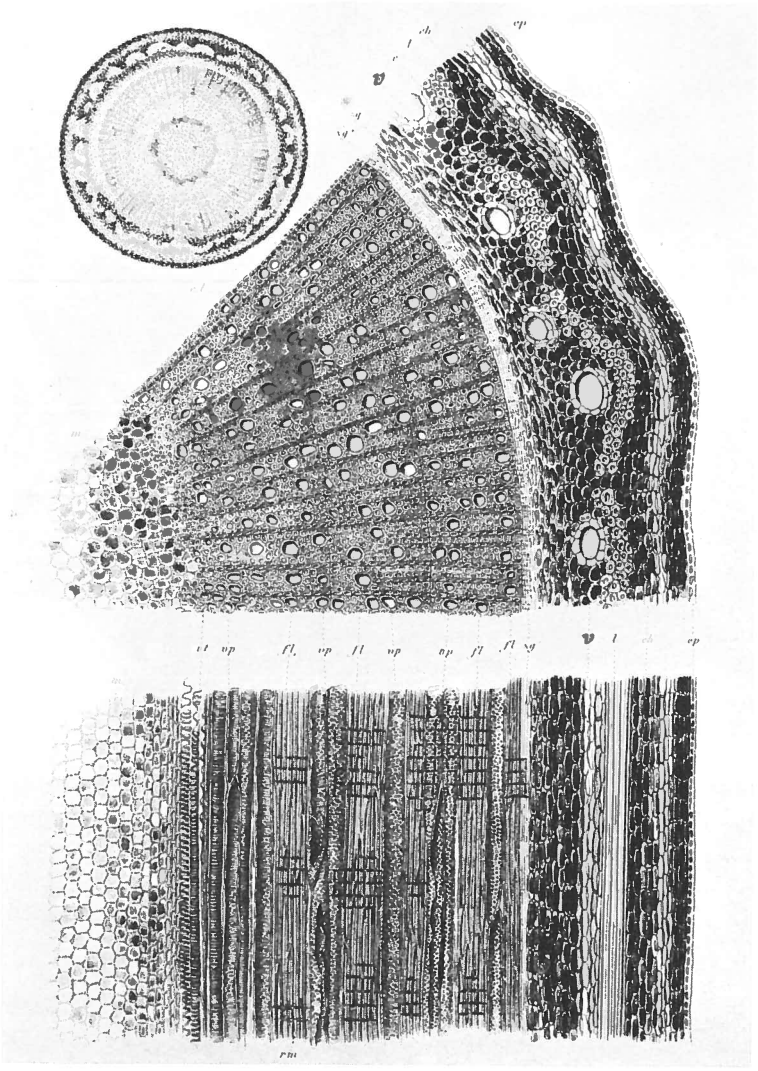
It was largely because of the generous Burseraceae that this semidesert region rose to such legendary wealth. The area now called Yemen earned from the Romans the name of *Arabia felix*, "happy Arabia," and eventually attracted Roman greed in the form of a military expedition, which ended in total failure.[34] In the meantime, the southern harbor of Aden, lying midway between India and the Mediterranean, grew to such importance that it earned the Greek name of *Eudáimon Arabía*, "Happy Arabia" again, until the jealous Romans destroyed it.[35] Regardless of whether myrrh and frankincense ever soothed any wounds, they surely caused a lot of bloodshed.

The peculiar feature of these trees, which raised them to such historical status, was revealed by the microscope over one hundred years ago. In and beneath the bark are small canals and larger cavities, full of an oleo-gum-resin, which is a specialty of the family (Fig. 5.5). A typical incense tree of South Arabia is shown in Fig. 5.6. Its product, known also as *frankincense* (archaic for "choice incense"), is still collected as described in 1848 by a British surgeon, in somewhat surgical terms:

> The gum is procured by making longitudinal incisions through the bark in the months of May and December, when the cuticle glistens with intumescence from the distended state of the parts beneath; the operation is simple, and requires no skill on the part of the operator. On its first appearance the gum comes forth white as milk, and according to its degree of fluidity, finds its way to the ground, or concretes on the branch near the place from which it first issued, from whence it is collected by men and boys employed to look after the trees by the different families who possess the land in which they grow.[36]

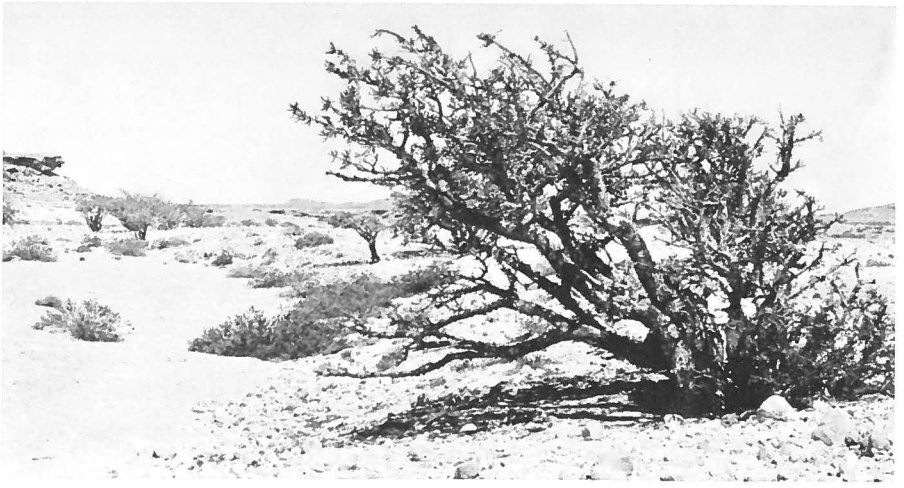
The lumps of fresh, milky sap (Fig. 5.7) gave incense its Arabic name, *al lubán* (from the Semitic root *lbn*, "milk"), which has been Anglicized to "olibanum."[37] In a week or two the white lumps dry into an amber-colored oleo-gum-resin, which ignites easily and smolders, giving off a pleasant smell. *Incense*, in fact, means "that which is lit."[38]

Myrrh is tapped from a scraggy, unfriendly tree of "crippled appearance," with a grey-white bark, and usually gathered from thickets not over three meters high. It is leafless most of the year, and its rough branches end in thorns (Fig. 5.8). The bark tends to crack spontaneously letting the myrrh trickle out even without man-made wounds. Eventually it hardens into reddish-brown masses (Fig. 5.9). The old name of *bitter myrrh*[39] refers to the characteristic taste—in fact, twice so, because the word *myrrh* itself comes from the Hebrew and Arabic *murr* for "bitter."[40]



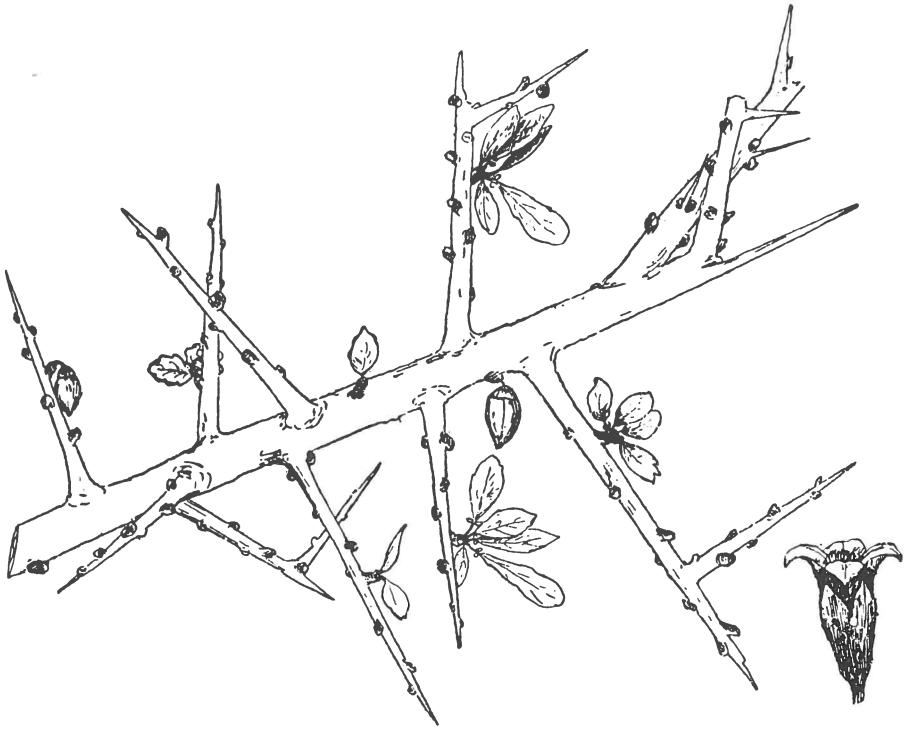
5.5 The secret of the myrrh tree as seen through a microscope: the oleo-gum-resin collects in and beneath the bark, especially in the canals marked *v*.

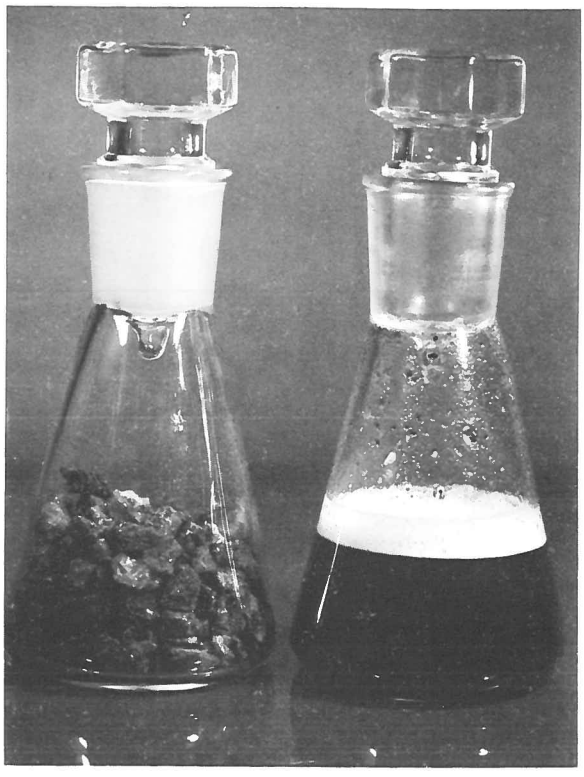
5.6 Frankincense trees in Hadramawt, South Arabia.



5.7 Milky-white drops of frankincense oozing out of a wounded tree, *Boswellia carterii*, in South Arabia.

5.8 The thorny branch of a myrrh tree, *Balsamodendron myrrha*.





5.9 Grains of myrrh (left). In water (right) they easily form an opaque suspension, with many impurities.

From Tree Wounds to Human Wounds

The use of tree sap for treating injuries must be older than man's oldest documents. About 3000 B.C. the Egyptians were barely starting to write, yet in 2500 B.C. they were already importing huge loads of myrrh. Whether any of that lot went for medical purposes is not known for sure, but a few centuries later there are records of excellent wound-salves in the Smith and Ebers papyri, based on resins. About 1370 B.C. Milkili made his cryptic request for myrrh, most likely to use for battle casualties. Eight hundred years later, around 480 B.C., in the eastern Mediterranean Greeks and Persians happened to fight a fierce naval battle. According to the account of Herodotos, the captain of a Greek trireme "bore himself very gallantly; for his ship being taken, he would not give over fighting till he was all hacked about with wounds; and when he fell, yet was not slain but had life in him, the Persian soldiers on the ships were at great pains to save him alive for his valour, tending his wounds . . . with myrrh."[41] In the Hippocratic books, myrrh is by far the favorite resin, being prescribed fifty-four times.[42] The Romans kept up the trend. A lotion of wine and myrrh for burns is one of the many uses mentioned by Celsus in the first century A.D.,[43] and about the same time, a Roman doctor in the military camp at Vindonissa, Switzerland, lost his stamp for DIAZMYRNES, a rather poorly spelled myrrh-medicine "for old scars" (Fig. 5.10).

5.10 Stone stamp with which L[UCIUS] CORNELIUS ADIUTOR, a Roman physician, marked his little sticks of myrrh medicine, DIAZMYRNES, for old scars, AD CIC[ATRICES] VET[ERES]. Such sticks, called collyria, were dissolved in milk or eggwhite, especially to make eyedrops. Enlarged almost three times.

This is only a part of the evidence to prove that myrrh and other resins were among the commonest drugs used on wounds. But there is better yet:

> I am wounded at the sight of my people's wound;
> I go like a mourner, overcome with horror.
> Is there no balm in Gilead, no physician there? . . .
>
> Go up into Gilead and fetch balm,
> O virgin people of Egypt.
> You have tried many remedies, all in vain;
> No skin shall grow over your wounds.[44]

In the language of the Old Testament, the surgical use of balsams has an overtone of salvation. There could be no better proof that the sap of wounded trees was the treatment par excellence of human wounds.

Why did balsams come to be used as "balm"? I can suggest four reasons. First, the ancients might have been guided by a conscious or subconscious analogy, namely, that what fills gashes in plants should also heal gashes in people.[45]

Second, wounds used to smell. There was nothing perfumed that was not called upon for help, spices included. One of the countless examples appears in Theophrastos (from the third century B.C.). In his treatise *Concerning Odors* (who would write such a treatise nowadays?) he gives the formula of *megaléion*, a perfume "believed to relieve the inflammation caused by any wound." It was composed of burnt resin, cassia, cinnamon, and myrrh, all more or less fragrant.[46] Since we have been blessed by Listerian antisepsis, this smell problem can no longer be fully appreciated. It was memorialized by Homer in the sad case of Philoctetes, whose festering wound was so unbearable that the Greeks left him stranded alone on an island. In the tragedy of Sophocles, when Neoptolemus finally came to look for him, the ailing hero wailed:

> Alas, my son! I fear thy prayers are in vain
> For once again upwelling from the wound
> The black blood trickles auguring a relapse.

Out, out upon thee, damned foot! Alack!
What plague hast yet in store for me? Alack!
It prowls, it stalks amain, ready to spring,
Woe! Now ye know my torture, leave me not . . .
Raise me thyself and spare thy men this task,
Lest they be sickened by my fetidness
Before the time; they'll have enough to bear
With me for messmate when we are aboard . . .[47]

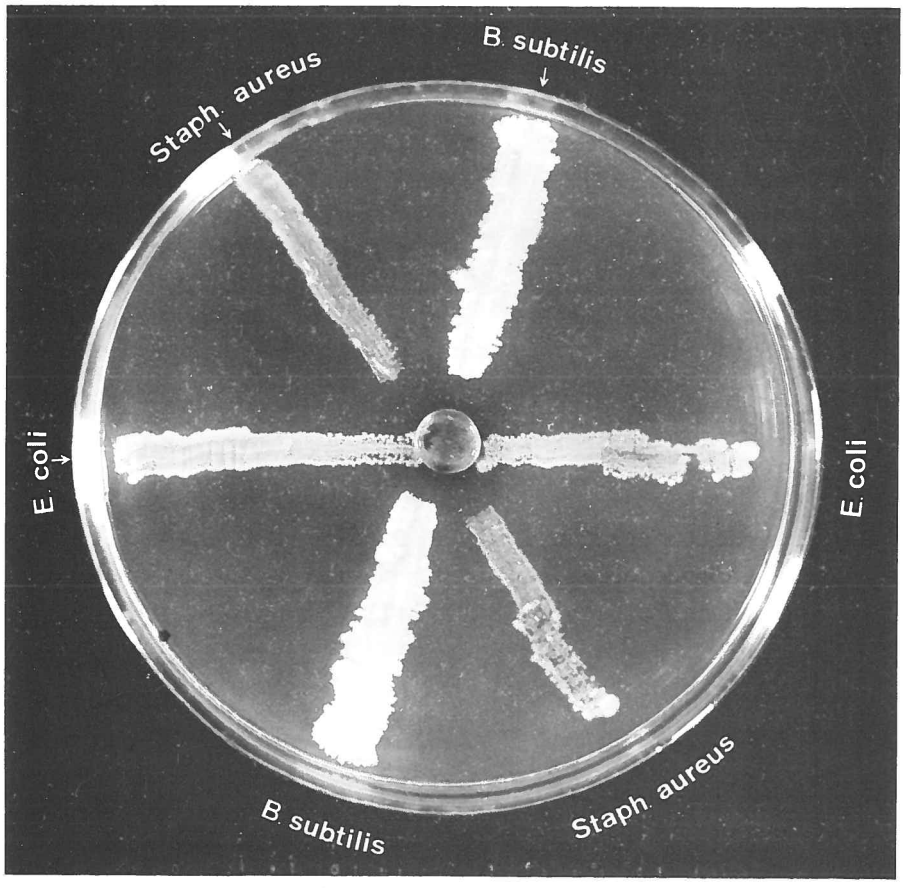
The ancient gesture of spreading perfume on a wound was as logical, in its context, as putting out a fire with water. The most offensive-smelling sores (the gangrenous) were also the most lethal: the obvious cure was perfume.

A third reason for using resins on wounds must have come from observing that resins are among the few products of nature that never decay, and from the hope that they might transmit this property to wounds. In this the sense of smell was truly prophetic, for antisepsis is a "transmissible" property almost by definition: antibacterial substances do not themselves decay, and applied to organic matter they can preserve it too from decay.

The fourth and probably most important reason for the surgical use of resins is that they actually improved the course of wound healing. A modern study of the effect of resins, balsams, or spices on wound healing does not seem to exist; hence, I cannot support my statement with scientific proof. However, indirect evidence is powerful. Let us first consider the case of myrrh. As a wound drug, myrrh has lived past its fourth or fifth millennium: we can therefore conclude, at the very least, that it does no harm to the tissues. Second, myrrh is said to have antiseptic properties (I am obliged to use this cautious expression, because the modern treatise from which I quote this statement gives no supporting reference).[48] A drug that is harmless to the tissues as well as antiseptic should be useful in the treatment of wounds.

The flaw in my argument thus far is that it hinges on textbook authority rather than on scientific proof. I therefore set about to find a kindly and competent bacteriologist who would be willing to test the effect of myrrh on bacteria (almost as hard as finding the myrrh itself). The first surprise was that the hard, resinous lumps of crude myrrh dissolve quite easily in water (Fig. 5.9). The fluid was tested against a selection of bacteria, including a typical wound bacterium, *Staphylococcus aureus*. The result was clearcut: myrrh acts as a bacteriostatic against *Staphylococcus aureus* and other gram-positive bacteria (Fig. 5.11).[49]

I conclude that the ancient use of myrrh as a wound drug was fully justified. Doubtless the same holds true for the many other resins and balsams that have been traditionally used for the same purpose. Indeed, I believe that the antiseptic properties of myrrh may be among the lowest in the entire family of drugs, because it has almost no perfume, suggesting that it has a low content in antiseptic volatile oils (this may explain the limited use of myrrh in present times: it is still burned with incense, but its only medical use is as a mouthwash[50]). Some of the most popular resins and balsams came from the New World, as gifts of the American Indians; and they, too, are



5.11 Antibiotic effect of myrrh. Cultures of three different species of bacteria were streaked across the whole plate, to form a star; a suspension of myrrh was placed in the center well. After incubation at 37°C for twenty-four hours, two of the three bacteria failed to grow in the vicinity of the myrrh.

currently listed as antiseptics. Brazilian Indians treated their wounds with copaiba,[51] an oleoresin that enjoyed thereafter a formal career as a urinary antiseptic.[52] The balsam of Tolu was "muche esteemed amongest the Indians" of Colombia and Venezuela, because "it healeth all freashe woundes, comfortying the partes, and joynyng them without makyng any matter."[53] The balsam of Peru is a pathologic secretion of *Myroxylon pereirae,* which the Indians of Central America obtain by beating the bark and then charring it a week later.[54] It soon became part of the U.S. Pharmacopoeia and is still used as an antiseptic; I found it at work as late as 1967 in a routine study of wound healing in a U.S. Army hospital.[55] Among its constituents are two that echo the names of spices, *cinnamate* and *vanillin.*[56] In Russia, a very successful wound salve is the *Unguentum Vishnievskii,* made of resin, mineral oil, and bismuth.[57]

Really, the antiseptic power of resins and balsams needs no pleading. One can go a step further and include certain plant perfumes that are not necessarily resins or balsams. A good example is thyme. The Hippocratic books, surely guided by the fragrance, prescribe it for several infectious diseases.[58] In that context, and in that low dosage, it was probably used in vain;

but today, its essence—crystalline thymol—adds a fragrant touch to laboratory life, where it floats on solutions to preserve them from bacteria and mildew. Industry uses it to preserve meat, and it is an all-round, pleasant, aromatic antiseptic.[59] In this case, then, the use of an aroma was not yet a discovery; but it was, if I may say so, the aroma of a discovery.

Someone spread the rumor that burning incense, the prototype of all aromata, gives off carbolic acid, the magic, odorous drug with which Lister opened the era of antisepsis.[60] Startled by this overlap of bodily and spiritual health, I had the statement verified. It turned out to be chemically true, but medically irrelevant. In the words of the chemist, "The amount of phenols set free in the atmosphere of a church should be far from having a purifying effect, at least on a material level."[61] It is nevertheless perfectly true that the chemical formula of many scents given off by balsams and spices are variations on a theme: the skeleton of carbolic acid (Fig. 5.12).

The trail of aromata has kept its promise.

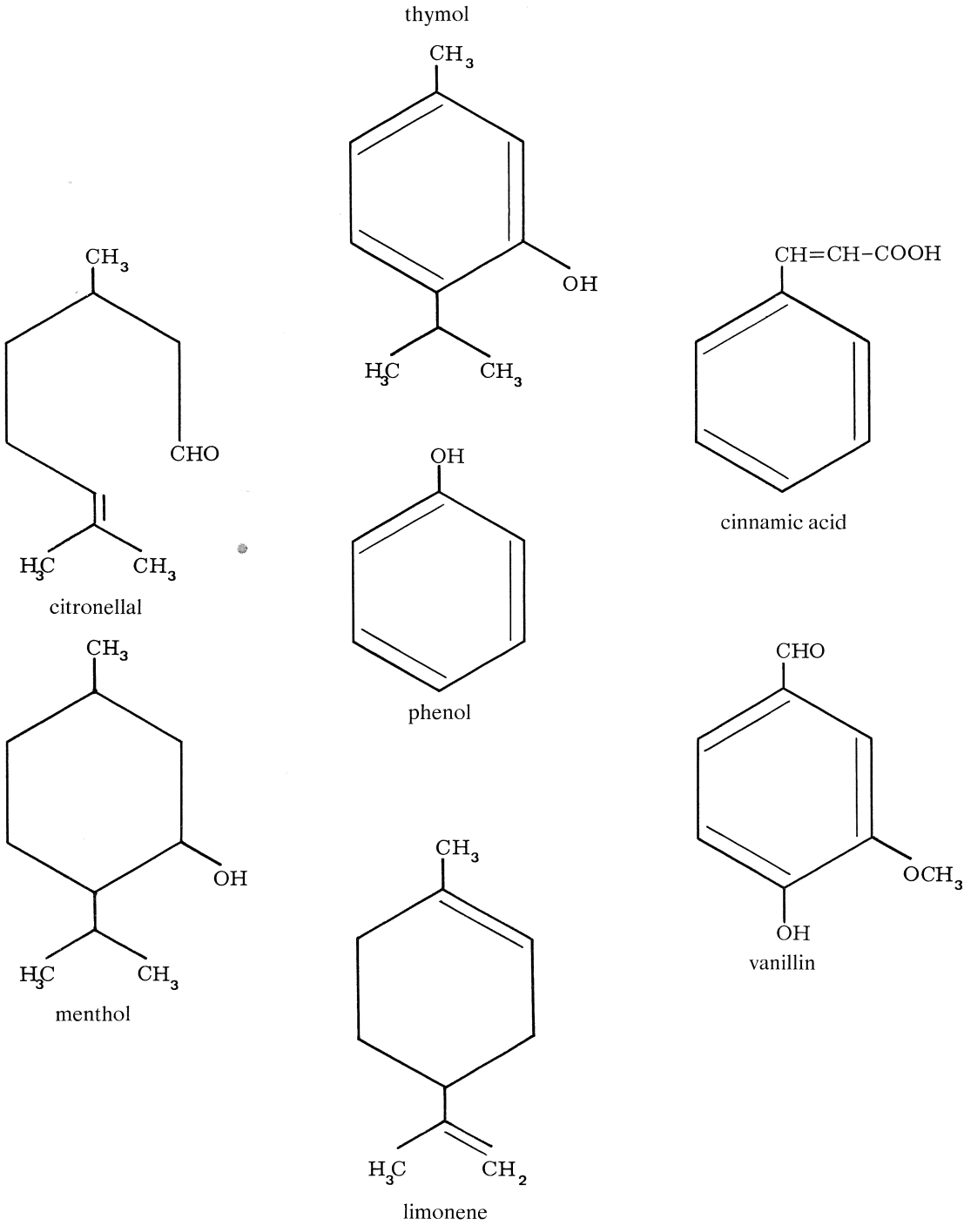
Two Spices from Nowhere: Cinnamon and Cassia

Like myrrh and frankincense, there was another twin set of drugs that had a special appeal to the nostrils of antiquity: cinnamon and cassia. They tend to be treated as a couple because they taste alike and because they come from the same botanical family, the Lauraceae. The best cinnamon nowadays is the variety *Cinnamomum zeylanicum* from Ceylon; cassia comes from *Cinnamomum cassia.* Although cinnamon is considered the finer of the two, their similarity has caused much confusion. Because the bark of cassia is rougher, its name was often used for "low-grade cinnamon." The confusion continues: Americans order "cinnamon toast" but eat cassia toast.[62]

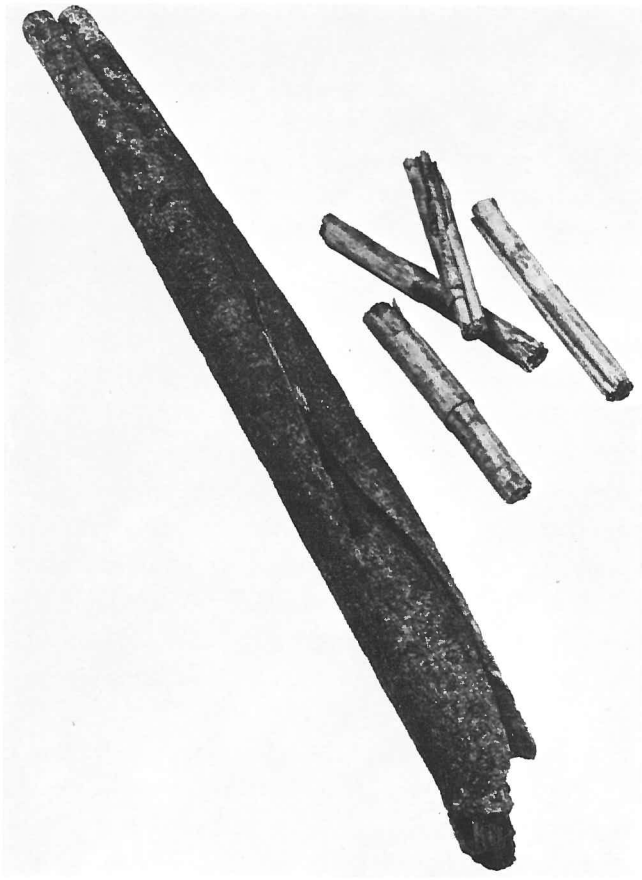
Nobody will ever know the cost of cinnamon and cassia in human lives, for they had to sail west a record distance, on double outrigger canoes: cinnamon came from India, cassia from North Vietnam and southern China.[63] The Cinnamon Route, based on the two-way sweep of the monsoons, ran from India to East Africa. It may have been open as early as 1500 B.C.[64]

One can only marvel at the impact of these gentle perfumes. I cannot even say spices, for there is no evidence that they were used on food before the ninth century A.D.[65] One of the oldest records on the subject is again the Bible. Thus spoke the Lord to Moses: "You yourself shall take spices as follows: five hundred shekels of sticks of myrrh, half that amount (two hundred and fifty shekels) of fragrant cinnamon, two hundred and fifty shekels of aromatic cane, five hundred shekels of cassia by the sacred standard, and a hin of olive oil . . . This shall be the holy anointing oil for my service in every generation."[66] And to quote from a Hippocratic book: "If there is inflammation and pain in the womb, take rose leaves, cinnamon, cassia . . . fumigate therewith, and it will sooth the pain."[67]

The actual spices came, and still come, as little rolls, being the bark of trees, stripped and sun-dried into little quills or hollow canes; hence the



5.12 Chemical formulas of six plant perfumes: their shape is similar to that of carbolic acid or phenol, the pioneer antiseptic (center).



5.13 Four quills of Ceylon cinnamon and one of the coarser cassia: little rolls of sun-dried bark. About half-size.

French name *cannelle* (Fig. 5.13). The laurel family to which they belong is a very scented collection of trees, all aromatic, and growing in the warmer parts of the world. Some of these trees carry eugenol, an antiseptic,[68] and smell like cloves. Others contain camphor, another wound drug, which did not come West until the Middle Ages.[69]

Concerning the effect of cassia and cinnamon on wounds I have no personal data, but a recent treatise on pharmacognosy reports that oil of cinnamon is a powerful germicide.[70] Another germicidal aroma.

Wounds, Wine, and Bacteria

The jump from spices to wounds to wine is not as long as it may seem. For wounds and wine, to begin, have the same problem: bacterial infection. And both can be cured by aromatic substances.

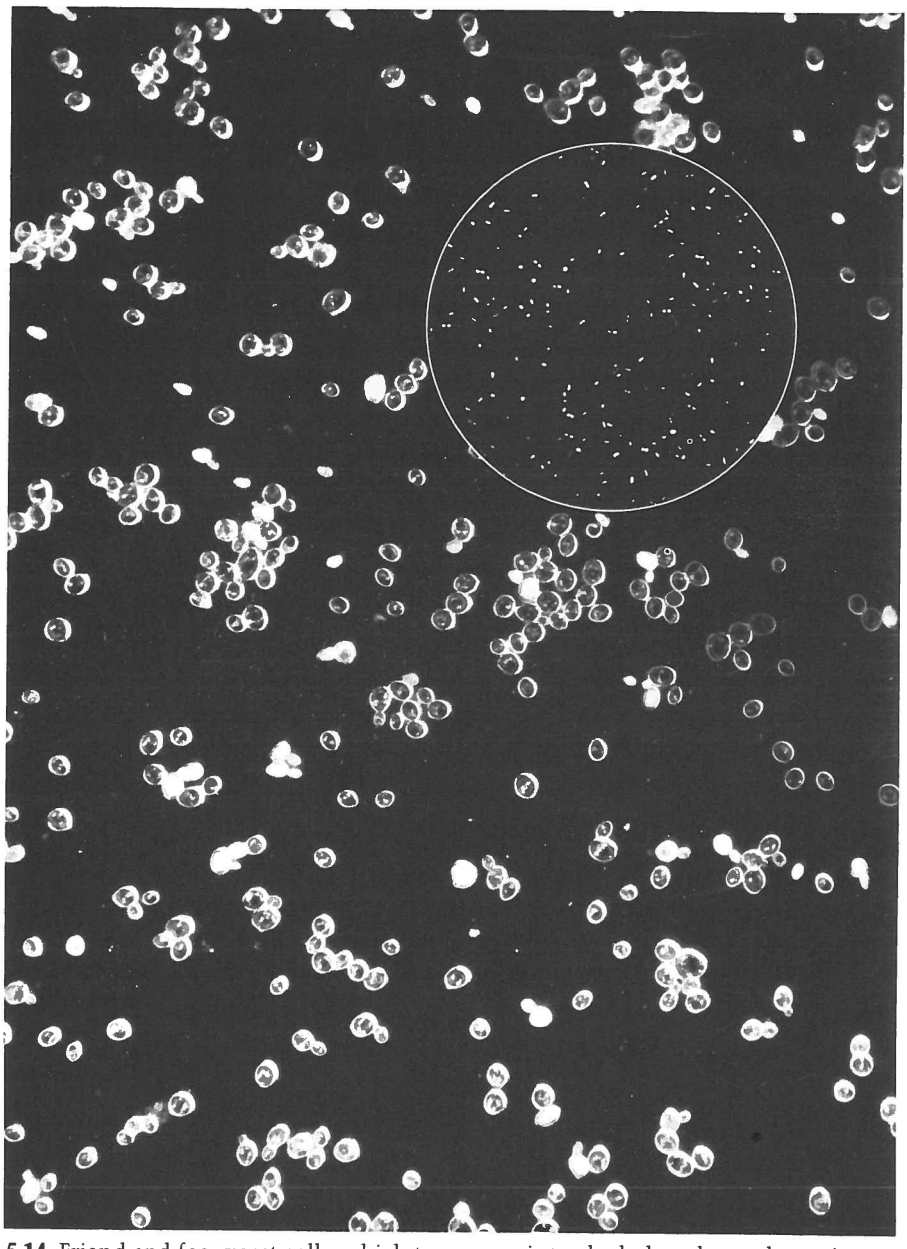
The main infectious disease of wine is vinegar. So, while the people of antiquity were trying to prevent their wounds from developing what they called "corruption," they were also spending enormous amounts of energy in trying to keep their wine from turning into vinegar. The villains, be they staphylococci or acetobacteria, were always microorganisms, and they had to

be killed with antiseptics.[71] Consciously or not, our ancestors did make the connection between the two problems, for they discovered that many of the substances that kept wounds clean, also kept wine from becoming vinegar, especially the aromata. And I would venture to say that they came closer to a final solution with their wine problem, perhaps because of the amount of research that went into it: "there is no department of man's life on which more labour is spent."[72] Although this statement comes from a Roman, Pliny the Elder, it probably applies to many other peoples of antiquity. The following pages deal mostly with the Romans only because they have left more documents on their struggles against vinegar.

Most of us amateur wine-lovers do not realize this paradoxical fact: wine is not the natural end-product of must fermentation.[73] Left to its own means, must will usually give vinegar. Granted, wine will form first; but the wine stage can be very short. A Roman expert of the first century A.D., Columella, mentions wines that "scarcely kept sound for thirty days."[74] The reason is that lurking in must are the seeds of its own destruction: the bacteria of acetic fermentation. It follows that the very first problem of wine making is to stop the bad bacteria that produce vinegar, without disturbing the good yeasts that produce alcohol. This is a tall order, for the two microorganisms swim side by side (Fig. 5.14).

The problem has not changed in the last two thousand years, nor is a perfect solution yet at hand. Since the early 1800s, however, the answer has been sulphur: more precisely, SO_2 or sulphur dioxide.[75] It is generally added to the must (and wine) as a concentrated solution of sulphur dioxide in water, and sometimes also by burning sulphur in a sort of spoon suspended in the air space of the vat, over the wine. The spoon contains a wick (*mèche* in French) soaked with sulphur; its fumes are literally asphyxiating, and the wine can become too *méché*. Fine noses can apparently detect the typical smell of sulphur when the dose is excessive, whereas the smell of regular doses has now become so much a part of the establised bouquet that its absence, I am told, may rather be recognized as "something wrong." To the public at large the smell of sulphur dioxide is therefore not an issue, so wine makers are free to enjoy its special property, which is to inhibit acetic fermentation without significantly affecting alcoholic fermentation. The must goes on to wine, then graciously stops there, unless the wine is exposed to air.[76] This is the magic whereby it is possible, nowadays, to open almost any bottle of wine with near-mathematical certainty that it will not be a bottle of vinegar.

The magic, however, comes at a price. When dissolved in water, sulphur dioxide becomes sulphurous acid, which is said to be "not very toxic" (and even "good for allergies")—but still, it is not comfortable to hear that the average bottle of wine contains—besides the friendly poison, ethyl alcohol—about $\frac{1}{30}$ of a lethal dose of sulphurous acid.[77] This is a constant worry for wine makers, who are trying hard to get away from sulphur; yet nothing better has been found. One has only to leaf through the issues of the most important journal of wine making, the *Bulletin de l'Office International du Vin*, to realize how much effort is going into the search for alternatives.[78]



5.14 Friend and foe: yeast cells, which turn sugar into alcohol, and acetobacteria (circle), which turn alcohol into vinegar. Wine inherits both these organisms from the grapes. Pure cultures, enlarged about 1250x.

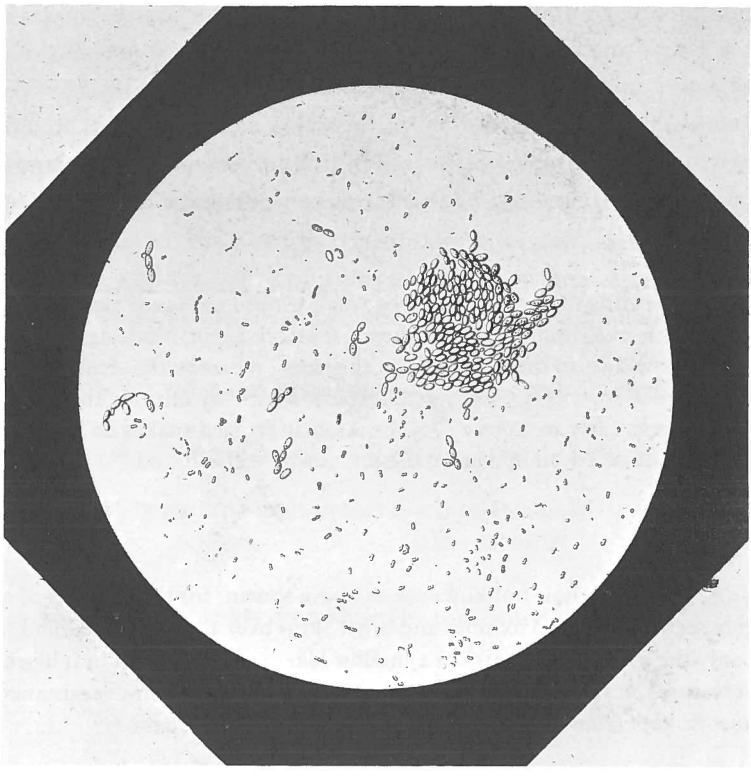
So this is where we stand. But how did the ancients fight off *acetobacter*, the maker of vinegar? The most sophisticated method, described in detail by Columella, was to make up a *medicamentum*, literally a "medicine;" today one would say a preservative. Here is the recipe, containing a selection of the world's best aromata.[79] Boil some must, not in a bronze vessel, which would impart a bad taste, but in a leaden vessel (!) well rubbed with oil. When the volume of the must has boiled down to ¾ or ½, add liquid pitch and turpentine resin; then sprinkle on myrrh, cassia, cardamom, saffron, six other spices, and more resin. Only small amounts of this preservative could be used, for if its flavor was noticeable, it "drove away the purchasers."

Many other techniques were also used. Pliny reports that whole volumes had been written on how to prevent wine from turning into vinegar.[80] He mentions turpentine and all sorts of resins, pitch, honey, spices, perfumes, salt, even sea water. Between spices and perfumes there was no clear-cut boundary. Myrrh was the veteran preservative: "The finest wines in the early days were those spiced with the scent of myrrh."[81] Remember the myrrh wine offered to Jesus before he was put on the cross: "He was offered drugged wine, but he would not take it."[82] The great variety of aromatic wines was probably a matter not only of choice or taste, but also of preservation.[83] "Aromatic wine is constantly made from almost the same ingredients as perfumes (*unguenti*)—first from myrrh . . . next also from nard, reed," horehound, sweet rush, costus, cardamom, cinnamon, saffron, marjoram, dittany, mint, thyme, mandrake, hazelwort, lavender, pepper, and many others, including Pontic wormwood[84] (*wormwood*, incidentally, is the word—and the substance—that gave *vermouth*). Another possibility was to treat the must with certain berries, or to boil it with chips of sweet-smelling woods, like cedar, laurel, and terebinth, added in the amount of about "ten drachms per congius," or about 13 grams per liter.[85]

The barrels themselves were coated inside with hot pitch and fumigated with myrrh.[86] Pliny makes a tantalizing reference to "adjusting wine with sulphur," with no further details.[87] Fumigations of sulphur were used to purify homes, but only in religious ceremonies.[88] So here is another mysterious crossroads for antiseptics, cookery, cosmetics, and religion.

After all this, I cannot vouch that the Romans produced wines that would suit our taste; but their methods worked, at least sometimes.[89] Pliny mentions wines that increased in value for twenty years, and only then declined.[90] One priceless vintage was about to score two thousand years when it was dug up in France. A far-sighted Gallo-Roman gentleman had taken with him several sealed glass containers of his favorite drink. When found, all were broken but one, which contained a yellowish fluid that smelled like wine and tasted a bit sour. Analysis found it to be 0.12 percent acetic acid and a surprising 4.5 percent alcohol.[91]

Ultimately, man's consuming interest in wine paid off. Much wine had to flow—and much vinegar—until the catharsis came in the nineteenth century. One great day Napoleon III, heeding the call of distressed French wine makers, looked around for a scientist who could solve their problems, and chose Louis Pasteur. That was July 1863. Within three years, Pasteur had earned a gold medal for proposing a cheap remedy that was later called pasteurization. Thus, pasteurization was born in wine, not milk.[92] Pasteur's classical book on the *maladies du vin*, published in 1866, contains many lovely drawings of bacteria in "diseased wines" (Fig. 5.15). The work on human infections that eventually made of Pasteur one of the saviors of mankind, the work that inspired Lister's antisepsis, grew from Pasteur's earlier studies on what makes sugar turn to alcohol, and alcohol to vinegar.[93]



5.15 The good yeasts and the vinegar-making bacteria swim side-by-side in wine, as drawn in 1866 by Pasteur.

The Spice Curtain

The many roles of aromata in human affairs created a near-global network of commercial interests and led eventually to an Arabian monopoly, which may have had far-reaching effects on all cultural exchanges between ancient East and West. Look first at a map of the Red Sea, with the names of antiquity (Fig. 5.4). The Horn of Africa is called the Cape of Spices; on it is a city bearing the very name of Aromata. Clearly this city was a major trading post between East and West, and the trade was based largely on spices.

Look also at the strategic position of the Arab merchants, placed naturally as middlemen between Europe, Africa, and the East. The "happiness" of Arabia depended as much on this situation as on the fabled trees. Something had to be done to protect this advantage—perhaps not from the Egyptians, who let themselves be outsailed by almost everybody else,[94] but certainly from the other great Mediterranean powers.

But how could one keep these seaworthy customers from sailing directly to the sources? Fighting off their ships would have been bad for business. The Arabian merchants therefore chose the psychological approach, and they knew how to handle it. When they resold their cassia or cinnamon, imported from the East, they made up tall tales about the tremendous risks they had faced in order to obtain these goods, so that no Greek or Roman in his right mind would ever bother to try his own luck at it; or if he did, his informers

made sure that he wound up in the wrong place. Covered by the screen of nonsense were also Arabia's domestic products, incense and myrrh.

The Arabs' tales were highly imaginative. Yet they were swallowed even by Herodotos, the Father of History, for he wrote that Arabia was "the only country which yields frankincense and myrrh and cassia and cinnamon."[95] Just read the facts of the Arab spice trade as he understood them. On frankincense:

> The spice-bearing trees are guarded by small winged snakes of varied colour, many round each tree; these are the snakes that attack Egypt. Nothing save the smoke of storax will drive them away from the trees [*whereby the Arabs were also raising the price of storax*] . . . They gather frankincense by burning that storax which Phoenicians carry to Greece . . . The Arabian winged snakes do indeed seem to be many . . . these are all in Arabia and are nowhere else found.[96]

On cassia:

> The Arabians get their frankincense as I have shown: for the winning of cassia, when they seek it they bind oxhides and other skins over all their bodies and faces, leaving only the eyes. Cassia grows in a shallow lake; round this and in it live certain winged creatures, very like bats, that squeak shrilly and make a stout resistance; these must be kept from the men's eyes if the cassia is to be plucked.[97]

The spiciest account of all is on cinnamon:

> As for cinnamon, they gather it in a fashion even stranger. Where it grows and what kind of land nurtures it they cannot say, save that it is reported, reasonably enough, to grow in the places where Dionysus was reared. There are great birds, it is said, that take these dry sticks which the Phoenicians have taught us to call cinnamon, and carry them off to nests built of mud and attached to precipitous crags, to which no man can approach. The Arabian device for defeating the birds is to cut into very large pieces dead oxen and asses and other beasts of burden, then to set these near the eyries, withdrawing themselves far off. The birds then fly down (it is said) and carry the pieces of the beasts up to their nests; which not being able to bear the weight break and fall down the mountain side; and then the Arabians come up and gather what they seek. Thus is cinnamon said to be gathered, and so to come from Arabia to other lands.[98]

Even Aristotle mentions the cinnamon birds.[99] Much later yet, about 77 A.D., Pliny repeats the "fables" of Herodotos, adding sourly they have been "invented by the natives to raise the price of their commodities."[100] But he concludes: "all these stories being false . . . inasmuch as . . . cinnamon grows in Ethiopia."[101] So the Arabs had won anyway.[102]

But not for long. Just as Pliny was writing, the Spice Curtain was being ripped apart. Greek and Roman ships were learning to use the monsoons, another well-kept secret, and were trading directly with India.[103] Gold kept flowing directly east, to the discomfiture of the middlemen. In the end, however, nobody laughed. The imbalance of payments, largely due to the trade of spices and perfumes, was one of the forces that brought about the downfall of the Roman Empire.[104]

The Arabian states withered. Many of their cities vanished altogether. Even the magnificent dam at Marib, capital of Saba, which was one of the wonders of antiquity, returned to the desert.[105] The caravans that used to carry aromata now carry rock salt.[106]

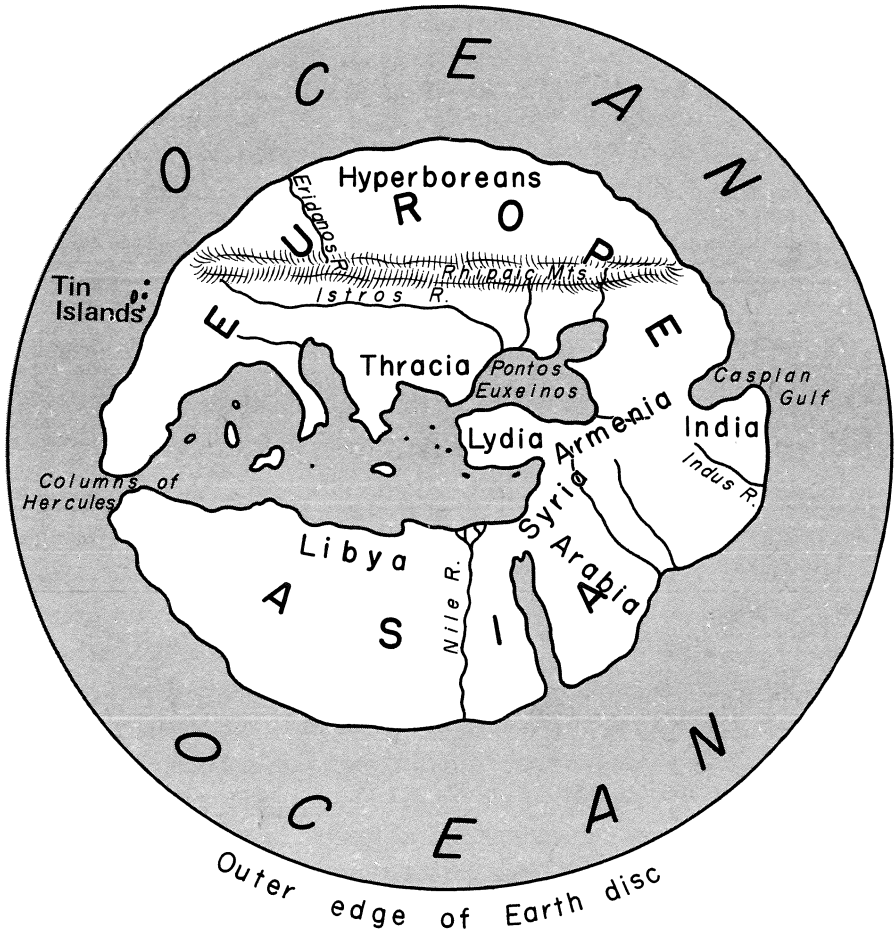
Thus ends the tale of the Spice Curtain.[107] It had lasted perhaps 1500 years, a success of connivance unmatched, except perhaps by the secret of the silk trade. In relation to the history of medicine, this commercial barrier may well have played a role in restricting communications between East and West: it let the spices through, but no information with them, except for the bare names.

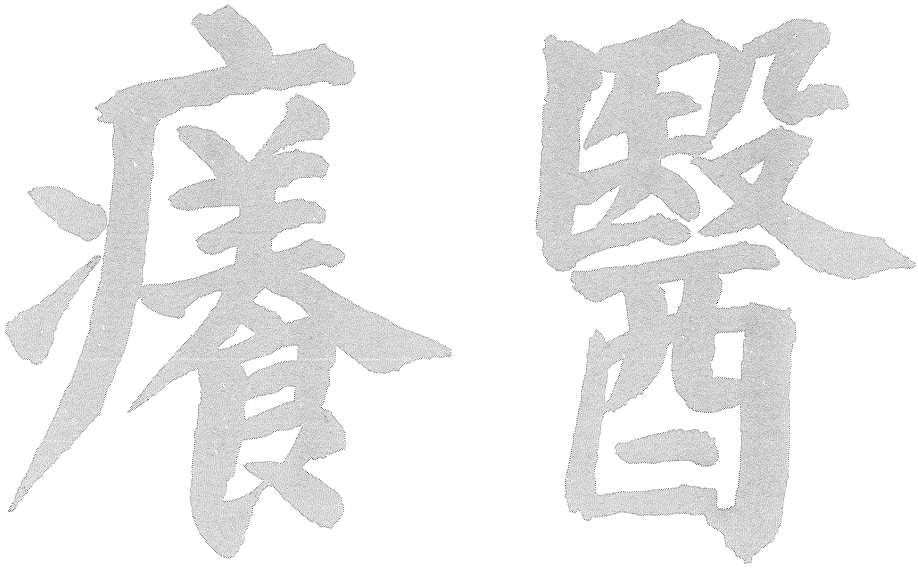
We will now see what was going on beyond the Spice Curtain.

> Arabia . . . airs wondrous sweet blow from that land.
>
> Herodotos[108]

> Her good fortune has been caused by the luxury of mankind.
>
> Pliny the Elder[109]

6.1 The world as Hippocrates knew it: China did not yet exist. Mapped about 500 B.C. by Hekataios, a Greek of Miletos surnamed "the Father of Geography."





