Appendices: Oribasius *De Laqueis*

A. Bibliographical notes on Oribasius's *Medical Collections* .......... 103

B. A literal translation of Heraklas's descriptions of surgeon's knots used by Greek physicians in the first century, with illustrative diagrams and notes ......................................................... 107

C. The anonymous drawings in the fifteenth-century MS. Grec 2248 (Bibliothèque Nationale). Reduced in size ......................... 132

D. Primaticcio's drawings in the sixteenth-century MS. Latin 6866 (Bibliothèque Nationale). Reduced in size ....................... 136

E. The woodcuts in Vidus Vidius's *Chirurgia*, 1544, pages 467-476. Reduced in size ................................................................. 142

F. P. Lackerbauer's drawings in Bussemaker and Daremberg's *Œuvres d'Oribase*, IV, 1861, 691; and Elli Öhrvall's drawings in Hjalmar Öhrvall's "Något om knutar i antiken, särskilt hos Oribasius," *Eranos*, XVI (1916), 57. Reduced in size ................................................................. 148
APPENDIX A

MANUSCRIPTS, EDITIONS, AND ILLUSTRATIONS

The oldest extant manuscript of Oribasius's *Medical Collections* is the Laurentian Library's MS. Plut. 74.7. This "noble" manuscript—the adjective is Raeder's—was made in the tenth century by the Byzantine physician Nicetas, possibly at the command of the Emperor Constantine Porphyrogenitus (905-959). Parts of it are illustrated by colored miniatures, but not the parts, unfortunately, attributed to Heraklas.

The Codex of Nicetas, as MS. Plut. 74.7 is sometimes called, was brought to Italy in the fifteenth century by an eminent Greek scholar, John Lascaris by name, a refugee from Turkish-dominated Constantinople. Cardinal Niccolo Ridolfi, the bibliophile, acquired it, and Vidius Vidius (1500-1569), a Florentine who became physician to Francis I and professor of medicine in the Collège de France, translated it into Latin. Vidius is remembered today, not only because he translated Oribasius, but also because the Vidian nerve, the Vidian canal, and the Vidian artery, which he first described, are named for him.

The manuscript of Vidius's translation (MS. Latin 6866 in the Bibliothèque Nationale) contains about two hundred pen-and-bistre drawings by the Italian painter, sculptor, and architect Francesco Primaticcio (1504-1570), the leading artist in France during the middle years of the sixteenth century. Most of his drawings are modified copies or imitations of the miniatures in the Codex of Nicetas, but at least eighteen of them, illustrative of Heraklas's chapters on surgeon's slings, are new. Only one of the eighteen, the drawing of the ertos brokhos (Heraklas's Chapter 1), interprets Heraklas's meaning correctly.

Some impressive woodcuts, based on Primaticcio's drawings—mirror copies of them, in effect—are included in a handsome folio edition of Vidius's translation, sponsored by Francis I, and entitled *Chirurgia e Graeco in Latinum conuersa, Vido Vidio Florentino interprete, cum nonnullis eiusdem Vidii commentariis*, Paris, 1544. These woodcuts are obviously the work of a master, and may be by Primaticcio himself.

Imitations of the woodcuts in Vidius's folio, all of them artistically commonplace, are included in at least three early editions of Oribasius: namely, 1. *Chirurgia. De Chirurgia Scriptores Optimi quiue Veteres et Recentiores, Plerique in Germania Antehoc Non Editi*, Zurich, 1555
APPENDIX A

(folio); 2. *Medicae artis principes, post Hippocratem & Galenum*, Paris, 1567 (2 volumes in 5 parts, folio, edited by Henricus Stephanus, i.e., Henri Estienne, 1528-1598, called “le Grand”); and 3. *Les Anciens et Renommés Auteurs de la Medicine & Chirurgie*, Lyon, 1555, and Paris, 1634 and 1654 (octavo). The 1555 and 1654 editions, which I have not seen, are listed in the printed catalogue of the Bibliothèque Nationale. The British Museum and the College of Physicians of Philadelphia possess copies of the other works cited in this and the preceding paragraph.

Vidius, in a note on Folio 305 of Latin MS. 6866 prefixed to Heliodorus’s chapters in Oribasius’s *Medical Collections*, speaks about the effort he has made “to paint and make wooden” the machines described by Heliodorus, and to place them before the eyes of the reader (*ob oculos ponerem, et pingere et lignea conficere studeo*). He uses the first person singular, but does not mean, of course, that he made the drawings and the woodcuts with his own hands. John Santorinos of Rhodes, he says, and Francisco Primaticcio of Bologna, “distinguished painter to the King of France,” assisted him.