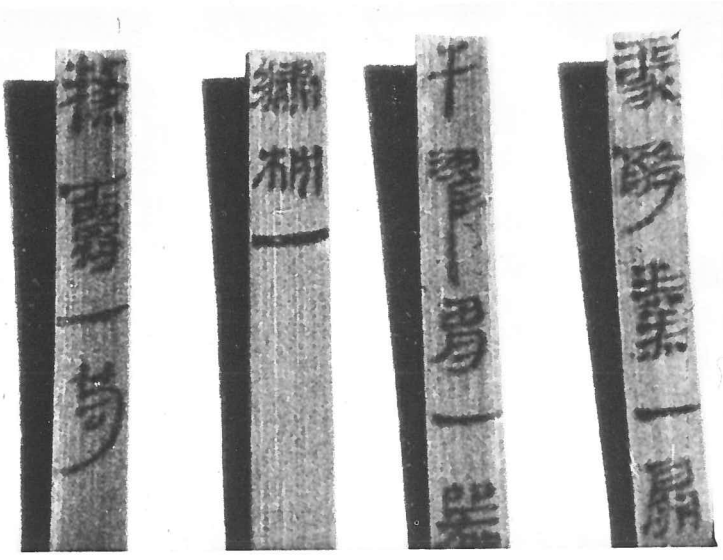
6 The Yang I

It is again 400 B.C. About this time Hippocrates, clad in his woollen tunic, was sailing among the Greek isles. If his skipper owned a map of the world, it must have looked more or less like the map of Hekataios (Fig. 6.1).

In the meantime, great things were happening beyond the eastern border of that map, in a world so isolated that it might almost have been on another planet. Somewhere in that never-never land, a black-haired scholar, clad in shining silk, was busily compiling the chronicles of his king.[1] He kept the records in booklets made of wooden tablets and on bamboo strips, writing vertically (Fig. 6.2).[2] The beautiful characters that he was tracing were already more than one thousand years old (Fig. 6.3).[3]

Books of the Chou

We have landed at the court of the Chou, a Chinese dynasty that lasted from about 1030 to 221 B.C. and ruled a small area south of the Yellow River. Chou was just one of some twenty-five small states, all clustered in a fraction of modern China (Fig. 6.4), nominally bound as a feudal empire under the Chou, but actually building walls against each other and fighting for supremacy; in this process they were gradually merging into larger and larger units, on the way to becoming unified in 221 B.C. as the great empire of Chhin (221 B.C.–1912 A.D.).



6.2 Ancient Chinese writing on bamboo strips: an inventory of treasure deposited in a Han tomb, about 180 B.C.

6.3 The character *ts'ê*, for "book." *Left:* the ancient form (slips of wood or bamboo held together with two lines of cord). *Right:* the modern printed form.

This was the period of Chinese history known as "The Warring States." Despite the political turmoil, it was also the intellectual golden era of ancient China. Two of its greatest minds were Lao Tzu, spiritual father of Taoism, and Khung the Master or Khung Fu-tsu, whom we know as Confucius, adviser to the Chou emperor and contemporary of Buddha (c.552–479 B.C.). Strangely enough, this flowering almost paralleled that of Greek philosophy, to the point that the Academy of the Gate of Chi, founded about 318 B.C. in the state of Chhi, came into being between the two Athenian academies, the Peripatetic and Stoic.[4]

So the court library at the disposal of the Chou historian, if it was anywhere near complete, was probably as large as any that Plato could muster at the time in Athens. Let us look among the shelves, with the help of an expert, and see what we might find.[5] Among the medical books would probably be the works that a couple of centuries later were to be compiled into the *Huang Ti Nei Ching*, the great medical classic that already deals extensively with acupuncture. There would be books of poetry, like the *Shih Ching* or "Book of Odes," at least as old as the *Iliad* and the *Odyssey* and not devoid of medical interest; as well as books on music, like the *Yo Ching* or "Music Classic," now lost.[6] Also on the shelves would be vast numbers of chronicles and histories, especially works of philosophers, for that happened to be the time of the "Hundred Schools of Philosophy."[7] We would surely

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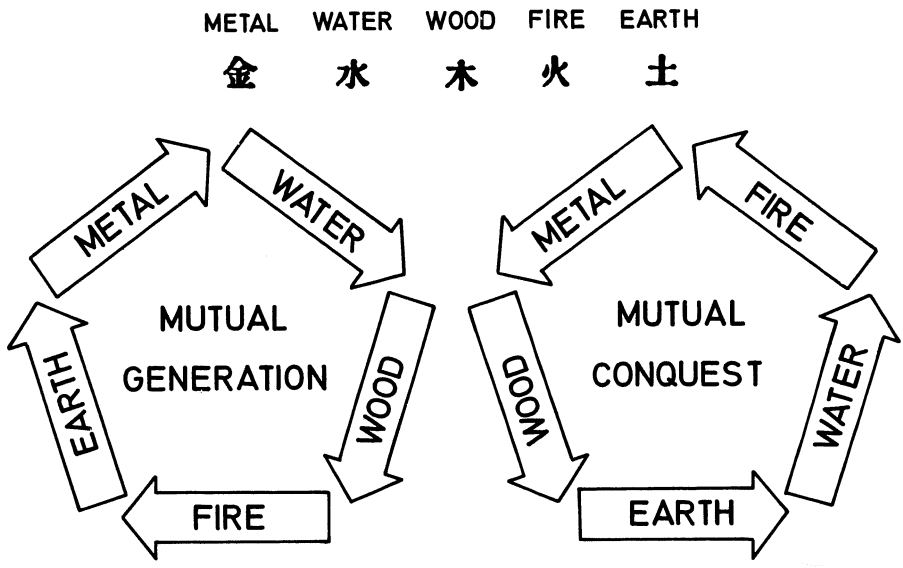
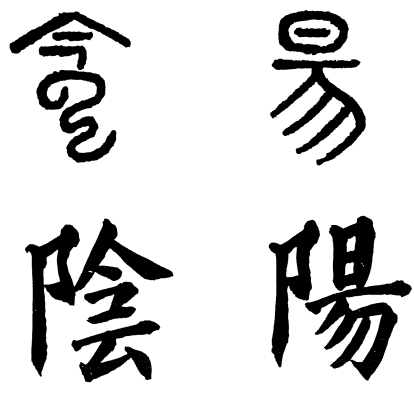
6.4 China about 400 B.C., when it was a loose feudal empire of warring states, partly separated by walls and occupying a small part of present China. Note the mountain barrier toward India and the distance from Greece. The march of Alexander, 334–323 B.C., is shown by a solid line. There were many more walls ( ) than indicated.



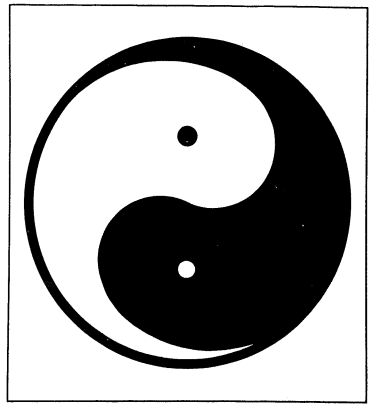
6.5 The five elements and their interrelations.



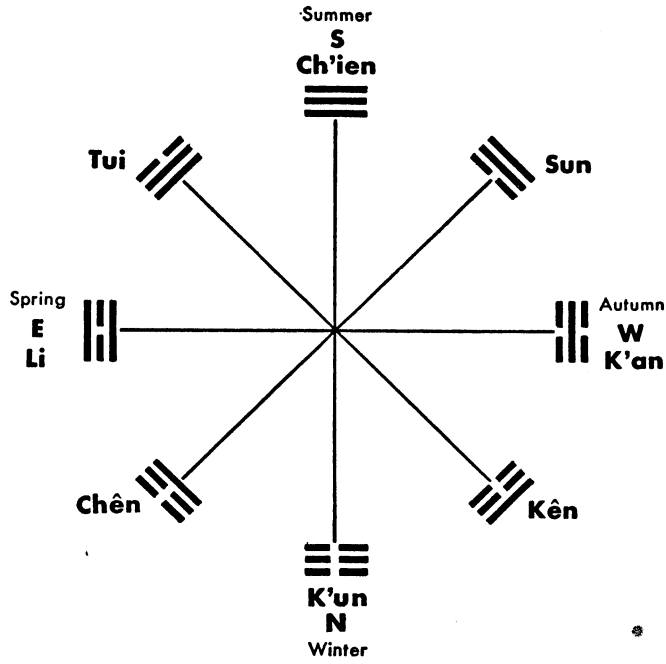
6.6 Origin of the signs *yin*, the female, moist principle, and *yang*, the male, dry principle. *Above left:* ancient form of *yin*, a cloud beneath a roof-shaped sign, "cloudy weather." *Below left:* modern form, with the radical 阝 for "hill." Hence, one of the original meanings of *yin* was "shady side of a hill" (a *radical* is a part of a character that gives the general meaning of the word, much like the Egyptian determinative). *Above right:* ancient form of *yang*, sun above the horizon and sunrays. *Below right:* modern form again with the radical 阝 for "hill." Hence, *yang* also meant "sunny side of a hill."

find the *Lun Yü* or "Conversations and Discourses" of Confucius, and leafing among tablets and bamboo strips, we might find hints of the five-element theory that was about to crystallize.[8] It held that everything was made of water, fire, wood, metal and earth, bound by an "order of mutual production" and an "order of mutual conquest" (Fig. 6.5).[9]

Somewhere we would run into the characters 会 and 昜, the archaic versions of yin and yang (Fig. 6.6). The two inseparable forces had already been a theme of Chinese philosophy for some time. One can envision Chou scholars discussing yin and yang at the time the Parthenon was going up.[10] Yang was the bright, dry, masculine aspect; yin the dark, moist,

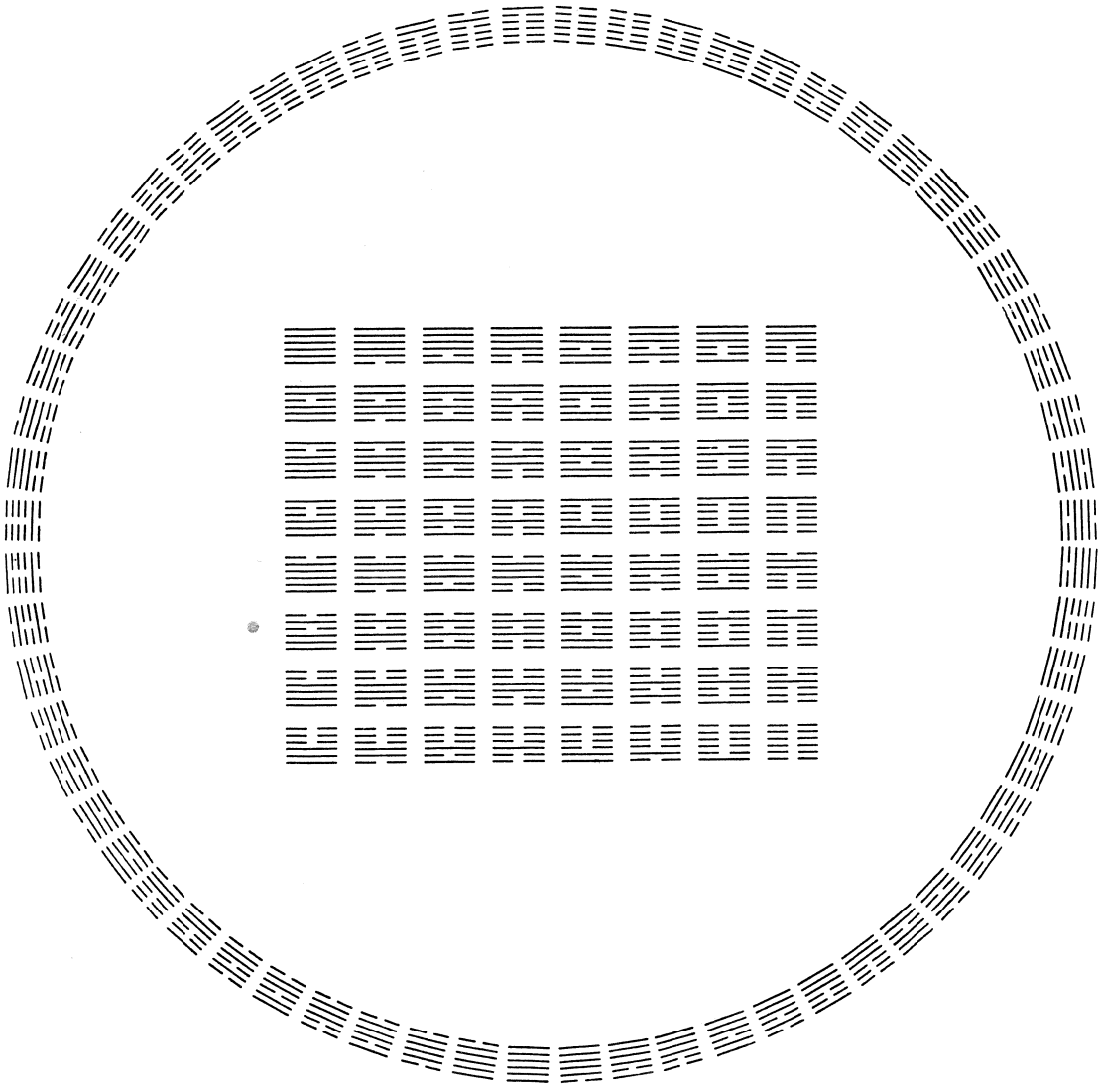


6.7 This figuration of yin and yang implies that the two principles are inseparable: there is yin in yang, and yang in yin.



6.8 The Eight Trigrams, arranged in the "Sequence of Earlier Heaven," one of several possible patterns. Each trigram has a name and correlates with a season, a cardinal point, and many other notions (note that the south, Chinese style, is at the top).

feminine. They were not opposed as "good" and "bad,"[11] but were complementary, and both were necessary for proper balance, so that pure yang and pure yin could not exist. There is always yin in yang and yang in yin. Nowadays everybody knows the visual symbol of this ancient scheme, made of two figures shaped as tadpoles inscribed in a circle (Fig. 6.7). Less familiar is the linear representation, which was probably already known at the time of the Chou scholar. Three continuous yang lines ☰ and three broken yin lines ☷ were diversely combined to produce eight (*pa*) trigrams (*kua*), each combination having a name, a special meaning, and a long list of associations (Fig. 6.8).[12] The number of lines could also be doubled to form a



6.9 Two arrangements of the Sixty-Four Hexagrams, formed by doubling the trigrams. Each hexagram supports a chapter in the Book of Changes.

hexagram. This gave birth to a series of sixty-four combinations, from the purely yang-line set ䷀ to the purely yin-line set ䷁, each one of the symbols again having a name and an abstract significance, like "coherence," "slow advance," "corruption," "inspiration" (Fig. 6.9).

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These sixty-four hexagrams formed the basis of another great classic available in the Chou library, the *I Ching* or "Book of Changes," which also began to take shape long before the Golden Age of Greece.[13] This is an oracle book of tremendous reputation, especially the reputation for giving the right answer.[14] It has been consulted throughout Chinese history until recent times.[15] Unlike any other oracle book, the *I Ching* attracted a vast amount of comment and scholarly work, which mingled with the original "irrational" element to form something not known in other cultures: an oracle book with high ethical overtones.[16]

The *I Ching* consists of sixty-four short texts, one per hexagram, written in a style that is both lofty and obscure.[17] It works like this. The reader who needs advice performs certain manipulations with fifty little sticks; in this way he obtains a series of six lines, whole or broken, that build up a hexagram. This is the key to the proper place in the *I Ching*. For example, for the hexagram ䷘, which stands *wu wang*, "innocence," he would find:

> Use no medicine in an illness
> Incurred through no fault of your own.
> It will pass of itself.[18]

From there on the reader has to decide for himself what to do.

The success of this book is difficult to grasp for Western readers. It was discussed not long ago by C. G. Jung, the Swiss psychologist, who interpreted the use of the *I Ching* as a subtle technique for exploring the unconscious.[19] The idea is fascinating, although it would apply as well to any other oracle book, for it simply means that the reader is unconsciously guided to search for his own solution.

One of the statements in the *I Ching* is that "the great-souled man always meditates on trouble in advance and takes steps to prevent it."[20] The same thought is expressed in many other books, political as well as medical, and even in an old geography treatise on the shelves of the Chou library, the *Shan Hai Ching* or "Classic of Mountains and Rivers," which mentions in passing a number of herbs and drugs "good for preventing" this or that ailment.[21]

Prevention is better than repression: why would this particular thought keep reappearing, like a tune played in different keys? A likely reason is that it came about at first as a political principle, reflecting the strains of a feudal society in which forethought and prevention were means of survival. Then the same concept was applied to bodily illness. There is nothing strange about this shift from politics to medicine, for in the Chinese view of the world, everything was correlated: a healthy state depended on a balance of individuals, the health of individuals depended on the world around, and the health of each organ depended on all the others—so that nothing could change without changing the whole. A fifth century A.D. commentary on the *I Ching* actually states that this is the basic idea of the book; it "can be expressed in one single word, *Resonance* (Kan)."[22]

I will stop here, for it is uncomfortable to browse in a dream library. But the point of this survey is that the Chou scholar had at hand a vast and ancient literature, utterly unknown in the Mediterranean world, and utterly unaware of that world. The actual records that the Chou scholar himself was compiling were used about two hundred years after his death by historians of the early Han Dynasty (2nd century B.C.), to compile a book on the organization of the Chou state as they saw it.[23] Called the *Chou Li*, or "Institutions of the Chou," this book is a document of great interest, because it portrays the ideal state as the Han imagined it. It also contains a few nuggets about things medical.

For those who wrote it, the table of contents of the *Chou Li* was a purely technical list of palace administrators; to us it reads as if it came from a fable: Chief of the Palace, Cooks for the Interior, Cooks for the Exterior, Workers of the Extracts, Workers of the Ice-room, Chief of the Writings, Imperial Concubines, Director of the Silk, Officer of the Feathers, Superintendent of Violence . . .[24] Each service was assigned a specific staff, so that one can assess its relative importance. The personnel assignments for the five medical services ran as follows, arranged here as in the original text, after the turtle-catchers and officers of dried food, and before the wine-people:[25]

Service of the Turtle-Catchers

Third-class graduates	4
Warehouse-wardens	2
Scribes	2
Apprentices	16
	24

Service of the Officers of Dried Food

Third-class graduates	4
Warehouse-wardens	2
Scribes	2
Apprentices	20
	28

Service of the Chief of Physicians

First-class graduates	2
Third-class graduates	4
Warehouse-wardens	2
Scribes	2
Apprentices	20
	30

Service of the Physician for Simple Diseases

Second-class graduates	**8**

Service of the Ulcer Physicians (Yang I)

Third-class graduates	**8**

Service of the Food Physician

Second-class graduates	**2**

Service of the Physician for the Animals

Third-class graduates	**4**

Service of the Superintendent of Wines

Second-class graduates	4
Third-class graduates	8
Warehouse-wardens	2
Scribes	8
Aides	8
Apprentices	80
	110

Service of the Wine-Men [sic]

Eunuchs	10
Wine-women	30
Convicts	300
	340

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It is obvious from these lists that the employees of the Chou were fitted into a system of degrees, much like that of today's state administration.[26]

The specific duties of each employee are listed in Book 5 of the *Chou Li.* Quoted below are the main duties of the physicians, with explanations contributed by ancient commentators in brackets.[27] Note the recurring "established sets" of items, usually five, six, or eight, and the persistent references to seasons in human affairs.

Chief of Physicians (I Shih)

He is entrusted with the overall direction of the physicians. He collects the powerful drugs [literally "poisonous drugs;" these are "the bitter substances used as medicines. According to the *Chou-king*, a drug cannot heal unless it is disagreeable"] used in the art of healing. All the people belonging to the administration of the kingdom, who suffer from ordinary diseases, head diseases, or wounds, come to him. Thereupon he orders the various physicians to share among them the treatment of these diseases. At the end of the year he examines the work of the physicians, in order to settle their appointments. The first degree corresponds to ten complete recoveries, or to ten complete treatments. One mistake out of ten cases is the second degree. Then, two mistakes out of ten cases; three mistakes out of ten cases; the last degree is four mistakes out of ten cases. [According to one commentator, there were five degrees below the maximum. Two other commentators disagree about the requirement of complete recovery, for "there are incurable diseases. The Chief of Physicians only verifies whether the treatment has been applied with knowledge of the disease. One cannot demand recovery"].

Food Physician (Shih I, *"Dietician"*)

He must arrange for the regular preparation of the six vegetable foods, the six types of drinks, the six main foods, the one hundred delicate foods, the one hundred dressings, the eight choice dishes for the Emperor. In general, for the regular preparation of the vegetable foods, he considers spring. To prepare juices or sauces, he considers summer. To prepare dressings, he considers autumn. To prepare drinks, he considers winter [meaning of the seasons: "vegetables must be warm, sauces hot, dressings cool, drinks cold"].

Physicians for Simple Diseases (Chi I)

They treat the minor ailments and the diseases of the people.

There are special diseases for each season. In spring, there are headaches and troubles with the head. In summer there are ulcers and sores. In autumn there are fevers and colds. In winter there are coughs and troubles of breathing.

They look after and treat these diseases with the five tastes [vinegar, wine, honey, ginger, and salt], with the five kinds of grain, with the five kinds of drugs [herbs, trees, insects, stones, and grains].

They test by the five kinds of breaths, by the five kinds of sounds, by the five colors, whether the patients are alive or dead.

They test a second time by changes in the nine orifices of the body. They test a third time by movements of the nine viscera.

They treat separately the men of the people who are sick. If death occurs, or end of life [death applies to the young, end of life to the aged], then each physician writes the causes whereby this happened, and hands over this note to the Chief of Physicians [The Chief of Physicians collects the death-notes; he uses them to fix the level of appointment, or even to forbid a physician from treating any further].

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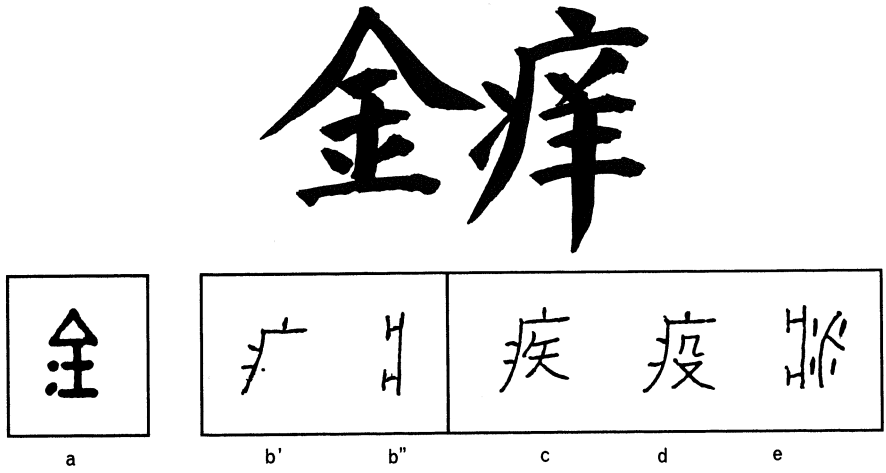
Ulcer Physicians (Yang I)

They are in charge of treating swollen ulcers, ulcers that drip, ulcers caused by metal ["wounds caused by cutting weapons"; Fig. 6.10], ulcers of fractures ["those caused by falling"]. They apply drugs to them. They cleanse them and destroy them [the comments suggest that the "destruction of bad flesh and of spoiled blood" is accomplished by the drugs applied].



6.10 "Metal ulcer" (above), the expression used in the *Chou Li* for wounds caused by weapons. Some older, related signs appear below: (a) "metal," probably a mine-shaft with a cover and lumps of ore; (b', b") "bed," the radical *ni* contained in the character for "ulcer" (most diseases were later classified under this radical; see Fig. 6.15, for example; (c) "epidemic disease," a man on a bed; (d) "epidemic fever," a hand and stick over a bed, symbolizing a man belabored by disease (the same hand and stick as in the character for "physician"; see Fig. 6.11); (e) "itching scabies-like epidemic" (presumably an infectious fever with a skin rash), a man with spots lying on a bed.

In general, to heal the ulcers, they attack them with the five poisonous substances; they fortify them with the five emanations or with the five kinds of grains; they heal them with the five medicinal substances; they temper them by the five flavors.

In general, when they apply drugs, they fortify the bones with the acid principle; they fortify the nerves with the stinging principle; they fortify the pulse with the salty principle; they fortify respiration with the bitter principle; they fortify the bodily openings with the oily principle.

All those that have ulcers receive their drugs.

Physicians for the Animals (Shou I, "*Veterinarians*")

In general, to heal the simple diseases of the animals, they sprinkle them and make them walk ["Diseases of animals are difficult to recognize. The animal is sprinkled with an infusion of medicinal plants, so as to make it feel comfortable." "When the animal has walked at a moderate pace, its pulse is examined: this way its disease is recognized"] . . .

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In case of death, the number of lost animals is counted, so as to raise or lower the physician's level of appointment.

[*The duties of the Superintendent of Wines, which follow, are quite a bit longer and more complex.*]

Dissected by the historian's scalpel, these pages of the *Chou Li* reveal more than they say. First of all, they show that medicine—as in Greece—had

6.11 A step in the evolution of Chinese medicine, reflected in the evolution of the character *i* for "physician." The lower part changes from "sorcerer" (bottom left) to "wine" (bottom right).

slipped out of the hands of the priests and sorcerers, whose duties are listed separately. This evolution must have fully occurred by the time of Confucius, who said around 500 B.C. that "a man without persistence will never make a good magician (*wu*) or a good physician (*i*)."[28] The birth of professional Chinese medicine corresponds to an interesting change in the character *I* for "physician."[29] Its ancient form consists of three parts (Fig. 6.11). At the top left is the radical for "quiver of arrows" or "chest of arms," on its right is a hand grasping a weapon 殳 and below is the symbol for "sorcerer" or "priest" 巫. The complete character conveys that the priest uses strong weapons to fight off the demons of disease. Later, the lower part of the character changes to the symbol for "wine" 酉—indicating that the practice of medicine is in the hands of professionals, who are now giving drugs—indeed "wine-drugs."

A second message of the *Chou Li* is the low status of surgery, since it was limited to a small group of "third-rate graduates." Things were quite different in China's great neighbor India, where surgery was a noble art.

Third, the practice of medicine was a tightly organized state system, in which the physicians were graded according to achievement, like everybody else. The grading of state employees remained a typical feature of Chinese administration from the Chou onward. At first the criterion was achievement; then came regular exams. On this subject the Chinese claim to priority is unbeatable: objective techniques for measuring the ability of a candidate for service in the government was devised as early as the fourth century B.C., and the earliest formal written examination of which there is an unimpeachable record, anywhere in the world, was given at the Chinese court in 165 B.C.[30] Slowly the idea diffused West, via Baghdad and the Islamic world. It reached Europe early in the twelfth century and was applied first in the medical field: the practice of examining physicians, required in Sicily by the statute of Roger II the Norman in 1140, was in all likelihood a distant reflection of Chinese standards.[31] Classical Greece had no such rational system for selecting its public physicians. What little is known about it suggests that if there was any test, it was rather a matter of delivering a good speech.[32]

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The Cornerstone of Chinese Medicine

The most important medical text of Chinese antiquity, indeed of Chinese medicine altogether, is by far the *Huang Ti Nei Ching*, or *Nei Ching* for short, comparable for its impact to the Hippocratic Collection. Scholars, Chinese or not, agree on one point: although its basic principles are relatively simple, the *Nei Ching* is an extremely difficult book to translate, and often also to understand. The difficulties begin with the title, usually translated as "The Yellow Emperor's Classic on Internal Medicine." Huang Ti was in fact the Yellow Emperor (his yellowness, however, had nothing to do with skin color: yellow stood for "centrality," hence "majesty," doubtless because of the color of the cradle of Chinese civilization—think of the Yellow River[33]). According to tradition, Huang Ti lived between 2629 and 2598 B.C., and it was he who wrote the *Nei Ching*. It is now known that Huang Ti belongs to legend, and in any event Chinese history cannot be pushed farther back than about 1500 B.C.[34] *Nei* means "inside," and by extension everything "this-worldly," rational, practical; as opposed to *wai*, "outside," and by extension "other-worldly," having to do with gods and spirits. *Ching* may be rendered as "classic" or "manual." Therefore, the best translation of *Nei Ching*—to use an old English word—might be "Manual of Physic."[35]

One basic difference with the Hippocratic Collection is the certainty of dates. The Collection unquestionably took shape between 450 and 350 B.C. As for the *Nei Ching*, Huang Wên believes that the original text was probably put together between 479 and 300 B.C. (which would make it almost exactly contemporary with the Hippocratic corpus) and then recast or reedited four times, the last between 1068 and 1078 A.D. According to Lu Gwei-Djen and Joseph Needham, the text had probably reached its present form—or nearly so—by the first century B.C.[36] In any event, it is certain that in the course of successive editions the original message lost some of its purity. How much it lost, nobody knows. Part of the problem is that in ancient manuscripts the comments were written into the text and therefore became practically indistinguishable from it. In this respect, a special debt of gratitude is owed to the ancient Egyptian commentator who inserted his glosses into the Smith papyrus, but always labeled them with the formula *yr . . . pw . . .*, "As for . . . it means . . ."[37] Thus, his own text and the original cannot be confused.

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To someone who cannot read any of the 49,000 Chinese characters, a complete translation of the great Chinese medical classic is available only in French, and that only since 1957. It is a book of average size and reads rather like a catechism, being written in the form of a conversation between Emperor Huang Ti and his prime minister, Ch'i Po, who speaks like a wise logician and never presents himself specifically as a medical man. If the book originally had a plan, not much of it is left; the discourse runs unpredictably about disease mechanisms at a physiophilosophical level. On the whole, what would be called practical advice is left in the shade. The author seems much more concerned about guiding the patient back to *Tao*, "The Way," than about specifics for his diarrhea (Fig. 6.12). The single form of treatment

6.12 *Tao,* "The Way" or "The Way of Nature." The bottom stroke and the left part of the sign are the radical for "treading a path;" the right part means "head."

discussed in some detail is acupuncture; even treatment by drugs is just hinted.

A book that presided over the health of one quarter of the people on this globe for 2500 years is not to be taken lightly. However, an overall judgement on the *Nei Ching* is very difficult to give. The English translation is incomplete and tentative;[38] as a layman, I have my own doubts about the French version too, for it uses expressions such as "epidermis" and "violin strings."[39] The Chinese original is said to be in parts very obscure; and there is always the risk of mistaking obscurity for profundity.

It is safe to say that the book has a definite coherence, in that it is based on the yin-yang concept, on the five elements, and on the maze of correlations so typical of ancient Chinese philosophy. Inevitably, to anyone who does not share these premises, the beauty of the system becomes vagueness and irrelevance. A German scholar has recently undertaken to explain the inner logic of the yin-yang world using Latin terminology:[40] to the average reader the result is thoroughly forbidding.

Yet, even in translation, and even if its literal message is partially lost, the *Nei Ching* is a document of great human interest; the very fact that it is more philosophical than strictly medical may contain an important message for physicians of the Western world. I will quote below a few paragraphs that I find especially pertinent, although I feel obliged to warn the reader once again that the *Nei Ching* in English garb may come as close to the original as dream to reality. I should never have tried to compare the translations. For example, consider Su Wên 14. In the French version, the Emperor asks: "Comment doit-on soigner le malade?"—"How should one look after the patient?" In the English, he asks: "How can one prepare soup?"[41] In Su Wên 16, the Emperor is inquiring, in French, about "the examination of the patient;" in English, about "the rules of death."[42] I find this unnerving. On the whole, however, the topics and the "atmosphere" remain similar enough to warrant the following quotations.[43]

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The first one shows that some problems have not changed in two millennia:

> The Yellow Emperor once addressed T'ien Shih, the divinely inspired teacher: "I have heard that in ancient times the people lived (through the years) to be over a hundred years, and yet they remained active and did not become decrepit in their

activities. But nowadays people reach only half of that age and yet become decrepit and failing. Is it because the world changes from generation to generation? Or is it that mankind is becoming negligent (of the laws of nature)?"

Ch'i Po answered: "In ancient times those people who understood Tao patterned themselves upon the Yin and the Yang and they lived in harmony with the arts of divination.

"There was temperance in eating and drinking. Their hours of rising and retiring were regular and not disorderly and wild. By these means the ancients kept their bodies united with their souls, so as to fulfill their allotted span completely, measuring unto a hundred years before they passed away.

"Nowadays people are not like this; they use wine as beverage and they adopt recklessness as usual behavior . . . They do not know how to find contentment within themselves; they are not skilled in the control of their spirits. They devote all their attention to the amusement of their minds, thus cutting themselves off from the joys of long (life). Their rising and retiring is without regularity. For these reasons they reach only one half of the hundred years and then they degenerate."[44]

The next two examples, though typical of the *Nei Ching*, develop the same theme as the Hippocratic treatise *Airs Waters Places*—disease depends on geography and the seasons:

The Yellow Emperor asked: "When the physicians treat diseases, do they treat each disease differently from the others and can they all be healed?"

Ch'i Po answered: "Yes, they can all be healed according to the physical features of the place where one lives . . . The people of the regions of the East eat fish and crave salt; their living is tranquil and their food delicious. Fish causes people to burn within (thirst), and the eating of salt injures (defeats) the blood . . . Their diseases are ulcers, which are most properly treated with acupuncture by means of a needle of flint. Thus, the treatment with acupuncture with a needle of flint has its origin in the regions of the East."[45]

Those who disobey the laws of Spring will be punished with an injury to the liver. For them the following Summer will bring chills . . .

Those who disobey the laws of Summer will be punished with an injury to the heart. For them the Fall will bring intermittent fevers.[46]

And here is the case for preventive medicine. Note the arguments drawn, typically, from politics:

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The superior physician helps before the early budding of the disease. He must first examine the three regions of the body and define the atmosphere of the nine subdivisions so that they are entirely in harmony . . . Therefore he is called the superior physician.

The inferior physician begins to help when (the disease) has already developed; he helps when destruction has already set in. And since his help comes when the disease has already developed, it is said of him that he is ignorant.[47]

Hence, the sages did not treat those who were already ill; they instructed those who were not yet ill. They did not want to rule those who were already rebellious; they guided those who were not yet rebellious . . . To administer medicines to diseases which have already developed and to suppress revolts which have already developed is comparable to the behavior of those persons who begin to dig a well

after they have become thirsty, and of those who begin to cast weapons after they have already engaged in battle. Would these actions not be too late?[48]

The following is an example of yin and yang theory. It, too, is related to the seasons:

Thus, mankind should correspond to this system: the Yin and Yang of man are (arranged in the order) that on the outside there is Yang, and inside there is Yin. Yin and Yang of the human body (are arranged) that Yang is in back and Yin is within the front part. Yin and Yang of the (five) viscera and the (six) bowels are (arranged) that the viscera are Yin and the hollow organs are Yang. All of the five viscera—liver, heart, spleen, lungs, and kidneys—are Yin; and all of the five hollow organs—gall-bladder, stomach, lower intestines, bladder, and the three burning spaces [*imaginary organs*]—are all Yang.

The reason why we must know (the rule of) the Yin within the Yin and (the rule of) the Yang within the Yang is that the diseases of Winter are located in (the region of) Yang and the diseases of Summer in (the region of) Yin; the diseases of Spring are located in the (region of) Yin and the diseases of Fall in the (region of) Yang. We must know the location of all these diseases for (the purpose of) acupuncture.[49]

Now hear an interesting statement on acupuncture, one that may contain a profound truth—cure depends on the patient's will:

The Emperor asked: "When the body is worn out and the blood is exhausted, is it still possible to achieve good results?"

Ch'i Po replied: "No, because there is no more energy left."

The Emperor inquired: "What does it mean, there is no more energy left?"

Ch'i Po answered: "*This is the way of acupuncture: if man's vitality and energy do not propel his own will, his disease cannot be cured.*"[50]

More about acupuncture, the seasons, and wind as a cause of disease:

If one perspires while (physically) weary, one is susceptible to (evil) winds which cause eruptions of the skin; and those, if irritated, will develop into sores . . .

If the atmosphere of the (main) "ducts" is not harmonious with the system of the flesh, it will cause ulcers and swellings. Then the perspiration of the animal spirit is unable to reach out . . . the "(acupuncture) spots" will be closed, and there arise winds and intermittent fevers.

Thus, wind is the cause of a hundred diseases. When people are quiet and clear, their skin and flesh is closed and protected. Even a heavy storm, afflictions, or poison cannot injure those people who live in accord with the natural order.

If a sickness lasts a long time, there is danger that it might spread, then the upper and the lower (parts of the body) cannot communicate; and even skillful physicians are then not able to help.

If Yang accumulates excessively, one will die from the (resulting) disease . . .

If one does not drain it thoroughly and guide away the rough matter [with acupuncture], there will be destruction.[51]

And finally, here are some thoughts on the soul, the body, and disease:

When the spirit is hurt, severe pains ensue; when the body is hurt, there will be swellings. Thus, in those cases where severe pains are felt first and the swellings

6.13 Confucius on the bank of the Yellow River. This is an episode of his life, drawn by an artist of the Yüan Dynasty, 1260–1368 A.D. Confucius died in 479 B.C., a few years before the birth of Hippocrates.

appear later, one can say that the spirit has injured the body. And in those cases where swellings appear first and severe pains are felt later, one can say that the body has injured the spirit.[52]

Ch'i Po answered: "The utmost in the art of healing can be achieved when there is unity."

The Emperor inquired: "What is meant by unity?"

Ch'i Po answered: "When the minds of the people are closed and wisdom is locked out they remain tied to disease. Yet their feelings and desires should be investigated and made known, their wishes and ideas should be followed; and then it becomes apparent that those who have attained spirit and energy are flourishing and prosperous, while those perish who lose their spirit and energy."[53]

Life itself is the beginning of illness.[54]

The Yang I Approach to a Sore

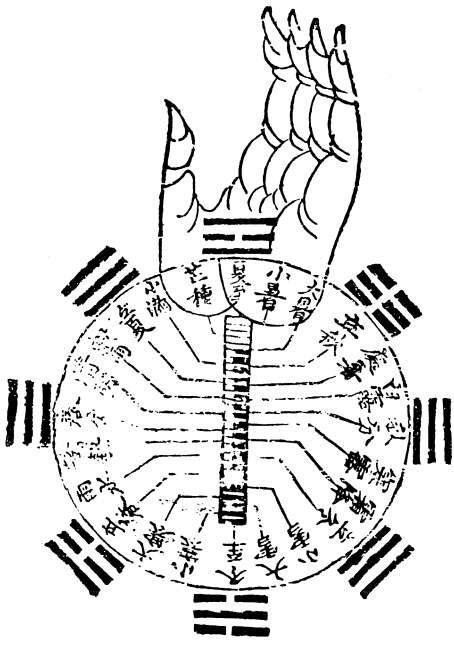
Surely, about 400 B.C., some prince at the Chou court in Loyang limped from a varicose ulcer on the ankle, a bad case, complicated with infection and inflammation. How would he have been treated, compared with a similar patient in an Athenian infirmary?

I have not forgotten the warning of Calvin Wells about imaginative insight having to stop short of delirium; but defeatism is a crime, too. I shall therefore attempt to answer my own question, using the *Nei Ching* as a guide, as I have done with the Hippocratic books. If Huang Wên is right, the core of the *Nei Ching* appeared at the time of our story, around 400 B.C.; some of its content, like the yin and the yang, is even older, and if some is later, it still refers to ancient Chinese practice. So here is a sequence of medical gestures, reconstructed from the *Nei Ching*.[55]

Upon meeting his patient, the yang i would begin—as we do today—by asking questions, though not quite the same as we would choose: was he rich or poor? had he seen better times? had he noticed any change in appetite? had there been any change in his comfort of living? was his disease affected by changes in the weather? Failure to ask any of these questions was one of the "five errors" and "four mistakes."[56]

Then he would feel the pulse on both of the patient's wrists and compare it with his own, in an elaborate ritual, which could take hours (Fig. 6.14). He was supposed to recognize dozens of subtle changes, poetically described in the *Nei Ching*. The pulse could be:

> . . . sharp as a hook
> fine as a hair
> taut as a music string
> dead as a rock
> smooth as a flowing stream
> continuous like a string of pearls
> slightly indented in the middle
> the front crooked
> and the back delayed
> soft and fluttering
> like floating feathers
> blown by the wind
> elastic like a bending pole
> taut as a bow when first bent
> following up delicately
> like a cock treading ground
> or lifting a foot
> sharp as a bird's beak
> like water dripping
> through the roof
> resonant like striking a stone
> rapid as the edge of a knife
> in cutting
> vibrating as when one stops the strings
> of a musical instrument



6.14 Instructions for feeling the pulse during each of the twenty-four seasons of the year.

light as flicking the skin
  with a plume
arriving like a suspended hook
multiple as the seeds
  of the flower blossom
like burning firewood
like leaves scattering
like visiting strangers
like a dry mud-ball
like mixing lacquer
like spring water welling up
like sparse earth
like being stopped
  by a horizontal partition
like a suspended curtain
like a sword lying flat ready to be used
like a smooth pill
like glory . . .[57]

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If the translation is correct, one can visualize the yang i holding the wrist, closing his eyes, and trying to decide whether the throbbing beneath his fingers felt like any one of the items listed above, or even like the colors red, white, green, yellow, or black.[58] The purpose of this exercise was to extract from the pulse the whole picture of the disease, which is about as hopeless as trying to gather the contents of a page—or of a whole book—from a single line. Thus, it is inaccurate to say that these or any other ancient physicians developed a great "mastery" of the pulse.[59] However, it must be remembered that while little information was passing—through the pulse—from patient to physician, much comfort was surely flowing the other way.

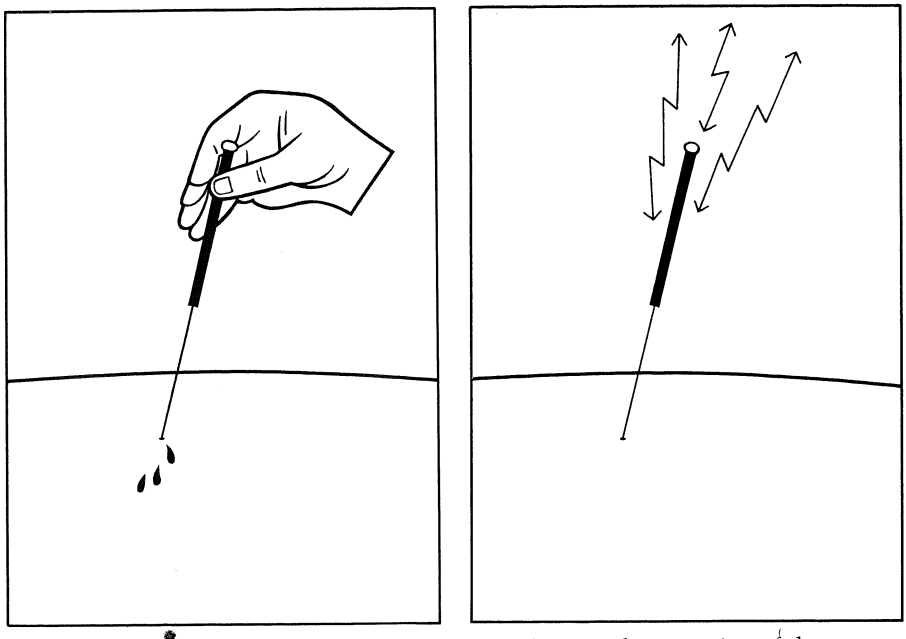
6.15 The "hot disease," mentioned in the *Nei Ching*, presumably a variety of feverish conditions, including inflammation. Note the flames (bottom left).

Next, the yang i would examine the hot, inflamed skin around the ulcer. He might conclude that this was a form of the "hot disease," as indicated by the flames in the Chinese character (Fig. 6.15; there were also a cold and a lukewarm disease).[60] Now it was thought that heat developed when yin was wanting and yang prevailed. Remember: yin is cold and moist; yang is hot and dry. To bring back the balance, there were at least two maneuvers of the kind that we would call "local treatment": piercing the skin with one or more needles (acupuncture), and burning it with small lumps of smoldering material, a procedure known today—outside of China—as *moxa*.

Drainage, Chinese Style

Drainage: this was, indeed, the basic meaning of acupuncture. It was not a mild form of Chinese torture, dreamed up by a sadist; nor was it an Eastern fantasy, created out of thin air. It was a different solution to the problem of restoring the balance. The Greeks had the same general idea; but their imbalanced four humors were all in the blood, so their response was to draw out blood. The Chinese solution was much more subtle. It seems that the barbarous procedure of slitting veins was totally unknown in ancient China[61] (though a few drops of capillary blood were drawn at times by acupuncture). Instead, the Chinese conceived a set of imaginary, or spiritual, vessels or "meridians," containing not blood but *ch'i*. This principle was something like the Greek *pneuma* or "energy."[62] It could be either drawn out or replenished (inward), simply by needling the right ch'i vessel. Thus, the needling could be called a form of drainage—of "energy" rather than blood.

This dual "inward" and "outward" purpose of needling is evident throughout the *Nei Ching*.[63] The terms used in the translations are "extraction," "purging," "draining."[64] It is possible that the use of the needle as an "energy drain" may have had its roots in true surgical drainage; at least it is often said—on what authority I do not know—that acupuncture began in prehistoric times, with the practice of piercing to let out pus or blood.[65] However, an advantage of spiritual drainage is that it can go both ways. The needles could let "energy" out as well as in and thus replenish it from the outside (Fig. 6.16). Even today's acupuncturists sometimes "disperse" and sometimes "tonify."[66]



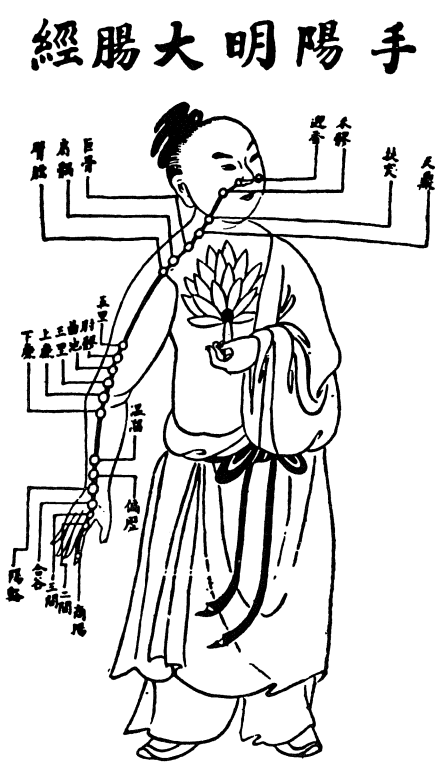
6.16 Scheme of the ways in which a needle can "drain in the intention of the acupuncturist: letting blood out (left), letting energy in and out (right).

Yin and yang were seen then, as they are still, not as bodily juices—like black bile and yellow bile—but as cosmic forces present everywhere. Yang gives the heat of fever and inflammation, but also the warm air of the south; and the clammy excess of yin is also responsible for the chills of the north. In the words of a modern scholar-acupuncturist, "the vital energy of the body is the same energy that fills the cosmos."[67] All this adds up to a beautiful, universal scheme, easily explained to any patient, and perfectly designed to suit the needs of men and women who firmly believed in the need to be tuned to the outside world.

So the yang i, having first established that the season, the day, the hour, and everything else was right, took a sliver of flint from his set of nine needles and stabbed it into the skin along a certain line. Of the 365 possible points, only one would do (Fig. 6.17).[68] What was the effect on the varicose ulcer? I transcribe this astonishing statement from the modern preface to the French version of the *Nei Ching:* "[It is here again] that we found, as regards technique, that sensational novelty—the handling of the triangular needle. With it, the most rebellious varicose ulcers disappear in a short time."[69]

However, accidents were also possible. Even the *Nei Ching* admits that sometimes the condition worsened, and that needles "wrongly applied" could cause abscesses and even death.[70] "Wrongly applied" means that if an infection developed, the yang i could not write it off to bad luck or accident; he would be guilty of having hit the wrong point. Hindu surgeons reasoned the same way in cases where an abscess developed after piercing an ear lobe.

The next step of the treatment for the ulcer might be to rekindle the fiery yang—of course, not on the leg, where it had been drawn by the ulcer,



6.17 One of the vessels or "meridians" of acupuncture, none of which follow the blood vessels. This one, for instance, runs from the tip of a finger to the nose.

but at some other distant spot. To do so, the yang i would ask the patient to lie on his bed, face down. Then he would reach into a bag, pull out two or three pinches of a gray, powdery fuzz, roll it into a little cone, and balance it on the back of the patient, at one precise spot.[71] After carefully setting fire to the tip of the cone, he would let it smolder until nothing was left but ashes, and—presumably—a blister.