This note of Vidius’s is the only direct evidence, as far as I know, that Primaticcio made the drawings in MS. Latin 6866, and it is for this reason, I suspect, that Henri Omont uses the cautious phrase “attribués au Primatice” on the title-page of his *Collection de Chirurgiens Crées* [1908], which includes facsimiles of the drawings in the manuscript. Louis Dimier, on the other hand, does not question the attribution in his authoritative *Le Primatice*, 1928.

But if Primaticcio was solely responsible for the drawings in Vidius’s manuscript, who was Santorinos, and what was his role in the undertaking? According to Dimier (who does not cite the source of his information), Santorinos was an apothecary, and Primaticcio worked under his direction. Omont, on the other hand, cites a Greek epigram by John Lascaris (who brought the Codex of Nicetas to Italy) in which Santorinos is credited with having made the drawings in MS. Grec 2247 (Bibliothèque Nationale). This manuscript is a copy of the Codex of Nicetas. It does not contain any drawings of Heraklas’s knots. Lascaris’s epigram can be found in Emile Legrand’s *Bibliographie Hellénique*, III (1903), 410.

Somewhat before Vidius’s time, and Primaticcio’s—probably, in
APPENDIX A

fact, in the fifteenth century—an anonymous artist had tried to identify and depict Heraklas's knots. His drawings, which are in one of the Greek manuscripts of Oribasius in the Bibliothèque Nationale (MS. Grec 2248), are clumsy in comparison with Primaticcio's, and they reveal an even more fundamental misunderstanding of Heraklas's meaning. They are rather charming, however, in a naïve sort of way. Thus, when Heraklas prescribes a noose round a broken bone in a patient's limb, the literal-minded artist draws a picture of a bone—sans flesh, sans skin, sans everything. Vidius and Primaticcio were probably acquainted with his drawings, for their interpretations of Heraklas's Chapters 1, 2, 4, 7, and 18 are identical with his. Only his first diagram, illustrative of the erts brokhos, is correct.

More than four and a half centuries went by before another attempt was made to identify Heraklas's knots, and then, in 1916, Öhrvall published his article “Något om knutar i antiken, särskilt hos Oribasios” in the Swedish periodical Eranos. Bussemaker and Daremberg had included drawings by P. Lackerbauer, purporting to depict Heraklas's knots, in their comprehensive edition of Oribasius (Euvres d'Oribase, 6 volumes, Paris, 1851-1876);¹ but these are mere copies, chosen haphazardly, of the drawings in MS. Grec 2248 and in MS. Latin 6866. Only the first is correct.

Hjalmar Öhrvall was well qualified to understand Heraklas's descriptions. A physiologist with an international reputation, a popular professor in Upsala University, and an experienced yachtsman, he was the author of an excellent knot-book entitled Om Knutar (first edition, 1908; second edition enlarged, 1916). Öhrvall's identification of Heraklas's Chapters 2, 5, 7, 8, 9, 10, 11, 13, 14, 17, and 18 are correct, in my opinion, but he goes astray in his interpretations of Chapters 1, 3, 4, 6, 12, 15, and 16. Further comment on his identifications is provided on page 151 in my notes on the individual knots.

The late Lawrence G. Miller of Boston, a man with an analytical turn of mind, became interested in Heraklas's knots and slings during World War II and succeeded in identifying all of them to his own satis-

¹ Raeder's edition of Oribasius (Oribasii Collectionum Medicarum Reliquiae, 4 volumes, Berlin, 1928-1933) has superseded Bussemaker and Daremberg's. It does not contain any illustrations.
faction and to mine. He published only one of his identifications himself: the *plinthios* (Heraklas's Chapter 13)—see his article entitled "The Earliest (?) Description of a String Figure" in *The American Anthropologist*, XLVII (1945), 461-462. I included them, however, together with a free translation of Heraklas, based primarily on Bussemaker and Daremberg's French translation, in *The Art of Knotting and Splicing* (Dodd, Mead, 1947; U. S. Naval Institute, 1955). Miller's interest in Heraklas was a by-product of his familiarity, acquired during many years of practice as a patent attorney, with the intricacies of the knot-tying machines that are used in the textile industry.

Vidius's purpose in publishing his translation of Oribasius was to furnish the physicians of his day with useful information about Greek medical lore. Öhrvall and Miller labored over Heraklas's descriptions for their own amusement. I have labored over them because of a quixotic compulsion to finish the things that I begin. The result of my labor, presented in the following pages, is a memorial (definitive, I hope) to the obscure Greek physician named Heraklas and his obscure but fascinating little essay on knots.
CHAPTER I: THE ERTOS BROKHOS

1. How the noose called continuous is tied. From Heraklas.

For the tying of the continuous noose, a cord, folded double, is procured. The ends are held in the left hand, and the loop is placed on the ends with the right hand. Then the slack parts of the cord, that is, the ends, are passed together through the middle of the loop. In this way the knot of the noose is on one side and the ends are on the other.