This method is still used widely today as an adjunct to acupuncture (Fig. 6.18). The material consists of powdered leaves of *Artemisia vulgaris* or *alba* (mugwort, a relative of wormwood); its active principle is supposed to be the down of these leaves. Basically, this treatment is a cautery, but a discreet, even thrifty one, typical of a culture closer to plants than to minerals.[72] Its Latin name of *ignipuncture*, literally "stinging with fire," implies the link with acupuncture. The more common name, however, is a word of Japanese origin, *moxa*. Fire being yang, the theory seems to be that moxa is indicated when there is an excess of yin.[73]

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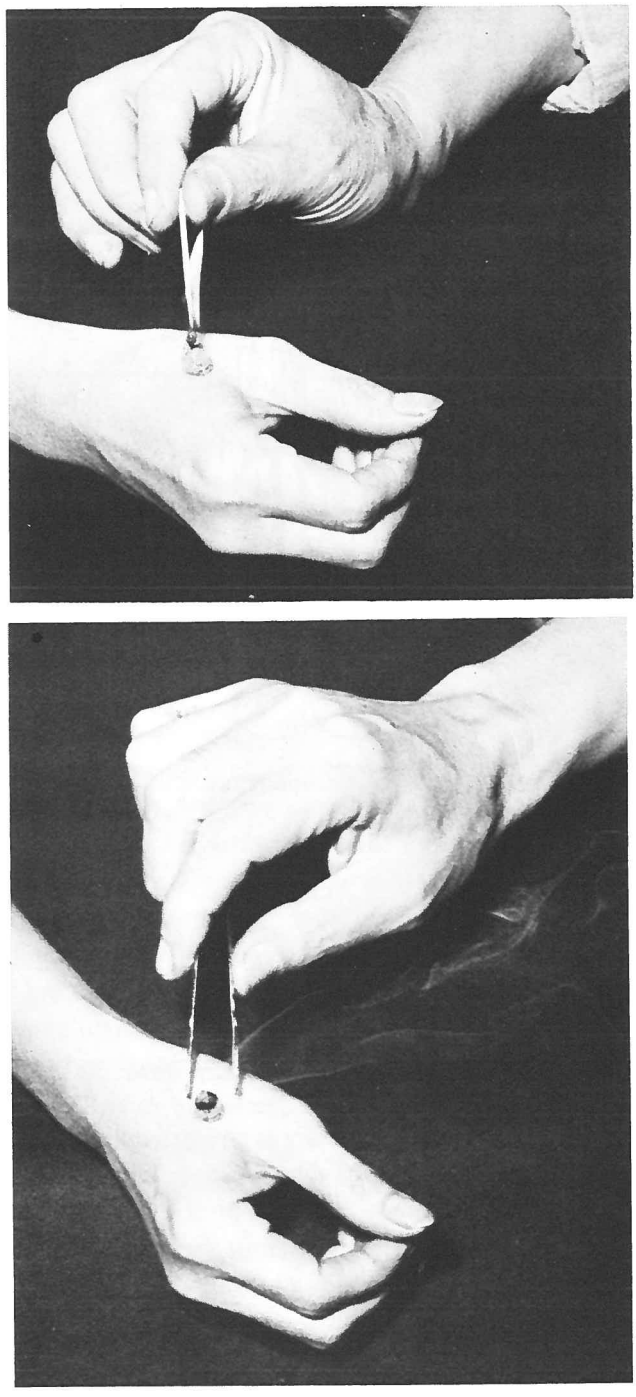
It goes without saying that the moxa hurts, though less than did the red-hot irons of the Greeks. Nowadays, a slice of onion, garlic, or ginger may be placed beneath the smoldering cone; or the cone is removed before it has burned down to the skin.[74] Otherwise, patients grin and bear it. The Chinese approach to pain is epitomized in the traditional story (perhaps 1800 years old) of the surgeon Hua T'o operating on General Kuan Yü, whose arm had



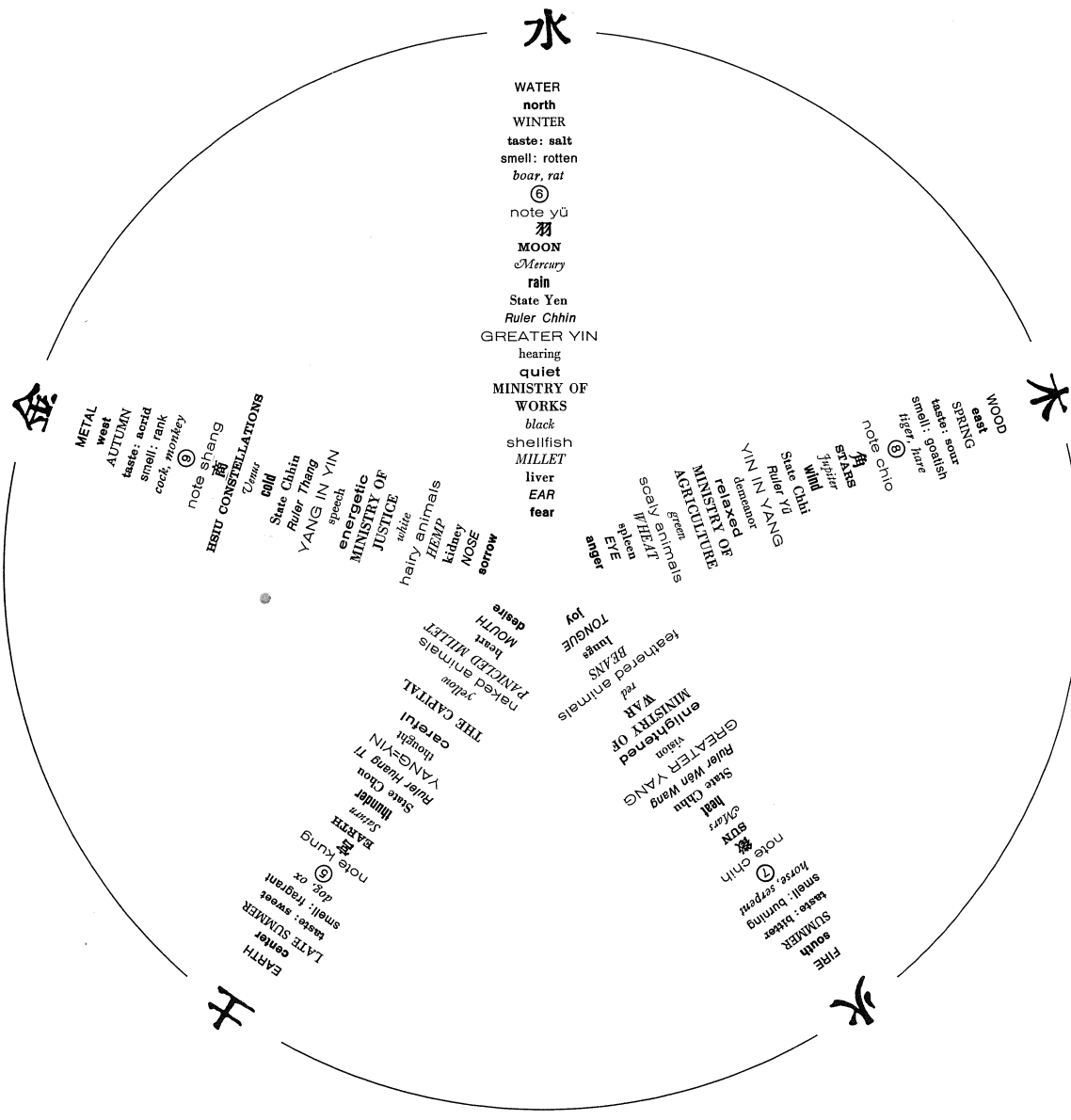
6.18 Chinese ignipuncture or *moxa* as practiced today. A cone of *Artemisia* fluff is placed on the proper point and lit (above), then allowed to smolder. According to this particular modern scheme, the cone is removed just as it begins to cause a reddening of the skin (below). In this mild version, the moxa can no longer be considered a cautery in the ordinary sense; however, the burning *Artemisia* fluff is supposed to produce curative effects of its own, independent of cauterization.

6.19 Ancient Chinese anesthesia: stoicism, a game of chess, and some wine in the cup. Hua T'o, a surgeon, is operating on General Kuan Yü for a poisoned arrow-wound.

been pierced by a poisoned arrow. While the knife went *hsi, hsi,* scraping the bone, the general played chess—and drank cups of wine (Fig. 6.19).[75]

After the use of the needle or the burn to treat an ulcer, there would come some medicine, possibly also a purge,[76] and the prescription of a diet. On these I cannot comment,[77] except to say that if the yang i was really to observe his five-fold correlations, I doubt that he could do so without a book. In the tables of correlations that eventually grew out of Chinese medico-philosophical thought, everything was linked to everything else (Fig. 6.20). To make the "correct" move in that maze today, one would need a computer; and even then the answer would be nonsense, or the computer would jam, because the tables were contradictory. In one catalog, for example, the correlations add up to more than one hundred categories.[78]

In the end, if the patient did not improve, the yang i had the perfect excuse: he had been called in too late. In the words of the sages, who would wait to be thirsty before beginning to dig his well?



6.20 Some of the fivefold correlations. Within each of the five categories, everything "fits." For instance, "spring" (top right) brings "wood," the mood is "relaxed," the color is "green," and the time is good for the Ministry of Agriculture. It must have been impossible to live according to the letter of this bureaucratic philosophy, but certainly some of the correlations were observed. For example, the Ministry of Justice (under the sign for "metal," top left) did in fact postpone all executions until autumn.

Yang i has been translated as "ulcer physician"[79] or "Physician-in-Ordinary for External Medicine."[80] "Surgeon" might be too much, at least until we know more about the type of "external medicine" that the yang i performed. It is usually said that the yang i operated rarely; but his status being low, his labors were not liable to be mentioned. It is possible that he knew how to sew up a wound; surgical sutures are well documented for Hua T'o (this famous surgeon of the second century A.D. was a contemporary of Galen), and there is evidence for sutures as far back as the second century B.C., which brings them close to Hippocratic times. Soporific drugs are also mentioned in ancient texts; their sociological importance in ancient China went beyond surgery, because physicians used them at times to alleviate pain caused by the severe physical punishments inflicted by the law. It is now certain that neither opium nor hemp were used, whereas several drugs of the so-called anticholinergic group were known (including henbane, *Hyoscyamus*, known also in Greco-Roman antiquity).[81]

Until further research provides more data on Chinese surgery as it was about the time of Hippocrates, the wound practice of the yang i rather recalls the type of surgery prevailing in Egypt at the time of the Smith papyrus, a practice that dealt broadly with matters surgical, but only on wounds that were ready-made or on sores.

The "surgical" Smith papyrus never mentions the knife; the *Nei Ching* mentions surgery only twice,[82] and then very much as a side issue. Most revealing is a passage that lists the five kinds of treatment, in this order:

PSYCHOLOGY ("cure the spirit")
DIET ("give proper nourishment to the body")
DRUGS
ACUPUNCTURE
CLINICAL MEDICINE ("examine and treat the bowels, the viscera, the blood and the breath"[?]).[83]

Surgery does not even fit into this picture. It did far better with the Hindus, with the surgically-oriented Hippocratics, and even more so with the down-to-earth Romans. Celsus says that there are three ways to treat a patient—through diet, medicine, and surgery—but that only surgery gives definite help.[84]

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The single act of surgery that the ancient Chinese surely performed was not a treatment for disease. Many court employees were eunuchs. The *Chou Li* takes this situation for granted, without explaining the procedure. If the surgical method was the same in ancient days as under later dynasties, it was dangerous, because all the external genitalia were removed.[85] According to tradition, when Hua T'o was jailed by order of the emperor, he entrusted his manuscripts to the jailer, who burned them all except the improved castration technique.[86] Today the method of Hua T'o is lost. Yet a method that was practiced in 1929 cannot be very different:

When about to be operated on, the patient is placed in a semi-supine position on a broad bench. One man squatting behind him grasps his waist, and another is told to look after each leg. Bandages are fastened tightly round the hypogastric and inguinal regions, the penis and the scrotum are three times bathed in a hot decoction of pepper pods, and the patient, if an adult, is solemnly asked, whether he repents or will ever repent his decision. If he appears doubtful he is unbound and dismissed, but if his courage has held out, as it usually does, all the parts are swiftly swept away by one stroke of a sickle-shaped knife, a pewter-plug is inserted into the urethra, and the wound is covered with paper soaked in cold water and is firmly bandaged. The patient, supported by two men, is then walked about the room for two or three hours, after which he is permitted to lie down. For three days he gets nothing to drink nor is the plug removed from the urethra. At the end of this period the dressings are changed, and the accumulated urine is allowed to escape. The parts generally heal in about one hundred days . . . About two percent of all cases prove fatal, some by hemorrhage, some by extravasation, and some doubtless by sepsis . . . For a long time there is incontinence of urine.[87]

Note that the blood vessels are only compressed, not tied, just as in Hippocratic surgery. Perhaps there was some anesthesia with drugs taken by mouth—or just wine, since it was built into the character *i* for physician.[88]

This barbaric practice was not unique to China. In Mesopotamia, judicial castration and the employment of castrated domestics were perhaps two thousand years older than Hua T'o. In Syria, during a certain religious festival, young men would work themselves up to such a state of exaltation that they would seize a knife, castrate themselves, then run naked through the streets and fling the amputated parts into some house; those who lived there were obliged to provide them with clothes.[89] In the Roman Empire castration was forbidden, but it was performed all the same despite severe penalties. The emperors set a bad example by importing eunuchs at high prices.[90] This trade was legal as long as the operation had been performed abroad; but it also encouraged a sordid, clandestine industry in Rome. According to an official report from the sixth century A.D., after a series of ninety operations, only three of the victims survived.[91] A satire of Juvenal mentions the castration of slaves as a matter of fact. It also gives the name of a physician who took the dirty job away from the barbers; some of his clients were in high demand among women, but they paid for it by being objects of general curiosity at the public baths.[92]

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Eunuchs in China were offered an odd sort of compensation in public life: open doors at the court. Because they were unable to found competitive dynasties, they were particularly welcome there. It was under the Han that eunuchs first began to play an important role in politics.[93]

Chinese Wound Dressings and the Message of the Han Lady

In one way my surgical curiosity remains dissatisfied. What were the wound-dressings of the yang i? Not a word about it appears in the *Nei Ching,* in stark contrast to the Hippocratic books, where this is a major issue. In the *Chou Li* is that single sentence, "In general, to heal the ulcers, they attack them with the five poisonous substances."

6.21 The characters for "dragon teeth," a common Chinese drug—actually pounded fossilized mammoth teeth.

A commentator of the second century A.D. explains the "poisons" as follows: "Nowadays, physicians prepare them in a special yellow clay pot. They put in this pot some "bile stone" (Chi-than), cinnabar [*mercuric sulphide*], sulphur, magnetic stone, and a poisonous stone called *Yü* [*arsenolite, an oxide of arsenic*[94]] . . . They heat this mixture three days and three nights. When vapor rises, they collect it on a little brush of cock feathers, and with it they wipe the suffering part. The bad flesh and broken bones come out completely. They cleanse, corrode, and fortify the sound flesh."[95] All five "poisons" are minerals. The analogy with the Greek antiseptic *énaima* based on inorganic salts is obvious, though the inorganic materials are different—with the possible exception of cinnabar.[96]

Chinese pharmacy after the *Nei Ching* grew to huge proportions, involving some 2000 items, especially plants, and 16,000 prescriptions.[97] It would use anything at all as a "drug," including old drum-skins and toad secretions; but there is nothing particularly Chinese about this. Pliny mentions Greek gymnasium-keepers who made a fortune by selling, as a drug, the scrapings from the skin of athletes, consisting of sweat, oil, and sand.[98] And if the strange Chinese used "dragon teeth" as a drug—actually fossilized mammoth teeth (Fig. 6.21)[99]—the Europeans used fossilized shark teeth until the seventeenth century at least, thinking that they were snake tongues (Fig. 9.3).

It would be interesting to discover, some day, whether the Chinese knew about the antiseptic properties of resins and balsams. Certainly they knew of incense; in fact, they burned it before consulting their favorite oracle book, the *I Ching*.[100] Like the Mediterranean peoples they did a lot with resins, though again in a different way.[101] Their favorite balsam was storax, which was most unusual for the Chinese, as it was imported. It came at first from wounds of a tree in the Greek Levant, *Styrax officinalis*,[102] and later from *Liquidambar orientale*. The latter happens to be very rich in cinnamic acid and balsamic acids,[103] both of which we have already encountered as powerful antiseptics. The high prices that the Chinese were willing to pay for storax led to another curious parallel with the Mediterranean situation: the Indian middlemen made up outrageous tales about the danger of obtaining it, just as the Arabs did about cassia and cinnamon: they tried to pass storax off as lion dung.[104]

Guessing is not a respected historical approach, about antiseptics or anything else. However, there is the provocative new fact of the Han lady. In 1972, Chinese archeologists discovered a tomb of the early Han period,

6.22 The only known preserved body from ancient China, about 180 B.C. It had been submerged in a pink fluid and sealed inside the triple coffin.

dedicated by a feudal lord to the body of his wife who died about 180 B.C. At a depth of sixteen meters they found three huge coffins, one inside the other; priceless treasures of silk and craftsmanship were stacked in the free spaces. In the innermost coffin, half bathed in a pink fluid, was the body of a woman, preserved in a manner that had never before been witnessed (Fig. 6.22). Since the ancient spell had been broken, the noble lady had to be taken to a hospital for injections of modern preservative drugs; and European television audiences gasped at the sight of her soft arm, resilient under the finger of a physician.[105] Shortly thereafter the *Peking Review* released the first scientific data: "Chemical analysis proved that the fluid inside the intermost coffin contained various organic acids and mercurial compounds and was slightly antibacterial."[106]

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If one of the organic acids was acetic acid, my guess is that the pink fluid was mainly vinegar. The *Chou Li* describe a whole staff of Employees of the Vinegar, "in charge of preparing the Five Pickles [*marinades*], the Five Vegetable Preserves, and all that is [kept in] vinegar."[107] So the Han, who followed the Chou, had vinegar and knew how to use it. Note also the presence of mercury, which appeared among the five "poisons" used on wounds. Mercury is more toxic than lead (a favorite drug in Roman wound dressings) but also more bactericidal;[108] a property exploited in many modern antiseptics.

All this means that by the second century B.C. the Chinese had learned a great deal about decay. Somebody, at the time of the early Han, knew enough to stop decay for 2100 years.[109] I venture to suggest that people who had discovered a "pink fluid" to preserve corpses had also invented some "pink fluid" to fight the infection of wounds.

East and West of the Headache Mountains

In the hands of the yang i, then, an ulcer patient was punctured, blistered, probably also purged, and put on a special diet. None of this did him much good, which placed him on a par with a comparable Greek patient. His dressings were fairly safe, also as in Greece. And his treatment was well rooted in philosophy, as in Greece.

And yet, while the basic therapeutic themes were the same East and West, they were developed quite differently in the East, and more gently. The Chinese diet, for all of its intricate rationale tied to geography, the weather, and almost everything else, was not a starvation diet. The single use of starvation that I found in the *Nei Ching* was in the treatment for "madness and rage."[110] So it seems that the Chinese were spared this particular medical aberration—starvation as a wound therapy. This is confirmed indirectly by the report of a Chinese Buddhist who went to India in the seventh century and commented on its medical science: "In it, the most important rule is fasting . . . Most of the Chinese were not accustomed to such a practice, and consider it as a separate religious fast."[111]

The cautery, too, was toned down in China: it was made not of iron but of fluff from a plant. More important yet, the patient did not run the risk of having his veins slit and being bled to a faint: a truly enormous advantage over his fellow-sufferers in the West. There was, in fact, no theoretical reason to draw large amounts of blood: Chinese medical theory did not include any "peccant humors" requiring to be drained out. Bleeding was reduced to little punctures, and most of the time the punctures drew no blood at all, just energy. Nothing of this kind ever saw the light in Mediterranean countries. The only possible relative of acupuncture, I believe, may be the Indian doctrine of the vital points.

As regards theory, the mental pathways of the yang i were bound up with yin and yang, the five elements, and number lore. All this was for more complex, rigid, and demanding than any Greek system.[112] A Greek iatrós, whether he believed in the two-, three-, four-, or five-element theory, did not have to worry about such concepts as resonance and correlations. His acts remained basically the same: bleeding and purging to "restore the balance." It has been said that Greek medicine became the prisoner of philosophy; Chinese medicine came close to being identified with philosophy. An eleventh century commentator of the *Nei Ching* made this clear when he deplored the old mistake of considering the *Nei Ching* as a "medical" text: "How could they give the most essential and the most delicate methods to the lowest and most humble men"—the physicians?[113] It was obviously a book for


Südamerika, welche Fundſtellen
:tracht kom-
ı und ſpär-
und Steier-
man allein
den erſten
:nn 6½ Fuß
rlikhügels,
urg. Gelb-
:er Nephrit
veißer nur
bietet uns
Werkzeuge
ſchon in

9. Meißel aus grünem Nephrit (natürliche Größe).

6.23 A prehistoric Chinese export: one of twenty-seven green or white jade axes found by Heinrich Schliemann at Troy (Hissarlik). Being extremely hard, jade was much praised for making tools in prehistoric times. The white jade could come only from China. Slightly enlarged from a German book on Schliemann's excavations.

the sages. This may explain the relatively slow progress of Chinese medicine from the *Nei Ching* on, whereas other Chinese sciences flourished.[114]

The real question, therefore, is how ancient China came to share some healing *ideas* with Europe, yet developed a healing *art* so distinctly its own. The reasons are both geographic and human. Prehistoric contacts across the Eurasian continent surely existed, on what might be called a capillary level.[115] The idea of the wheel did seep eastward from Mesopotamia, and a Chinese jade axe found its way to prehistoric Troy (Fig. 6.23). Perhaps it passed from hand to hand, and its last owner never even heard of its homeland. But despite these subtle contacts, on the whole, isolation prevailed. During the great upsurge of Egyptian and Mesopotamian cultures, China was still living in prehistory; it joined the Bronze Age only around 1600 B.C.[116] When a Chinese civilization eventually began to take shape, it was largely bound to agriculture rather than to the sea, and was therefore land-oriented.[117] And because the land produced practically all that the people needed, there was no compelling reason to look elsewhere. While the Chinese had items that other people wanted badly, like silk, they had little to ask in exchange.[118] Gradually, the Chinese people developed a "marked disinclination to travel far outside what they felt to be their natural geographical boundaries," and the Chinese sages possessed a certain "psychological disinclination . . . to believe that other countries could have anything valuable to add to the sciences that they had so far developed in their own country."[119]

瘠醫

The first major "tunnel" from China to the West was the adventurous eleven-year expedition of the Chinese ambassador Chang Ch'ien, who never got very far and spent most of his time abroad as a prisoner of the Huns, but who still managed to bring back information from far-away Syria, Mesopo-

tamia, and perhaps even Egypt.[120] This led to the opening of the Old Silk Road across the two continents in 106 B.C.[121] But to grasp the meaning of geographical difficulties, consider this passage from one of the Chinese annals, the *T'ung Chien Kang Mu.*[122] It is in the report of Tu Ch'in, a high official, telling the prime minister what he thinks about the prospect of communicating with the country of Chi-Pin, somewhere north and northwest of India:

> Friendly intercourse with barbarian nations is advisable only where communications are reasonably easy . . . (In order to reach Chi-Pin) after passing the P'i-Shan mountains, our envoys would have to traverse four or five countries, each of which is full of robbers. Then one must cross the Greater and the Lesser Headache Mountains, chains of naked and burning rocks, so named because they cause headache, dizziness and vomiting . . . Then comes the Shan-Ch'ih-P'an gorge, thirty *li* long, where the path is only 16 or 17 inches wide, on the edge of a precipice, and where the travellers have to be tied together with ropes . . . Such useless enterprises should not be the policy of an enduring dynasty.[123]

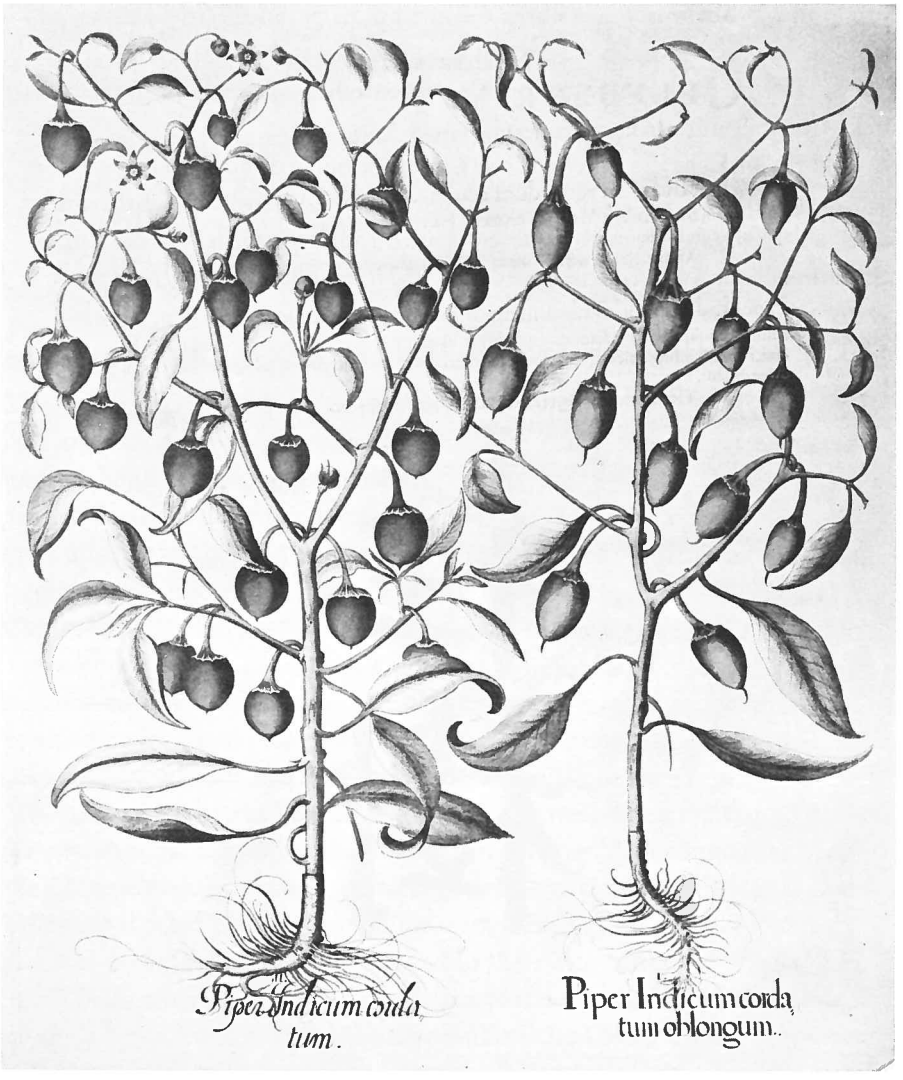
Tu Ch'in was obviously describing the symptoms of mountain sickness, an eerie malady that might have carried the message "stay at home."[124]

Such were the basic obstacles that prevented Hippocrates from trying his luck with acupuncture.

Oddly enough, the geographic gap men found so difficult to bridge—or not worth bridging—the gap that slowed down so effectively the diffusion of ideas, was easily overcome by homely little bundles of spices. Cassia, *Cinnamomum cassia,* was a Chinese specialty.[125] Hippocrates used it. And there is a faint chance that when Hippocrates prescribed *kasía,* or *kassía,* he was speaking two words of garbled Chinese,[126] the only two that had spread across the seas and beyond the Headache Mountains—*kuei shu:*

cinnamon

tree



7.1 Pepper, one of the first Indian ambassadors to Greece.

7 The Vaidya

South of the Headache Mountains, at the foggy fringe of the Greek map (Fig. 6.1), was India. Just how foggy, judge from the plans of Alexander the Great: when he drove his troops east through Persia, barely two generations after Hippocrates, he was hoping to discover the sources of the Nile! It is true, though, that when he realized his mistake, he went back to a letter he had just finished to his mother and "deleted what he had written about the Nile."[1]

On the evidence of the Hippocratic books, all that India meant to their authors was pepper and a mouthwash for bad breath.[2] Even the pepper sounds unusual, for it is "the Indian substance that the Persians call *péperi*" and "the Indian drug for the eyes, that is called *péperi*"[3] (Fig. 7.1). After all the tribulations of a 6000-mile trip—escaping robbers, pirates, and storms at sea—*Piper indicum* was used by the Greek physicians merely as an ingredient for pessaries: miserable tokens indeed to represent a highly civilized Hindu world that was over a thousand years old.

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Indian civilization itself was even older. The original, dark-skinned inhabitants of India, the people who built the city of Mohenjo-daro, now famous for its beautiful baths, had a writing of their own in 2500 B.C. About 1500 B.C. they were overrun by lighter-skinned people who called themselves Aryans, a name perhaps connected with their origin, Iran.[4] Their language came from the same stem as Greek and Latin, and from it evolved, with many dialects, the literary language that came to be known as Sanskrit: a word

made of two parts, *san-skrit,* like the Latin *con-fectus,* meaning "put together," hence "finished," hence "elegant," and thus the language of the elite.

The newcomers brought with them, or produced as they settled, a huge body of literature: primarily the four Vedas, sacred books in Sanskrit reputed to have arisen by divine inspiration. They may well have appeared without ever having been written down, because according to Indian custom, they were meticulously transmitted by word of mouth—the investment of time being approximately twelve years to memorize one Veda.[5] The chant of a Hindu vedic reciter—a highly controlled blend of melody and staccato—can be heard to this day. Although Sanskrit may sound quite abstruse, being an Indo-European language it has many familiar roots. The word *Veda,* for instance, has the same root as *wisdom;* and so does the word for physician, *vaidya,* "he who knows."[6]

Another product of Hindu culture was a system of medicine that was eventually called *Ayurveda,* literally "knowledge of life" or "science of life."[7] It was fitted into the stream of tradition as part of the fourth Veda, the *Atharva Veda:* a collection of magic and spells representing the lore of the Atharvan priests. Ayurvedic medicine is based essentially on two treatises by Charaka and Sushruta, composed in verse and prose: the *Charaka Samhita,* mainly on medicine, and the *Sushruta Samhita,* mainly on surgery (*samhita* means "collection").[8] Both were preserved in full: oral reciters have their advantages!

These two great classics of Ayurveda are not actually volumes of the *Atharva Veda;* rather, they developed, in a general sense, the basic theme of the Atharvans: warding off trouble, including disease. The spells of the Atharvans included formulas for almost any need: stopping hemorrhage, curing snakebite, ensuring success in warfare, or even extolling a cow. Charaka had no quarrel with Atharvan magic; his ideal lying-in room, for instance, is equipped (besides an ox, a mule, and much else) with "Brahmans conversant with the *Atharva Veda.*"[9]

The dates of these literary works, and the dates of ancient Indian history altogether, are distressingly uncertain. The climate and the people of India have conspired to erase them, perhaps forever. Most of the annals of the rajas—kept on birchbark in the north, on banana leaves in the south—have succumbed to rain, war, and insects,[10] under the indifferent eyes of the Brahmans, who shrugged at such frivolities: life being an illusion, a mere step to reincarnation and nirvana, biographies and histories were part of human vanity.[11] This attitude, combined with two other cultural traits—worship of the ancient and an aversion against committing texts to the written form—drives modern scholars to despair: dating an Indian classic is almost hopeless. Sushruta, for instance, has been thought to live anywhere between 1000 B.C. and 1000 A.D.[12] The first definite date for all of Indian history is Greek—326 B.C., the year that Alexander crossed the Indus River.[13] As for the first Indian writings that can be approximately dated, they are the edicts that King Ashoka began to carve in rock half a century later.

A map of India as it was at about the time of the Golden Age of Greece

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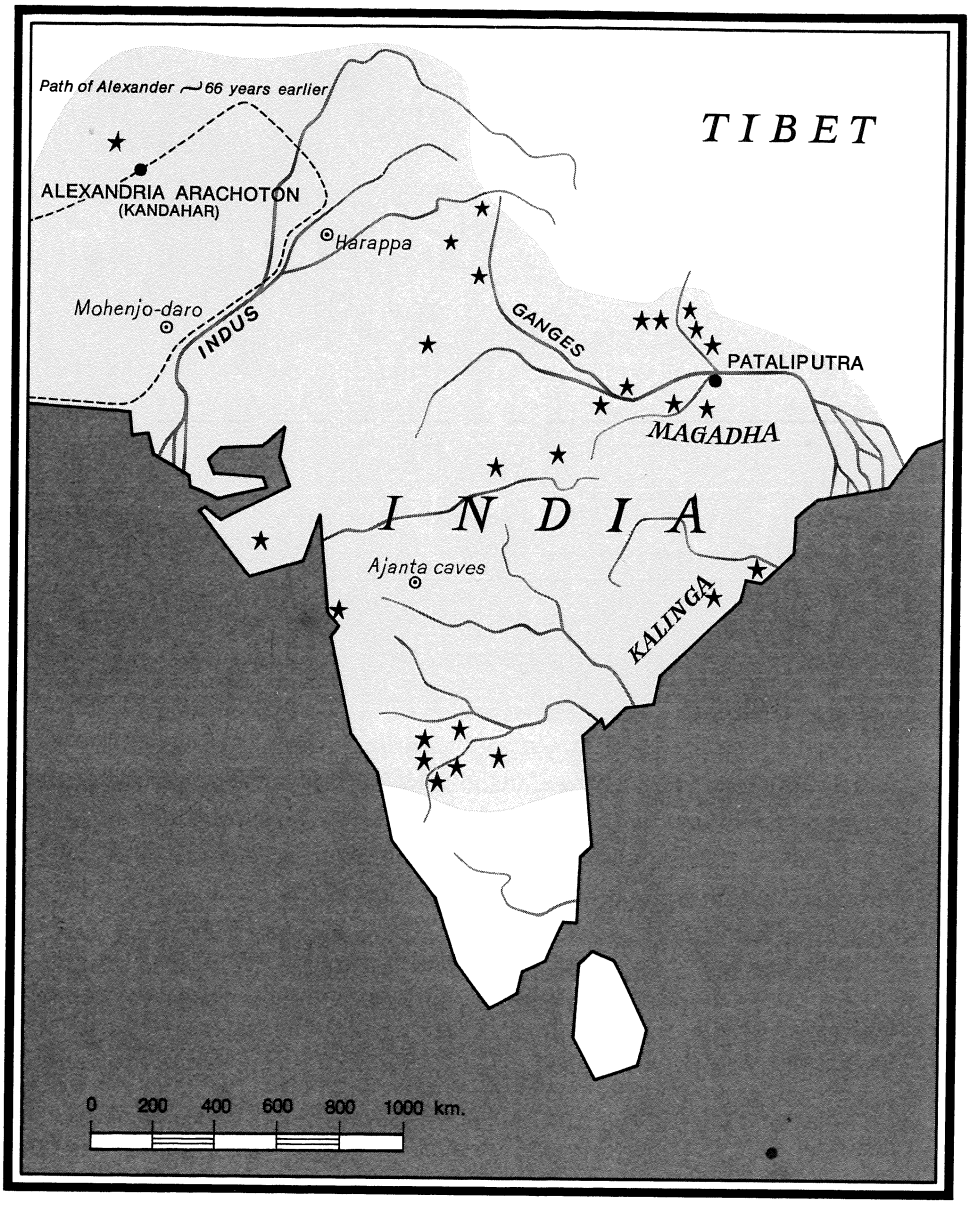

7.2 Map of the Maurya Empire about 260 B.C. (shaded), showing the distribution of Ashoka's inscriptions (★).

shows that the two great valleys of the north were following separate destinies. The Indus Valley, in the west, was part of the Persian Empire (to become with Alexander a Greek dominion), while the valley of the Ganges, in the east, was subdivided among many small kingdoms fighting for supremacy, much as in China. The vast Indian triangle to the south was almost entirely absent from the mainstream of history.

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Among the kingdoms of the east, Magadha became the most powerful and eventually took over most of India (Fig. 7.2). Its kings were converted to Buddhism by Buddha himself.[14] One of them was Ashoka (c.269–c.232 B.C.), third of the Maurya Dynasty. No history of the wound would be complete without a page about this great king, whom the horrors of war turned into an apostle of peace.

Nonviolence Carved in Rock

Ashoka's dynasty bursts into history with an odd assortment of writings. One of them is, in plain words, a revolting book: the *Artashastra.* It is a treatise on government, written under the first king of the dynasty, Chandragupta (the one who probably met Alexander the Great). Suffice it to mention that the art of governing is called *dandaniti,* "the science of punishment," and included among its practices is a horrible list of eighteen kinds of torture to elicit confessions from citizens accused of theft.[15] In essence, the *Artashastra* is a cynical version of Machiavelli's *The Prince.*

The second book is by the hand of an exceptional visitor, Megasthenes, a Greek ambassador, who was pacing the streets of Pataliputra, the capital of Magadha, at the time that the *Artashastra* was being written. This sophisticated outsider was much impressed with what he saw and wrote a report on his mission, the *Indiká,* most of which is unfortunately lost. It is also unfortunate that while on duty Megasthenes never fell so ill as to use an Indian physician, for his account of Indian medicine, though laudative, is vague.[16]

The third set of documents is unique. King Ashoka himself, "the Beloved of the Gods," laid bare his soul on India's rocks in words that no other king has used. His "edicts," some carved in boulders, others in pillars, are strewn all over the country (Fig. 7.2). One of the earliest stemmed from remorse. Shortly after rising to the throne, Ashoka had decided to unleash his massive army against Kalinga on the eastern border. The campaign was victorious, but at the price of tremendous slaughter. Such was Ashoka's remorse that he turned to Buddhism for relief, and he told his people about the experience in Rock Edict XIII:

> Kalinga was conquered by His Sacred and Gracious Majesty when he had been consecrated eight years [*261* B.C.]. 150,000 persons were thence carried away captive, 100,000 were there slain, and many times that number perished.
>
> Directly after the annexation of the Kalingas began His Sacred Majesty's zealous protection of the Law of Duty, his love of that Law, and his giving instruction in that Law [*Buddhism*]. Thus arose His Sacred Majesty's remorse for having conquered the Kalingas, because the conquest of a country previously unconquered involves the slaughter, death, and carrying away captive of the people. That is a matter of profound sorrow and regret to His Sacred Majesty . . .
>
> Of all the people who were then slain, done to death, or carried away captive in the Kalingas, if the hundredth or the thousandth part were to suffer the same fate, it would now be matter of regret to His Sacred Majesty . . . For His Sacred Majesty desires that all animate beings should have security, self-control, peace of mind, and joyousness.[17]

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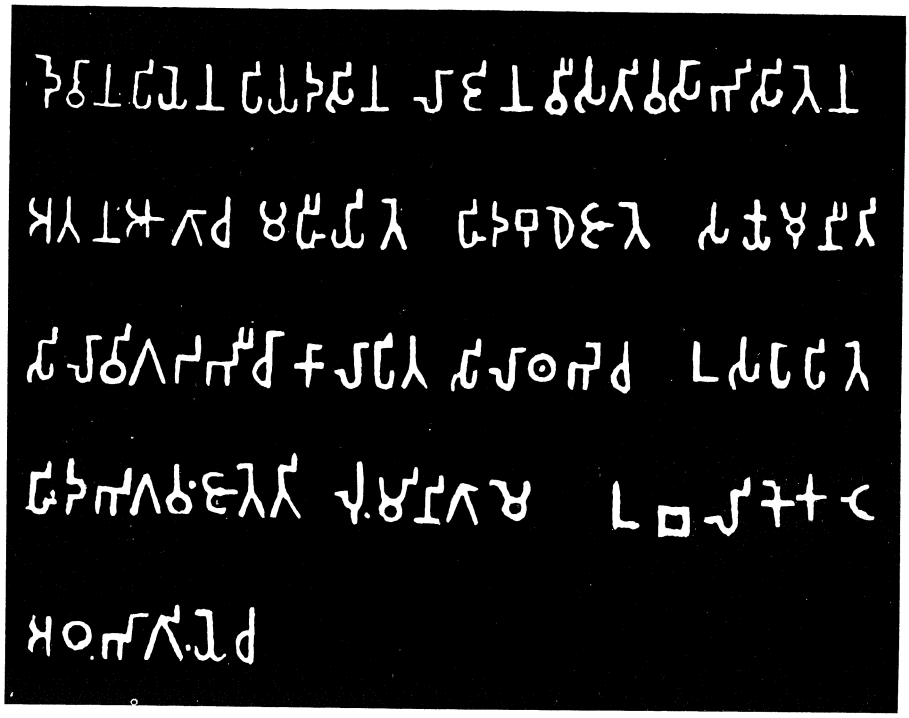
Ashoka's conscience never recovered from this war. Later edicts portray him as a fatherly, hard-working monarch and as a fervent Buddhist (Fig. 7.3). Here are two more excerpts, from Rock Edicts III and I, to set the tone of India under his rule:

> Thus saith His Majesty King Priyadarsin [*"of pleasing mien," one of Ashoka's designations*[18]]:



7.3 One of Ashoka's inscriptions, on a pillar in Rummindei, 249 B.C. It declares the village tax-free, being the birthplace of Buddha.

In the thirteenth year of my reign I issued this command:

Everywhere in my dominions . . . the Commissioners, and the District Officers must every five years repair to the General Assembly, for the special purpose, in addition to other business, of proclaiming the Law of Piety, to wit, "Obedience to father and mother is good; liberality to friends, acquaintances, relatives, Brahmans, and ascetics is good; respect for the sacredness of life is good; avoidance of extravagance and violence of language is good" . . .

Here [*in the capital?*] no animal may be slaughtered for sacrifice, nor may holiday-feasts be held, for His Majesty King Priyadarsin sees manifold evil in holiday-feasts. Nevertheless, certain holiday-feasts are meritorious in the sight of His Majesty King Priyadarsin.

Formerly, in the kitchen of His Majesty King Priyadarsin, each day many thousands of living creatures were slain to make curries.

At the present moment, when this pious edict is being written, only these three living creatures, namely two peacocks and one deer, are killed daily, and the deer not invariably.

Even these three creatures shall not be slaughtered in future.[19]

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Presumably King Ashoka of the Maurya Dynasty had to have his daily peacock because *maurya* meant "peacock."[20]

Rock Edict II is often quoted as representing the world's first reference to hospitals.[21] Much as I regret to cast doubt on this aspect of Ashoka's heritage, I find that it hinges on a single word, *chikisakâ*, which one translator renders as "hospitals," but most others as "remedies."[22] Sanskrit words are notorious for their multiple meanings; I looked up *svastika* and found "well-being,"

"cross," "cake," "demon," "mode of sitting," and "libertine," which is just average. Here is the edict in question, which has been given the modern title of "Provision of Comforts for Men and Animals":

> Everywhere in the dominions of His Majesty King Priyadarsin, and likewise in neighbouring realms such as those of the Chola, Pândya, . . . the dominions of the Greek King Antiochus, . . . have two kinds of remedies [*hospitals?*] been disseminated—remedies for men, and remedies for beasts. Healing herbs, medicinal for man and medicinal for beast, wherever they were lacking, have everywhere been imported and planted.
>
> In like manner, roots and fruits, wherever they were lacking, have been imported and planted.
>
> On the roads, trees have been planted, and wells have been dug for the use of man and beast.[23]

However this edict is read, the concern for life under the Maurya Dynasty should not be overestimated. Much of that concern was for animals, as Ashoka's edicts show.[24] Although the *Artashastra* remarks that the army had an ambulance service, with well-equipped surgeons and women to prepare food and beverages,[25] compassion was definitely not the slogan of state administration. Care for the wounded in the Maurya army, as in most armies, was first of all a matter of economy.

Now, returning to the history of wounds, I will invite my reader to visit some ancient Hindu patients. Using the treatises of Sushruta and Charaka as I used the Hippocratic books, I have reconstructed ten case histories. For ease of comparison with Greek medicine, I chose the time that our ten Greek patients were queuing up at the Athenian infirmary—about 400 B.C. I assume that Sushruta had just lived,[26] and that the patients all came from the outskirts of Benares, where Buddha had lived and taught (Fig. 7.4), and where Sushruta had acquired his knowledge, or so the legend goes, by divine dictation.[27]

Nine of the ten Hindu patients will be men: not only because men were more likely to be wounded, but also because there are not enough data to reconstruct a likely relationship between vaidya and female patient. Sushruta and Charaka rarely mention women except in relation to childbirth and gynecologic diseases. Two patients could have been women (those with earring problems), but I chose males to bring out other cultural traits, such as that men wore earrings. Hindus loved their women but were far from considering them as equals. Charaka speaks of their "state of dependence and ignorance"[28]: enforced ignorance, for women were not allowed to learn Sanskrit!

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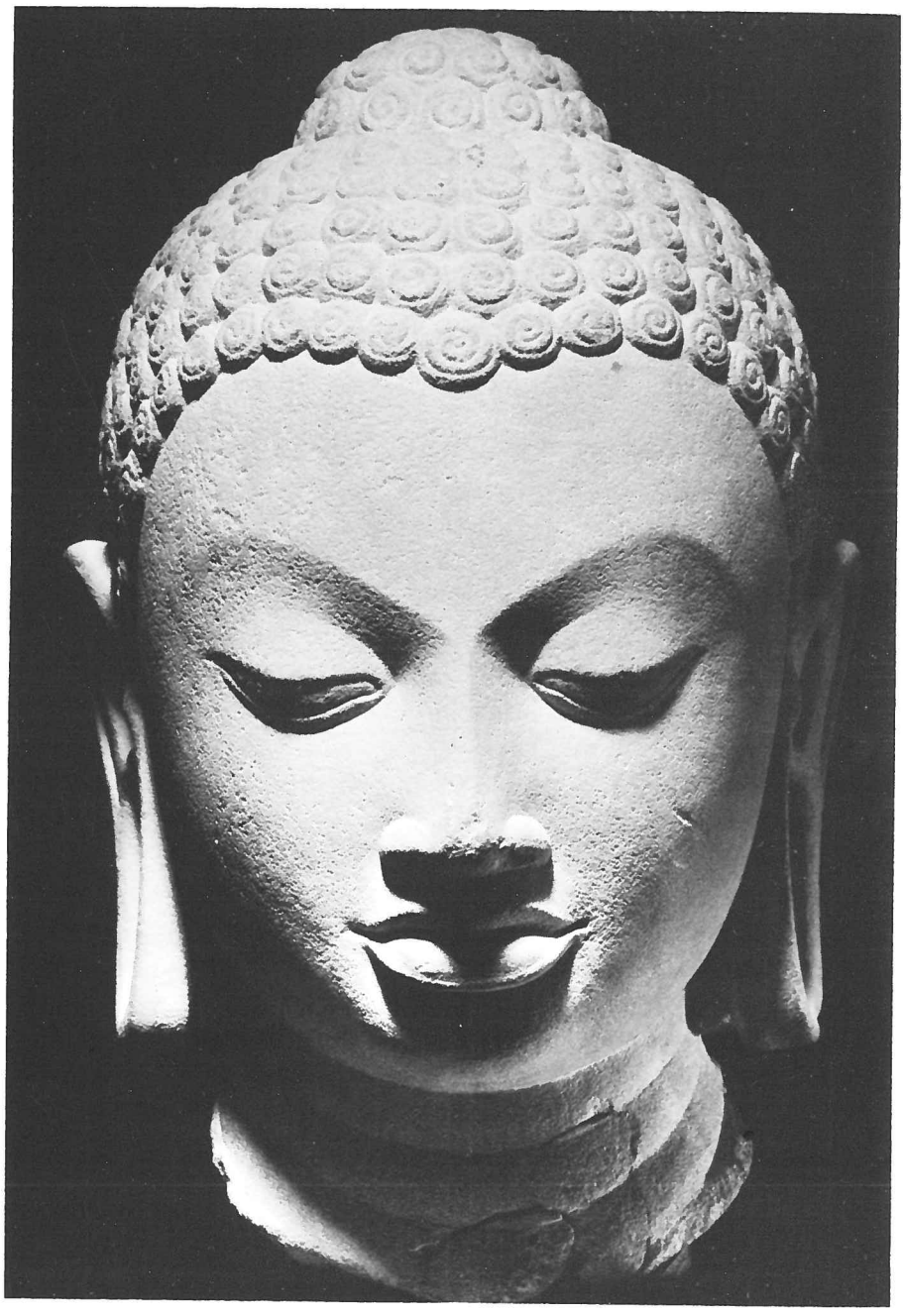
The Home of the Arrow-Doctor

A messenger was running along the bank of the Ganges. Two men had been wounded by arrows in a skirmish with outlaws,[29] and he was going to get the vaidya.



7.4 Head of Buddha. Fifth–sixth century A.D.

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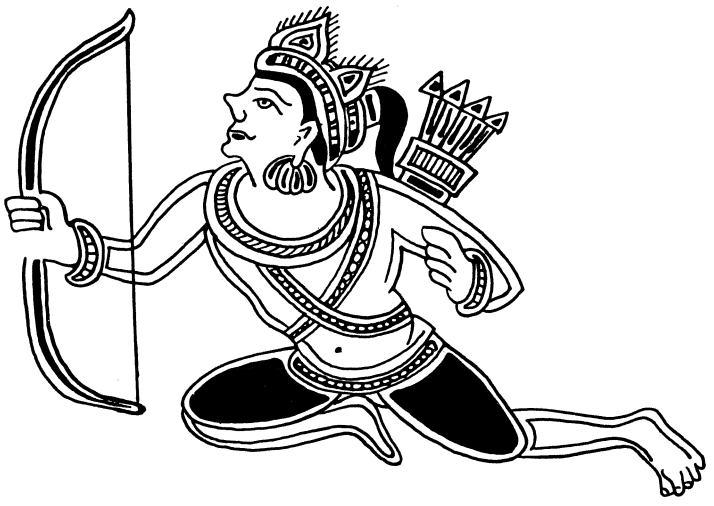
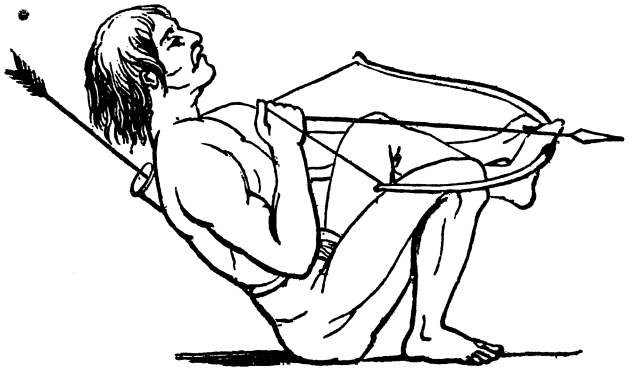
A Greek on a similar mission would have just headed for the nearest iatrós, but the ancient Hindu, for better or for worse, had the privilege of being able to choose among a whole array of specialists.[30] In this particular case, however, there was no real choice: neither the internist (*rogahara*), nor the poison expert (*vishahara*), nor the demon expert or magic expert (*krityahara* and *bishag-atharvan*) would be of any help; but only the surgeon, *shalyahara*. *Shalya* meant "arrow," "sword," "lance," in fact almost any weapon, and ultimately any foreign body embedded in the flesh; *hara*



7.5 Indian hunter, redrawn from an ivory carving. Note large earrings and the typical Indian weapon, a bow and arrow. About second century A.D.