In its function, this is a noose of unequal tension, and it is useful not only for traction but also for holding a limb during reduction and for placing the body in position during a surgical operation. It has been adapted for traction on limbs with two bones when one of the bones is injured, the loops of the noose being arranged on the injured bone, and the ends on the sound one. The loops, applied close to the skin, pull the injured parts vigorously; the ends, separated from the skin, do not pull the injured parts, or pull them less.

This noose is adapted for holding a limb that is being reduced, as in the three kinds of elbow dislocations, that is, the interior, exterior, and posterior kinds, when the arm is bent and cannot be straightened. The noose is placed round the bones of the forearm close to the wrist, and then the ends are carried up and attached to something immovable to hold them. The noose is also useful for holding the body in position during surgery. In ailments of the rectum, the forearms are placed
under the hams, and continuous nooses are put round the forearms near the wrists, and then the ends of the nooses are carried up behind the patient's neck and knotted together.

The continuous noose is not only tied before being put round, but it is also completed while being put round the limb. A cord . . . and the loop is placed under the limb, and the ends of the cord are passed together through the middle of the loop. And in this way the noose in question is produced while being put round.

The ertos brokhos is the easiest of Heraklas's knots to identify. MS. Grec 2248, MS. Latin 6866 (Vidius and Primaticcio), and Miller agree that it is the knot commonly seen on keys and baggage tags and called, in English, the lark's head or cow hitch. Öhrvall alone has doubts and argues that Heraklas's directions, although they seem to produce a lark's head, actually produce what he calls an enkelt taljerepsstek, which, literally translated, means "single lanyard hitch," and must not be confused with the enkelt taljerepsknop, or Matthew Walker knot.

But Heraklas's directions produce an enkelt taljerepsstek only if, after the loop of the cord is folded back, the ends are separated, carried past the loop, and then returned through the loop. Heraklas, as I read him, does not suggest anything of the sort.

Öhrvall appears to have been influenced by Bussemaker and Daremberg, who translate the word ἐπτῶν by the word tressé (braided). Öhrvall translates it by the Swedish equivalent snodd (twisted), and since the lark's head, as he points out, does not in any way deserve the name snodd knot, he concludes that the ertos brokhos is not a lark's head.

Eπτῶν, however, does not mean tressé, snodd, braided, or twisted. Liddell and Scott define it as "threaded, passed through," and derive it from the verb ἐπω (tie, join, fasten together). They seem to have inferred its meaning from their interpretation of Heraklas's directions as well as from its etymology. I have translated it by the word "continuous," for ἐπω, which is related to the Latin sero, implies a "fastening together in rows," as a string of beads; and the hitches of a lark's head can be laid on continuously, one after the other, and need not be limited to two. Vidius calls the ertos brokhos a laqueus attolens, or lifting hitch, an appropriate name in view of the universal use of the knot as a sling for lifting barrels, bales, and other heavy objects.
The word ἐπρός is not a hapax legomenon, as the Thesaurus Graecae Linguae seems to imply, for Heliodorus, one of Heraklas's contemporaries, uses it twice in his account of the machines used by physicians in the first century A.D. for the purpose of exerting traction and achieving extension in the reduction of dislocations (Oribasius, Book XLIX, Chapters 10 and 30). Primaticcio's drawings of Heliodorus's machines correctly depict the ertos brokhos as a lark's head—for example, the drawing on folio 346 of Vidius's manuscript and (as a woodcut) on page 529 of Vidius's 1544 folio.

CHAPTER II: THE NAUTIKOS BROKHOS

2. How the noose called nautical is tied.

A cord is procured, and two loops (placed beside each other according to an opposite arrangement, one of them outside from within, the other inside from without) are tied in the middle of the slack part of the cord. Thus the knot of the noose is on one side and the ends on the other.

This noose, too, is considered useful for exerting unequal tension, and also for holding splints when applying splints to fractures. After the bandaging, the end of the thong is held in the left hand, and with the rest of the slack part, first one loop is made, and then another, round the injured limb. Then the opposite end of the thong is passed through the middle of the loops from the near to the opposite side and held with the left hand. The noose having been formed, the splints are placed round the injured limb between the noose and the bandage, and the ends of the thong are pulled tight and knotted together to hold the splints.

The same noose has been adapted for suspending the forearm as well as for traction and for holding the splints together. It is tied and placed round the forearm when the available bandage is not large enough for the suspension of the arm. The loops of the noose are separated from each other, one loop being placed near the elbow and the other near the wrist, and the ends are carried up round the patient's neck and knotted together.