7.6 A special Indian style for firing arrows with great force, noticed by the ancient Greeks and still in use in 1860, at the time of this drawing. Perhaps it was a shot of this kind that pierced the breastplate of Alexander the Great, bowled him over, and almost killed him.

meant "remover." So the name of the vaidya who specialized in surgery meant something like arrow-remover—an appropriate term in India, where the bow and arrow (which did not enjoy great favor in Greece) had been the traditional weapon (Figs. 7.5–7.6).[31]

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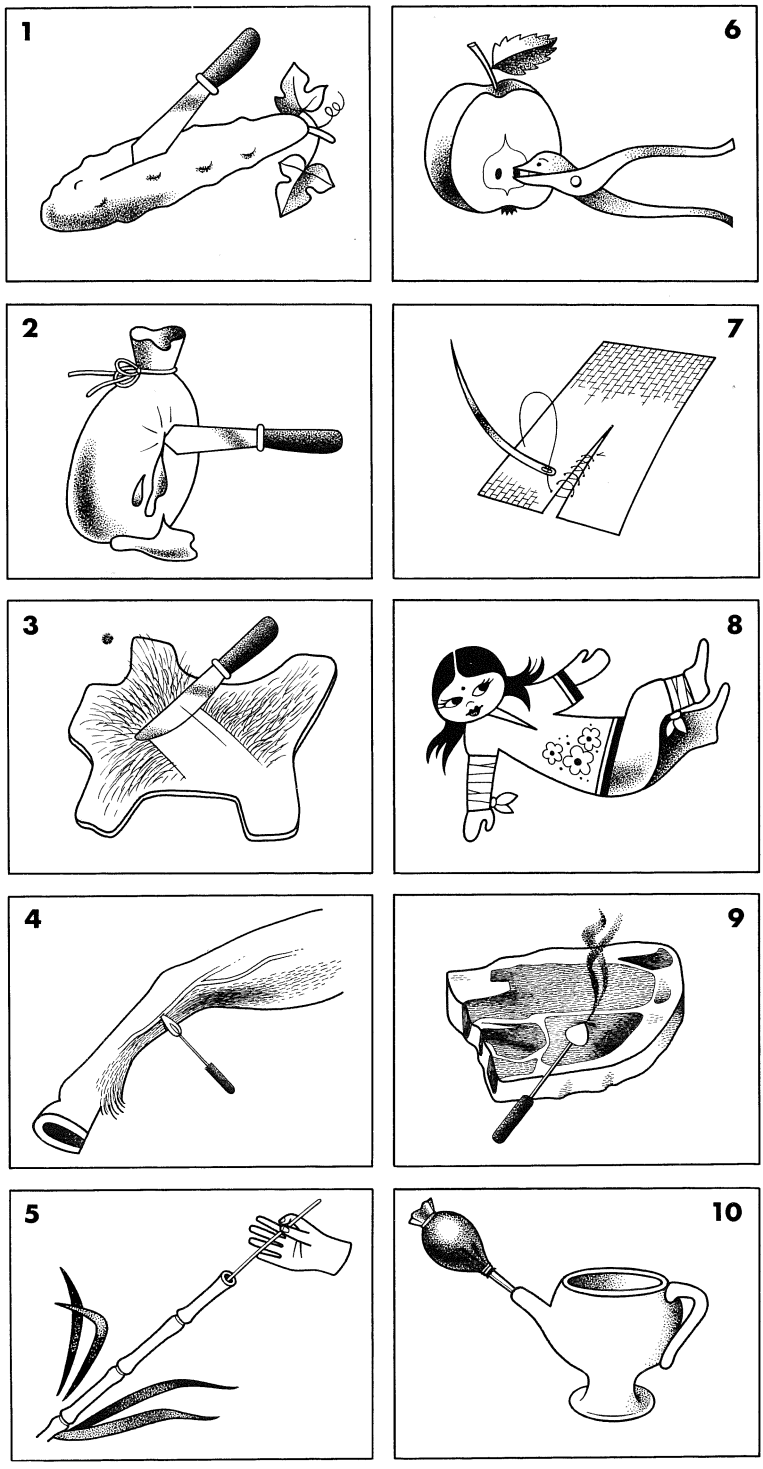
When the messenger reached the house of the surgeon, he recognized it by the neatly kept garden of medicinal herbs,[32] and by the scene taking place before the front door.[33] A Greek might have thought that he had come upon some bizarre religious rite, which would not have been far wrong. Seated on the ground on his ritual sand cushion, "measuring a cubit in length and breadth" and plastered with cow dung,[34] was the vaidya, wearing a white cloth and turban. At his side was the sacred fire of cow dung. Before him sat three young men, each wearing a yellowish cloth.[35] The vaidya chanted verses of the Ayurveda, in a precise, monotonous rhythm; the young men repeated them. These were from the surgeon's part of the Ayurveda, the

Sushruta Samhita. No amount of gold could have bought that precious text, for it was not for sale: the only way to become an acceptable surgeon was to learn it all by heart, from someone who had done the same. Nor did the young apprentices understand what they were saying, for they spoke only a dialect, whereas Sanskrit was a literary language. They were taught, at first, just the rhythm of the syllables, word by word, forward and even backward; explanations would come later.[36]

The vaidya rose to greet the newcomer, listened to the message, and prepared for his mission of mercy. In the house, the two appropriate walls (north and east) were studded with wooden pegs,[37] from which hung bunches of herbs and leaves collected within the year.[38] Shelves bore earthen pots, little linen bags, and wooden containers shaped as tubes. The vaidya gathered half a dozen items into a bag, together with a box of instruments made of the excellent Indian steel.[39] A servant was handed the lot, with instructions to run ahead.[40] Then the vaidya took his umbrella and stick, gave last-minute instructions to his pupils, picked three fresh bamboo sprouts while studiously facing north,[41] and followed the guide.

The three apprentices, left to their own means, set to work as directed. They were a dainty group, hand-picked to meet Sushruta's requirements: "initiation should be imparted to a student, belonging to one of the three twice-born castes [*those whose members were born first into ordinary life, then again, ritually, into one of the higher castes*], such as the Brahmana [*priests*], the Kshatriya [*warriors and nobles*], and the Vaishya [*free men*]."[42] The motivation to practice medicine was different for each one of these castes, as explained by Charaka: Brahmans, to do good; Kshatriyas, for self-preservation; Vaishyas, for gain. But all three could derive religious merit, wealth, and pleasure from the practice, in that order.[43] The apprentice, Sushruta continues, "should be of tender years, born of a good family, possessed of a desire to learn, strength, energy of action, contentment, character, self-control, a good retentive memory, intellect, courage, purity of mind and body, and simple and clear comprehension, command a clear insight into the things studied, and should be found to have been further graced with the necessary qualifications, of thin lips, thin teeth and thin tongue, and possessed of a straight nose, large, honest, intelligent eyes, with a benign contour of the mouth, and a contented frame of mind, being pleasant in his speech and dealings, and usually painstaking in his efforts." Hippocrates was far less exacting, having no requirements as to social origin, although the tone was similar: the iatrós "should look healthy, and as plump as nature intended him to be" and "let him be of a serious but not harsh countenance."[44]

The efforts that the three Indian apprentices were about to undertake would now be called experimental surgery, of a kind unique in the world.[45] One of the youngsters, armed with a sword-shaped knife, began to practice making incisions of peculiar shapes in a watermelon. Another waited for his cautery to become red-hot in the hearth; he was going to practice with it on a small piece of fresh meat. The third threaded a curved needle of triangular



7.7 Hindu experimental surgery. For practice in the various surgical techniques, Sushruta recommends the following: (1) *incising* on a cucumber or the like, (2) *lancing an abscess* on a leather bag full of slime, (3) *scraping* on a piece of fur, (4) *venesection* on the veins of a dead animal, (5) *probing* on a bamboo reed or worm-eaten wood, (6) *extracting* by picking seeds out of fruit (here with the appropriate butcher-bird forceps), (7) *suturing* on cloth, (8) *bandaging or tying* (for snake bite) on a full-sized stuffed doll, (9) *cauterizing* on a piece of meat, (10) *injecting* on a pitcher.

section;[46] his assignment was to practice surgical knots on a piece of hide. These were only three of the many established exercises (Fig. 7.7).

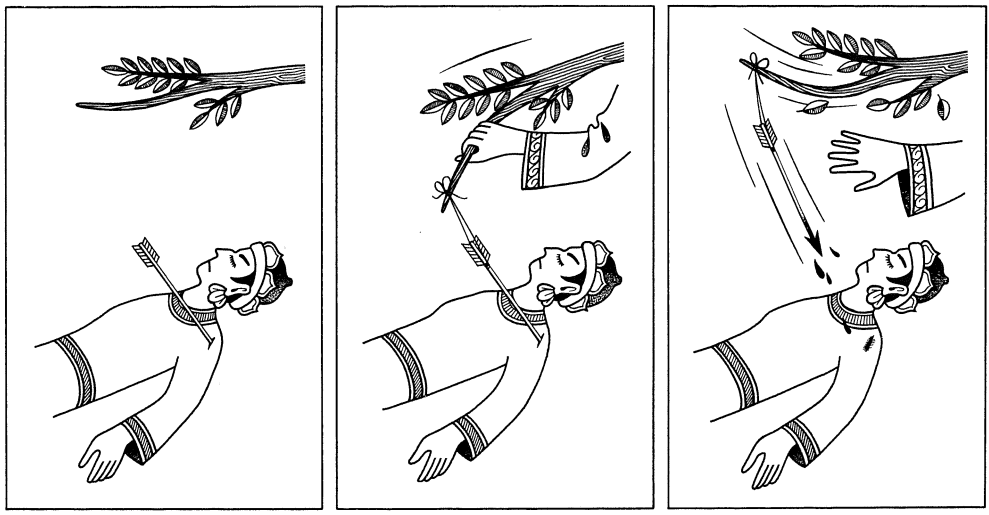
In the meantime, the vaidya was on his way with the messenger, trying to reconcile the professional duty of having a friendly chat[47] with the serious business of studying the omens. He had memorized dozens of verses on this topic, because "the favorable or unfavorable termination of a disease may be predicted from the appearance, speech, dress and demeanour of the messenger sent in to call the physician, or from the nature of the asterism and the lunar phase marking the time of his arrival, or from the direction of the wind blowing at the time, or from the nature of the omens seen by him on the road."[48] The messenger belonged to the same caste as the patients: good. He had been breathing heavily on arrival, his garments were not too clean, and he had spoken facing south: bad, bad, bad. He wore a couple of ornaments: good. Here came a cow: good. Elephants were trumpeting in the distance: good. A bird whose name ended with a masculine termination was seen on the right: bad. A horse: good. In front of a farmhouse were corn husks, straw, and sesamum: all three bad. A eunuch and a cripple: both bad. They were talking about something being "cut": good in general, but not in relation to wounds. The sound of chanting Vedic verses: good. A dog running right to left: good . . .[49]

Patients Nos. 1 and 2: Arrow Wounds

When the vaidya reached the house, one of the wounded men was outside, under a tree. He lay on his back, as if pinned down by the feathered arrow-shaft rising vertically from his left shoulder. Bright red blood trickled from the wound, which was considered good; "black blood" was thought to mean poisoned arrows.[50]

The very first worry for the vaidya, before he could make any helpful move, was to find out whether his patient had been hit in a deadly spot or *marma,* because the Hindu surgeon, like his Greek and to some extent his Egyptian counterparts, would not take on a definitely fatal case.[51] The marmas being safe, the next step for any arrow casualty was to find out whether it was an *anuloma* situation or a *pratiloma* one (Ayurvedic medicine bristles with technical terms). Arrows that had to be pushed through, continuing their path, and therefore moving in the direction "from hair to root," were called anuloma arrows (lit. "along the hair root"); those that could be pulled back were called pratiloma ("against the hair root").[52] The vaidya tried a gentle tug on the shaft; it did not budge. Next, he tried the gentlest of the forward or anuloma methods: he held a small magnet next to the skin over the buried arrowhead[53] (most arrowheads were made of iron or steel) and waited. Again nothing happened.

So it was a tossup between applying more drastic anuloma methods, like striking the feathered end with a hammer,[54] or trying to yank out the arrow, pratiloma style. The ruse of shielding the barbs and easing the arrowhead



7.8 Sushruta's quick way of removing an arrow that cannot be easily pulled back out.

back out was apparently not yet known.[55] Speed was therefore essential. One possibility was to tie the shaft to the bridle of a horse and make the horse jerk its head.[56] But since the patient was lying under a tree, there was a simpler solution.[57] The vaidya strained down a branch, had it tied to the shaft, and let go (Fig. 7.8). Success came so fast that the extraction was scarcely painful.

Then, reaching for one of his earthen pots, the vaidya plastered the wound with a generous scoop of honey-butter paste and bandaged it "with a clean piece of linen."[58] The honey-butter paste was a favorite of Ayurvedic surgery.[59] It was essentially the same as the salve of the Smith papyrus, except that the fatty ingredient was a kind of oil (clarified butter or *ghee*) and that it was sometimes mixed with another wound-drug. Ghee, the commonest source of fat, was made like butter except that sour instead of fresh milk was used. It had the great advantage of keeping longer than ordinary butter; for use as a drug, it was even allowed to age beyond one hundred years.[60] There was practically no disease for which ghee was not rubbed on, swallowed, or offered to the gods. And a man who made sure to see his face reflected in ghee every day was sure to live a long life.[61]

The second wounded patient was more difficult to handle, because the broken arrow shaft was buried deeply in the thigh and the stump was out of sight. The vaidya began to search the wound with his blunt probe, the *eshani*. It was shaped much like the Greek wound probe, the spathomele, except that the blunt end was likened not to a small apple, or to an olive stone, but to the head of an earthworm:[62] tradition required that the working ends of surgical instruments be shaped like suitable animal heads.[63] The eshani, however, caused the patient too much pain. The vaidya, having expected this, had taken along three softer probes, the bamboo shoots.[64] But they, too, could not find a path in the swollen tissues. What was the direction of the buried shaft?

In this predicament, Sushruta suggested several tricks. The most elaborate was to load the patient into a carriage "with a broken or lopped-off wheel"[65] and drag it up and down a bumpy road. The sharp pain caused by

the jolting would indicate the position of the shaft.[66] Or one could plaster the skin with clarified butter, clay, or sandal paste.[67] The embedded arrow "is then exactly located at the spot where, owing to the heat of the affected part, the clarified butter, or earth, or sandal paste would be found to have melted, or dried up."[68] This is comparable to the clay method used by the Hippocratics to detect the center of an inflamed area.

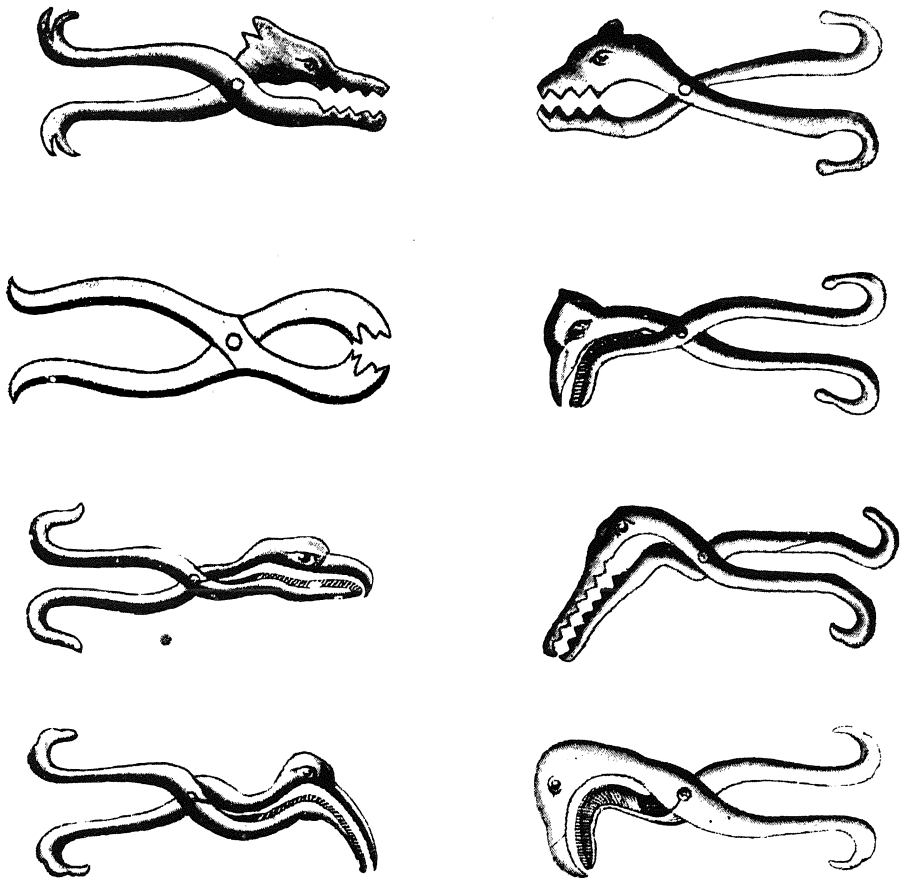
But while the surgeon was studying the problem, the patient unknowingly provided the solution. His hand kept stroking and pressing a very painful spot on the back of the thigh. That was enough, for "the part which the patient repeatedly handles, or constantly presses with his own hand . . . and is marked by a sort of excruciating pain, or which he involuntarily withdraws from, or constantly guards against . . . should be regarded as clearly indicative of the exact location of the embedded Shalya."[69] So the arrow had been traveling from front to back.

The mouth of the wound was cautiously enlarged with a sharp knife,[70] and promptly the broken shaft appeared. The surgeon tried to seize it first with one of his most powerful forceps, the *sinha-mukha*, or "lion-mouth" (Fig. 7.9).[71] When that failed, he tried his trusty "heron-mouth" forceps (Fig. 7.10), because he knew that when other forceps failed, the long-jawed *kanka-mukha* often did the job.[72] It is no wonder that the same implement was reinvented a couple of thousand years later for the same purpose, and with very nearly the same name, as the French *bec de corbin* (Fig. 7.11). One tug, and out came the shalya. By great good luck, it was not a barbed arrow.[73] Its tip, shaped like a ferocious animal head,[74] seemed to express dismay.

Honey-butter, then a bandage in the shape of an 8 called a *svastika* ("cross"), and it was all over. The vaidya made sure that the knot of the bandage was not tied just above the wound, a preoccupation that the Hippocratics may have shared.[75]

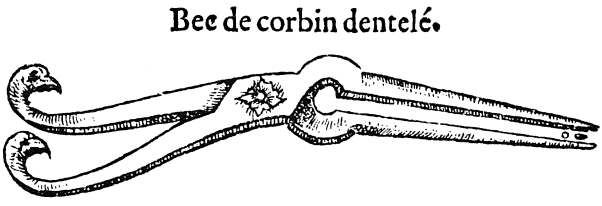
Next came elaborate instructions for the attendants. The bedsteads had to be turned to face east: "The reason for the head being turned towards the East is that the patient may easily make obeisance to the (demons and) celestial spirits, who inhabit that quarter of the sky. Thus the patient shall lie in comfortable posture, attended upon by his sweet-talking friends and relations."[76] Afterward, "rites of benediction and divine peace should be done unto him. Wherefore? Because the monsters and demons of mighty prowess, who are the attendants of the gods Pashupati, Kuvera and Kumára, roam about in quest of prey, and visit the bedside of an ulcer-patient out of their fondness for flesh and blood, being attracted thereto by the smell of the secreted and morbid matter in the ulcer. These evil spirits come to take away the life of a patient in a case which is doomed to terminate fatally, while in a successful case their advent is due to the desire of extorting sacrificial oblations from him."[77]

In practice, subduing the demons meant burning incense sticks and making sacrifices of food.[78] Once subdued, the evil spirits tended to "spare the life of a self-controlled patient."[79] Therefore, the patient had to impress them with his light-heartedness and determination by keeping a weapon at



7.9 Hindu surgical instruments were named and fashioned after animals. *Left to right, from top:* The jackal-, cat-, lion-, bluejay-, hawk-, crocodile-, curlew-, and kite-mouth forceps. They were usually made of iron.

7.10 Sushruta's *kanka-mukha* and *kaka-mukha* forceps ("heron-mouth" and "crow-mouth"), for removing deep-seated foreign bodies.



7.11 Ambroise Paré's *bec de corbin dentelé,* rediscovered in the 1500s under the stimulus of gunshot wounds.

his bedside, as well as by keeping flowers, garlands, fried paddy (rice in the husk), and lamps burning day and night, while his friends and relations contributed to the cure "with fond and loving topics to drive away the feeling of sleepiness with the prospect of a speedy cure."[80] Sleep during the day was considered dangerous.[81]

The whole room would have to be fumigated for ten days, morning and evening, with mustard, special leaves, clarified butter, and salt, all rolled into a kind of incense stick.[82] Morning and evening, the physician and some Brahman would perform rites of benediction as laid down in the four Vedas.[83] "Demons, that get abroad in the night, fly from the presence of an ulcer-patient protected as above, as herds of deer fly from the forest where lions are found."[84]

The diet would be boiled rice with clarified butter and some cooked meat,[85] but no cakes, treacle candy, meat of animals connected with water, milk, curd, or whey.[86] It is not very different from the Hippocratic diet, especially the prohibition of milk products. Another surprising parallel is the recommendation of barley powder in boiled water as "food and drink."[87]

To make the patient more comfortable, his wounded limb would be soothed with fumes "of pain-killing substances."[88] Because it was summer, the dressing would be changed every other day; in other seasons it would have been changed every third day.[89] However, in case of excruciating pain, the physician could rush in earlier, "as to a house in flames," and apply a warm salve of clarified butter boiled with *yashtimadhu*, "liquorice," which was thought to bring certain relief.[90] Whether liquorice really has any soothing effect I do not know, but it was also a favorite Chinese drug.[91]

The vaidya had now done all he could. But on departing, he chanted a couple of verses of the Ayurveda, reminding the bystanders that the success of medical treatment rested on four pillars: the physician and the drugs, but also the nursing and the patient.[92]

These two cases illustrate the great role that religion played in Indian medicine. Charaka's words leave no doubt:

> Medicines are of three kinds . . .
> First, Mantras [*magic formulas*] and religious acts;
> Second, dieting and drugs;
> Third, the subjugation of the mind by withdrawing it from every kind of injurious or harmful act.[93]

Religion is first, surgery last: Charaka gives it the fourth place (in this case, however, Sushruta disagrees: he has surgery at the top of the list[94]). Again, in Charaka's summary of the 152 most important principles of *medicine*, one is that "the atheist is the foremost of all persons to be avoided."[95]

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A Parenthesis: How the Vaidya Saw the Body

When he removed an arrow, the vaidya could not visualize the damage that had been wrought inside. Dissecting the dead, in theory at least, was not

permissible: mere contact with a corpse was a contaminating act. The vaidya's anatomy was therefore very poor. He had learned it—if at all—by Sushruta's method, which required a great deal of motivation: take a dead body, lay it in a still and solitary pool, enclose it in a cage (to keep it from drifting away or being eaten by fish), cover it with grass, and leave it there for a week. At that time "it will be thoroughly decomposed" and it will be possible to "slowly scrape off the decomposed skin etc. with a whisk made of grass-roots . . . or a strip of split bamboo, and carefully observe with his own eyes all the various different organs."[96] There is no touching, just poking with a little stick. Result: the taboo was successfully overcome, but anatomy was lost in the process. The proof is Hindu anatomy, which is almost nonexistent: all the blood vessels were supposed to come from the navel, no word existed for the lungs, and there was a bone in the penis.[97]

As to physiology, it hinged on the notion that the 700 vessels carried, in varying proportions, three basic *doshas* or "principles,"—plus blood: *vayu, pitta, kapha*—plus *rakta*.[98] The three doshas were very capricious, became easily deranged, and caused disease. The most dangerous was *vayu* or *vata*, "wind" (*vayu, vata,* and *wind* have in fact the same root); *pitta* has been translated as "bile," *kapha* (which may have the same root as *cough*[99]) has great similarities with "phlegm." *Rakta,* the blood, became upset everytime one of the three doshas was upset: it follows that venesection to draw out "bad blood" was as common as in Greece.

This theory, the mainstay of the vaidya's thinking,[100] overlaps in many ways with the Greek theory of the four humors. Despite differences in detail, the similarities are striking. How these similarities came about—whether by coincidence or exchange, and if by the latter, in which direction—is not known; but some sort of capillary, subhistorical, two-way exchange with the Greek world is most likely.[101]

Uniquely Hindu, instead, is the manner in which the Ayurvedic surgeons dealt with their ignorance in matters anatomical. They made up for it empirically—to some extent at least—thanks to centuries of experience with piercing weapons. This experience had taught them that wounds at certain precise points, which they called *marmas,* were critical or deadly (the word *marma* may well have the same root as *mortal*). Some marmas were said to cause paralysis; others hemorrhage, which was dreaded because Ayurvedic surgeons, just like the Hippocratics, did not know how to tie off a bleeding vessel. Thus, for example, the Hindu practitioner knew nothing about the popliteal nerve running behind the knee, but he knew that "an injury to, or piercing of, the *Janu-Marma* situated at the union of the thigh and the knee, results in lameness of the patient."[102]

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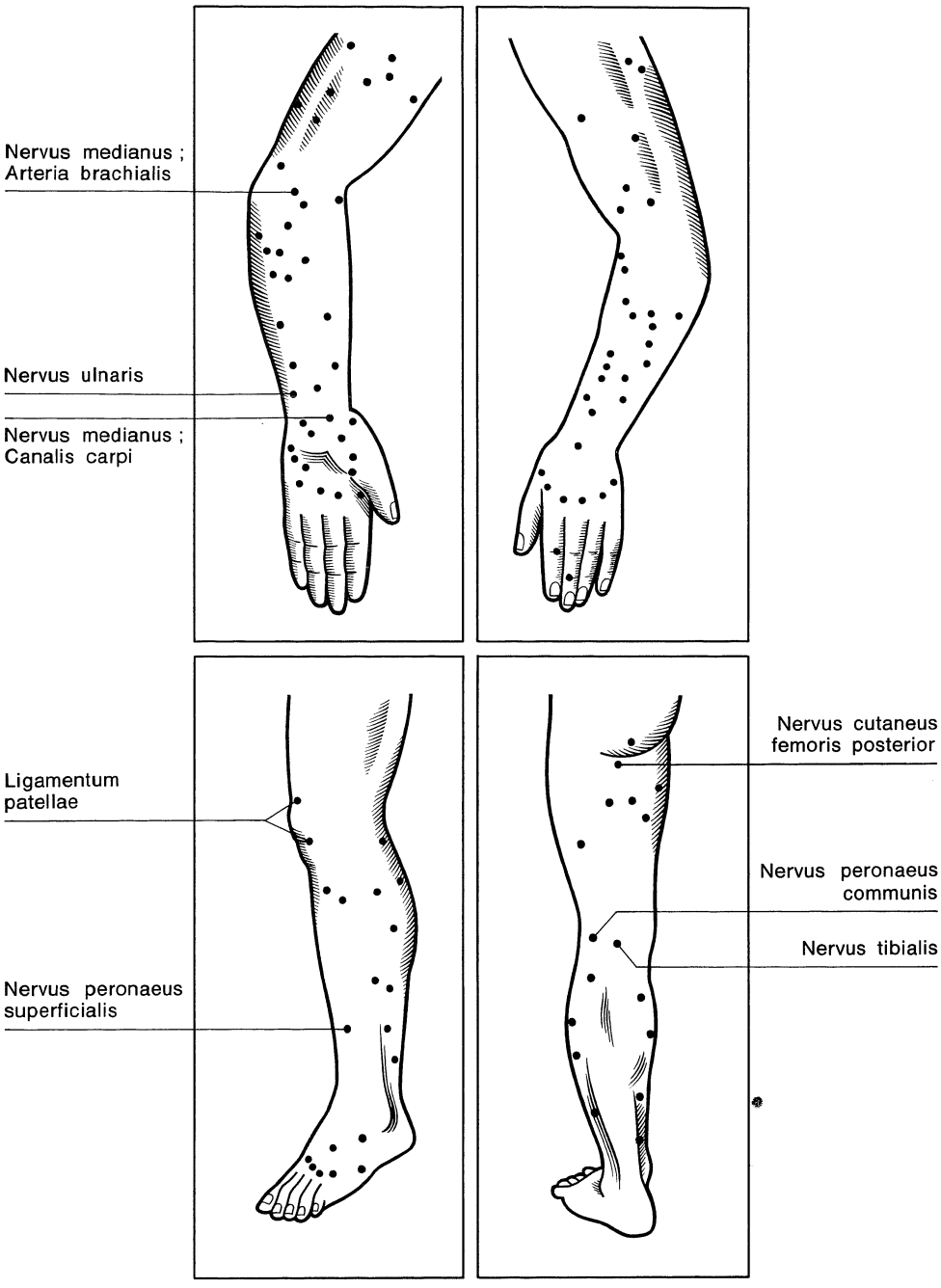
Each marma had its own name, and there were 107 in all.[103] Some do not really qualify as deadly, such as the eleven marmas on each hand (Fig. 7.12). Others correspond to definite anatomical danger points. The two *kukundara* marmas, for instance, are located on either side of the spinal column, slightly below the waist; a penetrating wound there led to "loss of feeling and motion in the lower limbs."[104] The famous paraplegic Mesopotamian lioness (Fig.



7.12 Vital points or *marmas* of the limbs, according to Hindu anatomy. Some correspond to major arteries, nerves, or tendons.

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2.10) had been hit at just that place, but what the Akkadians had expressed solely as art, the Hindus had worked into a system.

Certain marmas were said to be fatal as soon as the weapon was extracted; others within one day, or two to four weeks.[105] A wound on the edge of a marma was expected either to cause death after some delay, or sometimes merely to cause a deformity.[106] Death was not always inevitable even with direct wounds. If a weapon stuck in the marmas of the temple, for

instance, immediate death ensued if the weapon was pulled out, but if it was left in place and allowed to drop out on its own by suppuration, the patient could survive.[107] The meaning of "*deadly* point" should not be taken too literally, for the Hindus liked to embellish their truths with a glimmer of legend. Death by wounds in some marmas was explained as the result of excessive hemorrhage, but Sushruta also thought that the breath of life could escape out of the wounded marma in the form of vayu or vata, the bodily wind.[108]

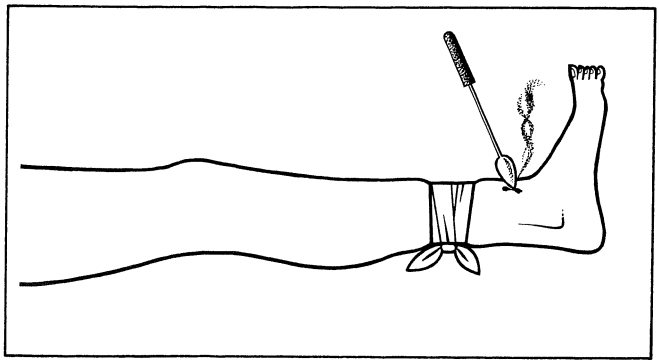
For sheer antiquity, the doctrine of the marmas beats anything known of Greek medicine. It is already mentioned in the *Rig Veda,* which dates from about 1500–1200 B.C.[109] Vritra the demon, for instance, who fancied himself invulnerable, dammed up the river waters—but the warlike Indra killed him by piercing his marma.[110] Today, the idea survives not only in Ayurvedic medicine but also in Indian parlance: thus of someone who fell unconscious from a blow one might say, "he must have been hit in a marma." And some of the vital points have found a practical application in wrestling.[111]

Such was the practical anatomy of the Hindus, learned from studying wounds in the living rather than from dissecting the dead.

Sushruta's paragraph on human dissection has a puzzling appendix: "*Memorable Verses.* The Self, the occult or invisible Lord of the body cannot be detected except with the psychic eye or with that of the mind. He, who has observed the internal mechanism of the human body . . . is alone qualified in the science of Ayurveda and has a rightful claim to the art of healing."[112] Sushruta is using a favorite expression of the Greeks, the eye of the mind,[113] but it is a strange place to use it, right after discussing a very practical and messy job. Perhaps he is hinting that putrefied bodies had little to teach, and that human anatomy really had to be discovered by *thinking.* So it was, in a way, because the doctrine of the marmas was anatomy by dint of memory and correlation. Sometimes a very fine correlation: there is a marma that anticipated one of Galen's discoveries, and went beyond it, as we shall see in the last chapter.

Patient No. 3: A Snake Bite

Strolling back home, the self-satisfied vaidya in his white garment was the living image of Sushruta's perfect physician: he wore shoes, carried a stick and an umbrella, and walked "with a mild and benignant look, as a friend of all created beings, ready to help all."[114] And he pondered about the two wounded men. They certainly looked curable, but Sushruta warned that diseases affecting certain kinds of people "are apt to run into an incurable type, though appearing in a common or curable form at the outset."[115] Here is the list of such dangerous patients: "A Brahmana well versed in the Vedas, or a king, or a woman, or an infant, or an old man, or a timid person, or a man in the royal service, or a cunning man, or a man who pretends to possess a knowledge of the science of medicine, or a man who conceals his disease, or a man of an excessively irascible temperament, or a man who has no control



7.13 Sushruta's first aid for snake bite (besides sucking the wound): ligature and cautery.

over his senses, or a man in extremely indigent circumstances of life or without anyone to take care of him."[116] Sushruta had given much thought to his list of alibis.

Suddenly, as the vaidya came across the farm where he had seen the three bad omens, his well-trained ears detected signs of commotion. He speeded up and walked into the house. The family was clustered around a child, perhaps three years old, who had just been bitten in the left foot by a snake. The father glanced up and uttered one word—*darvi-kara*, "hooded cobra." Thanks to a smattering of Ayurvedic medicine, he had already applied the *arishta*, a strip of cloth tied four fingers above the ankle, very tight (Fig. 7.13).[117] He was now sprinkling cold water over the child's face, to counteract "the heat of the poison."[118]

The vaidya took over, acting "as fast as a man grabs a metal tool that has dropped in deep water."[119] It was good that the ligature had been applied: "Arishtas—says Charaka—are to poison what embankment is to the water"[120]—a marvellous statement, especially from people who did not know about the circulation. However, no ligature could be effective unless consecrated by the proper mantras, the sacred formulas. The vaidya had learned them as part of his training, during a special period of "self-control and cleanliness in body and spirit," while foregoing sexual intercourse, animal diet, honey, etc. . . . and lying on a mattress of *Kusha* grass." He chanted one over the arishta while the mother prepared an offering of clarified butter to burn on the family shrine:[121]

I have gone about the race of snakes
as the sun about the sky
As night about living creatures
other than the swan
Thereby do I ward off your poison[122]

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Then the vaidya rose, asked that someone fetch a clod of fresh earth, and turned to reassure the terrified child. The bite, he pointed out, was of the shallow variety known as *radita*, which meant that there was very little poison in the wound.[123] Whatever poison there was, the ligature would prevent it from climbing up into the rest of the body,[124] and maybe the

poison was of poor quality anyway. The cobra could very well have been an old and miserable one, or a baby, or a member of the lower castes—because snakes, too, had castes; only the lustrous and sweetly smelling were Brahmans[125] (Fig. 7.14). Or it could have just cast off its skin, or been "attacked and discomfited by a mongoose,"[126] or simply been very frightened. All these kinds of cobras had a weak poison.[127] It would have done the patient a lot of good to be able to bite back into that wicked cobra, but it was just as good to bite into the clod of earth.[128] That was something he could do for himself. As for the doctor, he would take care of that little bit of poison in the wound; it really had to be taken out, even if it hurt.

The vaidya stuffed his mouth with a piece of linen and began sucking at the sore.[129] The gesture is still recommended in modern medical books, but it probably required more courage in ancient India, because the power of poison was overestimated. The flesh of an animal killed by a poisoned arrow or by a snake was thought to become venomous throughout and to remain so for about an hour after death.[130]

Next, with a dramatic gesture, while the parents held the boy, the surgeon plunged his blade between the marks of the two fangs, for he had learned that, "even as a tree does not grow when its roots are cut asunder, poison does not grow if an incision be made on the puncture."[131] Then he took a forceps, picked a blazing coal from the cooking fire, and quickly pressed it onto the wound. There was a scream, but the child felt a gush of relief when he saw the red coal fly out the door, toward the bushes where he had been bitten.[132]

Not much else could be done for the time being, as the child was too young for bloodletting, "the best treatment" for snakebite in an adult.[133] An apprentice would come along later with a special *agada*, an antipoison plaster.[134] In the meantime, a good agada-drink would be water blackened with the earth of an anthill;[135] and, if the mother had any in her herb garden,[136] a decoction of *sarpagandha* root. The last should have helped, for sarpagandha is none other than *Rauwolfia serpentina*, the source of reserpine, the potent drug that first earned the name of *tranquilizer* in the mid-1950s.[137] Perhaps this root was used against snake bite because it looks like a snake (hence its name *serpentina*).[138]

The mother then came with a gift of candy—fresh, succulent treacle—but the vaidya declined, for he was not allowed "to take anything but cooked rice from the hands of a woman."[139] He collected his fee and took his leave, recommending more sacrifices and prayer.

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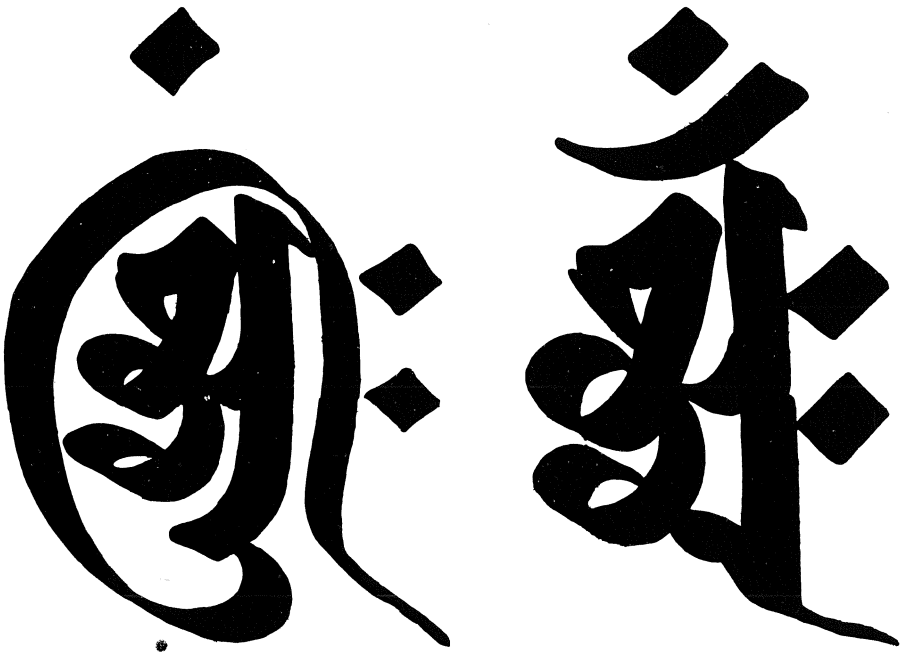
Everybody was prepared for the worst, for it was only too well-known that the bite of a "young" hooded cobra could be "as fatal as personified death."[140] In the vaidya's mental textbook the clinical picture of snake poisoning was carefully codified, like everything else, and subdivided into seven[141] or eight[142] stages. There was a treatment for each stage: emetics (*vamya*),[143] purges, collyria, antipoison snuffs (*nasya*),[144] even "brain purgatives" if the poison should rise as high as the head.[145] If consciousness began

7.14 A *darvi-kara*—the hooded cobra.



7.15 Sacred formulas or *mantras.* A mantra could be a short prayer, a word, even a single letter; eventually their spiritual value could be expressed by pure calligraphy. These two represent sacred syllables. By a Japanese Buddhist monk, twelfth century A.D.

to fade, it could still be revived with the noise of drums, perhaps smeared with antipoison plasters.[146] The vaidya would not give up until the symptoms had become overwhelming. By that time the patient, being in "an insane state like that of a drunkard,"[147] would no longer realize that he was being abandoned.

But despite it all the vaidya continued to believe that the mantras *never* failed: "The Mantras, full of occult energy and perfect truth and divine communion, never fail to eliminate the poison from the system, and hold their own even in cases of deadliest poisons" (Fig. 7.15).[148] And there is a good chance that the mantras did work. The local treatment was of a nature to help. In India, moreover, well over half of those who have been bitten by poisonous snakes escape without any symptoms of poisoning.[149] Many recover from cobra bites even without any effective treatment, perhaps because the snakes inject little venom when biting defensively.[150]

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It was a tired man who walked back into his herb garden. The vaidya had just enough energy for the last chore of the day, testing the rain water by boiling Shali rice in his home. If the rice changed color, the clouds had been formed by vapors arising from the sea. If it did not, "the rain-cloud [had been] charged with vapors evaporated from the bosom of the Ganges."[151] That was the most wholesome water.

Outside, his eye caught one of the apprentices about to cull some medicinal herbs. Before doing so, he faced north.[152] The teaching had not been in vain.

Afterthoughts on the Arishta, the Hindu Ligature

Treatments that really treat are so rare in ancient medicine that the arishta deserves special mention. If it is true that Sushruta described the state of the art in the last centuries B.C., this is the first mention of a tourniquet in clinical practice.[153]

Note that this is not quite the same as the *hemostatic* tourniquet—a ligature tight enough to stop bleeding, already hinted in the Hippocratic books. Snake poison is reabsorbed and spread throughout the body by the veins as well as by the lymphatic vessels surrounding the bite; in both kinds of vessels, the pressure is so low that even a fairly loose ligature will close them (and therefore protect the bitten patient), even though blood continues to flow into the limb, beyond the ligature, through the arteries. To close the arteries, a much tighter ligature is required. However, the tourniquet for poisoned wounds does aim at stopping blood flow (although in the veins alone), and it is interesting that it was born as a response to snake bite, long before the circulation of the blood was recognized.

Much of India was covered with jungle. Poisonous snakes were everywhere, as they still are, for today they bring death to from 10,000 to 15,000 Indians every year.[154] The prevalence of snake bite in ancient India is proven by the lengthy chapters in Sushruta and Charaka, as well as by the dozens of antisnake charms in the much older *Atharva Veda*.[155]

Besides the tourniquet, another and perhaps even older response to the cobras had been to turn them into gods. The ancient snake-gods were called *nagas*, a word that may have the same root as *snake*.[156] One feels the presence of the nagas, as well as of real snakes, throughout Hindu art and literature (Fig. 7.16).

Alexander the Great was not prepared for the cobras. His men returned from India with terrifying tales. One was about a sacred snake living in a cave; it was 70 cubits long and had eyes the size of the large round Macedonian shields.[157] Snake bites became such a menace that Alexander felt obliged to hire Hindu physicians, who were kept on duty full time, and anyone bitten had to report immediately to the royal tent.[158]

None of the ancient historians who report these episodes mentions the ligature. Even Sushruta and Charaka deal with it in only a few lines, just enough to say that it is essential. Their descriptions of snake-bite poisoning show how the idea of the arishta developed. A bite in the foot causes symptoms in the head and neck.[159] Therefore, animal poison acts upward, with the inevitable corollary that plant poison acts downward.[160] If a poison rises from the foot, then a tie at the ankle comes about quite naturally.

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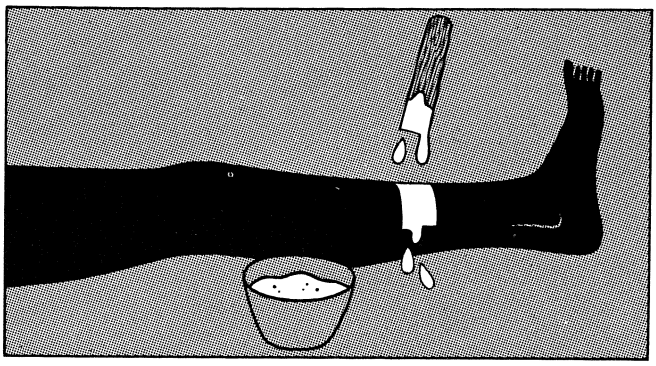
Historically, the Hindus may have been the first to apply such ligatures, but the same idea was born, perhaps independently, in another snake-infested part of the world. In our days, the Mano tribe of Liberia has such trouble with snakes that it maintains a secret Snake-Bite Society;[161] and the Mano apply real tourniquets of bark. One, in fact, was applied to an American physician who had been bitten on a finger—after he had already applied two tourni-

7.16 A statue to Nagini, the snake goddess: one of India's ways to cope with snakes.



7.17 An early step in the development of the ligature for snake bite: the Manos in Liberia sometimes paint a white ring around the limb.

quets of his own. He reported that the Mano tourniquet was just tight enough to stop the return of venous blood, and therefore should have been at least partially effective. But the Mano practice is to apply ties on both wrist and ankle, regardless of the place where the victim was bitten, and even if the bite was not in a limb. Furthermore, at night, "to stop the poison from reaching the heart" before dawn, a ring of white clay is painted around the limb (Fig. 7.17). To the Mano, the tourniquet also symbolizes "binding the patient" until he has paid his fee,[162] a clear indication that many do recover. So Liberia offers a good example of a discovery in its embryonic stage, half rational, half magic, but already evolved enough to help—sometimes.[163]

In what is left of his books, Hippocrates never mentions snake bite. Surely he was aware of the problem. But his methods cannot have been too effective if Alexander's army doctors had to be replaced by Hindus.

Patient No. 4: A Problem of Earrings

The next morning, a nurse appeared, dragging by the hand a reluctant little boy. He was stark naked, except for an amulet of tiger claws around his neck,[164] and he was to have his ears pierced. It was none too early, said the nurse, for he had just recovered from a case of *shita-putaná*, one of the nine dreaded diseases of infants, which was due to the influence of the *Grahas*, the malignant stars.[165] The parents knew full well, of course, that pierced ears were not only for looks but also for protection against "the evil influences of malignant stars and spirits."[166] However, they had been obliged to delay the operation until the proper month of the year (the sixth or seventh) and until the right lunar and astral combinations.[167] Daily life was full of Beings, good and bad, that could not be neglected—like the Grahas. There was, for example, a *yaksha*—a particular kind of ghost—in each and every tree (Fig. 7.18).[168]

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Piercing the earlobes was a standard operation:

The child should be placed on the lap of its nurse, and benedictions should be pronounced over it. Then having soothed it and lured it with toys and playthings,

7.18 A *yaksha* in a tree: just one kind of ghost among the crowd of *a-mánusha* (non-humans) that haunted everyday life in India.

the physician should draw down with his left hand the lobules of its ears with a view to detect, with the help of the reflected sunlight, (the closed up) apertures that are naturally found to exist in those localities [*sic!*]. Then he should pierce them straight through with a needle held in his right hand, or with an awl (*Arâ*), or with a thick needle where the appendages would be found to be too thick. The lobule of the right ear should be first pierced and then the left in the case of a male child, while the contrary should be the procedure in the case of a female. Plugs of cotton-lint should be then inserted into the holes of the pricked ear-lobules, which should be lubricated or rubbed with any unboiled oil. A copious bleeding attended with pain would indicate that the needle has passed through a place other than the natural (and closed up) fissure described above; whereas the absence of any serious after-effect would give rise to the presumption that the piercing has been done through the right spot.[169]

Over a sobbing child, the nurse was told what to do next:[170] "If all goes well, you will bring the child to me every third day; each time I will remove the lint, lubricate the hole with oil, and stretch it with a thicker plug. When the bodily humors in the ear will have settled down, I will then begin to expand the hole with rods of wood, or with lead weights." Perforating the lobes had been just a beginning: the real purpose was to stretch them into wide rings, flabby yet strong enough to carry heavy ornaments. In the famous paintings of the Ajanta caves[171] there is a fifth- or sixth-century lady who shows this very well (Plate 7.1). Some of her descendants need not envy her (Fig. 7.19). The custom also remains alive outside of India (Fig. 7.20).[172]

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Why pierced or stretched ear lobes were supposed to protect, I do not know.[173] Buddha's heads show both features prominently (Fig. 7.4). In any event, the piercing carried a sizable risk, possibly including tetanus. Here is Sushruta's warning:

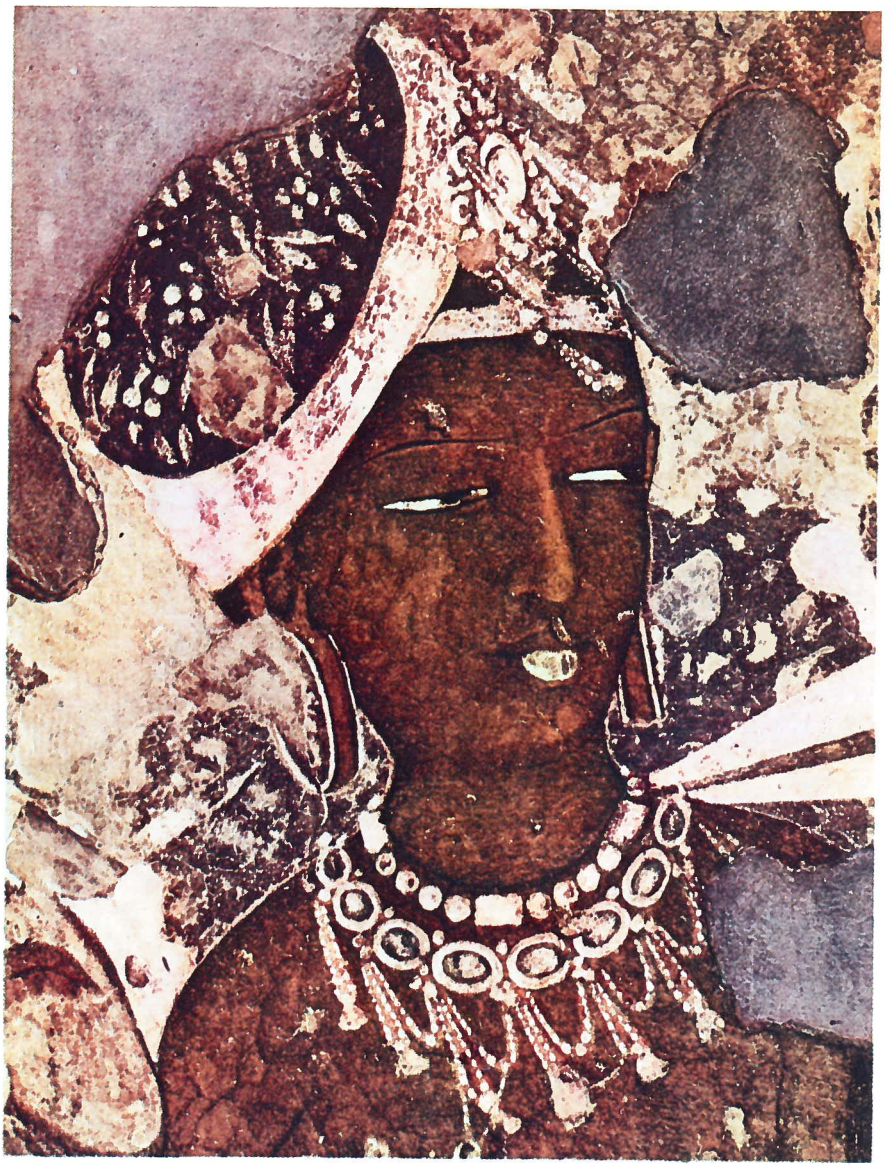

Plate 7.1 The purpose of stretched earlobes in ancient India, as shown by an *apsaras*, a celestial nymph. From a painting in the Ajanta caves, fifth-sixth century A.D.

Plate 7.2 The jaws of *Eciton burchelli* holding together the edges of a wound (top), in an experiment with a dead ant on a dead rat. In the second step of the clamping process (bottom), the body of the ant is twisted off. Scale in mm.

7.19 Stretched earlobes still exist in modern India.

Any of the local veins incidentally injured by an ignorant, bungling surgeon, may be attended with symptoms which will be described under the heads of Káliká, Marmariká, and Lohitiká.

Káliká is marked by fever and a burning pain in the affected part and swelling. *Marmariká* gives rise to pain and knotty formations about the affected region, accompanied by (the characteristic inflammatory) fever; while in the last named type (Lohitiká) symptoms such as, Manyá-Stambha (numbness of the tendons forming the nape of the neck), Apatának (a type of tetanus), Shirograha (headache) and Karna-shula (earache) exhibit themselves, and they should be duly treated with medicinal remedies laid down under their respective heads.[174]

The hole being stuffed with crude lint, some such infection was bound to occur. In cases of "extreme pain and swelling," Sushruta's advice was to remove the lint immediately, anoint the infected part with a paste of honey and clarified butter enriched with barley and four herbs,[175] wait for it to heal, then start all over again.

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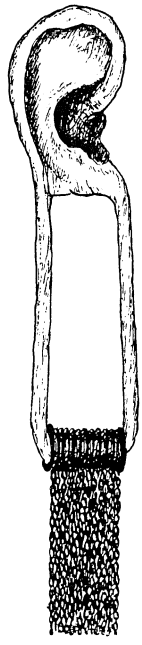
But woe to the surgeon who ran into this complication. The blame could be pinned on him, either for putting the hole "in the wrong place," or for making it "with a blunt, crooked or stunted needle," or for plugging it with an "inordinately large lint."[176] Sushruta was saying, in effect, that surgical infection is the surgeon's fault. Basically he was right, though for the wrong



7.20 A stretched earlobe from East Africa. It was observed on a Masai man about 1900. The earring weight was made of copper wire.

reasons. An intriguing parallel occurs in a Chinese classic, the *Nei Ching*, where an abscess appearing at the site of acupuncture means that the acupuncturist is at fault, for having struck the wrong place.

Patient No. 5: A Torn Earlobe

The story of this patient is another landmark: the birth of plastic and reconstructive surgery. One reason that it happened first in India may be that the Greeks went to war with efficient helmets, whereas the Hindus probably wore none and were therefore especially liable to have ears and noses lopped off in battle.[177] They also ran the risk of judicial mutilation, for according to the ancient laws of Manu, every conceivable part of the body was liable to be amputated as a punishment, including the anus of any citizen who might break wind against the king.[178] If challenge breeds competence, plastic surgery was bound to be born here. Native enthusiasts even speak of whole heads being sewn back into place.[179]

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Yet I believe that the principal stimulus for plastic surgery came from a very different, more peaceful, more commonplace event: torn earlobes. They were a major issue.[180] Sushruta gives ten pages to piercing earlobes and pertinent complications, but only two pages to repairing noses (how the nose was lost he does not say).

Now witness the facts in the vaidya's home. A very upset man stalks in, identified as a Brahman by the tuft of hair bunched together on top of his head. He asks for some perfumed water, fearing that he may have caught a filthy glimpse of a *chandāla*, an outcast of the lowest kind. The emergency is met; for it is wise to please the priestly caste without delay. As the stern

gentleman washes his eyes clean of the awful sight,[181] the surgeon realizes why he has really come. The Brahman is wearing only one, heavy earring; the other earlobe has been torn open, probably as the result of an accident, and has now shrunk to a little, stumpy scar. This is a very familiar sight, and a safe one too, for it allows the surgeon to show off his art at its best. Said Sushruta, the ways to repair an injured earlobe are "innumerable."[182]

There is of course an established list of deformities related to torn or distorted earlobes. Each one requires a certain kind of treatment, with its own precise name (Fig. 7.21). The lobe of the Brahman has shriveled to almost nothing, so that it can be repaired only by making a new one out of the skin nearby. This too can be done—although nobody in the world knows how, except the vaidyas.

But there is a hitch. The patient would have to gather strength with a light meal[183] and drink some wine to decrease the pain.[184] Yet neither is feasible, because the traumatic experience of having seen a chandāla requires a Brahman to abstain from food and liquor for the rest of the day.[185] So he will have to return tomorrow, with friends and relatives to assist him.[186]

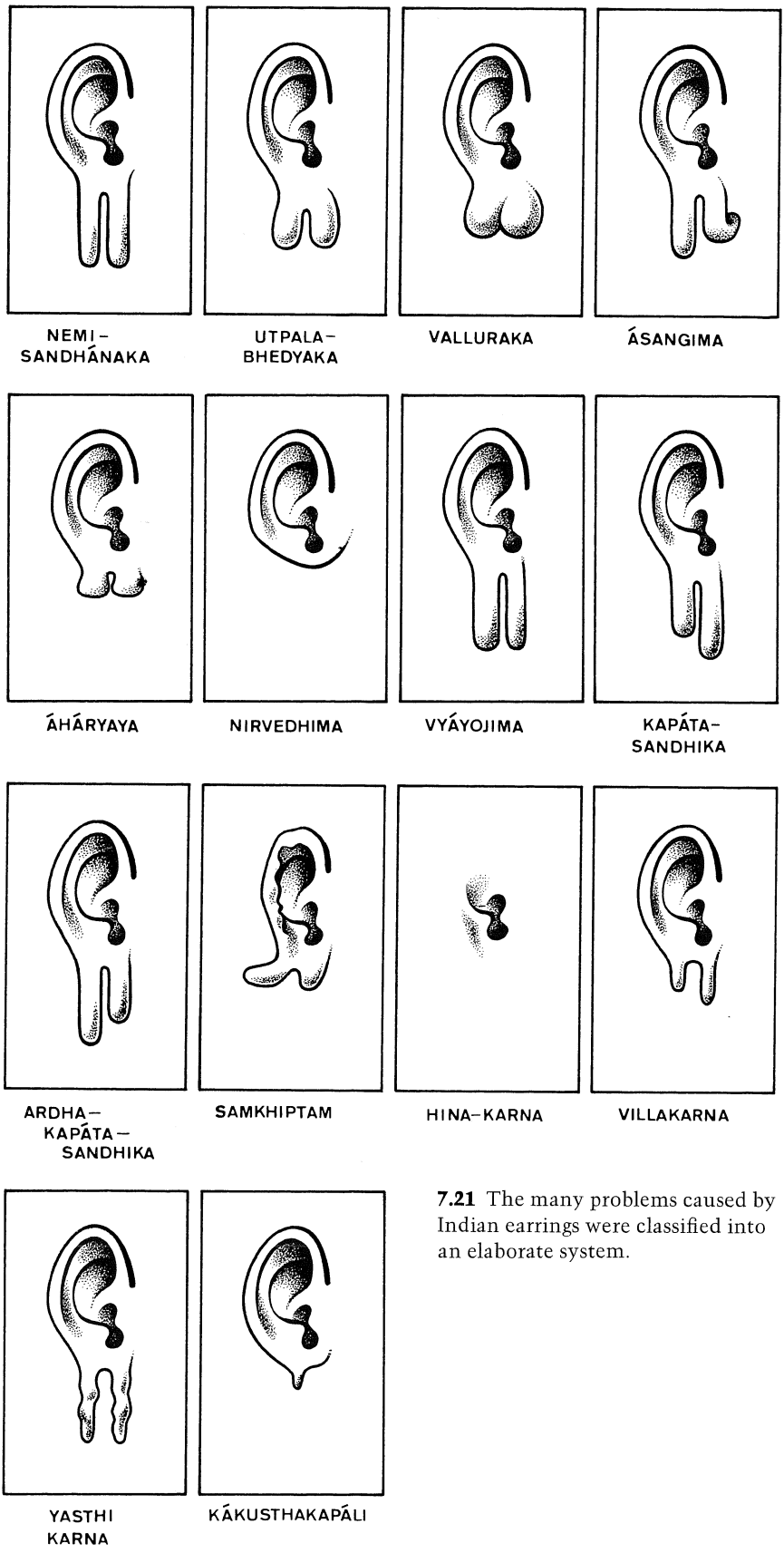
And there will be, of course, no fee for this operation. Brahmans tend to live off the other castes; the surgeon being a member of the Kshatriya caste, mainly comprising nobles and warriors, it is wholly in his interest to offer this gift to the Brahman. It will help his *karma,* or as we might say, his own investment in the next world, particularly the number of his reincarnations.[187]

The historic operation is described by Sushruta in two sentences, in which lies the beginning of that *shastra* or "science" now known as reconstructive surgery:

> A surgeon well-versed in the knowledge of surgery should slice off a patch of living flesh from the cheek of a person devoid of ear-lobes in a manner so as to have one of its ends attached to its former seat [*cheek*]. Then the part, where the artificial ear-lobe is to be made, should be slightly scarified [*with a knife*] and the living flesh, full of blood and sliced off as previously directed, should be adhesioned to it.[188]

The details of the operation are not clear. Its Sanskrit name is *ganda-karna,* literally "cheek-ear." The cheek, if it meant then what it now means, is an unlikely place to carve out the flap. It would make more sense to lift the flesh from behind the ear, as in one of the modern methods (Fig. 7.22).[189] However, the principle is clear: Sushruta is using the classical technique of the pedicle flap, whereby an area of skin is outlined with a cut in the shape of a long *U,* then dissected free so that it can be moved about as a kind of tongue. Its free end can then be sewn onto any raw part within reach. Eventually the two surfaces grow together and exchange blood; at this point, if necessary, the base of the *U* can be cut free.

To prepare for the operation, the first duty of the surgeon was to collect the necessary items: "Surgical appliances and instruments . . . cotton, lint, thread, leaves, tow, honey, clarified butter . . . medicated plasters . . . fan, cold water, hot water . . . and moreover he shall secure the services of



7.21 The many problems caused by Indian earrings were classified into an elaborate system.

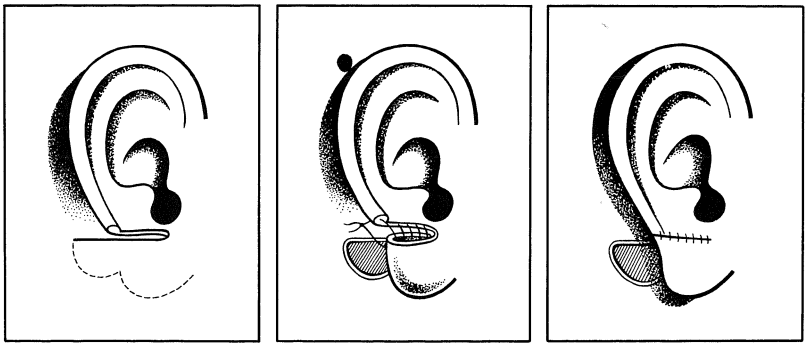
devoted and strong-nerved attendants."[190] He required three kinds of wound wash, to be used as we would use disinfectants. He chose among them on the spur of the moment, depending on the particular humor that seemed to be deranged. Unaccountably, he would also need a powder made of ground-up baked pottery, to dust on at the end.

The operation itself took place as follows:

> Then the hair of the patient, whether male or female, should be gathered and tied up in a knot, and the patient should be given a light food (so as to keep up his strength without hampering his digestion); after which his friends and relations should be asked to hold him firm. Then having ascertained the particular nature of adhesion to be effected in the case, the surgeon should examine the local blood by incising, excising, scarifying or puncturing the affected lobes as found necessary, and determine whether the same is pure or vitiated. Then having washed the blood with Dhányámla [*fermented rice gruel*] and tepid water, if found vitiated through the action of the deranged Váyu, or with milk and cold water in the event of the same being contaminated by the deranged Pitta, or with Surámanda [*"transparent surface-part of wine"*] and warm water in the case of its being vitiated by the action of the disordered Kapha, the surgeon shall bring about the adhesion by again scarifying the affected parts of the ear, so as not to leave the adhesioned parts elevated (raised), unequal and short. Of course the adhesion should be effected with the blood being still left in the parts that had been scraped. Then having anointed them with honey and clarified butter, they should be covered with cotton and linen, and tied with strings of thread, neither too loose nor too tight, and dusted over with powders of baked clay. Then directions should be given as regards the diet and nursing of the patient, who may be as well treated with the regimen laid down in the chapter on Dvi-vraniyam.[191]

And so it came to pass that, through the habit of stretching their earlobes, the Indians became masters in a branch of surgery that Europe ignored for another two thousand years. When the operation finally caught on, it was for a purpose much less common in India, but more applicable in Europe: making new noses.[192] In the ancient Indian operation, the new nose was built from a flap of skin folded down from the forehead. The flap itself was ingeniously drawn on the pattern of a leaf, with a stalk and two wings

7.22 A modern operation for making a new earlobe. Sushruta's *ganda-karna* or "cheek-ear" method must have been similar.



7.23 Reconstruction of the nose as described by Sushruta. A pedicle flap is brought down from the forehead and molded over two short tubes inserted in place of the nostrils. In 1794, the *Gentleman's Magazine* published a portrait of an Indian bullock-driver successfully operated on in this manner. The little tubes are still used in modern plastic surgery.

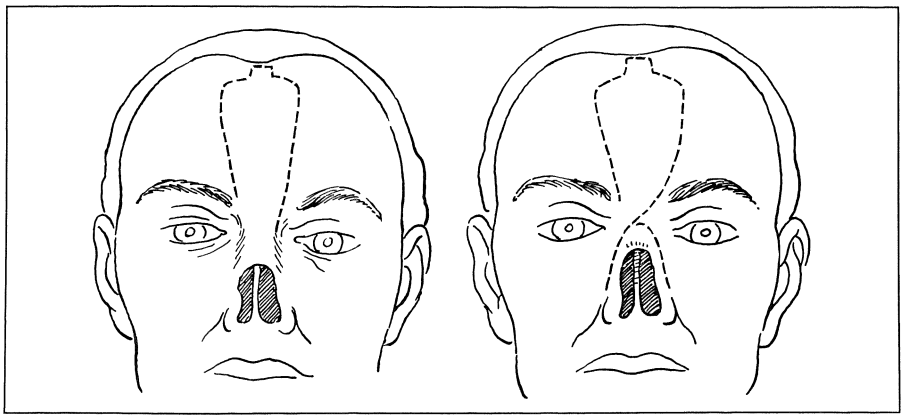
that gave the right contour when molded into nostrils (Fig. 7.23). The modern operation is essentially the same (Fig. 7.24); and the nostrils are still molded over two little tubes, as recommended by Sushruta.[193]

As to repairing earlobes, today's plastic surgeons still learn the technique, for the need persists. Sometimes the earring is torn out by its own weight; sometimes in the course of an argument.[194]

Another Parenthesis: Indian Infirmaries?

Sushruta never says where his patients are treated, but Charaka describes what appears to be, in that context, the ideal hospital. Here is most of the text:

> In the first place a mansion must be constructed under the supervision of an engineer well-conversant with the science of building mansions and houses. It should be spacious and roomy. The element of strength should not be wanting in it. Every part of it should not be exposed to strong winds or breezes. One portion at least should be open to the currents of wind . . .
>
> It should not be exposed to smoke, or the Sun, or dust, or injurious sound and touch and taste and form and scent. It should be furnished with staircases, with pestles and mortars, privies, . . . and cook-rooms.
>
> After this should be secured a body of attendants of good behaviour, distinguished for purity or cleanliness of habits, attached to the person for whose service they are engaged, possessed of cleverness and skill, endued with kindness, skilled in every kind of service that a patient may require . . . competent to cook food and curries, clever in bathing or washing a patient . . . or raising the patient or assisting him in walking or moving about, well-skilled in making or cleaning beds, patient and skillful in waiting upon one that is ailing, and never unwilling to do any act that they may be commanded to do. A number of men should also be secured that are skilled in vocal and instrumental music, in hymning encomiums and eulogies,



7.24 Two types of modern operation for rebuilding the nose with forehead flaps, essentially Sushruta's method and his leaf design. There still is a problem at the tip of the leaf: how to twist it by 180 degrees without choking the vessels.

conversant with and skilled in reciting verses and pleasant discourses and narratives and stories and legendary histories . . . fully conversant with all the requirements of time and place, and possessed of such politeness as to become agreeable companions. The mansion should also be stored with an adequate supply of partridge, hare, spotted deer, black antelope, black-tailed deer, etc. . . .

A cow also should be kept, yielding copious milk, of a quiet disposition, healthy, having all her calves living . . . So also should be kept little vessels or cups, larger vessels for washing the hands and face, water-vessels or jars, small jars or pitchers, dishes, metallic or earthen jars, cauldrons or pans . . . hollow vessels for covering articles, wooden or metallic ladles, mats . . . deer-skins and sheep-skins, rags, cloths made of cotton and wool, strings and cords, beds and seats, vessels called Bhringaras full of water and flatter vessels for holding spittle and evacuations, all placed ready for use, good beds placed upon bedsteads and overlaid with white sheets and containing pillows, for use when sleep is needed, beds and carpets for lying down or sitting upon . . . and diverse kinds of instruments, domestic and surgical. Smoking tubes, enemas . . . brushes and brooms, balances and weights, measuring vessels and baskets, Ghee, oil, fat, marrow, honey, treacle, salt, fuel, water, honey-wines, sour gruels of different varieties, different kinds of wines, whey, butter-milk, sour gruel of paddy or rice, and the different varieties of animal urine [*as drugs!*] should also be kept ready . . .

So also . . . emetics and purgatives, and articles that are both emetics and purgatives, those that are astringent, that increase the appetite, promote digestion, cool the system, and destroy the wind [*the most dangerous of the three doshas*] should be kept ready . . . Other things, again, that may conduce to the ease, comfort, and happiness of the patient, should similarly be kept ready.[195]

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Truth or fairy tale? I believe truth, lapsing into fairy tale. That was the style of Sushruta or Charaka, who quite often describe something that is, then glide into what should be, or might be, to end in purely verbal fireworks. They are especially prone to do so when they enumerate, as in the text above. In the long list of patients who should not be treated (sometimes for good reasons), Charaka goes so far as to say that one should never treat, *even in wish*, people whose image reflected in a mirror is upside down or headless.[196] In listing patients who might need enemas, he goes from people to cows (still

understandable) to camels, thence to a grand finale of fragrant enemas for snakes.[197] This is pushing snake worship too far. In listing the possible complications of enemas, he describes the ultimate possibility: the enema may reach high enough to come out of the throat, in which case the thing to do is of course to press on the neck.[198] All this does not mean that enemas were not given; it simply means that literature and fantasy had their share also in medicine.

So Charaka's infirmary surely existed, though probably only as an infirmary that rich people could afford as part of their household,[199] somewhat like the *valetudinaria* of Roman estates. Real Indian hospitals were not long in coming, however. Between 399 and 414 A.D., India was visited by Fa-hsien, a Chinese pilgrim and Buddhist monk, who was seeking the sources of the original faith.[200] With such a motivation, it was possible to brave the Headache Mountains and their eternal snows. "As far as the eye can reach, the route is marked out by the bleached bones of men who have perished in the attempt . . . scarcely one person in ten thousand survives . . . the wind, and the rain, and the snow, and the driving sand and gravel."[201] Crossing the Indus on a bridge of ropes, Fa-hsien reached Pataliputra. He marveled at the ruins of Ashoka's palace, which had been built, he says, with the help of Genii. Then he adds: "The respective nobles and landowners of this country have founded hospitals within the city, to which the poor of all countries, the destitute, cripples, and the diseased, may repair (for shelter). They receive every kind of requisite help gratuitously. Physicians inspect their diseases, and according to their cases order them food and drink, medicine or decoctions, everything in fact that may contribute to their ease. When cured they depart at their own convenience." Fa-hsien must have realized that this, too, was part of Buddha's heritage.[202]

Patient No. 6: An Internal Abscess

To be precise, this young man had more of a problem than just an abscess: he suffered from empyema—pus in his chest—just like Patient No. 3 whom we met at the Athenian clinic. For a couple of weeks, his horizon had been restricted to the bamboo frame of his bed.[203] The red, hot swelling on the side of his chest meant that pus, collected in that pleural cavity, was trying to find its way out. The vaidya was called to the bedside. Pneumonia was not in his books, nor was auscultation of the chest, so he merely studied the lump. It was rounded, painful. Because it reminded him of an anthill, it had to be an *antara-vidradhi* or "internal abscess."[204] One may disagree with this terminology, but for practical purposes it was correct.

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A nice, ripe abscess is a temptation for any surgeon, but the vaidya faced a difficult question: could it be cut open without touching a marma? "In a case of surgical operation, the situation and dimension of each local Marma should be first taken into account and the incision should be made in a way so as not to affect that particular Marma, inasmuch as an incision, even

extending or affecting in the least, the edge or the side of the Marma, may prove fatal."[205]

While studying how to incise without touching a marma, the vaidya asked cryptically: "Are you in the habit of taking strong wine?"[206] The patient did not quite know how to answer, because drink, he did, although he was not supposed to do so. The Brahmans, who were in charge of public mores, frowned upon fermented drinks. Yet there were dozens of such drinks—made from fruit juice, coconut juice, rice, barley, palm sap, and sugar cane; peppered, spiced, and perfumed; with a price for all pockets, up to grape wine, which was the most expensive.[207] Unlike most patients, the young man finally confessed, and he was rewarded, because the surgeon was on his side. Sushruta had no objection to fermented drinks and had written lavishly about their curative properties.[208] Better yet, if a patient was accustomed to liquor, he "should be provided with a meal before a surgical operation, or strong wine given to him . . . The effect of a good meal . . . will be to keep up the strength of the patient and to guard against his swooning during the operation, while the effect of wine will be to make him unconscious of the pain.[209] *The rule as regards the feeding and anaesthetising (wine giving) of the patient should be strictly adhered to.*"[210]

So the young man drank his way into a legitimate haze, feeling doubly good about it. It is hard to understand, incidentally, why the wine-loving Greeks did not mention wine in relation to surgery, except for external use. Maybe they left tipsiness to private initiative.[211]

A servant appeared, loaded down with bags and equipment.[212] The operating room was to be the great outdoors,[213] so the patient was directed to sit on the ground, facing east, while the servant tied his hands and feet.[214] The surgeon tested his steel blade by cutting a human hair.[215] Then, with "courage, light handedness, non-shaking, non-sweating, sharp instruments, self confidence and self command,"[216] and facing west, he cut the skin and helped the pus to flow out, while the servant dashed cold water on the face and eyes of the patient.[217] Afterward the wound was washed with an "astringent" decoction of herbs and wiped thoroughly dry with clean linen. A plug of lint, soaked in a herb preparation, was "plastered over with the paste of sesamum, honey and clarified butter . . . and . . . inserted deep into the wound."[218] Then came another plaster, spread on against the direction of the hair (*pratiloma*), to make it penetrate better;[219] followed by a thick layer of tow, "such as the leaves and bark of the Indian fig-tree;" and finally a wrapping of linen.

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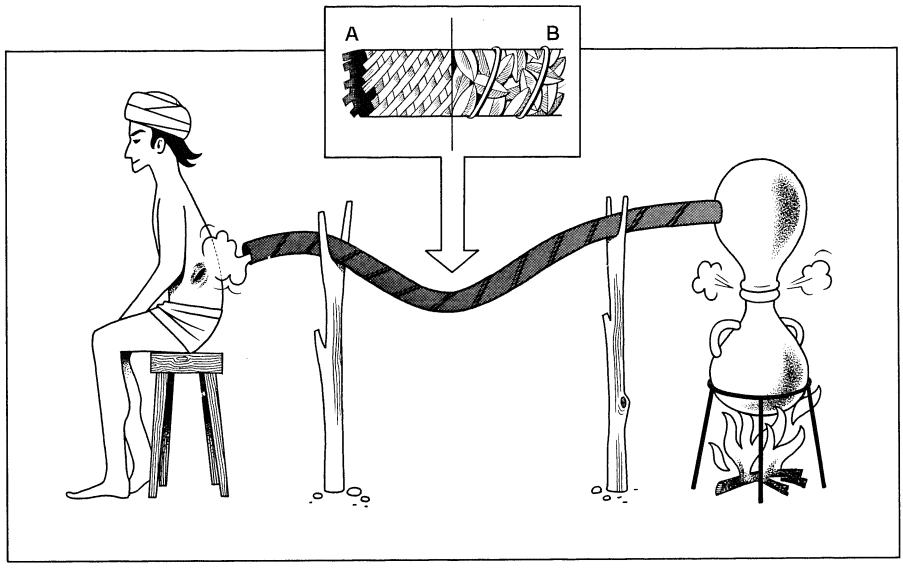
The patient could now relax, while the vaidya recited the appropriate mantras. The servant produced a long, light, flexible tube and began to set up the *nadi-sveda* (Fig. 7.25). This was an important operation. The word *nadi* is Sanskrit for "tube," and *sveda* has the same root as "sweat." The operation was in effect a sort of steam bath, with the double purpose of chasing away the pain as well as the malignant spirits.

The tube itself was a masterpiece of ingenuity. It was fashioned of woven



7.25 The *nadi-sveda*, a kind of local steam bath, which was part of Indian postoperative care. The pipe was made of woven grass (A), wrapped in leaves (B). The vapor was supposedly "made delightful" by bends in the pipe.

grass[220] and was made airtight with a wrapping of leaves.[221] The vapor, which came from a boiling soup of milk and urine,[222] was collected in an inverted pot, with an opening for the tube in its side. The critical feature was the shape of the tube: it had to have "three bends or turns in its body to resemble the trunk of an elephant."[223] "The reasons for the bending tube," explains the translator, "are to make the fomentation delightful, in consequence of the vapor not passing in a straight course,"[224] and to "break the strength of the vapor." The idea could only spring from the mind of a smoker. In fact, Charaka deals at length with the right length and shape of smoking pipes, the favorite materials for them being the same as for enema tubes. Smoke does no harm, he maintains, "if inhaled through a pipe made of three limbs."[225] Thus, the nadi-sveda blew gentle puffs at the wound as the vaidya chanted on. The patient listened, and his mind floated away, away from pain.

The wound would have to be dressed again every other day. There was no question of trying to sew it up "as long as the least bit of morbid matter, or pus remains inside it"[226] (three cheers for Sushruta). Then it would be essential to take measures against a relapse. As the patient certainly realized, an internal abscess meant that the three doshas or basic principles of his body were extremely "deranged, through eating heavy, incompatible and incongenial articles of food or of dry, putrid and decomposed substances, or by excessive coition and fatiguing physical exercise, or by voluntary repression of any natural urging of the body."[227] Hence, a list of "cures" which called for exceptional stamina: the unabridged version runs to sixty items.[228] Following are a few that could be prescribed for this patient:

> No sex, no meat, no exercise, no emotions of grief or fright, or ecstasies of joy.[229]

Fasting, again to bring under control the enraged doshas.[230]

Vomiting would also help, as by taking a stomachful of barley gruel, then ejecting it by sniffing a medicated flower.[231]

Sneezing too, since the wound was fairly high up in the body, by means of *nasya* or nose drugs,[232] such as pepper mixed with cow's urine or the watery exudation of cow dung.[233]

Purging,[234] plus added purification with "light agents," such as the urine of cows, buffaloes, goats, sheep, mules, horses, or camels[235]—there were six hundred purgatives in all.[236]

Enemas, with the urine group of drugs,[237] although enemas were best for sores in the lower part of the body.[238] Sushruta's directions for using the bladder-and-pipe contraption are the most detailed of antiquity, including lubrication of the tip with clarified butter.[239]

And venesection: "*Venesection . . . properly performed is half the treatment in surgery,* like the application of enematic measures in the therapeutics"![240]

On the whole, then, the young man's treatments would have been about the same as in Greece—the local techniques fair, the general ones dreadful. The Indian operation was less aggressive, no drain being left in the wound and no oil injected into the chest, and psychotherapy was more highly developed.

Patient No. 7: A Broken Nose

A *vaishya* or "workingman" came in next, holding a bloody rag over his face. It covered the result of a tavern brawl,[241] a fractured nose. Nothing serious; the sunken bone was raised with the help of a rod, just as in Greece. But the Indian technique was a touch more elegant. Instead of stuffing a leather plug into each nostril, the vaidya inserted two short pipes of bamboo cane.[242] He probably borrowed the idea from his plastic operation for making a new nose, in which the nostrils were molded around two little tubes. Again, concern for the patient.

His nose was bandaged, and sprinkled with the inevitable clarified butter.[243] The bonus was a lotus stem for sucking milk, if chewing was painful.[224]

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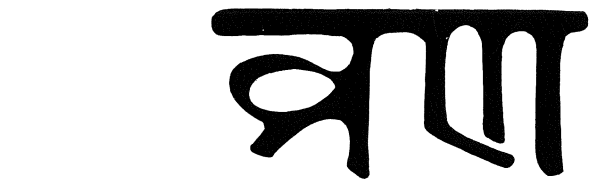
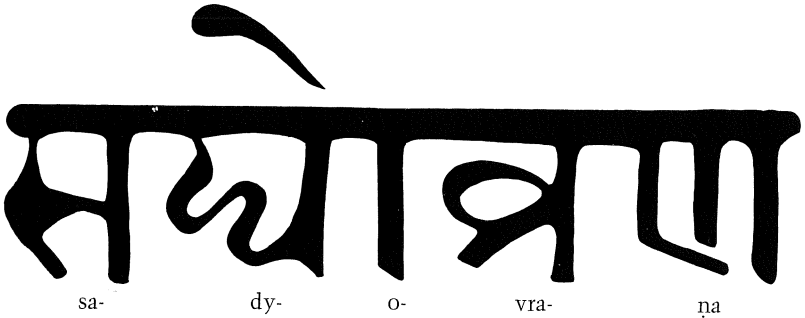
Patient No. 8: An Instant Ulcer

It had been a bad fall from horseback: a fellow Kshatriya of the warrior caste was brought in with a wound in his leg, bleeding profusely. Such a wound was called a *sadyovraṇa. Vraṇa* was a general name for "sore," including wounds as well as ulcers, like the Greek *hélkos* (Fig. 7.26);[245] *sa-dyás* stood literally for "same-day"; *sadyovraṇa* therefore meant "same-day sore," "recent sore," or in the words of the translator of Sushruta, "instant ulcer."[246]





7.26 Two Sanskrit words for wound: *vraṇa*, for any type of wound (including sores and ulcers); and *sadyovraṇa*, literally "same-day wound," for fresh wounds. In modern Russian the word for wound is *rana*, a close relative.

The trouble was that the vaidya knew very little about stopping hemorrhage. One way was to sew up the wound as fast as possible and bind it,[247] but he rightly decided against that method, because it was unclean—again a fine decision.[248] He tried pouring on some warm clarified butter; he gave some to swallow, and even a squirt by enema;[249] but the blood kept pouring. A poultice of rice and beans did no better. Eventually he took a bag of sand, put it over the wound, and sang over it the hemostatic charm of the *Atharva Veda* which went with that specific maneuver:[250]

> About you hath gone
> a great gravelly sandbank
> Stop and be quiet
> I pray

It worked. The Kshatriya was then bandaged and asked to return every third day.[251]

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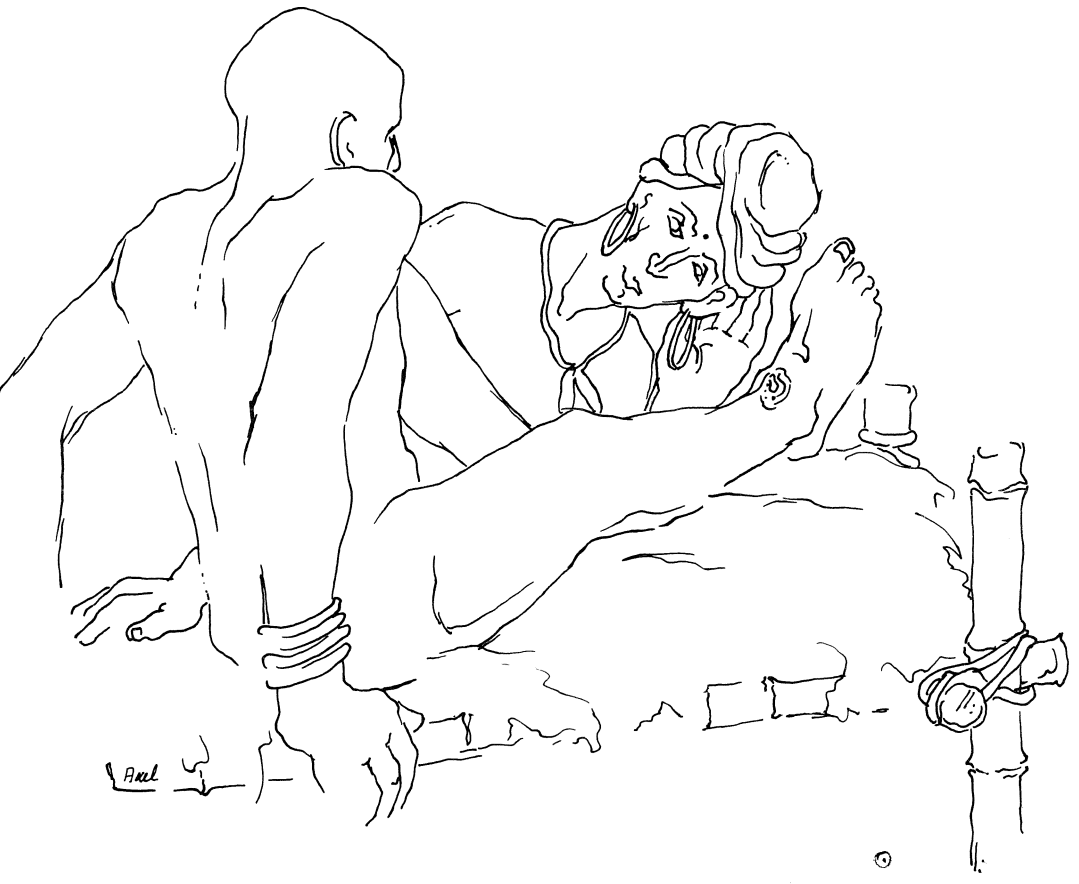
But he disobeyed, stayed at home, and tried to treat himself. A month later, when he reappeared, the dressing gave off a typical smell of putrid meat. This was duly noticed, for the sense of smell played an important part in all medical examinations.[252] A smell of dog, horse, or putrid meat, for example, was unfavorable; a smell of lotus "or any celestial flower" announced death. Note that the deadly smells are those that are clearly impossible: the same odd correlation occurs in other lists of symptoms.

Now the vaidya, besides his general policy of not accepting fatal cases, had an absolute rule: not to "take in hand the treatment of an ulcer-patient" without first examining the ulcer to determine whether it was curable.[253]



7.27 Auscultation of an ulcer, Indian style. Most diseases were caused by deranged *vayu* or *vata*, the "inner wind"; hence, in the words of Sushruta, "a distinctly audible sound or report is heard in . . . ulcers which are found charged with wind."

Sushruta's warning was probably suggested by hopeless cancerous sores. Considered incurable, for instance, was "an ulcer cropping up like a fleshy tumor . . . with its edges raised like the genitals of a mare."[254] Highly suspicious, and rightly so, were also those ulcers entirely devoid of pain.[255]

Removing the homemade dressing, the surgeon found that the sore was filthy, but acceptable; it was merely creeping with maggots.[256] "Worms due to flies," he said,[257] causing no great worry. These were only one in a list of twenty kinds of vermin that were a daily concern.[258] Maggots could be enticed out of the ulcer with a little piece of flesh, or smothered with a paste of herbs and cow urine; but the quickest way to take care of them was with an alkaline wash.[259] Afterward the ulcer looked better, though not yet clean enough to look "like the back of the tongue."[260] The vaidya leaned over to sniff the cleaned-out ulcer at close quarters. Now the smell was just fishy, and therefore "normal" for an ulcer.[261] But what about the sound?

He listened carefully, his ear to the ulcer. There was a definite sound of blowing, he said. The ulcer was charged with vayu, wind, that troublesome dosha (Fig. 7.27).[262]

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Standard treatment for a sore such as this was a good scraping with a linen pad and rock salt. The raised edges were scarified with a steel blade, much as in Greece, except for the final ointment of honey and clarified butter.[263] The dressing was a pad of selected leaves, again as in Greece (Fig. 4.41), but here we are told why: the "rationale . . . is that the leaves tied by an intelligent physician . . . serve to generate heat or cold and retain the liniment or medicated oil in their seat of application."[264] Since the patient could afford it, the leaves were bound on with a bandage of expensive, imported *Chinapatta:* Chinese cloth.[265]

The prognosis was fairly good, because the outline of the sore did not resemble any of the shapes that were regarded as fatal: the barb of a spear, a banner, a chariot, a horse, an elephant, a cow, an ox, a temple, or a palace.[266] The Kshatriya went home.

Two days later he was back again with a flare-up of inflammation, fever, a throbbing foot, and a throbbing headache; the surgeon's suggestion, to drain blood out of the temples, made good sense to him. It happened to be an acceptable time of the year (the rainy season) and an acceptable day, without rumblings from a thundercloud.[267] So, with the courage of a soldier, the patient followed orders: he sat on a stool, faced east, drew up his legs, rested his elbows on the knees, closed his fists, thumb inside, and rested his neck on them, one fist on either side of the neck. At that point, an apprentice wrapped a band of cloth around his neck, passing it over the fists, and held it rather tight so that he was practically handcuffed, while his fists were also pressing against the jugular veins. The temporal veins bulged, recalling to the vaidya the lotus stems on which he had practiced venesection (Fig. 7.28). He chose a point far removed from all the marmas, told the patient to hold his breath, keep his mouth open—and before he slit the vein "to the depth of a barley corn,"[268] he paused a moment, thinking of the twenty things that could go wrong with venesection: *durviddhá,* "bad incision"; *atividdhá,* "excessive incision"; *kunchitá,* "crooked incision"; *pichchitá,* "thrashed incision"; *kuttitá,* "lacerated incision"; *aprasrutá,* "non-bleeding incision"; *marma-viddhá,* "a deadly cut on a marma"; and then on to *atyudirná, parisushká, vepitá, shastrahatá, apaviddhá . . .*[269] He recited a mental mantra, and plunged his lancet.

Few indeed are the medical emergencies in which bleeding may help, and then only as a palliative. As for the Kshatriya's ulcer, there was not a chance in the world that it was being helped.

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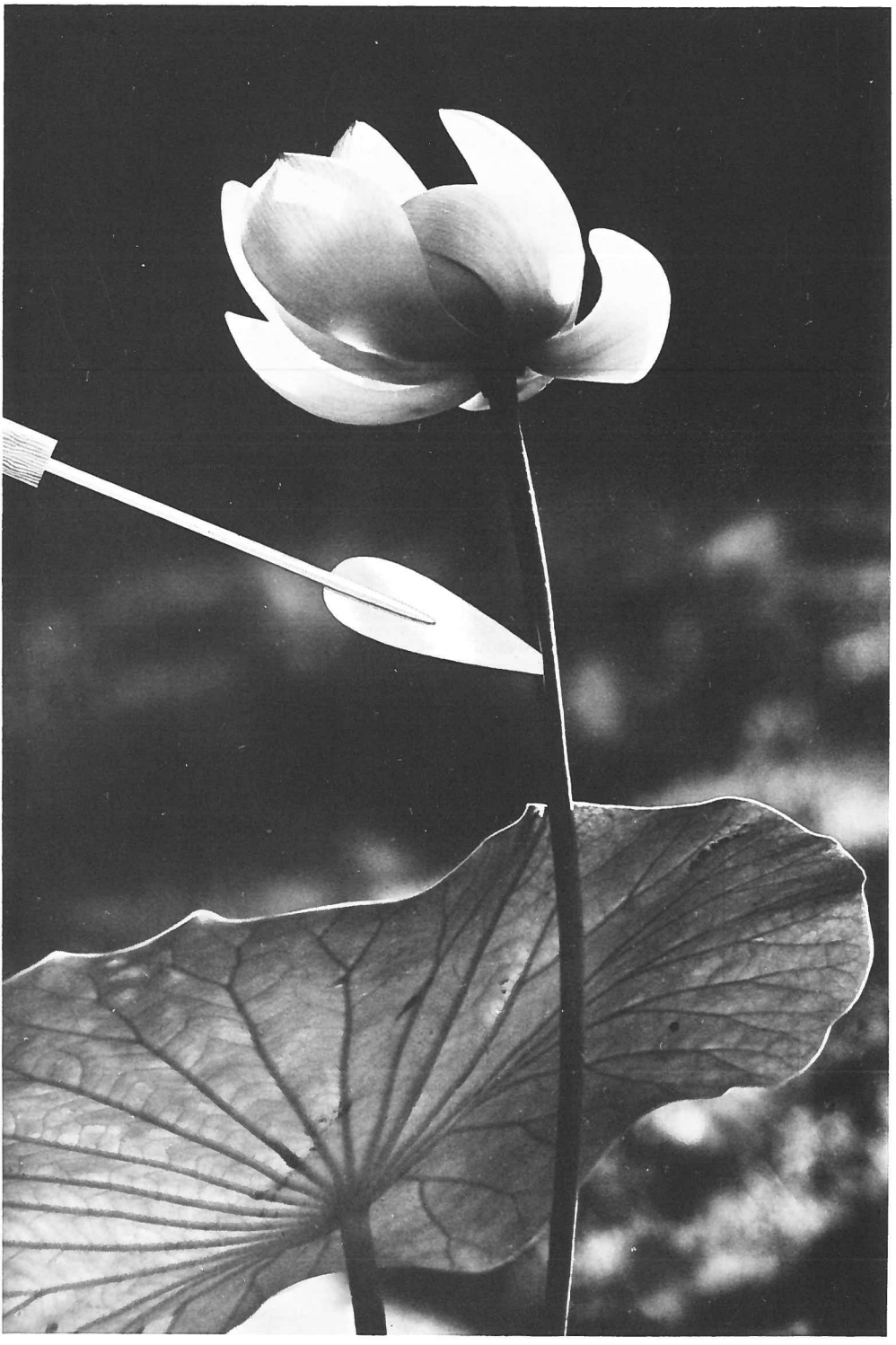
Patient No. 9: A Thorn, and a Nonpatient

A professional hunter, who had just sold a cart load of venison at the market,[270] stopped his wagon at the door and walked in carrying a little girl in tears. A huge thorn was buried in her foot.

The vaidya shuddered: the thorn had sunk straight into a marma. His mental text was formal: "The Marma known as *Kshipra* . . . between the first



7.28 There were days when surgeons practiced swift cuts on lotus stems.

and second toes . . . being injured or pierced, brings on death from convulsions."[271] Sushruta had probably generalized from one or more cases of tetanus, after a piercing wound in the foot. His conclusions were equally formal: "in case of piercing or injury to any of these Marmas [in the hand or foot], the hand or leg should be immediately amputated at the wrist or at the ankle, respectively."[272]

The father listened to this injunction in disbelief. Cut off the whole foot because of a thorn? That tender little foot? No, he would take the responsibility. There would be no amputation. It is very unlikely, in fact, that all such formal injunctions were taken literally. This one should perhaps be seen as an alibi for the surgeon. In any event, he finally gave in and set about the job of cutting out the thorn, in the deadly territory of a marma. It was the father's responsibility.

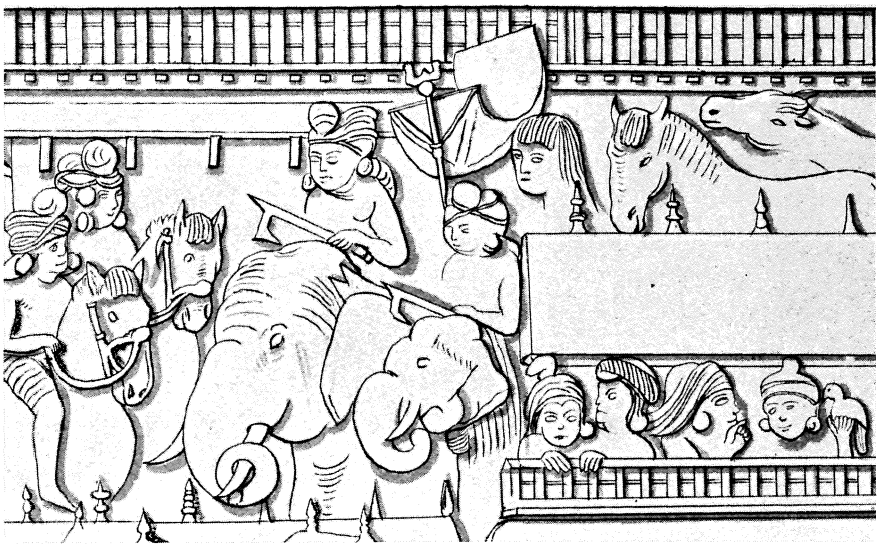
A steel blade, however, would not do. On children and on patients who "dreaded the knife," it was recommended to use cutting edges of "strips of bamboo skin [*sic*], crystals, bits of glass, and the rock known as Kuruvinda."[273] The bamboo blades recall the Egyptian and Roman reed knives—but the motivation is purely Indian. So the vaidya picked up a little bamboo blade: less effective, but more considerate. The thorn came out, in the beak of the heron-mouthed forceps. Cradled in her father's arms, the little girl stopped sobbing.

One of the father's arms appeared to be bandaged. "What happened there?" asked the surgeon.

"It was this morning. The hunting knife slipped while I was skinning a deer."

A fresh, clean cut: what a golden opportunity for a suture, with cotton, Chinese silk, hemp, linen, plaited horsehair, or any other thread that would fit the vaidya's special surgical needles.[274] But both men knew that this was impossible. An Ayurvedic surgeon was not allowed to treat a professional hunter, a professional fowler, or a habitual sinner.[275] All in all, it had been a frustrating visit.

Two aspects of this episode call for comment. First, the surgeon's ethics throughout were not very consistent: he refused to treat a hunter, and yet he was allowed to extract information from him about medicinal herbs of the forest.[276] Second, in his readiness to amputate he was more aggressive than the Hippocratics— though only in the case of injured marmas. The rather confused philosophy here is expressed by Sushruta as follows: by a wound in the marma "a man . . . meets doom like a tree whose roots have been severed"; whereas if the limb is actually cut off, it "does not necessarily prove fatal, like lopping off the branches of a tree."[277] Sushruta somehow believed that there was less hemorrhage by amputation than by injury to a marma: "The vessels become contracted in the case of [amputation of hand or foot], and hence the incidental bleeding is comparatively scantier."[278]



7.29 Indian elephant drivers. Buddhist bas-relief, perhaps first century A.D.

Patient No. 10: Enemas for the Elephant, Too

The poor old man could hardly walk. He had been an elephant driver as far back as he could remember (Fig. 7.29), lately also in the service of the king, but nothing like this had ever happened. His bottom, thighs, and groins were covered with eruptions—red, hot, painful boils, some as open sores. And he shook with fever.

This was a serious problem. The elephant had probably been poisoned, so as to poison the king. There was no limit to the treachery that a king had to expect. Poison could be placed in his turban, his garlands, his food, his bath, his cosmetics.[279] Even in his women. Sometimes a woman, slowly habituated to poison, was presented to a king: with a single embrace he could die "almost instantaneously."[280] So in this case it was necessary to treat the driver as well as the elephant.[281] Had the elephant been restless, the vaidya asked, or red-eyed? Had the driver noticed that flies died after eating the elephant's food, or that shadows were not reflected in his drinking water?[282] If so, it might be necessary to give the elephant a good healthy enema. There was a method laid out, all in verse.[283] As to the driver, his sores would be treated with clarified butter and herbs, and left unbandaged.[284]

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Now for the fever. The surgeon had memorized over forty pages about fever,[285] and he feared it. Fever, begotten by the wrathful fire of Rudra,[286] the god of destruction, "is a dangerous disease. It affects . . . appetite and the strength as well as the complexion of the body and is virtually the sum-total of all the other diseases. It is therefore called *the lord of all bodily diseases.* It is common to all created beings (men and animals), affects the whole of the organism (including also the mind), is extremely hard to cure and is present in all cases at the time of the death of all creatures. Hence it is rightly called the destroyer of created beings."[287] Elsewhere this thought is carried further:

fever is the lord of ailments because it is *perhaps an indispensable condition under which a creature can come into being or can depart from this life.*[288]

With all this, fever had no satisfactory treatment. Fasting was still the favorite cure[289] and of course also purging, or drinks of diluted barley gruel,[290] the same as the Hippocratics. Then there was also another famous therapy for the chills of fever: "Damsels young, beautiful and skilled in the sport of love, with faces glowing like the full moon of autumn and darting forth beams of love from their languid blue-lotus-like eyes, with eye-brows moving in the ardour of desire . . . clad in thin transparent garment, fumigated and scented . . . should be asked to take the patient into a firm embrace like a forest-creeper entwining itself around a sylvan tree, and the girls should be told to keep off as soon as the patient would feel himself heated" (Fig. 7.30).[291]

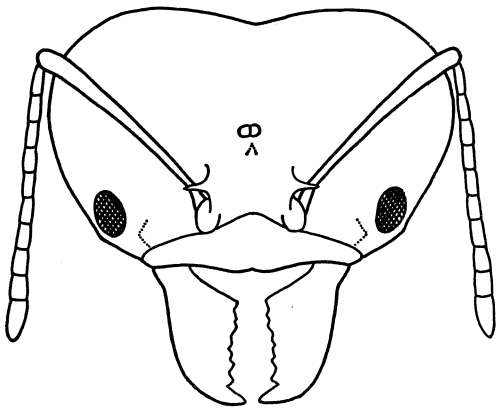
No, this was not for the old elephant driver. Maybe he could do with a lukewarm plaster of herbs in cow's urine and curd-cream.[292] And Sushruta never says how he would treat the chills of fever—in a woman!

The Ant Saga

Sushruta's pages on gored bellies are too vivid to represent theory alone. When the intestines spill out of a wound, he explains, to coax the slippery loops back into place, try to make your patient vomit by gently rubbing his throat with a finger, or lift him up into the air and shake him like a bag; and if in the meantime the intestines have dried up, wash them first with milk and lubricate them with clarified butter.[293] His advice in cases of intestinal perforation: "According to others . . . large black ants should be applied even to the perforated intestines [?] . . . and their bodies should be separated from their heads after they had firmly bitten the perforated parts with their claws [*jaws*]. After that the intestines with the heads of the ants attached to them should be gently pushed back into the cavity and reinstated in their original situation therein."[294]

Sutures with ant heads are often mentioned in connection with primitive medicine.[295] I had always dismissed them as probable nonsense, for I could not see how severed ant-heads could keep clinging to the skin. However, since Sushruta mentions the technique, albeit at secondhand, I decided to look into the matter. In a classic on entomology, Wheeler's *Ants,* I found this precise statement: "The huge heads of the soldiers of the South American leaf-cutting ants (*Atta cephalotes*) [Fig. 7.31] have been employed by the native surgeons in closing wounds. After the two edges of the wound have been brought together and have been grasped by the mandibles, the ant's head is severed from its body and left as a ligature."[296] William Beebe confirmed that Guiana Indians suture their wounds with the jaws of giant *Atta* "maxims," the largest workers. He added that a whole year after returning from the jungle, he found the jaws of two Attas clamped onto his own boots, "with a mechanical vise-like grip, wholly independent of life or death."[297]

7.30 Indian treatment for the chills of fever (in adult males).



7.31 The jaws of *Atta cephalotes* were made for chopping leaves. They can cause 6mm wounds but are not suitable as wound clamps. Their actual size is about like that of one of the eyes in this drawing.

Outside the Brazilian jungle, *Atta cephalotes* is hard to find. However, I secured a couple of pickled specimens and tried to use them. Complete failure. The jaws worked like scissors—as they should, being the jaws of the leaf-cutting ant—and could not possibly be used as clamps. Both Wheeler and Beebe were no longer there to argue the point, so I was ready to return to my original skepticism.

However, I kept writing letters, and the trail finally led to Prof. Neal A. Weber of Swarthmore College. He replied:

> You have a good opportunity in your book to lay at rest the myth that leaf-cutting ants were used to suture wounds in South America. The ants that were used were soldiers of *Eciton burchelli* (Westwood) and *Eciton hamatum* (Fabricius). These have a wide distribution in both middle and South America. My experience frequently here is that, when I am attacked by these soldiers, their fish-hooked shape mandibles engage so firmly in the skin or clothing that the heads remain when I try to brush off the ants. I am enclosing an old photo of my leather gloves with these soldiers impaled by their mandibles after death. In addition to the shape of the mandibles, the adductor mandibular muscles are stronger than the abductor and tend to keep the mandibles closed.

Through Prof. Weber I had the good fortune of finding another entomologist who had been personally sutured by ants, that is, bitten so effectively that his clothes had become sutured to his skin: the late Dr. T. C. Schneirla of the American Museum of Natural History. I quote from his letter:

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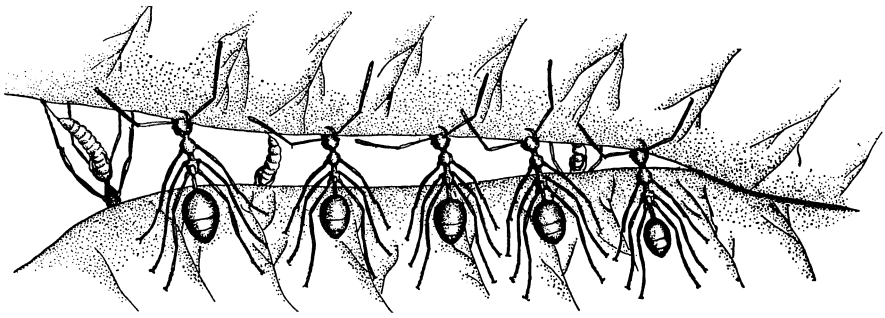
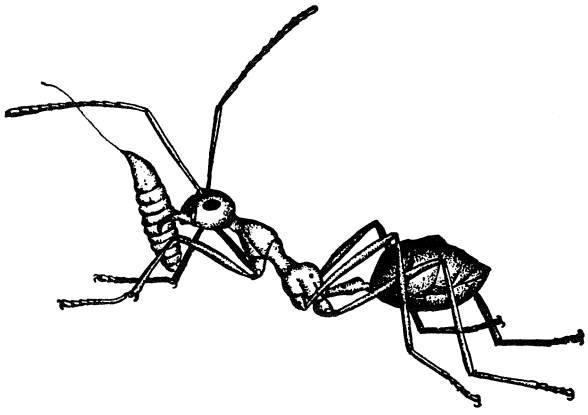
> It is most likely that the major worker of *Eciton burchelli,* the largest swarm-raiding army ant in the New World, would be used in suturing wounds, the smaller *Labidus praedator* or (next in order of probability) the majors of other *Eciton* species . . . In Africa and most of Asia, the leading probability would be the major worker of one of the driver ant (*Dorylus*) species. There are still other possibilities. In any case, use of the major workers of *Eciton* species in suturing wounds is definite, as it is a real problem to get the fish-hook-shaped and very sharp mandibles of these insects out of your skin once they have been firmly implanted. In most cases, I have removed them by inserting a pair of tweezers and spreading the points to forcibly extricate the hooked tips. Sometimes the rather brittle tips break off in the wound . . . There is no question that the mandibles remain firmly implanted after the body



7.32 The oldest silk suture: a brigade of *Oecophylla smaragdina* building a nest. Workers in front draw together the edges of two leaves, while workers in back bind them with silk spun by larvae.



7.33 An *Oecophylla smaragdina* worker holding a larva, used as a shuttle for weaving leaves together.

has been snipped off from the head. The mandibles are held firmly in the wound by virtue of their being sharply pointed and recurved so that the edges catch firmly on each side of the suture as would a pair of opposed fishhooks . . . To sum up, I think there is nothing mythical about the story of suturing wounds with these ants, as unavoidably I have been subjected to this operation countless times.

This letter was followed by six stupendous ants, looking more like miniature horses, fixed in alcohol. I did not feel like subjecting a live rat to the test of *Eciton* jaws, but on a dead one they worked beautifully (Plate 7.2).

Indian ants may still be at work. Recently an entomologist was exploring the jungle of southern Bhutan, at the foot of the Himalayas and not far from Ashoka's ancient capital, when a Bhutanese guide pointed out to him a nest of ants that were used, he said, for closing wounds.[298] The species was *Oecophylla smaragdina,* which performs some marvelous sutures of its own. When it is time to build a nest, a battery of workers line up along the edge of a green leaf, facing outward. Then they rise, snap their jaws into the edge of a leaf above, and pull down (Fig. 7.32). Last, a worker comes along, holding in its jaws one of the family larvae, in which the silk glands happen to be extremely well developed; and using the larva as a shuttle, it sews the two leaves together (Fig. 7.33).[299] This feat is surely the oldest suture on earth.[300]

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7.34 Ready to clamp: a sentinel of *Dorylus*, the African army ant, photographed in the Congolese jungle. It has climbed onto a piece of cloth dropped at the edge of the advancing army and taken its typical posture. Length up to 13mm.

I have ceased to doubt about the ancient Hindu sutures; in fact, I am beginning to suspect that the ancient Hindus may have borrowed the idea from *Oecophylla smaragdina*. In Africa, where the practice still exists, the fearful sight of driver ants on a swarm raid should be enough to suggest clamping even to the unprepared mind: the streaming black river is flanked by motionless, ferocious-looking sentinels, ready to clamp onto anything in sight (Fig. 7.34).

Hippocrates has nothing to say about ants; maybe he did not have the right kind.[301] This practical use of ant mandibles, however, recalls Raymond Dart's theory, whereby mammalian jaws may have been among the first tools of man-apes, three or four million years ago; especially antelope jaws, which can be used for cutting as well as sawing.[302] And did not Samson slay one thousand men with the jawbone of an ass?[303] Jaws, after all, are natural tools.

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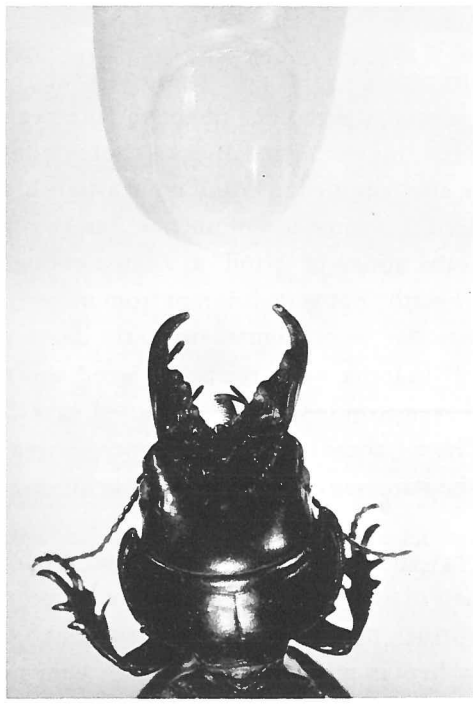
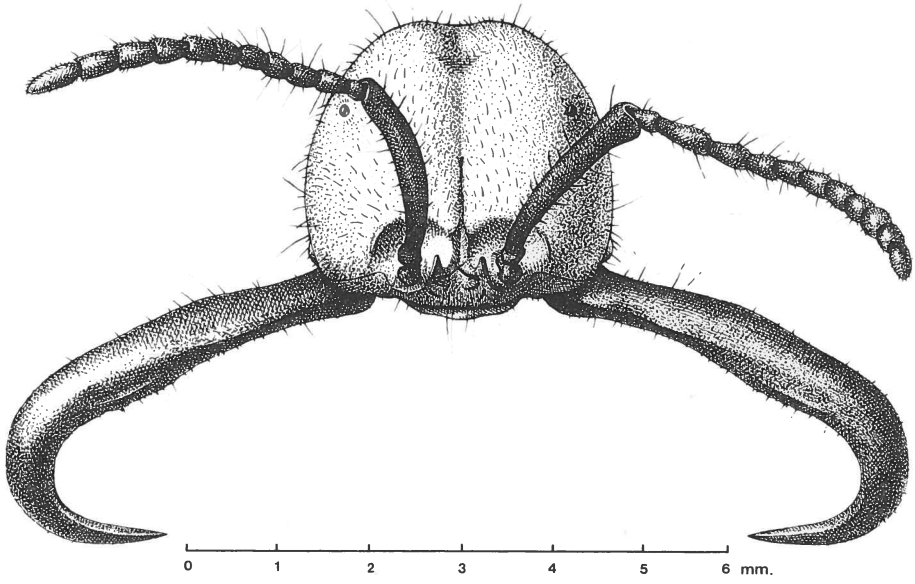
For use as wound clamps, even those of the beetle have been tried. One traveler returning from Algeria in 1845 claimed to have seen wounds clamped with *Scarites pyracmon*.[304] I did procure a specimen (Fig. 7.35), but so far, no insect clamp that I have seen comes anywhere near the mandibles of *Eciton* (Fig. 7.36).



7.35 Another candidate as a wound clamp, the beetle *Scarites pyracmon*, common in all Mediterranean countries. The finger is for scale.



7.36 Head and jaws of an *Eciton* soldier, possibly the best insect-clamp.

The Vaidya, the Iatrós, and the Yang I

At a summit meeting of a vaidya, a iatrós, and a yang i there would have been agreement on several basic points: on the importance of diet (but not on how to use it), on "draining out" some diseases (but not on how to do it—and the Chinese also "drained in") and more astonishingly, on a theoretical point so specialized that some sort of unconscious communication seems inevitable. This was the notion of "wind" as a cause of disease. In China, the internal *ch'i* was a "breath" not very different from meteorologic wind;[305] the *Nei Ching* reports that "winds contribute to the development of a hundred diseases."[306] In India, vayu, the bodily wind, was an inner equivalent of external and even cosmic winds;[307] it caused, says Charaka, 80 of the 140 diseases.[308] In Greece, there is a whole Hippocratic treatise *On Winds*,[309] which closes with the statement that "winds are, in all diseases, the principal agents."

Among neighbors, similarities were even greater. Sushruta's and Charaka's endless lists of five elements, six tastes, eight properties, five salts, four oils, and eight urines, not to mention the six triples followed by eight triples that had to be kept in mind in order to drink wine properly,[310] have a distinct flavor of Chinese numerology. Nor can it be an accident that the two neighboring cultures created similar doctrines of vital points, the marmas and the points of acupuncture.[311] Sushruta, after all, used Chinese silk for sutures and Chinese cloth for bandages.

The Indian exercises in experimental surgery have no parallel. The nearest approach was in Persia, where a believer in Zoroastrian religion had to practice first, not on a lotus stem, but in the flesh of a nonbeliever. Such is the rule as laid out in the sacred books of the *Zend-Avesta:*[312]

> O Maker of the material world, thou Holy One! If a worshipper of Mazda [*God*] want to practice the art of healing, on whom shall he first prove his skill? on worshippers of Mazda or on worshippers of the Daêvas [*demons*]?
>
> Ahura Mazda answered: On worshippers of the Daêvas shall he first prove himself, rather than on worshippers of Mazda. If he treat with a knife a worshipper of the Daêvas and he die; if he treat with the knife a second worshipper of the Daêvas and he die; if he treat with the knife for the third time a worshipper of the Daêvas and he die, he is unfit to practise the art of healing for ever and ever . . .
>
> If he shall ever attend any worshipper of Mazda, if he shall ever treat with the knife any worshipper of Mazda, and wound him with the knife, he shall pay for it the same penalty as is paid for wilful injury [*possibly amputation of six fingers*].
>
> If he treat with the knife a worshipper of the Daêvas and he recover; if he treat with the knife a second worshipper of the Daêvas and he recover; if for the third time he treat with the knife a worshipper of the Daêvas and he recover; then he is fit to practise the art of healing for ever and ever.[313]

वैद्य

The apprentice surgeon is thus graded, as in the Chinese system, by counting successes and failures. The infidels were of course Indians, Greeks, or Romans living in Iran.

If a Greek physician had been confronted with the medical practice in Pataliputra around 400 B.C.—assuming that this period for the writings of Sushruta is right—he would probably have been shocked, primarily by the use of religion as a part of medicine. He himself had split away from religion and from the psychotherapy it afforded, leaving both to the temples of Asklepios. The vaidya, instead, practiced the whole gamut. To him, religious acts were medicine of the first order. Nowhere as in India did religion mingle so thoroughly with private and public behavior.[314]

To the iatrós, the ethical standards of India would look familiar,[315] but not identical. The caste barriers would appear unreasonable, as also the outright recommendation not to treat the very poor.[316] Perhaps the concern with the patient's feelings would also look overplayed.

Technically, the iatrós would marvel at the Indian plastic surgery, especially at rhinoplasty or reconstruction of the nose, although his own clientele had few such problems with ears and noses. He would be equally aghast at the daring feat of "couching the cataract," an operation that destroyed many blind eyes, but restored partial eyesight to a large number of otherwise hopeless patients.[317] He would probably admire the courage of Hindu surgeons in amputating limbs, and their ability to stop the bleeding with hot oil. He would feel somewhat dizzy at the number of drugs, about six hundred of them or twice his own list,[318] and would wonder at the rare use of inorganic drugs.[319]

At the conceptual level, the Greek would surely recognize that vayu, pitta, kapha, and rakta behaved very much like wind, bile, phlegm, and blood. On one point, however, he would definitely recoil: the Indian passion for names, for splitting hairs, for classifying.[320] That was entirely against his grain. To him, in practice, the Greek four humors were an excuse to make all diseases more or less alike. In India, it was the other way around. Sores, for instance, had special names according to the particular humor supposed to be affected; thus there were fifteen *groups* of sores, but then varieties were "practically innumerable":

vataja,
pittaja,
kaphaja,
raktaja,
vata-pittaja,
kapha-vataja,
kapha-pittaja,
vata-raktaja,
vata-pitta-raktaja,
kapha-pitta-raktaja,
vata-pitta-kapha-raktaja,

and so forth, each one with its own special clinical picture.[321] Nothing could be farther removed from the Greek sense of synthesis.

And what could the vaidya have learned from the Greek?

Despite much thought, I still cannot see any major lesson that the Greek could have given in exchange. For all of his mantras and endless superstitions, the vaidya, particularly in his surgery, helped more people and saved more lives.

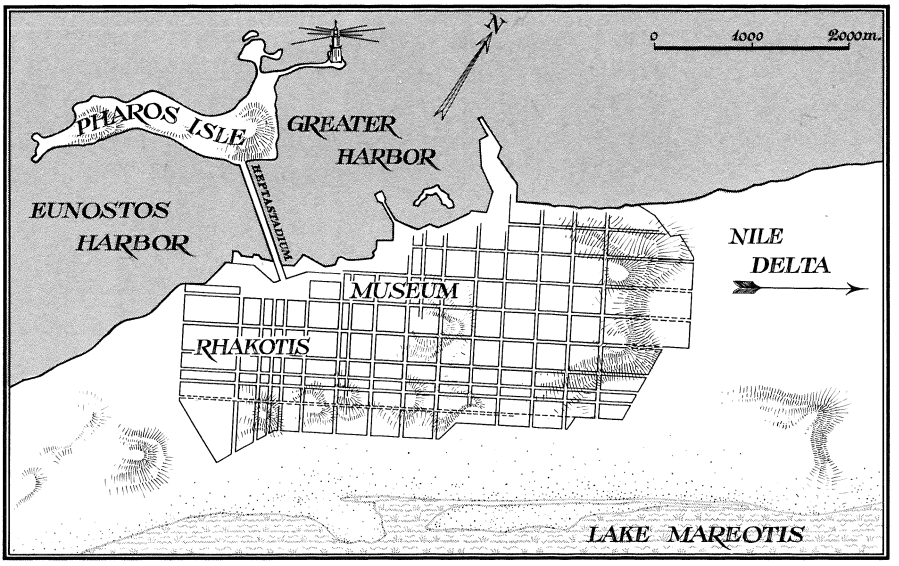
There is something unnerving about the ancient vaidya, because he cannot be placed exactly in time. Was it 400 B.C.? 200 B.C.? 200 A.D.? But the answer is not especially relevant, because the vaidya—unlike the asu, the swnw, and the iatrós—never disappeared. Ayurvedic medicine is still the medicine of millions.[322]

8 Alexandria the Great

Back to the Mediterranean, about 250 B.C. Here is the lighthouse of Alexandria, one of the seven wonders of the world: perfect symbol of that city, whose glory came and went like a flash, unique in the history of antiquity.

The very birth of Alexandria is something of a fairy tale. Imagine a crown prince who is also a private pupil of Aristotle, a Macedonian lad of twenty-two who sees himself as a descendant of Hercules, and fired with an ambition that will one day lead him to stab a friend in anger.[1] Imagine him taking off at the head of an army, crossing the sea, conquering all the land from Asia Minor to Egypt, then heading east into the vague territories of India—and founding a string of at least seventeen Alexandrias as he goes.[2] He will burn out on his path, like a falling star, but one of his cities will pick up the flame: Alexandria of Egypt.

As Plutarch tells the story, after the conquest of Egypt (it was 332 B.C.), Alexander's engineers dutifully mapped out, somewhere, the site for a new city.[3] But then the king had a dream in which a grand old man appeared to him, reciting verses about an island named Pharos. Alexander was a scholar worthy of his former tutor (he even slept with Aristotle's edition of the *Iliad*, and a dagger, under the pillow):[4] he recognized the old man as Homer and took the hint. True to style, he tore off to visit Pharos a few hundred yards offshore, west of the Nile Delta. The island itself was too small for settlement, and the coast just opposite was a dismal strip of wasteland, later called the



8.1 Rough map of ancient Alexandria: a poor harbor, were it not for the Heptastadium, a jetty (now silted up on both sides). Lake Mareotis was a huge tidal pool from the Nile floods. Rhakotis was a settlement of Egyptian fishermen and pirates, preexisting on the site of Alexandria; it left no known trace.

Taenia, running between swampy Lake Mareotis and the sea (Fig. 8.1): a flat, unsafe, unlikely place for a city.[5] But for Alexander there would be no other. Chalk to mark the boundaries was not on hand, so his men had to use flour. Birds ate up the flour; Alexander brushed aside the bad omen. The city shot up, and Alexander marched off to the East, never to return alive. Pharos was connected to the mainland by a jetty, the Heptastadium, which made two large harbors out of nature's small one. Within a matter of years this desolate strip of land was a bustling city and the hub of the Mediterranean world.

After the death of Alexander, one of his generals, Ptolemy, took over Egypt and finally declared himself king and Pharaoh, with residence in Alexandria. When he retired fifty years later, this genial Macedonian soldier had something to show for his reign, having founded the great lighthouse, the Mouseion or House of Muses (we call it Museum), and the library. The best of Greece was now happening in Egypt.

Near Egypt, I should say. By pedigree, Alexandria had little to do with the people of the pyramids, and its citizens were primarily Greeks: so the prevalent name in antiquity was "Alexandria near Egypt," *Alexandrea ad Aegyptum*.[6]

The Museum, though not the first nor the last of its kind, certainly became the prototype.[7] It was a fabulous, state-supported institution, where scholars from all branches of knowledge, set aside in majestic surroundings, were paid to think, search, read, and write. Strabo tells us that it included "a promenade, a place with seats for conferences, and a great hall where the scholars had their meals in common."[8] In fact and in principle, the House of Muses sounds very much like the Rockefeller Institute of the twentieth

century, except that its members did not pay for their meals in the common hall; they did not even have to pay taxes. The results, measured in science and scholarship, were phenomenal: within two or three generations the Museum could boast of such achievements as a figure for the diameter of the earth, accurate to better than 1 percent,[9] and a membership list with names like Euclid, and maybe even Archimedes.

Maybe: a historical drama in five letters. The astonishing truth is that *there is very little we can say with certainty* about the Museum, beyond a few superlatives. There is no ancient book about it. We have a long list of Alexandrian firsts—the valve, the pump, the screw[10]—and whole new fields, like hydraulics and pneumatics, but we cannot say how much of it all happened at the Museum—except for the medical events.

One of the few definite statements that can be made about the Museum is that is was *almost* unique. Almost, because six thousand miles away, unbeknown to the Mediterranean world, another state academy was born in the very same years, in the never-never land of China. It was the Academy of the Gate of Chi, founded in 318 B.C. in the state of Chhi.[11] It welcomed scholars from all other states as well as Chhi, and provided them with quarters and maintenance. But that was rather an academy of philosophers, much like the Athenian academies of the same period or the later Chinese Imperial Academy, which was called the Han-Lin Yuan or *"Forest of Pencils"*;[12] whereas the Alexandrian Museum cultivated the humanities as well as the sciences.

In both of these fields, the Museum could not have become what it was without the library. Run by bibliomaniacs in the homeland of papyrus, the library bought, copied, or pirated all the literature available. The library of Aristotle, and probably also that of the Hippocratic school, landed here; indeed, it seems that this is how we have come to inherit the Hippocratic Collection. Travelers were required to declare their books and, if necessary, to surrender them until copied; they got back only the cheaper certified copy.[13] A by-product of this huge enterprise is the very structure of this printed line, for it was the library staff who invented punctuation.[14] When the library was first threatened by fire under the last Ptolemy—Cleopatra—in 47 B.C., it may have contained 700,000 volumes.[15]

Pearls in the Rubbish

All this ancient history may sound as remote as Noah's ark; but something snaps—and everything comes alive—if you manage to peek through the secret window of the papyrologists. These elusive people belong to a breed as rare as any of the 120 mammalian species now threatened with extinction. They are known to be delightful company if you can only find one and coax him or her into conversation (for they live two thousand years ago, and do not advertise in the present). You may then be entertained for hours about the lives, deeds, quarrels, even the wounds of Greco-Egyptians as if they were next-door neighbors. You will also discover that papyrologists

study Egypt and papyri, but *not* Egyptian papyri, and that they specialize in broken pottery. Here are the facts.

The Greeks imported into Egypt their habit of using bits of broken pots, *óstraka,* as ordinary writing material. These were cheap, handy, and long-lasting, so that the family archives might be a jarful of óstraka: bills, tax receipts, letters, and daily budget, often dated to the day. Sometimes the same kind of message was written on the more costly papyrus, which later might be treated as waste paper, ending up in the cartonnage casing of mummies (a sort of papier mâché)[16] or simply on rubbish heaps.

The climate of Egypt preserved all these scribblings until the papyrologists came along, armed with saintly patience and devices such as a *Konträr-index,* a dictionary in which words are spelled backward, to help find suitable heads for decapitated words. Thanks to their unsung labors, the Greco-Egyptian trash of shards and papyrus scraps yielded precious facts and gossip such as we do not have for practically any other ancient people, and most of which is now buried once again, alas, in highly specialized publications, often without translation, sometimes with footnotes in Latin.[17]

These texts now number in the tens of thousands, ranging from 311 B.C. (the oldest known) to about 750 A.D.: this is the period during which Greek was one of the vernacular languages of Egypt, and in fact the message is usually written in Greek, more rarely in Latin.[18] In most cases it consists of a few lines scribbled in black ink. Here is a handful of the topics, mostly from the index of a *Papyrological Primer.*[19] Note the prevalence of legal documents:

Protest against an appointment
Contract with a castanets dancing girl
Circumcision of a priest's child
Statement of taxes
Prayer
Minutes of a session held by the Chief of Police
Loan of money upon mortgage
Action to state forgery in a document
Contract with a stenographer
Letter to an unfaithful manager
Account of taxes on sacrifices[20] and wool
Sale of a slave
Sale of a handmill
Notification of a surprise attack
Preparations for an official visit

Since the Greeks did not have surnames, in many of these legal documents the individuals are identified by their given name plus any identifying scar (*oulé*):

Cháretos, one-scar-small-finger-right-hand. . .
Máron, eldest son of Onnóphreus, aged 40, with a scar on his forehead, made an agreement with his brother Onnóphreus, born of the same father, aged 18, with no marks.[21]

There seems to have been enough trauma to ensure accurate identification. Otherwise, the individual was labeled *ásemos,* "not marked."[22]

Some of the texts refer to doctors and disease. From the second century B.C. there is this short letter, apparently from mother to son:

> I heard that you are learning Egyptian, and I was very happy, for you as well as for myself; because now, arriving in the city, you will tutor the sons of Phal . . . the enema-doctor, and make money towards old age.[23]

The "enema-doctor," *iatroklýstes,* must have been a specialist of intestinal diseases, a latterday Shepherd of the Anus.[24] One piece of pottery bears a crudely spelled statement sworn before a judge by two brothers, who deny having beaten up the third brother (Fig. 8.2). The tone is somewhat as follows: "The wound that you have we aint done it and we dont know who did it."[25]

8.2 A legal document, crudely written on an *óstrakon* (shard), presumably before a judge: "The wound that you have we ain't done it. . ." The detail of the boxed area shows how the word *trauma* (wound) is deciphered. Second century B.C.

Hear also this pitiful tale, which gives a rare glimpse of medicolegal practices. It is the morning of the seventh day of Athyr (November), 182 A.D.; Leonidas writes from Senepta to the police chief of Oxyrhynchus:

> Yesterday evening, during a local festivity, as the castanets dancers were performing as required . . . the 8-year old slave boy Epaphrodeitos, wanting to see the dancers, leaned over too far from the roof and fell to his death.[26]

Leonidas then requests the police to send someone. Miraculously, another bit of papyrus turned up showing that the chief of police took care of the matter the very same day: he sent one of his men, accompanied by a state physician (*demósios iatrós*), to examine the body and draw up a written report.[27]

The following was written in 237 B.C., on a small bit of papyrus recovered from the wrappings of a mummy:

> The 17th year [*of Ptolemy III*], on the 2nd day of Phaophi. We have had measured out to us by Stratius 5 artábes of rice-wheat as the physician-tax, and 9 artábes of rice-wheat as the police-tax. Total 14 artábes of rice-wheat. Farewell.[28]

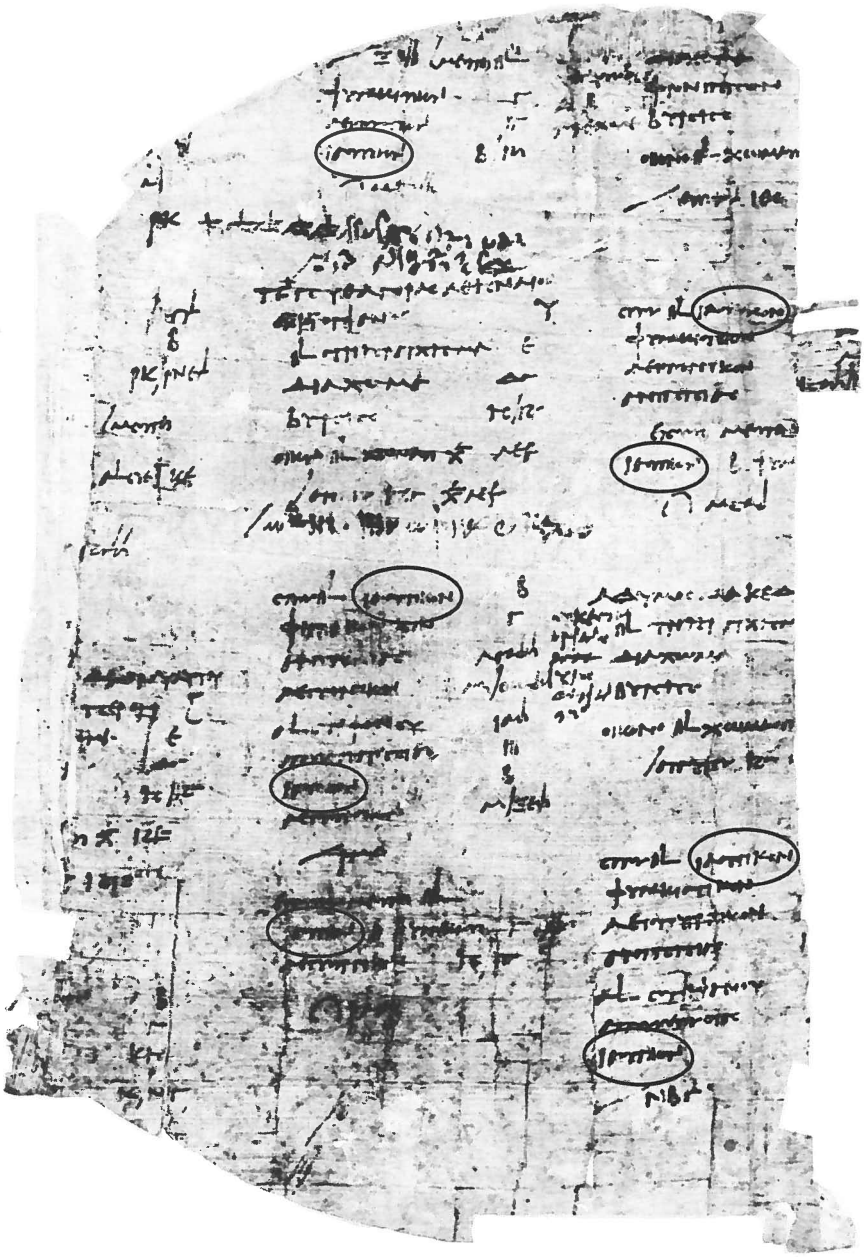
This is a tax receipt. It concerns the *iatrikón* (Fig. 8.3), a tax that went to support public physicians[29] such as the one we just met in Oxyrhynchus. Since one *artábe* came close to 40 litres,[30] to carry his 14 artábes Stratius must have gone to the office of the tax collector with a cart; so imagine the problem of the tax collector who then had to cart the rice-wheat to the iatrós. To avoid this trouble, the iatrikón was sometimes paid by the citizen directly to the physician. Witness this receipt from the wrappings of a different mummy dated 231 B.C:

> [*Name lost*] . . . Cyrenean, of Zoilus's troop, private, to Eucarpus, physician, greeting.
>
> It has been ordered that I shall pay you 10 artábes of rice-wheat, or 4 drachmae, as the iatrikón for the 38th year.[31]

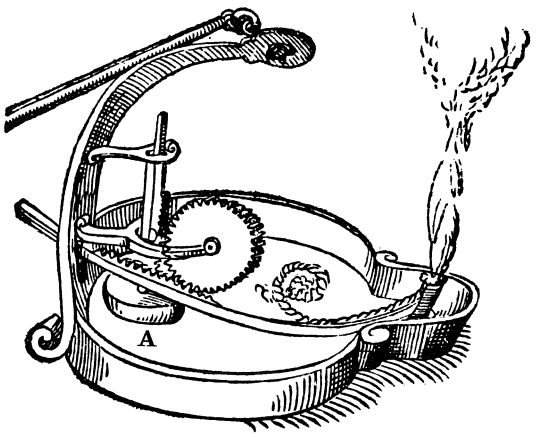
Physicians too had their burdens. Another tax receipt says that "Petronius the physician has paid his camel tax."[32]

Alexandrian Patents

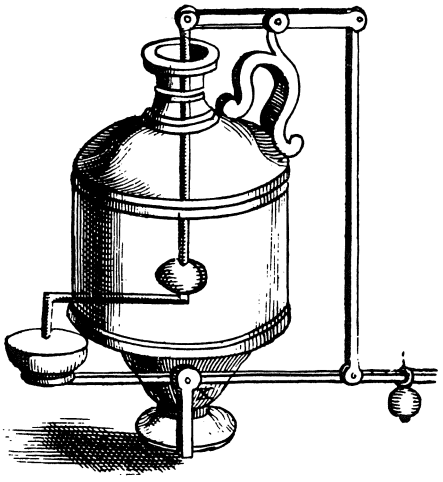
The Alexandrians developed, almost from the start around 300 B.C., a real passion for gadgets such as is not found again until modern times. One can appreciate it by leafing through Heron's astonishing book entitled *Pneumatics*. Heron of Alexandria came rather late (he lived in the first century A.D.) but many of his gadgets are borrowed from the third century B.C.: fountains with singing birds, revolving model theaters, a constant volume dispenser for liquids (Fig. 8.4), and most amazing of all, a kind of steam engine (Fig. 8.5).[33] More complicated schemes could make a toy bird drink "while its neck is being severed in two";[34] a priest could perform miracles,

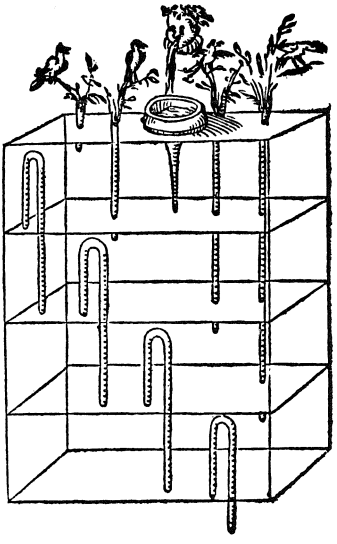


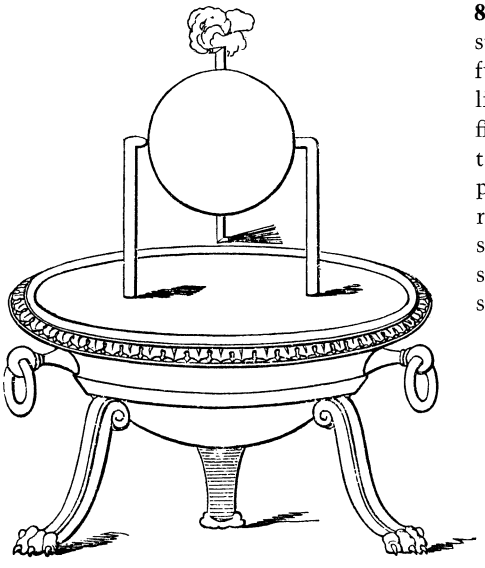
8.3 A list of taxes paid by orphans, on a Greco-Egyptian papyrus of the third century B.C. The physician tax, *iatrikón* (ιατρικόν, circled), figures eight times in the amount of β, which means 2: in this case, two measures of wheat.



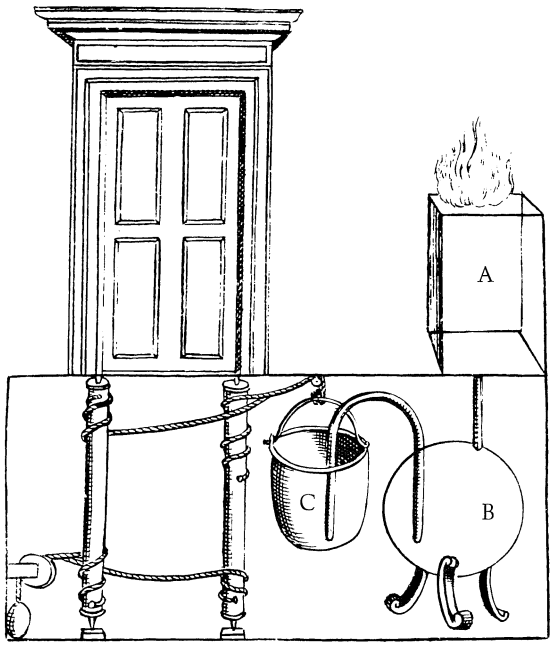
8.4 Examples of Alexandrian tricks and gadgets as described by Heron. *Left:* An oil lamp with an automatic feed for the wick. The float (A) rests on oil. *Below left:* A fountain with whistling birds. *Below right:* A constant volume dispenser, the *dikaiómeter,* which may or may not have worked.





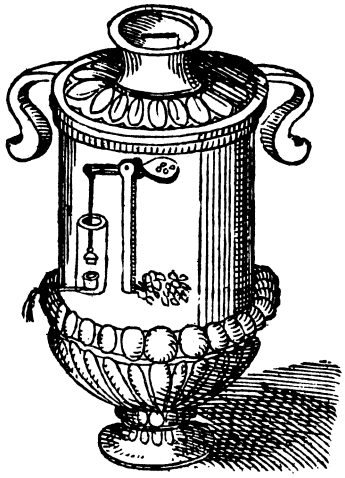


8.5 A steam turbine. The cauldron stands over a flame (not shown); it is full of water and covered with a flat lid, in which two vertical tubes are fitted. At the top, the tubes are bent toward each other to function as pivots for the hollow sphere. Steam rises through the right tube into the sphere and escapes through two smaller L-shaped tubes, causing the sphere to rotate.

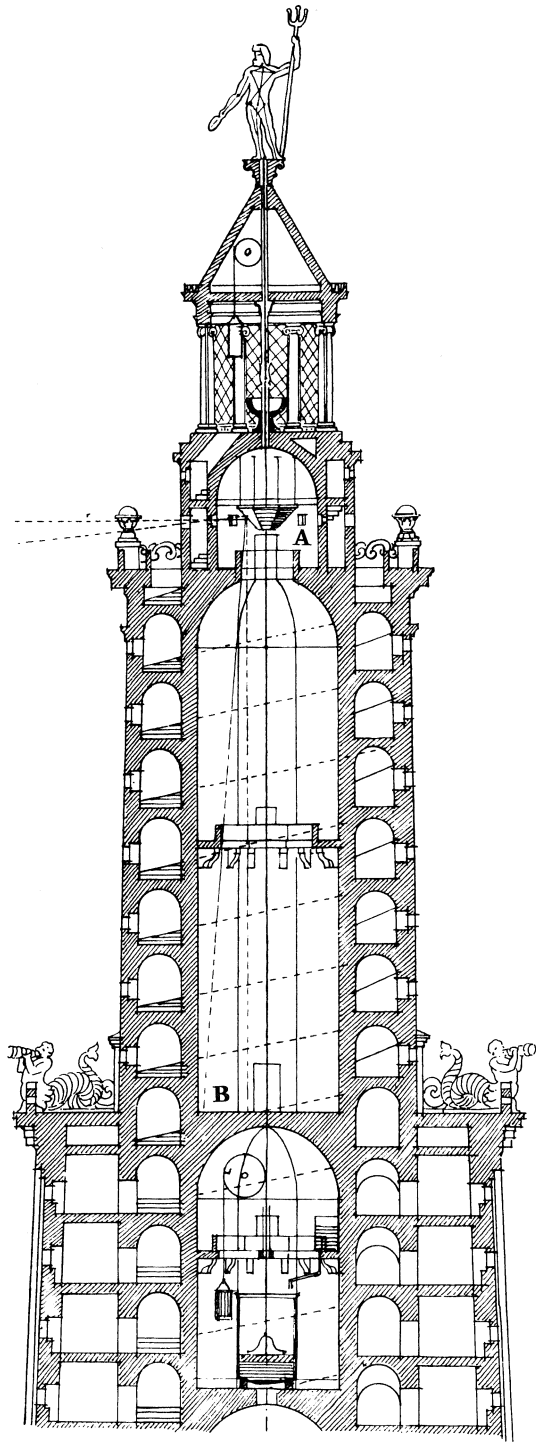


8.6 A gadget to promote religion. The priest lights a fire on *A*; the heated air expands and is driven down into the sphere *B*, which is full of water. The water escapes into the bucket *C*, which drops and causes the door of the temple to open, as if by a miracle.

8.7 A coin-in-the-slot machine, for dispensing holy water.



like the hilarious one illustrated (Fig. 8.6), while collecting five-drachma pieces on the side; and the world's first coin-in-the-slot machine dispensed tiny squirts of holy water (Fig. 8.7). The lighthouse itself carried its load of trickery: the 23-foot statue of Ptolemy I on its top could veer into the wind, which was not as simple as it sounds;[35] the bronze tritons may have been steam-driven foghorns;[36] and a radar system of sorts, based on mirrors, projected a view of the horizon to people stationed in the tower one hundred feet below (Fig. 8.8).



8.8 Gadgetry on top of the lighthouse of Alexandria. The 23-foot statue revolved as a weathervane. The upper section of the tower contained an optical system (A) for viewing the horizon from a platform one hundred feet below (B). The tritons may have been foghorns.

It is usually stated that all this Alexandrian machinery never outgrew the stage of toys for grownups. I must claim an exception for the syringe. Oddly enough, the syringe steps into medical history as an aid for the treatment of wounds. Here is how it happened.

From Barbers to Pistons

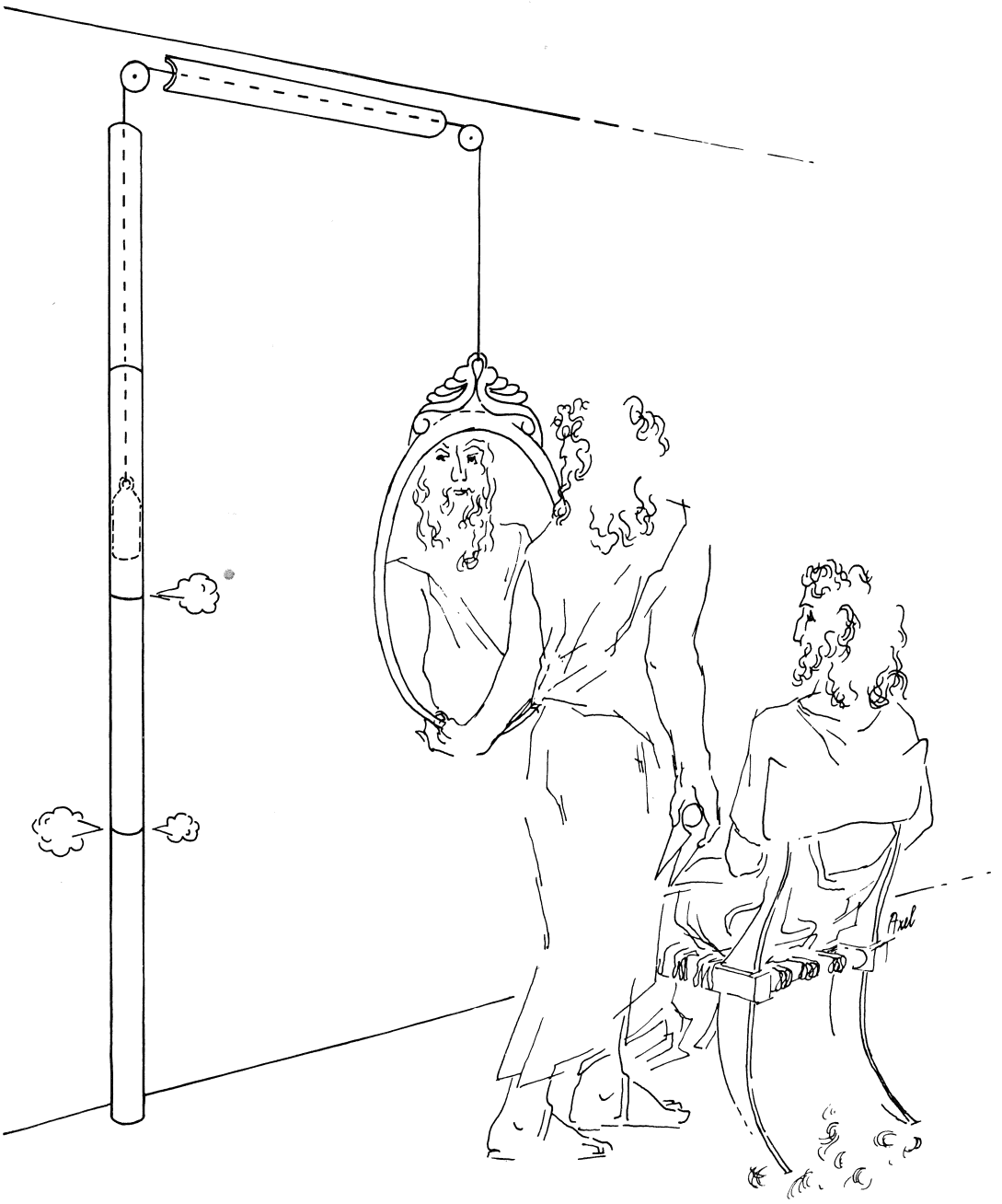
The syringe—in fact the very concept of piston and cylinder— was born in a barbershop, at the hands of a Greek, in Alexandria of Egypt about 280 B.C.[37] (Fig. 8.9). The story, as told by a Roman architect, Vitruvius, 250 years later, is a good example of the Alexandrian love for tricky gadgets:

> Now Ktesibios was the son of a barber and was born at Alexandria. He was marked out by his talent and great industry, and had the name of being especially fond of mechanical contrivances. On one occasion he wanted to hang the mirror in his father's shop, in such a way that when it was pulled down and pulled up again, a hidden cord drew down the weight; and he made use of the following expedient.
>
> He fixed a wooden channel under a beam of the ceiling, and inserted pulleys there. Along the channel he took the cord into a corner where he fixed upright tubes. In these he had a lead weight let down by the cord. Thus when the weight ran down into the narrow tubes[38] and compressed the air, the large amount of air was condensed as it ran violently down through the mouth of the tube and was forced into the open; meeting with an obstacle, the air was produced as a clear sound. Ktesibios, therefore, when he observed that the air being drawn along and forced out gave rise to wind-pressure and vocal sounds, was the first to use these principles and make hydraulic machines. He also described the use of water-power in making automata and many other curiosities, and among them the construction of water-clocks.[39]

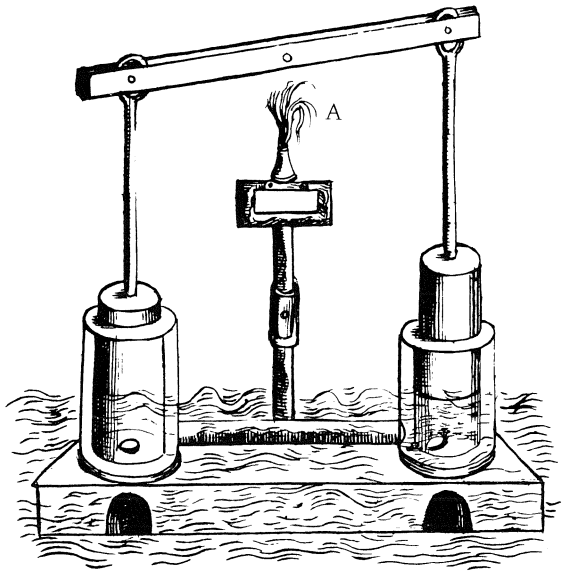
"Curiosities" indeed: this barber's son went on to invent nothing less than the valve, and because of the valve, the pump (Figs. 8.10-8.11). Ktesibios is acknowledged as one of the greatest engineers of antiquity. It is also true, as Vitruvius remarked, that he applied his basic discoveries to a colorful family of machines, toys, water clocks and automata. Though all his works are lost, they survive in the compilations of Philon of Byzantium (perhaps a generation later) and of Heron.[40]

One of these applications he called the water-flute. It was actually an organ that used water as a pressure regulator. The word *hydraulics*, born in the chatter of a barbershop, still echoes the song of this old *hydr-áulis*, "water-flute" (Fig. 8.12).

Another application was the syringe. Its precise birth record is lost, but it first appears in Heron's *Pneumatics*, with no reference (Fig. 8.13). Heron, who otherwise had no particular bent for things medical, may have lifted it from an Alexandrian medical text.[41] The instrument, he notes, is also good for injecting liquids; but the primary use is for sucking pus out of wounds, hence the Greek name *pyúlkos* latinized as *pyulcus*, the "pus-puller."[42] A

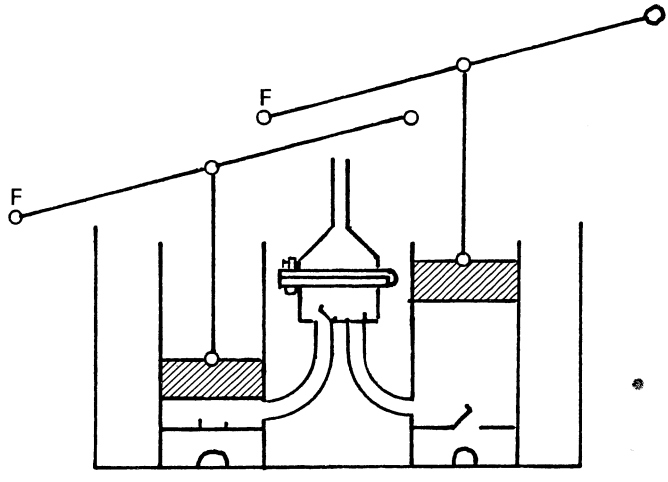


8.9 The principle of the piston and cylinder, as discovered by Ktesibios in the barbershop of his father. The original purpose of the gadgetry was to set up a mirror of adjustable height, with concealed cables and concealed weights. Whistles caused by the dropping weights suggested that compressed air could be exploited mechanically.



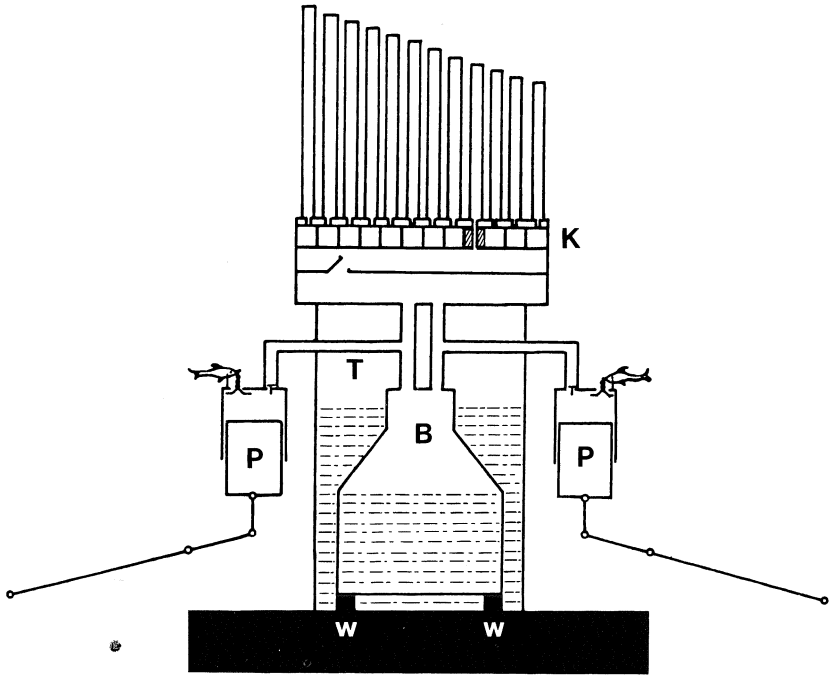
8.10 The valve and the pump, also invented by Ktesibios, as applied to a fire extinguisher in Heron's description. The water spouts at *A*.

8.11 Scheme of the Ktesibios pump, as described about 50 B.C. by Vitruvius. The points *F* are fixed.



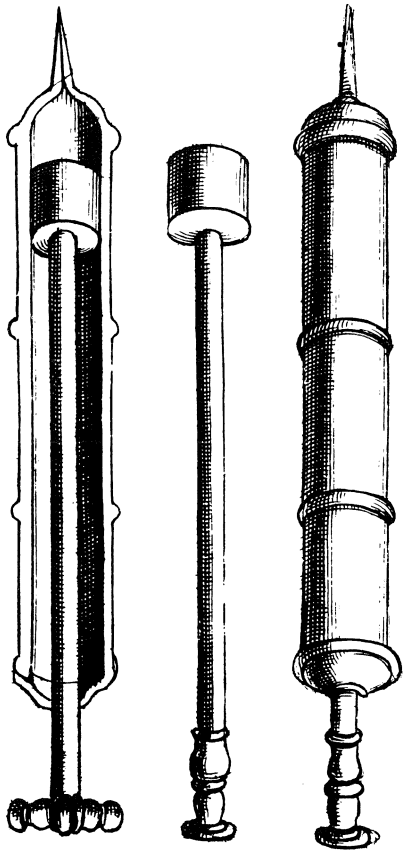
humanitarian toy, to be sure, but to a gadgeteer it is the principle that counts, not the application. In a book on warfare, Heron proposes the syringe as a flamethrower (Fig. 8.14).[43]

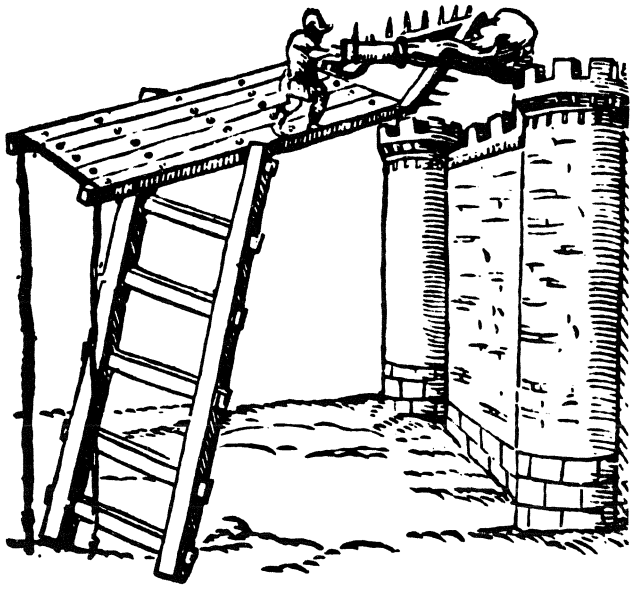
The subsequent fate of the syringe, that contrivance of the Greek colony, could be considered a revenge of the ancient Egyptian gods. The flamethrowing feature, so far as I know, never caught on; and the pus-pulling was never a great help, though Ambroise Paré still refers to the pyulcus as the "matter-drawer."[44] Forgotten by warfare and neglected by surgery, this great instrument spent its next two thousand years aiming at a target highly reminiscent of ancient Egypt: the anus.[45]



8.12 The organ, another invention of Ktesibios. Its name *hydraulis*, literally "water-flute," gave *hydraulics*. The tank (T) is half full of water, which flows freely into the mouth of the bell (B), raised on wooden blocks (W). Pistons (P) pump air into *B*, which displaces some of the water; this reservoir of compressed air supplies the pipes above the keyboard (K) with a relatively constant flow of wind.

8.13 The piston-and-cylinder principle was put to use in the syringe, described by Heron as *pyúlkos* or "pus-puller," to be used on wounds.





8.14 The syringe as a flamethrower, in Heron's book on war machines.

Alexandrian Medicine

In the hot climate of Alexandria some parts of the Museum must have spread quite a scent: the major field of medical research was anatomy, which included dissection of animals, human corpses—and even live men, growled Celsus three centuries later.[46] Let us hope that Celsus was wrong; but anyway, this was real, full-time, professional research, as new as the new world that had produced it.

It all happened so fast that the two top anatomists, Herophilos and Erasistratos, were just twenty or thirty years younger than the city itself.[47] To place them in time with respect to Hippocrates: if we assume that they started working roughly around 270 B.C., the great Master had died 110 years earlier. They were well aware of him. In fact, it is said that Erasistratos was the one who collected the Hippocratic books during his travels;[48] and Herophilos, whose teacher actually came from the school of Cos, wrote the first commentaries to the Hippocratic works.[49] Thus, both Alexandrian anatomists were free to inherit the knowledge as well as the handicaps of the Hippocratics. Unfortunately all their books have been lost, but later authors credited Herophilos with discovering and naming such unlikely organs as the prostate and the duodenum, as well as an oblong, hidden structure of the brain, which he named *calamus scriptorius* because it reminded him of the Greek writing pen.[50] As for his contemporary, Erasistratos, by a stroke of luck Galen found him particularly irritating: he took the trouble to write two books against Erasistratos, and vilified him on at least sixty separate occasions, while making concessions on about twelve others.[51] In the process we learn something about the man.

The personality of Erasistratos emerges as that of a surgeon-scientist, whose hand and whose beliefs were firm enough to slit open a belly and apply drugs directly onto the liver.[52] Despite Galen's wrath, there are some views of Erasistratos that will last as long as medicine. I like to think of him at work in his laboratory at the Museum, in front of a large balance, performing his famous "metabolic" experiment: he put a bird in a pot, kept weighing it together with its excrement, and found a progressive loss of weight. This he took to mean that there was an emanation "perceptible only to the mind"—*lógoi theoretén*.[53] The experiment is usually extolled as the world's first measure of basal metabolism; in fact, nobody could deny its three novel features: identifying a subtle metabolic problem, asking a question that is technically answerable, and using quantitative means to arrive at the answer. In the last respect Erasistratos was measuring up to his neighbors in the math department, where the chief was Euclid. At a more down-to-earth level, however, I find it difficult to repress a heretical thought: perhaps all that Erasistratos was really finding is that bird droppings, in a hot climate, tend to dry up!

With these two giants, Alexandrian medical science soared to its zenith; then, oddly enough, it petered out. Although Alexandrian training remained fashionable for almost a millennium, and even Galen studied there, the famous names remained those of old. Alexandrian physicians spent their time splitting hairs and acquired the reputation of being, on the whole, a frivolous bunch.[54] But once again, all this is essentially hearsay, for not a single medical work of the Alexandrians has come down to us—not one, not a page of Erasistratos—only short, scattered quotations. We are somewhat in the position of trying to understand the shape, life, and history of a beautiful frigate by studying its reflection in the sea.

Among the outsiders who saved something of Alexandrian medicine by quoting or discussing parts of it, the most important is a Roman: Cornelius Celsus, who wrote in the first century A.D. In fact, after the Hippocratic books, his *De medicina* is the first complete medical work. In between there is nothing but debris.

The first impression on reading Celsus, after Hippocrates, is that something major has happened to surgery. Hippocratic scalpels had never gone beyond what is today called minor surgery: mostly a matter of removing hemorrhoids or nasal polyps, draining pus, and slitting veins. The closest that Hippocrates ever came to amputation was watching people's legs falling off bit by bit from gangrene. But the operations listed by Celsus could figure in the daily schedule of a modern surgical ward: removal of goiters (I shudder at the thought), operations for hernia or stones in the bladder, amputation of limbs. What has happened?

The answer is in the preface to *De medicina:* after Hippocrates there had been the Alexandrian boom.[55] And the Alexandrian physicians had discovered a major technical trick, the most important step in the treatment of wounds until the advent of asepsis: the ligature of blood vessels. Celsus takes this technique for granted.

The name of the genius who first tied a bleeding artery has not been preserved. Perhaps it was Erasistratos, or at least one of his pupils (although it is strange that Galen should not have mentioned it), for Erasistratos was deeply interested in the body's plumbing system, from the heart to its finest roots. This brings us to examine his concept of tissues, which has a lot to do with plumbing problems.

Tissues and Their Plumbing System

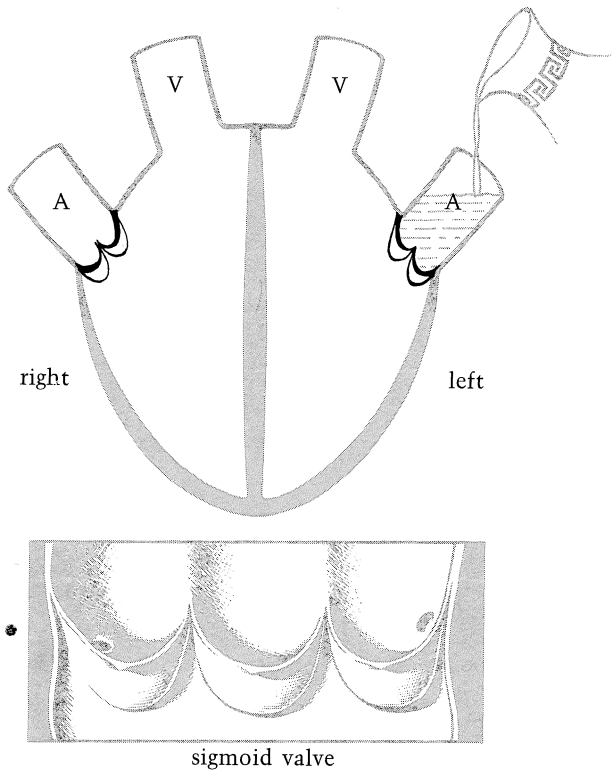
A severed artery bleeds, because the heart pumps out the blood: it sounds so simple, yet few biological events drew as many pages of nonsense. By the time the Alexandrian virtuosi of dissection started to look into it, the muddle was perhaps at its peak.[56]

Hippocrates had had no means of recognizing the heart as a pump, because there was no such item in his world, and no such word in his vocabulary. However, an unknown anatomist, perhaps a Greek from Sicily, whose treatise *Perí kardíes* or *On the Heart* is now in the Hippocratic Collection, dissected the mammalian heart (some think also the human) with unusual skill; and though he saw it as containing two cavities only, he discovered in it two interesting sets of "membranes" (*hyménes*), the sigmoid valves at the root of the aorta and the pulmonary artery (Fig. 8.15). He marveled at them:

> The last topic to discuss, concerning the heart, are the hidden membranes, a structure most worthy of attention . . . There are two aortae [*the aorta and pulmonary artery*]; at the entrance of each are arranged three membranes, rounded at their extremities, in the shape of a half-circle; and when they come together, it is marvelous to see how they close the orifices, at the border of the aortae. And if someone who knows the ancient ritual [*probably the technique of the augurs at sacrifices*] takes the heart after death, and [*the membranes*] are spread out and made to lean against each other, water poured in will not penetrate into the heart, nor will air blow in; and this especially on the left; for that side has been constructed more precisely, as it should be, since the intelligence of man lies in the left cavity.[57]

What the writer is saying is that these marvelous membranes, the valves, are useful, because they keep blood and its impurities *out* of the heart; think what a mess would happen, especially in the left heart, if blood were to pour in and mix with the intelligence that is held in there! This was in fact a brilliant suggestion: what else could he think, having discovered one-way valves in an organ through which, as far as he knew, nothing was flowing? The only solution was to interpret them as static safety devices. I note with due humility that his novel experiment is now routine in modern pathology: that is, the act of pouring water into the stumps of the aorta and pulmonary artery, to check whether the valves close properly (Fig. 8.15). The ancient author actually went further, for no modern pathologist ever blows into these severed vessels.

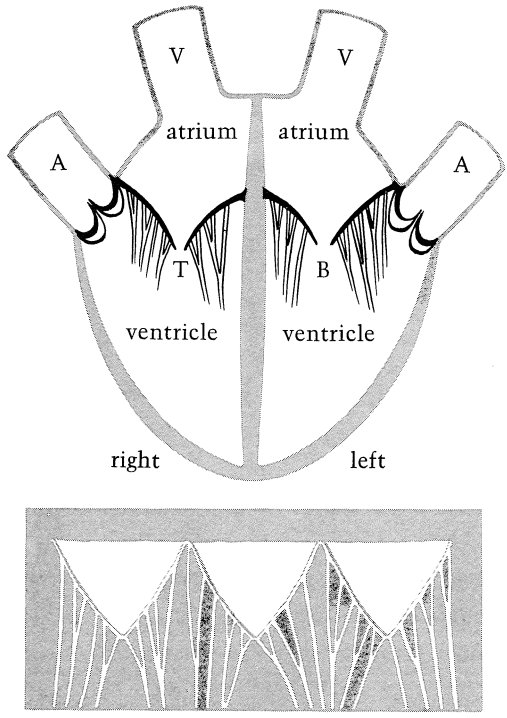
This short but important treatise *On the Heart* was probably written in Sicily, a few years before Erasistratos broached the same subject, perhaps



8.15 About 280 B.C. the heart was understood in this manner by an unknown Hippocratic anatomist. The scheme (top) shows the heart from the front in cross section. The four stumps represent the beginnings of the four main vessels—arteries (A) and veins (V)—which were then known. The heart was also known to consist of two sides, right and left, separated by a vertical septum, but the horizontal separation of each side into atrium and ventricle was not known. The right side of the heart was thought to hold blood (without pumping it); the left side contained intelligence. At the root of the large arteries, the anatomist discovered the three pockets forming the sigmoid valve (also shown below as it appears when the arteries are slit open). He tested this valve by pouring water into the stump.

around 280 B.C.[58] Another author who came after Hippocrates, and before Erasistratos, was Aristotle. For him, too, the heart was the seat of intelligence. He mistook its four cavities for three, and failed to notice the valves altogether.[59] With heart physiology in this state, the meaning of the pulse could not be understood. It was thought that every artery had the innate capacity to beat, like the heart, and that the real problem was to find out whether the active beat was inward, or outward.[60]

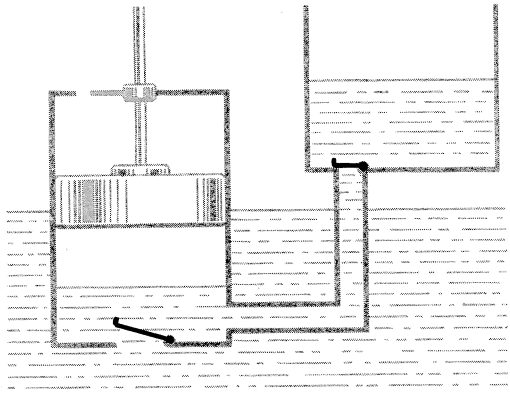
Finally, just half a century after the death of Hippocrates, the ultimate bit of vascular nonsense swept out of Cos: the great news that veins contain blood, arteries air ("pneuma").[61] This fascinating mistake found easy access into Alexandria, because it originated with the teacher of Herophilos, Praxagoras of Cos (c.350–300 B.C.). It enjoyed a career of five hundred years. How could anybody believe that arteries contain air? The excuse traditionally offered is that, after death, most of the blood goes to swell the large veins, which leaves very little blood in the large arteries.[62] Still, there is a long way



8.16 About 270 B.C. an Alexandrian physician, Erasistratos, realized that the heart is a pump. He discovered that each side of the heart is divided into two parts, upper and lower (atrium and ventricle), separated by the bicuspid (B) and tricuspid (T) valves (top). These valves are made, respectively, of two and three roughly triangular flaps, anchored to the inner surface of the heart by cords (bottom). In the scheme of the heart they are shown in profile. When the heart contracts, they are pressed together and prevent the blood from returning to the upper chamber. Thus, Erasistratos realized that the heart received blood from the veins and pumped it out into the arteries.

between "very little blood" and plain "air." Some years ago a Swedish pathologist attempted to bridge that gap. He measured the blood pressure in the carotid and femoral arteries, after death, and found negative values. Thereupon he opened the chest and severed the large vessels emerging from the heart: arterial pressure rose to zero, because the large arteries—due to their negative pressure—had drawn in some air.[63] Thus, it is indeed *possible* to find air in large arteries in dissecting a dead body; but I do regret having to admit that even the great Alexandrians fell into that trap—and went along with the myth that living arteries convey air.

Despite all these handicaps, when Erasistratos came to dissect the heart, he found in it two new sets of membranes: flat triangles that reminded him of *cuspids,* "spear points." He named them *bicuspid* and *tricuspid,*[64] and even understood that they were flaps of one-way, inlet valves, which opened and closed with the heartbeat (Fig. 8.16). It was Galen who preserved this gem of a discovery, "a golden fragment among the miserable ruins of Alexandrian



8.17 About 270 B.C. an engineer, Ktesibios of Alexandria, invented the valve and the pump.

medicine."[65] This is how Galen sums up the function of all the heart valves according to Erasistratos:

> The use of these membranes . . . is to perform for the heart contrary functions, alternating at successive intervals . . . Those attached to the vessels that bring in material [*bicuspid and tricuspid*], when pressed from without inward, yield to the influx of materials, and falling into the cavities of the heart, throw open its orifices and leave an unobstructed passage . . . The membranes attached . . . to the vessels of exit [*sigmoid valves*] act in the contrary way.

Erasistratos also knew, and understood, the aortic and pulmonary outlet-valves. Perhaps he had read about them in *On the Heart;* perhaps he had rediscovered them. Anyway, he was able to jump ahead of the anonymous pioneer and conclude that the four sets of "membranes" were flap valves belonging to a one-way pump. But then he also enjoyed the decisive advantage of working in the very birthplace of hydraulics. I envision that the brainstorm of Erasistratos—realizing that the heart is a pump—may have been helped by lunchtime discussions with a colleague from the physics department who had just invented the flap valve and the force pump: Ktesibios (Fig. 8.17).[66] Although the dates of these various steps are not quite certain, it is obvious that biology and physics interwove in the discovery of the valve and pump concepts (Figs. 8.15–8.17).

If ever a discovery came too early, it was this one of the heart as a pump. Veins and arteries were seen as sets of independent, dead-end canals; blood and air were supposed to slowly seep toward the periphery, where they were used up. So there was no real need for a busy, powerful, one-way pump; in fact it was an embarrassment. Galen inherited this difficulty and twisted the facts to fit an improved scheme that was horribly wrong.[67] The heart as a pump made no sense, really, until Harvey in 1628.

Branching out of the heart, the veins and arteries were thought to form two separate trees, whose branches intertwined and became thinner and

thinner until they faded out of sight. And here Erasistratos made two everlasting contributions, using what we have called the Greek "microscope," a compound of genius and wishful thinking. First:

> All living parts are a tissue of vein, artery and nerve, and each part is nourished by the vein contained in it: namely, the simple vein apprehensible by reason [*lógoi theoretés* again].[68]

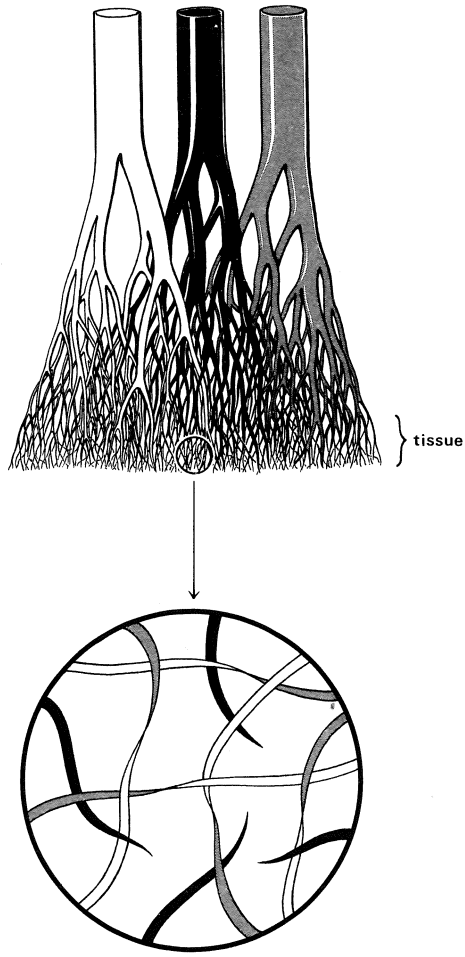
This is the original concept of *tissues*, which I have attempted to render in Fig. 8.18. It was referred to as the *triplokía* ("trinity" or "three-ply"). There is still more to it. Some tissues, notes Erasistratos, like the brain, fat, and liver, are different, because a deposit of nutriment is "poured-in-between" the tissue, *par-en-chyma* (Fig. 8.19).[69] The word *parenchyma* still means the cells that fill the spaces between the vessels and fibers of the connective tissue; and fat cells are, without any stretch of the imagination, a deposit of nutriment.

Now for a wound. Even Erasistratos could not escape the blatant truth that when an artery is severed, blood escapes, not air. But he stuck to his guns and invented this far-fetched explanation: the wall of the arteries is a tissue like all others, and it therefore includes the endings of innumerable little veins. When the artery is severed, its "pneuma" escapes and leaves a vacuum, so the little veins will instantly bleed into the artery to fill the void (an extenuating circumstance for the author: he was echoing the current Alexandrian jargon about pneumatics and the effects of a vacuum).[70] Yet notice that this *tour de force* obliged Erasistratos to postulate a fundamental truth, the communication between arteries and veins. He may have drawn the idea from the Hippocratic book *On Joints*,[71] and it was the beginning of a major discovery. But he carried it no further.

Practical Applications: Alexandrian Tourniquets

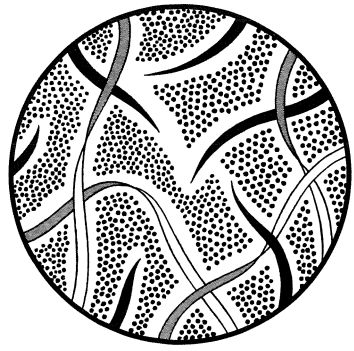
So much for the mechanics of the tissues; now see how they could explain illness. Erasistratos borrowed one of the favorite Hippocratic themes, the *plethora*, an "overabundance of blood,"[72] and built it up. Most diseases, he said, came about because the tissues receive more blood than they can use. Within his scheme of the triplokía, this meant that the tips of the little veins, when overloaded with blood, would bulge dangerously close to the tips of the arteries, filled with air: one more step and the two would form *synanastomoses*, "end to end connections," and the veins would spill blood into the arteries (Fig. 8.20).[73] In the case of a wound, for example, if the skin all around became red, hot and inflamed, the reason was simple: the arteries had lost all their pneuma and become flooded with blood. This concept was used to explain not only what we call now acute inflammation, but practically any disease.

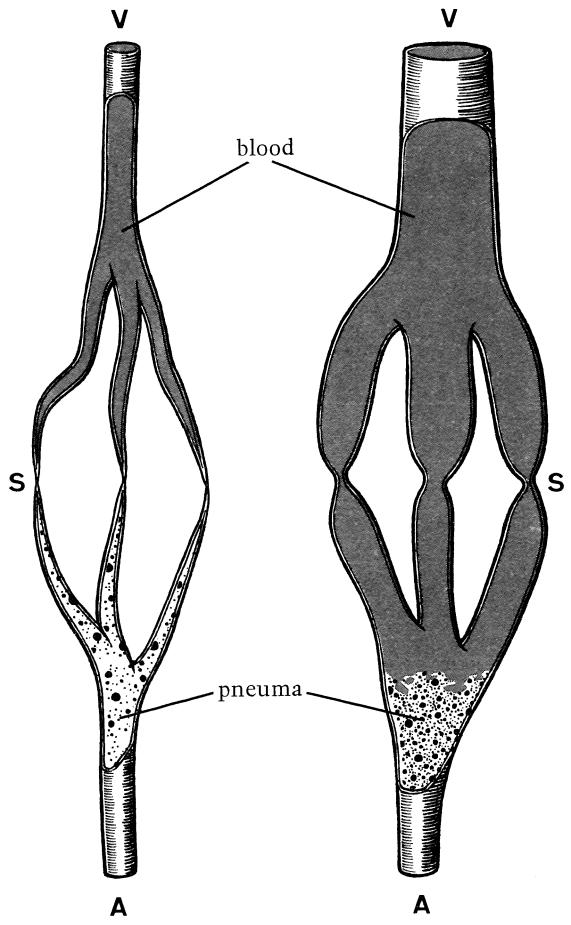
Absurd, of course, but how much more absurd it would have seemed to postulate that the outside world was crawling with untold billions of tiny, invisible creatures, and that *they* were the cause of inflammation. If a part of



8.18 The mental picture of tissues as first conceived by Erasistratos must have been something like this. Since the eye could perceive three sets of branching structures—veins, arteries, nerves (top)—all tissues had to be composed ultimately of the finest branches of these structures (bottom).

8.19 In some tissues, Erasistratos thought, nutriment (*parenchyma*) was "poured in" between the branches: another remarkable extrapolation.

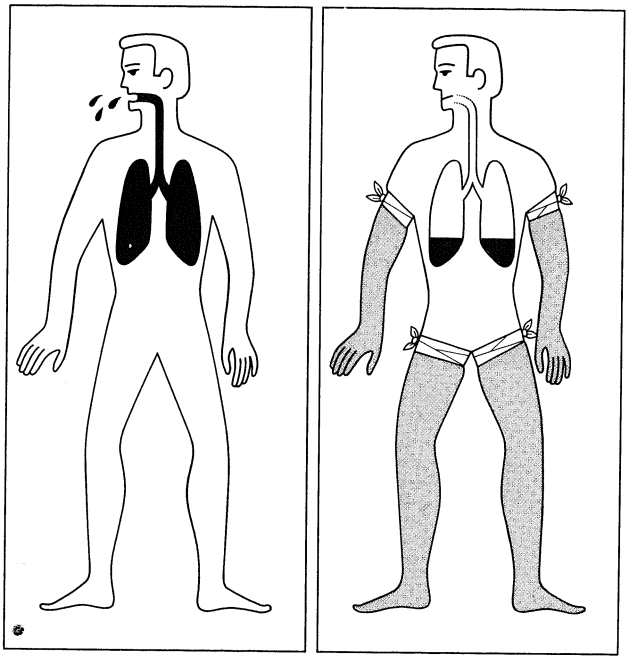




8.20 The mechanism of inflammation—and of most diseases—according to Erasistratos. *Left:* Normal veins contained blood, arteries air (*pneuma*). Their endings were dangerously close, being connected through extremely fine channels called *syn-anastomoses* (S). *Right:* An excess of blood (*plethora*) in the veins would force blood through these channels into the arteries. Nonsense, but it contained a good guess, that there are indeed connections between arteries and veins.

the body is sick, the likeliest cause (the gods have been ruled out) must be something within. So for Erasistratos it was an error of place (*parémptosis*): blood in the wrong place.[74] This concept had the further advantage of offering one and the same mechanism for the majority of diseases, and therefore one type of treatment.

Given a predicament like plethora, the logical treatment might have been bleeding; but Erasistratos was loathe to get rid of good blood, especially since he did not believe in the four humors and their faulty mixtures. He preferred cutting off the supply at the roots by starvation. And his authority surely contributed to the starving of thousands of wounded, up to the days of—pardon the shock—Napoleon. Behold, however, this other and more imaginative treatment of plethora: why not try to "blood-starve" the congested part, by trapping some of the blood supply in other parts of the body—until the sick tissues had used up their plethora? This was done by putting ligatures at the roots of the limbs, not too tightly. The limbs would



8.21 The treatment for patients who spat blood, according to Erasistratos. It was inferred that these patients suffered from too much blood in the lungs; hence, ties were placed on the limbs, to hold blood there. In some cases it could have worked.

become congested, and hold the blood within them, out of mischief (Fig. 8.21).

Do not mistake these ligatures for hemostatic tourniquets: in the case of a wounded limb they would be applied to all the limbs *except* the wounded one.[75] And here we miss, incidentally, an important piece of theory. I wonder how Erasistratos explained that a ligature at the root of a limb would cause congestion. It does, of course; but in his view, the blood flowed—very slowly—from the heart to the periphery, so his ligatures should have prevented the blood from flowing into the limb, rather than holding it there.

Anyway, a wounded patient would be forced to lie with tight, uncomfortable bands around his arms and thighs, and starve. As a treatment for wounds, these ligatures made no sense: they did subtract a certain amount of blood from the circulation, but never enough to stop the gush from a severed artery (somewhat as opening three faucets in a house would scarcely affect a leak in the main). However, the Erasistratean ligatures were especially recommended for plethora of the lungs: that is, for patients who spat up blood. Now, if the bleeding was due to pulmonary tuberculosis, there is no chance that the ligatures could work: by holding blood in the limbs it is impossible to lower arterial pressure to the point of stopping an arterial hemorrhage.[76] If, instead, the plethora of the lung meant the bloody froth that suffocates a patient in acute cardiac failure, the ligatures should have worked. They still work, and in a spectacular way. By retaining blood in the limbs, they do just what Erasistratos had in mind: they keep blood away from the lung. When

the left side of the heart fails suddenly, it can no longer clear the lungs of the blood that the right ventricle, still vigorous, pumps into them; the lungs become congested, and there is danger of sudden edema. One emergency procedure (besides drugs) is to cut down the supply of venous blood flowing into the right ventricle. This is done "by *venostasis*, which consists in applying tourniquets to three limbs. Every few minutes a tourniquet is placed on the fourth extremity and one of the others is released."[77] If the technique saved a few in ancient times, it was worth the discomfort of the others.

So much for Alexandrian insight. I should not close this chapter without attempting to analyze that curious Alexandrian failure, at first sight so very unlikely. There was Erasistratos, a born experimenter, with enough genius to recognize the heart as a pump, and to postulate connections (albeit "abnormal") between arteries and veins; yet he failed to recognize the circulation of the blood. He apparently never thought of filling a good Alexandrian syringe with ink, injecting it into the veins, and seeing if it came back through the arteries.

But think of the body's plumbing as he saw it. Arteries and veins formed two separate systems, one for blood, the other for air. There was no reason to look for a circulation between the two, when it was *obvious* that the two had to remain separate, because blood, spilled into the arteries, caused inflammation. If I may use a twentieth century comparison, Erasistratos visualized the arterial and venous systems about as separate as we see the water and gasoline ducts in our cars. There would be no purpose in trying to force one to mix with the other.

In practice, from the point of view of a wounded patient, none of the fancy new Alexandrian theories would have helped (even though they did help, by accident, some patients in cardiac failure). The trend against bleeding was good, but was probably canceled by the emphasis on starvation; and Galen reversed that trend anyway. The one great gift of Alexandrian medicine—the anonymous gift that made it possible for surgery to rise as a separate profession—was the ligature of bleeding vessels.

The flamboyant outburst of science and scholarship was already losing monentum after a century; its last great contribution was the Ptolemaic system.[78] In 295 A.D., during a revolt, the Museum was destroyed. Its headquarters were provisionally transferred to the nearby temple of Serapis, but in 391 the temple was sacked by a Christian mob, the library was burned, and the shell converted to a church. A few years later the last scholar—a woman, Hypatia—was seized by the Christians, dragged into a church, and lynched.[79] Whatever the Arabs burned in 642, if indeed they did,[80] could only have been a ghost.

Today, ancient Alexandria is almost out of sight; it has sunk below sea level, and the new city sits over it so tightly that archeological exploration is nearly hopeless.

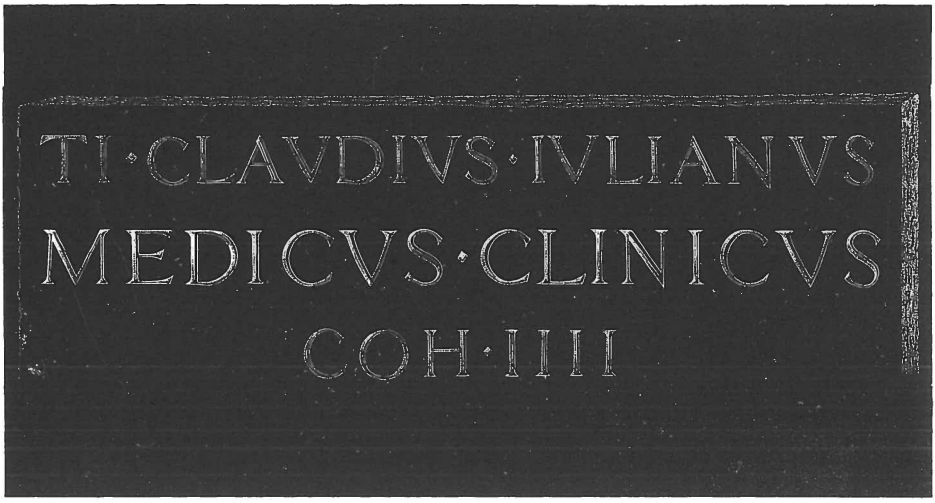
Nothing is left of the Museum.

In 1847, in the garden of the Prussian consulate, a block of stone turned

up. It was square, with a deep hollow, and one of its sides read: THREE TOMES OF DIOSKOURIDES. If this was a stone box for papyrus scrolls, it is all that is left to mark the site of the Museum and its library.[81]

As to the lighthouse, on 8 August 1303, an earthquake shook the island and the great tower collapsed.[82] But its light kept shining. On the opposite shore of the Mediterranean, in Greek, Italian, Spanish, and French, the word for "beacon" is the name of the tiny island facing Alexandria:

pharos
faro
faro
phare



9 The Medicus

Hippocrates passed away; Alexandria sprang up; Greek medicine discovered the laboratory. And all this time the Romans had no physicians at all.

Ignorance? Pliny has a six-word explanation: *non rem antiqui damnabant, sed artem;* "it was not medicine itself that the forefathers condemned, but medicine as a profession . . . chiefly because they refused to pay fees to profiteers in order to save their own lives."[1] So for six hundred years the frugal Romans carried on with folk remedies. Surely there was no reason to pay for *those.* To put crushed cabbage on a wound, as Cato recommended,[2] there was no need for an expert.

Then the plague struck; it was 293 B.C. The elders, if they were well informed, must have debated several alternatives: whether to follow tradition and just purify the air with the smoke of bonfires,[3] or try to import an Egyptian specialist (a *medicus,* "physician," assuming that the word appeared in Rome before the profession)—or perhaps one of those Greek iatrói. Finally the Sibylline books were consulted; their advice was to summon Asklepios from his shrine in Epidauros. A trireme was dispatched; it brought back Asklepios in the form of a snake (Fig. 9.1), the snake settled on the Island of the Tiber, and the plague abated.[4]

MEDICVS

Quite a while later, in 219 B.C.,[5] the first Greek physician drifted over from the Peloponnesus. His name was Archágathus, and his start was brilliant. "Citizen rights were given him, and a surgery at the crossway of Acilius was bought with public money for his own use. They say that he was

9.1 *Elaphe longissima longissima,* the first Greek healer that Rome imported, a century after the death of Hippocrates.

a wound specialist [*vulnerarius*] and that his arrival at first was wonderfully popular, but presently from his savage use of the knife and cautery he was nicknamed the executioner [*carnifex*] and his profession, with all physicians, became objects of loathing."[6] Cato the Censor raged: the Greeks, he wrote to his son Marcus about 200 B.C., "are a quite worthless people, and an intractable one, and you must consider my words prophetic: when that race gives us its literature it will corrupt all things, and even all the more if it sends hither its physicians. They have conspired together to murder all foreigners

with their physic, but this very thing they do for a fee, to gain credit and destroy us easily . . . I have forbidden you to have dealings with physicians."[7]

Cato died just in time to be spared the inevitable: another iatrós, much wiser, took aristocratic Rome by storm with the irresistible therapeutic slogan "swiftly safely and sweetly" (*cito tuto jucunde*). That was Asclepiades (124–50 B.C.). He prescribed few medicines, among them wine and music, and went so far as to oppose venesection.[8] Native Romans could not possibly compete with these people—who had nine rational ways to reset a shoulder, to mention only one problem—when the best the Romans could do to the same end was to bind on two pieces of a green reed and sing over them the gibberish of Cato the Censor:[9]

Huat haut haut
Istasis tarsis
Ardannabou dannaustra

There was no choice, to use Pliny's sarcasm, but to be "swept along on the puffs of the clever brains of Greece."[10]

The Setting: Roman Life As Seen by Pliny

When Vesuvius buried Pompeii in 79 A.D., Rome was at its height. Most of the facts discussed in this chapter belong to that period. To understand them best, we need a human portrait, one showing a Roman of the first century, with his thoughts, his background, his prejudices, and all that he took for granted. For this role I have chosen Pliny the Elder: for he lived from 23 to 79 A.D., and though by no means an average citizen, he was almost the caricature of a Roman.[11] He started his career as a public officer in Germany, by serving in the cavalry, then returned to Rome and studied law. Under Nero at first he kept quiet, but eventually he resumed public life and went to Spain as a procurator. All this time he was writing books, on subjects from history to grammar to the use of the javelin. When Vespasian took over, he again returned to Rome and was admitted to the intimate circle of the emperor, an old-time army acquaintance.

At age fifty-two, feeling that digests (*thesauroi*) were more needed than new books,[12] Pliny set out to write his only extant work, the *Historia naturalis* or *Natural History*. He compiled it at record speed in two years, setting an all-time example of compulsive, obsessive data-collecting, writing only during the night, having books read to him literally every spare moment—on vacation, even in the street, not *in* the bath but certainly while being rubbed down and dried, at table—and scolding friends for interrupting without good reason ("your interruption has cost us ten lines!").[13] As his readers droned on, he occasionally misheard the Greek or Latin words, so that the notes he was jotting down were sometimes garbled.[14] What he chose to record was not too critical, and was often colored by his love of the marvelous. But in his thirty-seven books he finally assembled (he says, and he

is probably right) 20,000 facts from about 2000 volumes by 100 selected authors,[15]—a gigantic enterprise for his day.

For 1600 years the *Natural History* was revered as a pillar of human knowledge. Nowadays, Pliny's reputation outside his native Como is low, for he is unjustly remembered for the poorest of his 20,000 facts; yet if he had not undertaken that ghastly two-year marathon, we would be denied a major source of information about antiquity. And we have it by mere chance. Barely two years after dedicating his finished work to a friend,[16] Pliny had become involved with the navy. On August 24 of the year 79, at age fifty-six, while he was in command of the fleet off the bay of Naples, a great mushroom-cloud rose from Mount Vesuvius.[17] It was unthinkable for Pliny to stand by and watch. He moved in with his quadriremes, braving the waves, the rising sea-bottom, and the hail of stones and ashes; he landed, and died on the shore the next day, in a cloud of poisonous fumes.[18] His nephew, Pliny the Younger, left a touching portrait of him in his letters to Tacitus and to another friend.[19]

I will now let Pliny speak for himself, out of the pages of his *Natural History.* To this effect I have chosen about one hundred passages that I considered typical or relevant, and I have grouped them by topic. Pliny's own words are italicized, the rest is my shortened version.

On the World and Physics

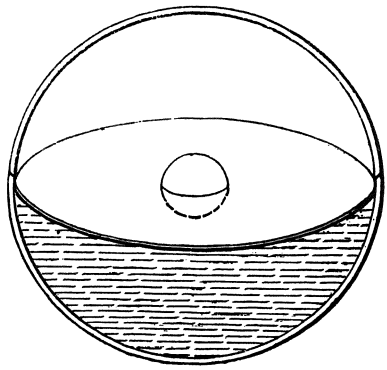
The Greeks call the world *cosmos,* "ornament," and the Romans *mundus,* "elegant," *because of its perfect finish and grace.*[20]

The world is a sphere that rotates with undescribable velocity. [Pliny may have seen the Alexandrian toy model of the earth as a sphere (Fig. 9.2)].[21]

Light travels faster than sound.[22]

Certainly it is found that every liquid becomes smaller when frozen [surprisingly wrong].[23]

MEDICVS



9.2 An Alexandrian model, described by Heron, to represent the earth as a sphere in the center of the universe: a ball floating on water, inside a glass globe. The globe is half full, and the ball is held in place by a perforated bronze plate. First century A.D.

On God and the Afterlife

What is this mad idea that life is renewed by death?[24]

I deem it a mark of human weakness to seek to discover the shape and form of God. Whoever God is—provided there is a God—and wherever he is, he consists wholly of sense, sight and hearing, wholly of soul, wholly of mind, wholly of himself.[25]

On Mankind

Snakes do not bite snakes, *whereas to man, I vow, most of his evils come from his fellow-men.*[26]

Man enters the world *wailing and weeping, and none other among all the animals is more prone to tears.*[27]

A foreigner scarcely counts as a human being for someone of another race.[28]

People will even give their name to a new variety of fruit, as if it were an outstanding achievement.[29]

Man is the only animal for whom mating for the first time is followed by repugnance.[30]

Nature appears to have created everything for the sake of man.[31]

Our civilization depends largely on paper.[32]

On the Good Old Days

It was not this way in bygone generations: there was no need to keep watch on domestics.[33]

In the past, *a certain barrenness of fortune made it necessary to exercise the gifts of the mind . . . but later generations have been positively handicapped by the expansion of the world and by abundance.*[34]

Craftsmanship of working in metals has quite disappeared; for this . . . like everything else, has now begun to be practiced for the sake of gain.[35]

The skill of casting in bronze has perished.[36]

Nobody knows any more what wine he is drinking. *Our commercial honesty has sunk so low that only the names of the vintages are sold, the wines are adulterated as soon as they are poured into the vats.*[37]

What an absurd idea to pay more money for an object [of crystalware], just because it is more breakable.[38]

What a difference from the old days, when Cato the Censor suggested that even the Forum be paved with sharp stones, to prevent loitering.[39]

Amber is now so expensive that *a human figurine, no matter how small, costs more than several human beings* [*slaves*] *alive and in good health.*[40]

Who could be blamed for complaining nowadays? *The cost of living has been raised by luxuries and extravagance.*[41]

On Women and Cosmetics

The reason why women are kissed by men is to know whether they have been at the wine—says Cato.[42]

Women have in their womb an animal called a mole, and it moves about.[43]

By the lowest reckoning India, China and the Arabian peninsula take from our empire 100 million sesterces every year: that is the sum which our luxuries and our women cost us. What fraction of these imports, I ask you, now goes to the gods or to the powers of the lower world?[44]

I find that a woman's breast-band tied around the head relieves headache.—Over and above this there is no limit to a woman's power.[45]

Perfume was probably invented by the Persians to quench the smell of dirt.[46]

The highest recommendation for perfume is that when a woman passes by, her scent may attract the attention even of persons occupied in something else (and it costs 400 denarii per pound!).[47]

Almond oil . . . smoothes the skin, improves the complexion.[48]

Perfume is the most superfluous of luxuries: it dies in the very hour when it is used.[49]

On Food and Wine

To gain weight, drink during meals. [Modern medicine gives the same advice in reverse: to avoid gaining weight, avoid drinking during meals. The rationale: dry food, being more difficult to swallow, allows one to eat less.][50]

A civilized life is impossible without salt.[51]

To think that the only pleasing quality of pepper is that it stings—and we go all the way to India to get it.[52]

Who discovered that great boon—the liver of stuffed geese [pâté de foie gras]?[53]

The pith at the top of the palm-tree is called "the brain," and it has a sweet taste [palm heart].[54]

Arabia produces a brittle kind of honey that collects in reeds [cane sugar]. It is used only in medicines.[55]

Butter is used by barbarian tribes, where it distinguishes the rich from the poor.[56]

Sergius Orata invented oyster ponds; he also invented shower baths and sold them to outfit country houses [about 90 B.C].[57]

Oysters are served on snow; *thus luxury has wedded the tops of the mountains to the bottom of the sea.*[58]

MEDICVS

Refrigerated drinks were invented by Nero. He boiled water and then put the container in snow. In this way one gets the coolness without the injurious qualities of the snow. [Little did Pliny know that the Chinese had been doing that for centuries!][59]

Artificial colors are now added to wine. *So many poisons are employed to force wine to suit our taste—and we are surprised that it is not wholesome!* [Pliny was right, although unaware of the most dangerous poison in Roman wine: lead.][60]

There is no topic more difficult to handle than wine . . . It is hard to say whether wine does good to more people than it harms . . . Medical opinion is very divided.[61]

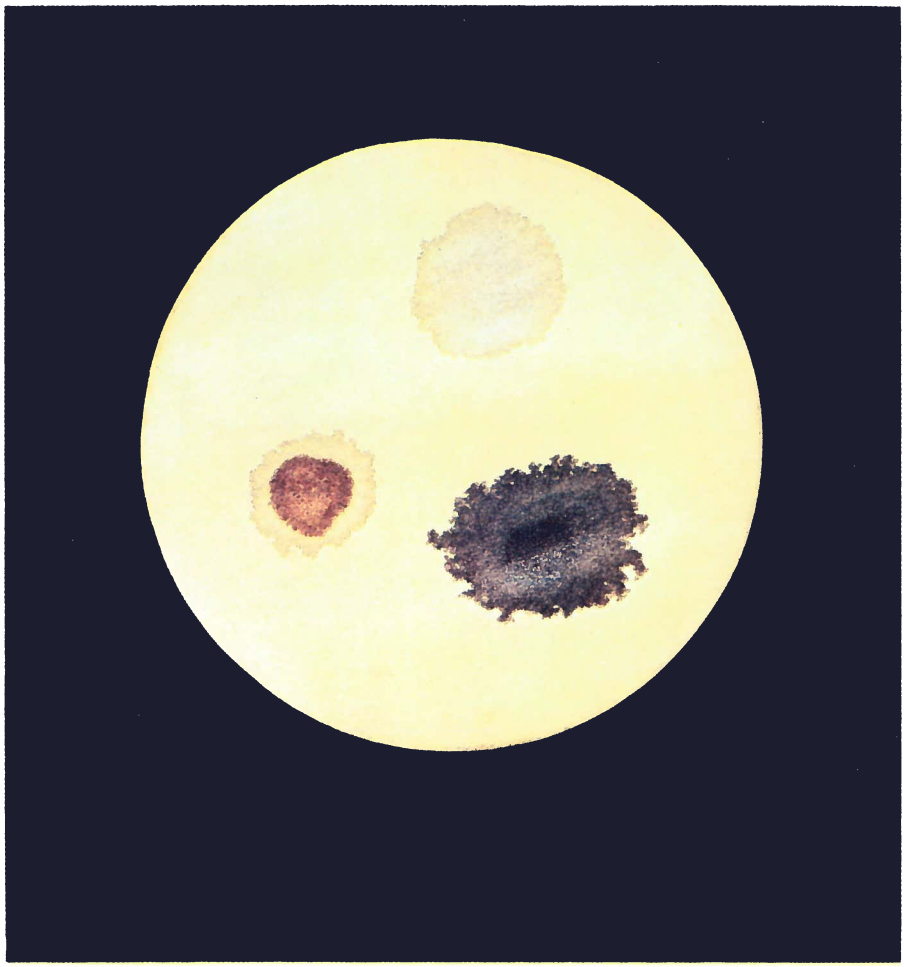


Plate 9.1 Chemical reaction described by Pliny to detect the adulteration of green copper acetate with green ferrous sulphate. A disk of filter paper—used here in place of papyrus—was impregnated with tannic acid (oak gall) and dried. *Top:* Effect of a drop of water. *Left:* 10 percent copper acetate. *Right:* 20 percent ferrous sulphate.

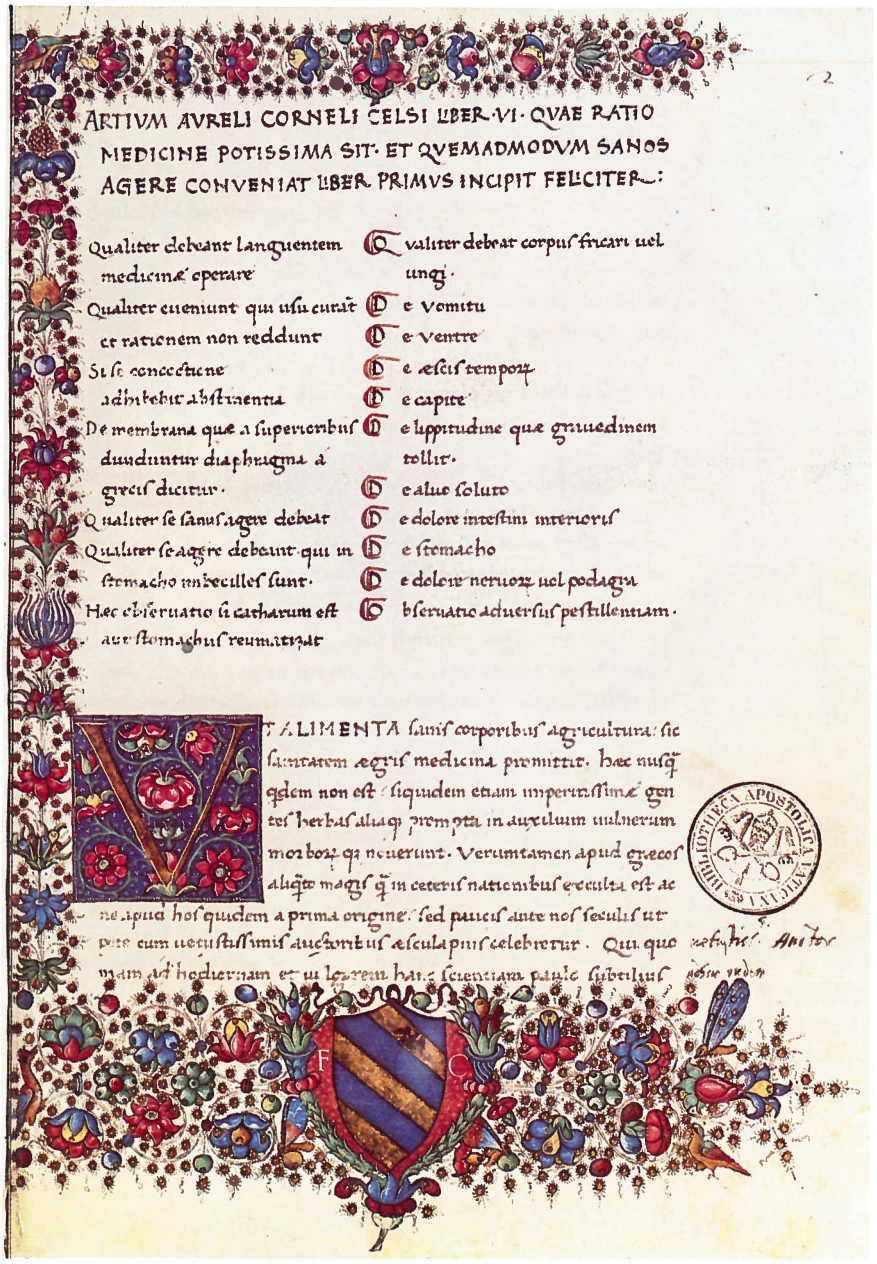


Plate 9.2 One of the fourteenth-century manuscript editions of Celsus, prepared from the ancient codices that had just been rediscovered.

On Geography and Peoples

Italy is much longer than it is broad, and bends toward the left at its top; it is 1020 Roman miles long [actually about 650 miles as the crow flies, along the backbone, the Roman mile being about 95 yards shorter than the modern English mile].[62]

One is ashamed to borrow an account of Italy from the Greeks.[63]

The Egyptian Sphynx is 243 feet long [almost exact: the Sphynx is 73.5m long, so Pliny's figure is about 1.5m short].[64]

The danger of lighthouses, such as are now burning in several places, is that their uninterrupted light can be mistaken for a star.[65]

The first international agreement was the adoption of the Ionian alphabet.[66]

The ambassadors from Ceylon were amazed at Roman honesty.[67]

The pirates of Germany navigate on boats made of a single tree hollowed out.[68]

I am of the opinion that the Assyrians always had writing, but others . . . hold that it was invented in Egypt [we are still not sure].[69]

Nowadays immense crowds go on voyages, but their object is profit, not learning.[70]

On Natural History, Biology, and Chemistry

How do bees multiply, since they can never be seen having intercourse?[71]

Dust in wool and clothes breeds moths.[72]

Many people have said that insects do not breathe.[73]

Fish run away from the bodies of dead fish. [This was the basis of a shark repellent developed in Woods Hole, Mass., during World War II.][74]

It is known from antiquity that amber is a form of resin.[75]

Glossopetrae [tongue stones] are said to fall from the sky; this is probably false.[85] [Sure enough, they are fossilized shark teeth (Fig. 9.3)][76]

To detect adulterations of copper acetate, smear it on a sheet of papyrus steeped in an infusion of plant gall. It should leave a black mark if genuine. [Although Pliny has it backward, this is still the world's first reactive paper (Plate 9.1).][77]

Going into the cellar, where the wine vats are, can be fatal. A good test is to let down a lamp; if it goes out, it means danger.[78]

On Superstition and Magic

Does foreknowledge really exist, *or is it a matter of chance like most things?*[79]

Have words and incantations any effect? This is a most important question, and one never settled.[80]

When somebody sneezes, why do we say "good health"?[81]

We certainly still have formulas to charm away hail, various diseases, and burns, some actually tested by experience, but I am very shy of quoting them, because of the widely different feelings they arouse. Wherefore everyone must form his own opinion about them as he pleases.[82]

9.3 The source of an ancient drug: fossilized shark teeth, which were called "tongue stones" (*glossopetrae*). Ground up, they were said to be very effective, both internally and externally, until the 1600s. Actual size.

Magic is detestable, vain and idle . . . though it has what I might call shadows of truth. [Pliny has a personal grudge against the Magi, whom he calls liars, yet fears. Originally they were a tribe of the Medes (Persia), who became a priestly caste, not unlike the Levi among the Hebrews. Their religion seems to have been somewhat esoteric, so that the word *Magi* slowly passed from meaning "wise men of the East" to "magicians." By Pliny's time the word had gone halfway on its journey.][83]

Magic arose in Persia with Zoroaster. Its power comes from a seductive mixture of medicine, religion, and astrology, and thus *holds men's emotions in a three-fold bond.*[84]

Here are some lies of the Magi . . . to prevent a wound being painful they prescribe wearing as an amulet, tied on the person with a thread, a nail or other object that he has trodden on . . . To relieve headaches, they advise the rope used by a suicide tied around the temples.[85]

The Magi recommend the eggs of a horned owl. *Who could ever have looked at a horned owl's egg, when it is a portent to have seen the bird itself?*[86]

Even today Britain practices magic . . . It is beyond calculation how great a debt humanity owes to the Romans for sweeping away the monstrous rites in which to kill a man was the highest religious duty, or to eat man a passport to health.[87]

In quartan fevers [malaria] *ordinary medicines are practically useless, for which reason I shall include several of the magicians' remedies.*[88]

On Prodigious Events

There have been rains of milk, blood, flesh, iron, sponges, wool, and baked bricks.[89]

There are islands that float and drift with the wind.[90]

People in Pontus cannot sink—it is reported—even if weighted down with clothes.[91]

King Cyrus knew all his soldiers by name.[92]

There are fish that grunt, others that climb trees [true].[93]

Pigeons have carried important messages.[94]

There was a man who could see 123 miles.[95]

The champion for love-making was Messalina: she beat a prostitute with a score of 25 in 24 hours.[96]

In the School of Gladiators of Gaius only two men of 20,000 did not blink and were therefore unconquerable.[97]

One professor of logic died of shame because he could not solve a problem put to him in jest.[98]

Julius Caesar could dictate or listen to four secretaries; *seven if he was not otherwise occupied.*[99]

Truth Misinterpreted

Bees have a government.[100]

Whales have their mouth on their forehead.[101]

Species with more than four feet [insects] have no blood.[102]

In Persia there are trees that bear wool [cotton].[103]

All trees are of both sexes, say the experts [varieties mistaken for sexes].[104]

Lime has a remarkable quality: once it has been burnt, its heat is increased by water.[105]

The human race is becoming smaller; in Crete there are remains of colossal men [probably fossils of prehistoric animals].[106]

Glass globes full of water become so hot when facing the sun that they can set clothes on fire.[107]

Naphtha has a close affinity with fire, which leaps to it at once when it sees it in any direction.[108]

Some Nonsense

Nails grow after death.[109]

Certain animals stop growing if they drink wine, it is said.[110]

Mixing several sorts of wine is bad.[111]

Sexual intercourse cures dullness of vision.[112]

Poisonous mushrooms are neutralized by cooking with vinegar.[113]

Haircuts are best just after the full moon—so as not to go bald, says Varro.[114]

On Doctors and Disease

New diseases, unknown in past years, have come to Italy and to Europe.[115]

The variety of diseases is unlimited. There was a poet who had fever only on his birthdays.[116]

Hippocrates is the prince of medicine [*princeps medicinae;* quite a concession by Pliny to a Greek] . . . *He founded that branch of medicine called "clinical"* [generous but debatable].[117]

Nature distributed medicines everywhere; *even the very desert was made a drug store.*[118]

For bruises, your hearth should be your medicine chest [quoted from Varro].[119]

For a tiny sore a medicine is imported from the Red Sea, though genuine remedies form the daily dinner of even the very poorest. But if remedies were sought in the kitchen garden . . . none of the arts would become cheaper than medicine.[120]

Physicians acquire their knowledge from our dangers, making experiments at the cost of our lives.[121]

Physicians make enormous amounts of money, up to 600,000 sesterces a year [roughly 100 times the minimum living wage].[122]

Heaven knows, the medical profession is the only one in which anybody professing to be a physician is at once trusted [there being no recognized medical diplomas], *although nowhere else is an untruth more dangerous. We pay however no attention to the danger, so great for each of us is the seductive sweetness of wishful thinking.*[123]

Our pleasures we enjoy ourselves, but our life we entrust to someone else [a physician], which *I personally hold to be the worst possible disgrace.*[124]

On Barbarians, Greeks, and Romans

There is a marvellous neatness in the titles of Greek books: but when you get inside them, good heavens, what a void![125]

There are foreign people who live like savages and then have the courage to complain when they are taken over by the Romans. Fortune ought to spare them as a punishment.[126]

The outstanding race in the whole world is undoubtedly the Roman.[127]

On Death

I do not indeed hold that life ought to be so prized that by any and every means it should be prolonged. You holding this view, whoever you are, will none the less die . . . Of all the blessings given to man by nature none is greater than a timely death.[128]

MEDICVS *Folk Remedies—and a Lost Pearl*

In his monumental collection of folk remedies, Pliny does not specify which ones were those of the forefathers; but here are a few that might qualify:[129]

"To commence with admitted medical aids, that is, wools and eggs" . . . wool is applied with honey to old sores. Wounds it heals if dipped in wine, or vinegar, or cold water and oil, and then squeezed out.

White of egg cools inflamed eyes and closes wounds.

Earth worms have a great reputation for uniting fresh wounds; they are used in honey or vinegar . . . also pounded cypress leaves.

A slice of veal will prevent wounds from swelling . . . and to make them close fast, use leaves and bark of the elm . . . or of the vine.

Pig dung, fresh or dried and powdered, is good for wounds made by iron.

Pellets of goat dung kneaded in vinegar and warmed are good for ulcers on the shins.

For poisoned arrows use dog's blood, for snake bite, a mouse cut in two.

For a painful wound, any pebble right side up—or a potsherd applied just as it was taken up—those applying it must not look back, and make sure that the sun does not behold them.

For chafings caused by foot wear, ash of an old shoe.

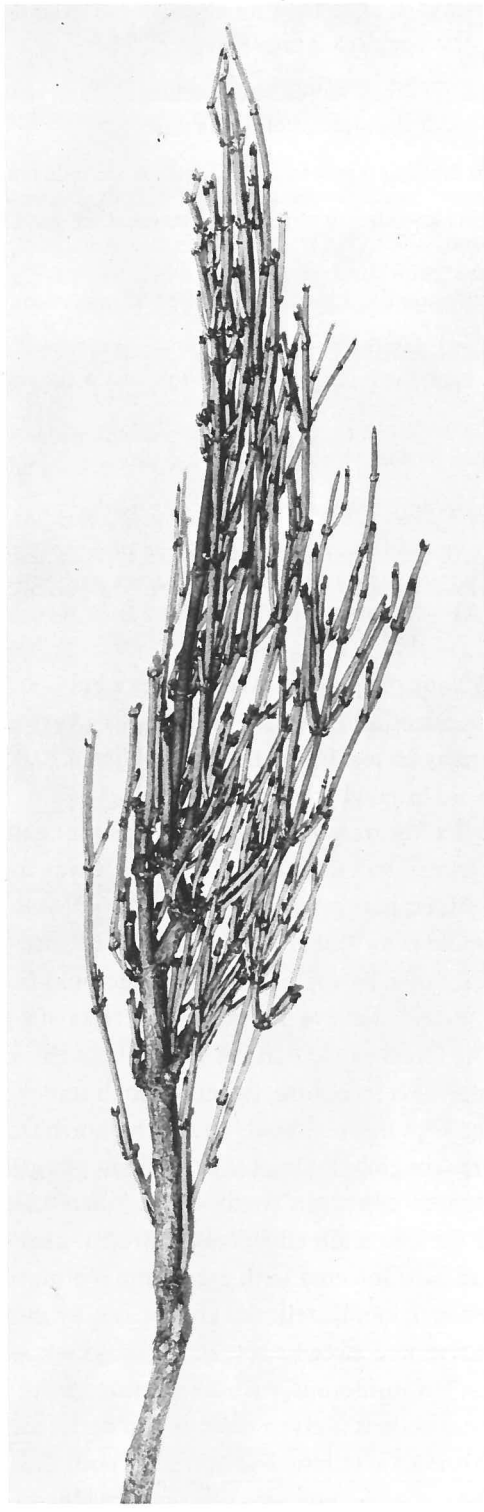
For sores of a whipping, fresh sheep skin.

And all wounds will heal faster if bound up with the very difficult Hercules knot [probably true; for a knot with invisible ends reduced the patient's chances of being treated].

Once in a while, one of Pliny's simples scores a bull's eye. Fern, for instance, is recommended for intestinal worms; it is a very effective drug.[130] Still other treasures may be lost in the thicket of Pliny's 20,000 data—perhaps even a drug that would be good on wounds.

In fact, I did find a lost treasure, when looking among the styptics. There were the famous cobwebs, still used in Italy.[131] There was the rennet again, as in Greece—kid rennet, hare rennet, deer rennet—[132] and this time it is obvious that its purpose is to "coagulate" or "bind," because it is used also to stay the diarrhea of infants, by applying it to the mother's breasts.[133] But then, reading on, I could scarcely believe my eyes. Pliny talks of a plant that "some call *ephedron* . . . The Greeks hold various views about this plant . . . assuring us that so wonderful is its nature, its mere touch stanches a patient's bleeding . . . its juice kept in the nostrils checks hemorrhage . . . and taken in sweet wine it cures cough."[134] One cannot help but be startled by the association of a plant named "ephedron" with stopping hemorrhage and curing cough: for these are the two main effects of a powerful drug called *ephedrine*. A surgical incision in skin injected with ephedrine is almost bloodless; and a spell of asthmatic cough can be relieved almost as if by miracle. Coincidence? The data are repeated elsewhere with a description of the plant: "*Ephedra* . . . has no leaves, but numerous, rush-like, jointed tufts . . . (Fig. 9.4). For cough, asthma and colic it is given pounded in dark-red, dry wine."

By Hercules, this is an accurate description of both the plant *Ephedra* and its product, ephedrine, the precious drug supposedly discovered only by the Chinese. I quote from a modern textbook of pharmacology: "Ephedrine . . . was used in China for over 5000 years before being introduced into Western medicine in 1924."[135] In fact, the introduction of ephedrine from China is a classic episode in the recent history of medicine. Between 1922 and 1924, a young American physician, Carl Frederic Schmidt, worked at the



9.4 Twig of a contemporary *Ephedra nebrodensis Tin.*, gathered in Sardinia. Note the typical segmented branches, with no leaves, as described by Pliny. Actual size.

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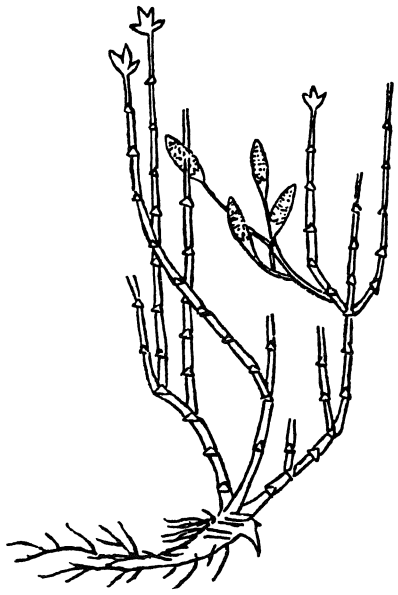
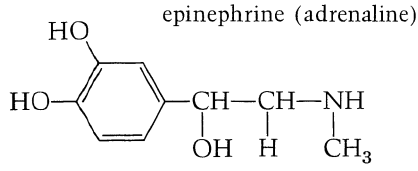
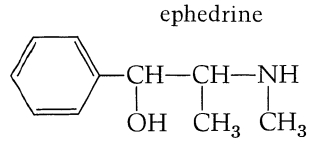


9.5 *Ma huang:* this is *Ephedra* as it was known to the Chinese, perhaps as far back as 2000 B.C.

9.6 Chemical formulas of ephedrine and adrenaline.

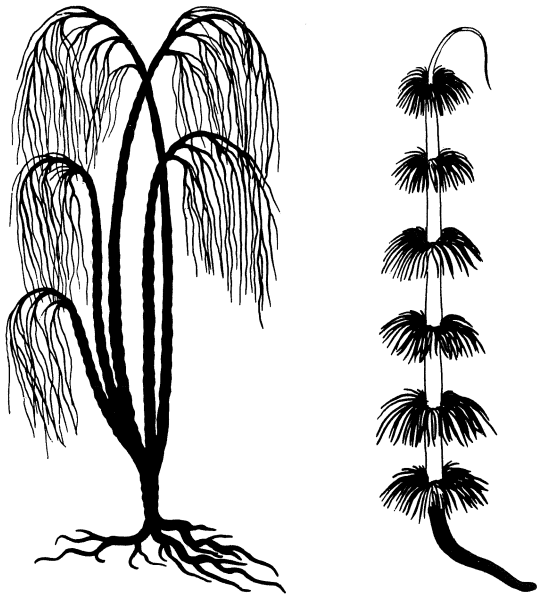




Peking Union Medical College, testing some of the most popular Chinese traditional herbs, in the hope of discovering some new active principle. Of the five drugs that were selected out of nearly two thousand, only one gave significant results: an extract of *Ephedra*, locally known as *ma huang* (Fig. 9.5). When injected intravenously in dogs, it caused a spectacular increase in blood pressure. Thus began the modern career of ephedrine.[136]

MEDICVS

Ephedrine (Fig. 9.6) has essentially the same effects as adrenaline, a hormone produced by the adrenal glands, but with two advantages: it can be given by mouth (as Pliny gives it), and its effects, though weaker, last longer. Its classical uses are for asthma, allergic cough, and hemorrhage; Pliny has all three.



9.7 *Ephedra* (left) in a drawing of 512 A.D., labeled "Two Species of Ippouris." It would have been difficult to recognize *Ephedra* here, because the distorted name *Ephudron* is given as the last of fifteen possible synonyms, and *Ephedra* is associated with a similar but unrelated plant, *Equisetum arvense* (right). These drawings may well derive from originals drawn at the time of Dioscorides.

Could it be that Pliny somehow inherited the notion of *Ephedra* from China? It is extremely unlikely. His immediate source could have been Dioscorides, who has essentially the same information (Fig. 9.7).[137] There is no record of anyone from China going to Rome in antiquity.[138] The Romans knew little about China, except that there were "people called Seres . . . famous for the woollen substance obtained from their forests."[139] If the use of ephedrine had come from China, it should have increased in Europe as contacts increased; but in fact, it was completely forgotten. In ancient India, Sushruta and Charaka do not mention it.[140] There are many *Ephedrae* in Europe, including an *Ephedra helvetica;* among the Italian varieties, some from Sardinia were even studied in 1940 for possible industrial exploitation.[141] So we are probably dealing with an independent Mediterranean discovery, not related to ma huang.

MEDICVS

The most obvious lesson here is that treasures are buried in ancient books. Dr. Schmidt retrieved this one by sifting through the two thousand drugs of China. One might say that he could also have sifted through the one thousand drugs of Pliny. But the story of ephedrine is loaded with irony: Dr. Schmidt might almost have ordered his precious drug from a catalog. As he and his Chinese collaborator, K. K. Chen, were wondering what to call their newly discovered substance, they found out that a crystalline substance extracted from ma huang had already been prepared in 1885; it had been called ephedrine in 1887, and even synthesized. Thereafter it had become a victim of its own progress. Because ephedrine had become available in large amounts, it had also become possible to prepare potent solutions and to inject huge doses into experimental animals. The animals dropped dead,

whereupon ephedrine was branded as highly toxic, and forgotten. Asthmatics went on coughing and wheezing—and all the while it lay written in the books of Pliny and Dioscorides that a gentler, impure decoction of *Ephedra* would have brought them instant relief.

The Star Witness: Cornelius Celsus

Aside from the usual flurry of minor historical tidbits, up to the first century A.D. there are only two major sources on wound care in Rome, both from the height of the empire: first Celsus, then Pliny.[142] Celsus is a special case. If this were a play, all the spotlights would be on; Cornelius Celsus would stride out in the glare and hold forth in impeccable, soul-stirring Latin, for his style has few equals in the drab world of medical literature. Practically all we know about him is that he lived under Tiberius (14–37 A.D.) and wrote in his mother tongue a vast treatise covering agriculture, warfare, rhetoric, medicine, and possibly more.[143] The medical section was entitled *De medicina,* "On Medicine," in eight books. Writing extensively on medicine, *in Latin,* was almost an act of courage: Pliny—who took the same risk in his *Natural History*—felt quite sore about the fact that "if medical treatises are written in a language other than Greek they have no prestige even among unlearned men ignorant of Greek; and if any should understand them they have less faith in [them]."[144]

Celsus was the second of three Roman authors—after Varro, and before Pliny—who wrote encyclopedias about fifty years apart. Of Varro, a few books survived; Pliny's *Natural History* sailed through the ages almost unscathed; Celsus very nearly shipwrecked. Shortly after his time, one stuffy grammarian acknowledges him only as a man of "average intellect."[145] The conscientious Pliny quotes him twenty-four times, mostly on matters nonmedical,[146] but then makes an interesting slip. As he sets about writing on medicine in Latin, half a century after Celsus, he says that "no one hitherto has treated the subject in Latin."[147] Apparently *De medicina* had made no great splash, even with Pliny (perhaps *because* it was written in Latin). Then the curtain dropped.

For thirteen centuries the manuscripts of Celsus were almost as good as buried. Someone cared enough to copy the eight books on medicine before they crumbled to dust; but all the others disappeared for good. The very name of Celsus recurs only four times in known documents of the Middle Ages.[148] Finally, as the new wind of the Renaissance sent Italian scholars rummaging for Greek and Latin codices, two copies of Celsus were unearthed: one in 1426 (promptly recopied and lost again) and one the year after, already five hundred years old, in the Basilica of Saint Ambrose in Milan (Plate 9.2).[149] For the discoverers the find was almost too good to be true: Greek medicine in perfect Latin dress! As soon as Gutenberg made it possible, Celsus rolled off the press, first among all medical authors (1478), and the only complete medical text that came down from antiquity: the Smith papyrus stops at the waist; the Hippocratic books are a jumble; *De medicina* is a gem with all facets intact.

Celsus on Human Vivisection

The substance of *De medicina* is Hippocratic (which also means that its surgery is far superior to its internal medicine), but enriched by Alexandrian progress, and almost surely by Indian imports.[150]

In his opening chapter Celsus discusses human experimentation. In principle, he asks, is it useful to use wounds as windows, to study what is going on inside the body? His answer:

> For when pain occurs internally, neither is it possible for one to learn what hurts the patient, unless he has acquainted himself with the position of each organ or intestine; nor can a diseased portion of the body be treated by one who does not know what that portion is. *When a man's viscera are exposed in a wound, he who is ignorant of the colour of a part in health may be unable to recognize which part is intact, and which part damaged; thus he cannot even relieve the damaged part.*[151]

In other words, knowledge of anatomy is essential.

Celsus draws this conviction not from the Hippocratic books but from the later studies at the Alexandrian Museum:

> They hold that Herophilos and Erasistratos did this in the best way by far, when they laid open men whilst alive—criminals received out of prison from the kings—and whilst these were still breathing, observed parts which beforehand nature had concealed, their position, colour, shape, size, arrangement, hardness, softness, smoothness, relation, processes and depressions of each, and whether any part is inserted into or is received into another.[152]

This gruesome story did not fail to draw thunder from two Fathers of the Church, Tertullian and St. Augustine, which led George Sarton to draw the obvious conclusion: "Celsus had been able to tell the story without disapproval because pagan ruthlessness had not yet been assuaged by Christian tenderness."[153]

Shock must have prevented all three eminent scholars from reading further,[154] because in the next breath Celsus goes on to blast human vivisection. Others believe, he says, that people's entrails are exposed often enough by accident:

> For sometimes a gladiator in the arena, or a soldier in battle, or a traveller who has been set upon by robbers, is so wounded that some or other interior part is exposed in one man or another. Thus, they say, an observant practitioner learns to recognize site, position, arrangement, shape, and such like, not when slaughtering, but whilst striving for health; and he learns in the course of a work of mercy, what others would come to know by means of dire cruelty.[155]

And here is the opinion of Celsus himself:

> I believe that medicine should be rational . . . But to open the bodies of men still alive is as cruel as it is needless [*et crudele et supervacuum*]. To open the dead is necessary to those who learn, who must know the positions and relations, which the corpse shows better than does a living and wounded man. As for all the rest that can

be learned only from the living, actual practice will demonstrate it in the course of treating the wounded, in a somewhat slower, but much milder way.[156]

This "opening the dead" was wishful thinking, for Rome was not ready to follow Alexandria in breaking the taboo.[157] But using wounds to study anatomy was true Roman reality. A century and a half later Galen, who raised it almost to an art, called it *vulneraria speculatio,* "the contemplation of wounds."[158]

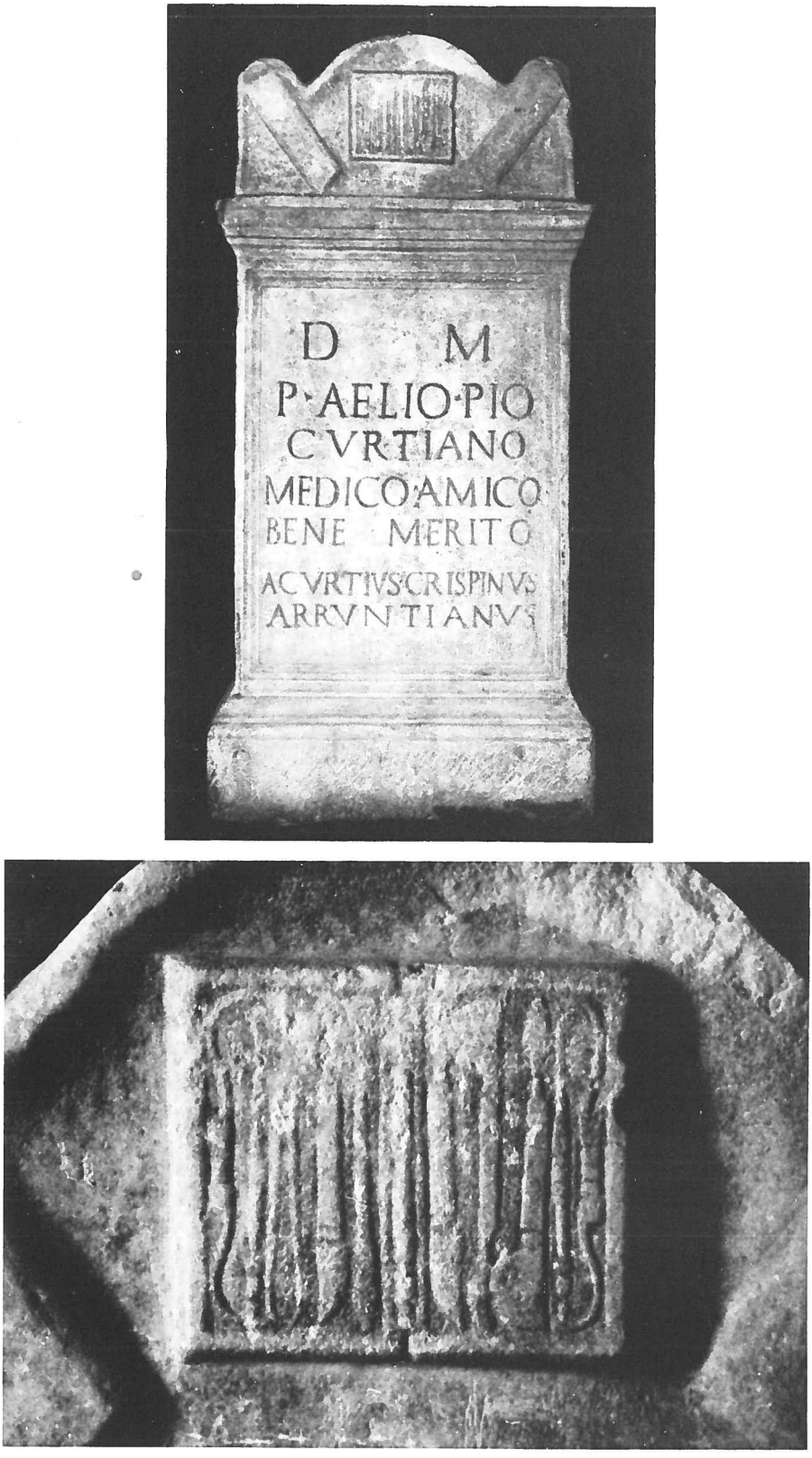
The Celsian Surgeon and Some of His Tools

Surgeons will relish these lines. After diet and drugs,

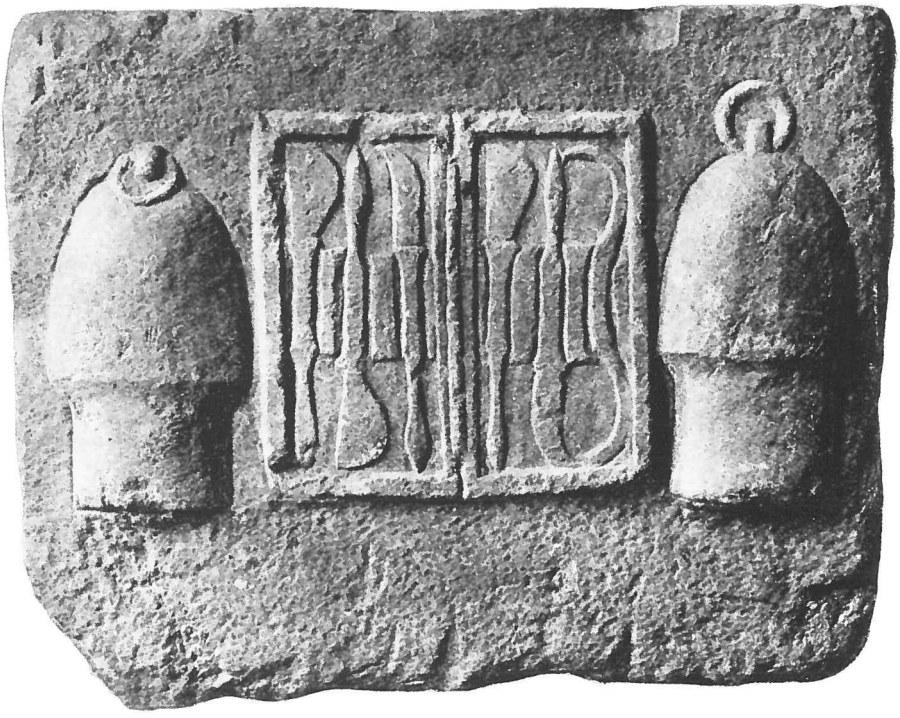
> The third part of the Art of Medicine is that which cures by the hand . . . It does not omit medicaments and regulated diets, but does most by hand. The effects of this treatment are more obvious than any other kind; inasmuch as in diseases since luck helps much, and the same things are often salutary, often of no use at all, it may be doubted whether recovery has been due to medicine, or a sound body, or good luck . . . But in that part of medicine which cures by hand, it is obvious that all improvement comes chiefly from this, even if it be assisted somewhat in other ways . . .
>
> Now a surgeon (*chirurgus*) should be youthful or at any rate nearer youth than age; with a strong and steady hand which never trembles, and ready to use the left hand as well as the right; with vision sharp and clear, and spirit undaunted; filled with pity, so that he wishes to cure his patient, yet is not moved by his cries, to go too fast, or cut less than is necessary; but he does everything just as if the cries of pain cause him no emotion.[159]

Celsian surgery is clear and practical, free of Greek-style aesthetic frills.[160] Yet many and perhaps most of the surgeons liable to read his lines were Greeks.[161] Pliny says that even the Romans who practiced medicine soon became "deserters to the Greeks."[162] Why not, after all: they practiced an art that was mostly Greek, and I suspect that even many of their instruments came from overseas. Look at the monument to the otherwise unrecorded practitioner Publius Aelius Pius Curtianus *medicus bene meritus* (Fig. 9.8). His name is as Roman as could be, but his folding surgical kit is astonishingly similar to a Greek model (Fig. 9.9).

Greek or homemade, the instruments of the Roman surgeon were many and specialized. The richest collection is that of Pompeii, with hundreds of specimens.[163] Its scalpels are identical to those represented on sculptures (Fig. 9.10). Folding kits like that of Curtianus were not preserved; but kits of another kind, cylinders now known as *thecae vulnerariae,* "wound boxes," are fairly common. The remains of one whole collection came to light in a dramatic setting. Among the Pompeians who were smothered by the ashes and fell to their death in the streets, some carrying their worldly possessions, one man tried to flee with a case that was more precious to him than money; he finally collapsed over it, and it was found under his skeleton. In it were several cylinders of polished metal, each containing half a dozen instruments. Unfortunately no photographs were taken on the spot, but a similar kit is shown in Fig. 9.11.[164]

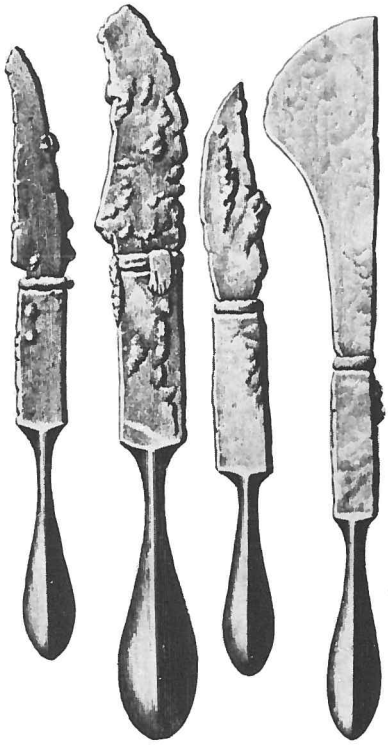


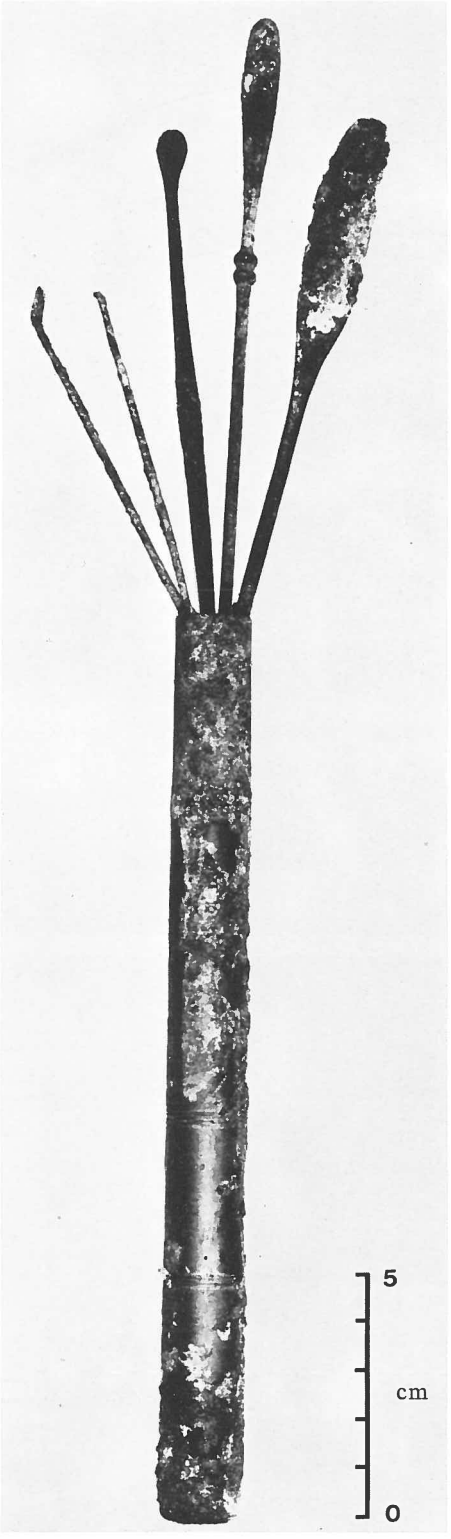
9.8 The Roman physician remembered in this monument had probably used a Greek-style instrument kit (shown in detail).



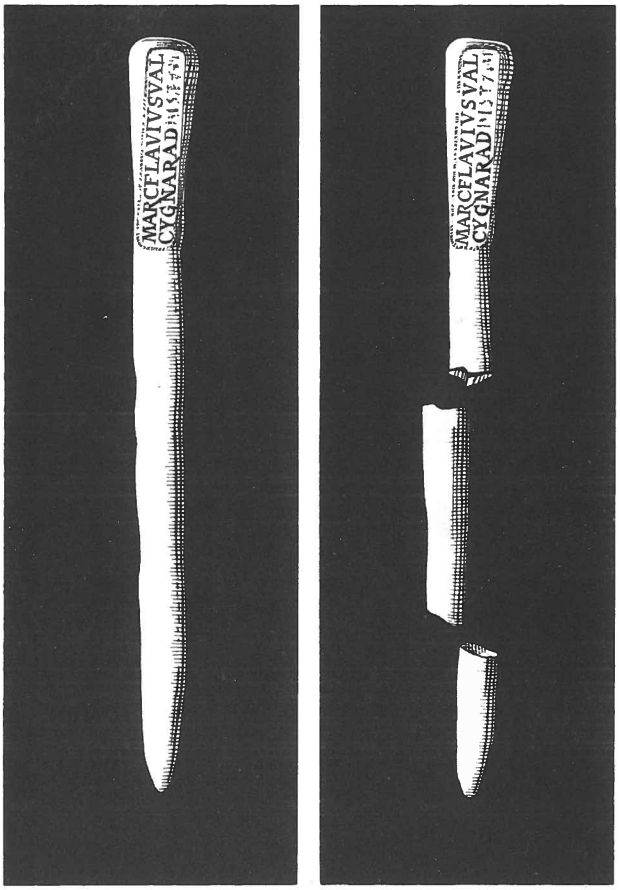
9.9 Instrument box of a Greek physician. Bas-relief found in Athens and dated 400 B.C.—100 A.D. About one-quarter original size.

9.10 Rusty surgical knives found at Pompeii. Unlike any modern scalpel, they were double-ended tools: Celsus says that the bronze handle (*manubríolum*) was used for blunt dissection in working around cysts or varicose veins. Apparently the surgeon did not mind holding the scalpel by the blade! About two-thirds original size.





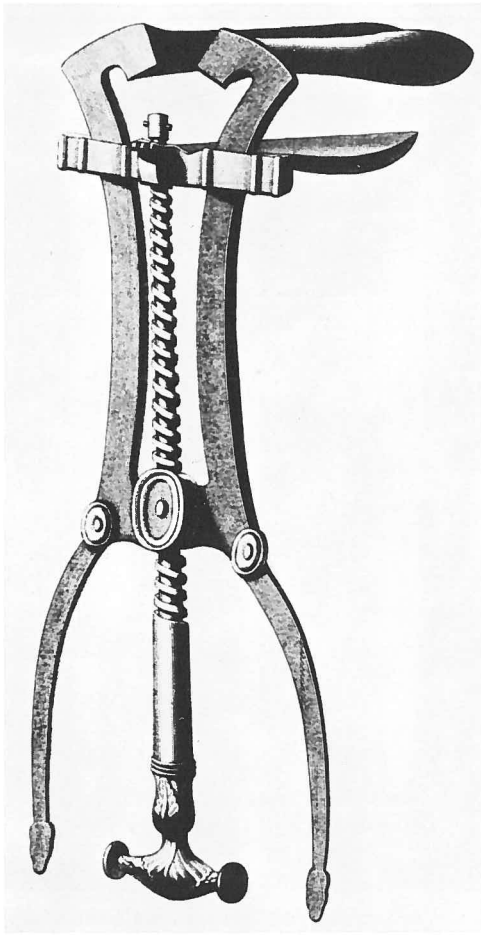
9.11 The commonest type of Roman medical kit: a pocket-sized cylindrical case. From Pompeii, first century A.D.



9.12 A guess at the shape and size of a collyrium stick, used as a probe (left) or in solution (right). One of the best varieties was the *cygnarium* (swan-white), made of starch and lead-white.

The two spoon-shaped probes emerging from the kit illustrated are made of bronze; they are typical examples of *spathoméle,* the simplest and most versatile tool of Greek medicine. Celsus mentions also another kind of probe, which—strangely enough—was soluble: a medicated stick, called *collyrium.* Collyria were made up of a glutinous paste rolled into long thin cones (Fig. 9.12). Nowadays their name sounds improper, because collyrium is the technical term for eyedrops. Actually, there is no mistake. The little sticks could be used as probes to explore wounds or fistulae, or they could be broken up and dissolved to make up a "medicated" solution. Eventually the second use prevailed, and the resulting solutions were used mainly for the eyes.[165]

Most famous of all the Pompeian instruments are the dilators, also because they are one of the earliest known applications of the screw (Fig. 9.13). Their use for dilating wounds, although not described, is certainly possible. For extracting barbed arrows, Celsus describes the Greek "spoon of Diokles."[166] In 1880, no original specimen having yet been found, H. Frölich (the German military surgeon who had studied Homer) proposed a model based on the description of Celsus (Fig. 9.14). His was a good guess, as proven by the specimen that was eventually discovered (Fig. 9.15).[167]



9.13 The *speculum* or dilator, a famous Pompeian medical instrument. Its prongs (top) are slowly spread by the powerful, square-threaded screw. About one-half actual size.

Celsus on Wounds and Ulcers

"There are still," writes Celsus, "some other things to be learnt about wounds and ulcerations in general, of which we will now speak . . . Blood comes out from a fresh wound or from one which is already healing . . . pus from an ulceration."[168]

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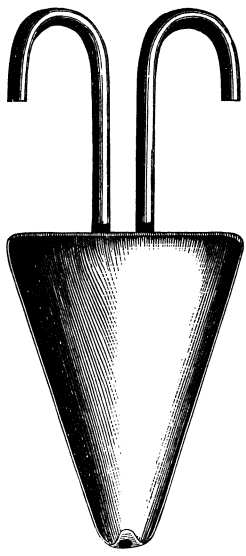
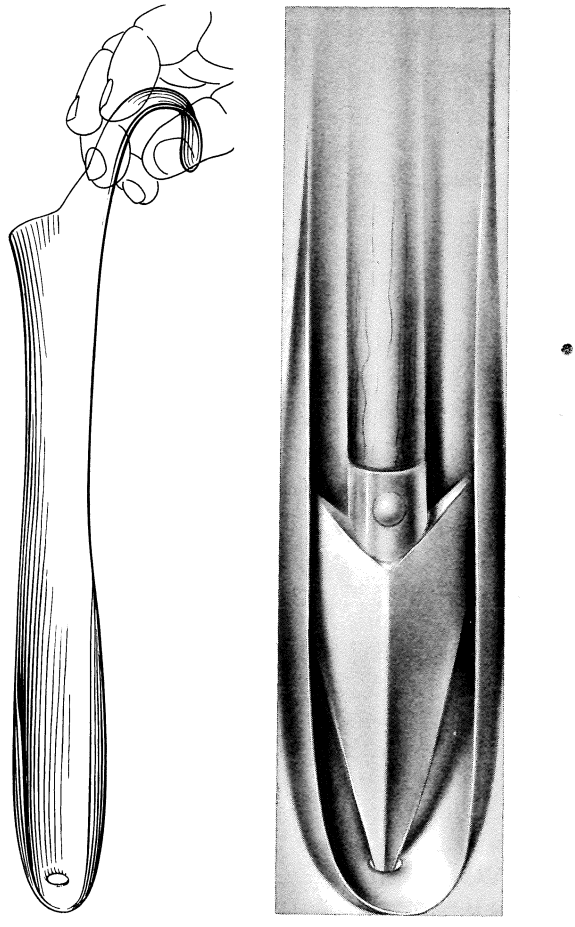
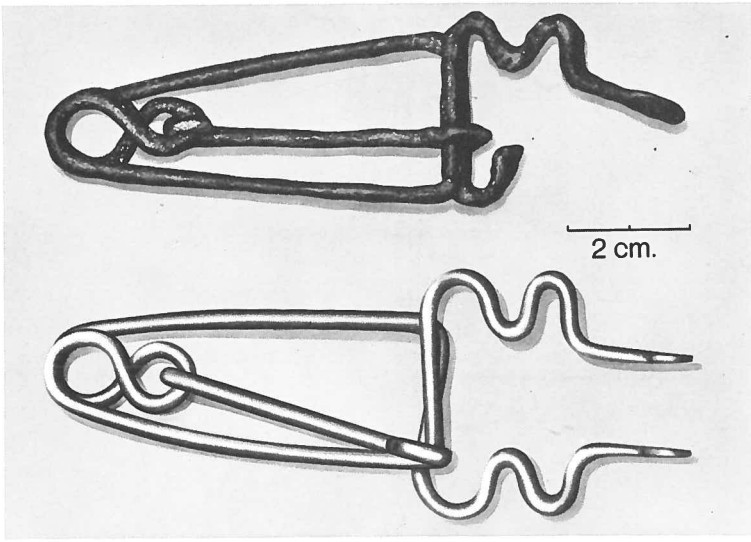
Here is, at long last, the use of two separate terms, "wound" and "ulcer," a distinction that does not yet exist in the Hippocratic books (an ulcer is characterized by its poor tendency to heal, due to infection, mechanical irritation, poor circulation, or the like). Celsus even refers to ulcers *of the stomach*,[169] and Pliny goes so far as to say that an ulcerated stomach (*stomachum exulceratum*) is cured by drinking milk.[170] Knowing that human dissection in Rome was almost certainly nonexistent, one is left to wonder how it was realized that ulcers can develop also in the stomach. Perhaps they were seen only (and it can be done) with that tool that the Greeks and the Hindus liked to use, the "eye of the mind."[171]



9.14 The spoon of Diokles for extracting barbed arrowheads, as drawn in 1880 from the description of Celsus, before an actual specimen had been found. The perspective is somewhat misleading: visualize the object not as a solid cone, but as a hollow spoon.

9.15 The spoon of Diokles (left, about one-half actual size) and how it worked (right). From a bronze specimen.





9.16 An object found in a Roman camp (above), which has been reconstructed (below) and interpreted as a "vein clamp." From Saalburg, Germany, second–third century A.D.

Celsus on Hemorrhage

This is how Celsus describes the basic problems of a wounded patient: "When a man has been wounded who can be saved, there are in the first place two things to be kept in mind: that he should not die from hemorrhage or inflammation."[172] Perfect: even Hippocrates is not as clear on this point. For "inflammation," of course, read "infection." Now see how Celsus deals with each problem. First, the bleeding:

> If we are afraid of haemorrhage which can be judged both from the position and size of the wound and from the force of the flowing blood, the wound is to be filled with dry lint, and over that a sponge applied, squeezed out of cold water, and pressed down by the hand. If the bleeding is not checked thus, the lint must be changed several times, and if it is not effective when dry, it is to be soaked in vinegar.[173]

All this is essentially Hippocratic. Pliny adds wisely that "old sponges do not close wounds."[174] Celsus continues:

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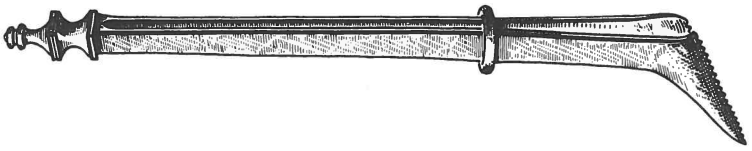
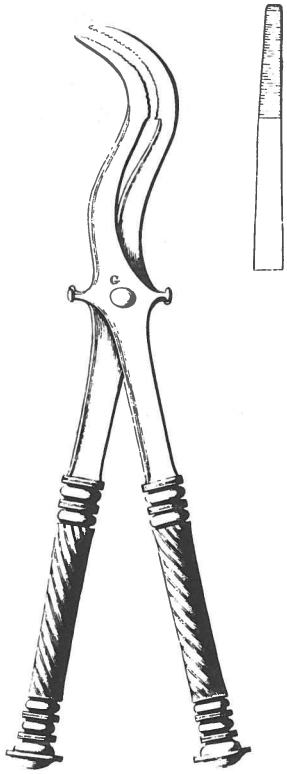
> Vinegar is powerful in suppressing a flow of blood; and some, therefore, pour it into wounds. But then there is an underlying fear of another kind, that if too much diseased matter is forcibly retained in the wound it will afterwards cause great inflammation [*namely, if you suppress a healthy outflow of blood, the retained blood will become pus: Hippocrates again*]. It is on this account that no use is made, either of corrosives or of caustics, owing to the crust they induce, although most of these medicaments suppress bleeding; but if for once recourse is had to them, choose those which have a milder action. But if even these are powerless against the profuse bleeding, [*and now comes something quite new*] THE VEINS THAT ARE POURING OUT BLOOD ARE TO BE SEIZED, AND ROUND THE WOUNDED SPOT THEY ARE TO BE TIED IN TWO PLACES, and cut across in between, so that each end may retract on itself, and yet have its orifice closed.[175]



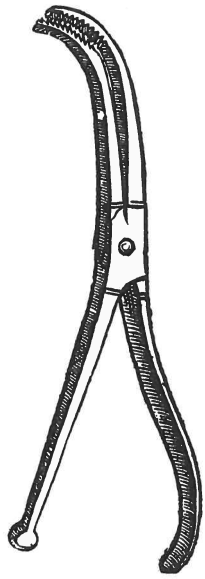
9.17 Forceps closed by a sliding ring, another Roman tool that could have been used to pinch bleeding vessels. This one is from Great Britain; one like it was found in Pompeii. Two-thirds actual size.

9.18 Pompeian forceps, which could very well be the one that Celsus had in mind when he wrote: "The veins, that are pouring out blood, should be seized." The detail (right) shows its serrated edge, as in the modern hemostatic forceps. About one-half actual size.



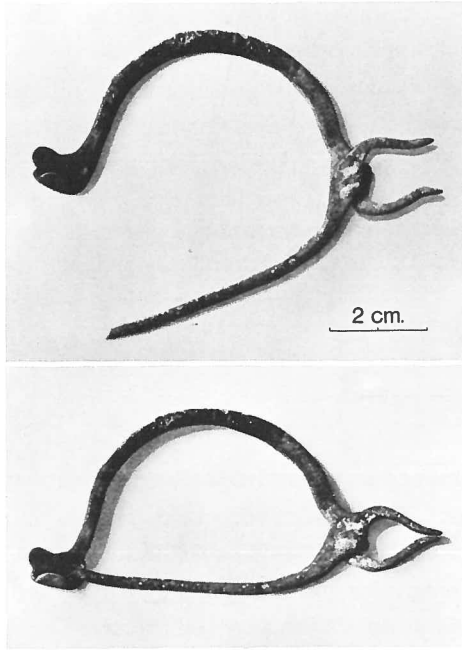
Surgery has finally learned its lesson from plumbing, probably thanks to the Alexandrian scientists. This is what allows Celsus to explain, for the first time, how to amputate a leg, on which occasion he even omits to mention the blood vessels, taking it for granted that they will be tied off.[176]

Presumably this was done with a special forceps. The difficulty here is to identify the right gadget among the many possible ones that have come to light. One of the candidates looks more like a clasp for the daily mail (Fig. 9.16). Whatever it is, I doubt it could be used as a hemostat. Much more likely is that variety of forceps which is closed by a sliding ring (Fig. 9.17). Another possibility is the well-known Pompeian instrument (Fig. 9.18) which looks like the *bec de corbin* that Ambroise Paré invented 1500 years later "to stanch the bleeding when the member is taken off" (Fig. 9.19).[177] But the



9.19 A "new kind" of forceps devised by Ambroise Paré in the 1500s: "The Crows-beak fit to draw the Vessels forth of the flesh, wherein they lie hid, that so they may be tied or bound fast." Under the name of *bec de corbin* (crow's beak) Paré grouped several types of curved forceps; this one was for seizing vessels.

9.20 Gallo-Roman surgical forceps, which locks automatically when closed (below), like the modern hemostatic forceps. First–third century A.D.



prize find belonged to one of the so-called Gallo-Roman "oculists"[178] and operates on the principle of the modern surgical hemostat (Fig. 9.20).

When circumstances did not allow for tying the bleeding *vena*, Celsus says that "it can be burnt with a red-hot iron." Or else, "apply a [*suction*] cup to a distant part, in order to divert thither the course [*cursus*] of the blood." There were good reasons to give this method last: it could not possibly work.

Note that Celsus always speaks of bleeding *venae;* he still has in mind that arteries contain air.[179]

Bleeding and inflammation in a wound, in the mind of a modern surgeon, are about as unrelated as leak and a fire on board, in the mind of a skipper; but the Greeks, obsessed with the notion that blood is attracted around the wound and causes inflammation, felt that bleeding *protected* the wound against inflammation. If one remembers this, the following passage of Celsus becomes understandable:

> Against bleeding there is help in the foregoing measures; but against inflammation it lies simply in the bleeding itself. Inflammation is to be feared when a bone is injured or sinew or cartilage or muscle, or whenever there is little outflow of blood compared to the wound. Therefore, in such cases, it will not be desirable to suppress the bleeding early, but to let blood flow as long as it is safe; so that if there seems too little bleeding, blood should be let from the arm as well, at any rate when the patient is young and robust and used to exercise, and much more so when a drinking bout has preceded the wound [*back to the awful practice of bleeding the wounded*].
>
> Now, when bleeding has been suppressed if excessive, or encouraged when not enough has escaped of itself, then by far the best thing is for the wound to become agglutinated.[180]

In other words: once the wound has bled, let it heal (rather than keeping it open to let the bad humors drain out). This wiser choice is stated much more emphatically than in the Hippocratic books.

Celsus on Closing Wounds

To close a wound, "there are two treatments. For if the wound is in a soft part, it should be stitched up, and particularly when the cut is in the tip of the ear or the point of the nose or forehead or cheek or eyelid or lip or the skin over the throat or abdomen."[181] Stitching has become much more commonplace. As in Greece, it is recommended mostly for the face. For very fine work, as on the eyelids, Celsus recommends the hair of a woman[182]—a method that has only just died away: the last Deaconess sister to provide her hair for corneal sutures still works at the University Eye Clinic in Geneva (her hair is no longer requested, but I understand that it served the purpose quite well[183]).

Celsus continues:

> But if the wound is in the flesh, and gapes, and its margins are not easily drawn together, then stitching is unsuitable; fibulae (the Greeks call them *anctéres*) are then to be inserted, which draw together the margins to some extent and so render the subsequent scar less broad.[184]

Closing wounds with metal pins, *fibulae,* must have been introduced sometime during the four hundred years since Hippocrates—a rather late development, since the method is used among primitive peoples. The very fact that Celsus feels compelled to quote the technical name of *ancteres* points to a