Both Öhrvall and Miller identify the nautikos brokhos, probably correctly, as the familiar mariner's knot called in English the clove
hitch. Heraklas describes two ways to tie it, in hand and in situ, and both of his descriptions present problems. To tie it in hand, according to his first description, place two loops beside each other, “one of them outside from within, the other inside from without.” These are enigmatical words, to say the least, and they illustrate very well the inadequacy of verbal descriptions of knots unaccompanied by diagrams. My interpretation of what they mean is shown in Fig. 1. Primaticcio and the anonymous artist of MS. Grec. 2248 picture the knot that Öhrvall, in his interpretation of the ertos brokhos, calls the enkelt taljerepsstek.

Heraklas’s description of the way to tie the nautikos brokhos in situ (i.e., while putting it round a patient’s limb) is clear enough, but nonetheless unsatisfactory. Forming two loops round an object and then passing the end through both loops (see Fig. 3) does not produce a clove hitch, or in fact any knot at all. Öhrvall, disturbed by the plural
“loops,” suggests that Heraklas “without doubt refers to the second loop.

My way out of the difficulty is to assume that the second loop is laid over the first loop (see Fig. 4). This solution to the problem salvages the plural “loops,” but does not dispose of all possible doubts.

If the working end is passed over the standing part (Fig. 6) instead of under it (Fig. 4), the result is the constrictor knot instead of the clove hitch. I am not suggesting that the nautikos brokhos is the constrictor knot, but in view of the similarity between the technique of tying it and Heraklas’s technique of tying the clove hitch (or at least my interpretation of his technique), it is interesting to speculate if the ancients were familiar with it.

Modern users of knots are not generally familiar with it. Indeed, it seems to have been utterly unknown in the English-speaking world until Clifford Ashley (who thought he had originated it) taught it to the Portuguese swordfishermen of New Bedford, gave it the name “constrictor knot,” and published it in The Ashley Book of Knots (1944). Since then, a great many people have become acquainted with it.

Ashley did not originate it, however, for Martta Ropponen, a Finnish Girl Scout leader, had already published it in her excellent handbook entitled Solmukirja (1931). She had never seen it in Finland, she wrote me in 1954, but had learned about it from a Spaniard named Raphael Gaston, who called it a whip knot, and told her it was used in the mountains of Spain by muleteers and herdsmen.

We may take it for granted, I think, that it is a traditional knot, handed down from generation to generation (in Spain, at least, if not elsewhere) ever since Roman times and earlier. Some day, I hope, it will turn up somewhere else—among the Arab fishermen of the Red Sea, perhaps, or on a Greek merchant vessel brought to the surface by a modern under-water archaeologist.

The word Heraklas usually uses for “cord” is καυρία, which Liddell and Scott define as a “tape or cord used for ligatures.” In the present chapter, he uses the word ἱφάς, which Liddell and Scott define as “a leathern strap or thong.” Whether the καυρίαι were also made of leather is a question that perhaps cannot be answered. Heliodorus generally uses the word καυρία in his treatise on machines (Oribasius, Book XLIX, Chapters 1-35), but in at least one instance (Chapter 22), when
discussing a machine invented by Apellides and Archimedes, he uses
the word κάλος, which means "rope."

CHAPTER III: THE CHIESTOS BROKHOS

3. How the noose called crossed is tied.

For the tying of the crossed noose, a cord, folded double, is procured,
and the ends of the cord are held in the left hand, and the loop is held
in the right hand. Then the loop is twisted so that the slack parts of the
cord are crossed. Hence the noose is called crossed. After the slack
parts of the cord have been crossed, the loop is placed on the crossing,
and the lower slack part of the cord is pulled up through the middle of
the loop. Thus the knot of the noose is in the middle, with a loop on
one side and two ends on the other. This likewise, in function, is a
noose of unequal tension.

III. CHIESTOS BROKHOS

The chiestos brokhos is undoubtedly our overhand slip knot or run­
nning knot. Heraklas's directions, if interpreted literally, seem to pro­
duce a mere overhand knot, and Öhrvall so interprets them. It is
impossible to believe, however, that anyone as intelligent as Heraklas
would tie a mere overhand knot by the involved technique he recom­
mends.
Accordingly, when he says that "the lower slack part is pulled up through the middle of the loop, we must assume that he means a loop (or bight) in the lower slack part (Fig. 3), and not the entire slack part, end and all.

Öhrvall's interpretation is untenable for two additional reasons: (1) the overhand knot is treated separately in Heraklas's Chapter 6 under the name haploun hamma or single knot; and (2) if the chiestos brokhos were a mere overhand knot rather than an overhand slip knot, Heraklas's Chapters 4, 15, and 16 would be unintelligible—as, indeed, to Öhrvall they are.

CHAPTER IV: THE SANDALIOS OR BOUKOLIKOS BROKHOS

4. How the noose called pastoral or sandal is tied.

The pastoral noose is also called, by some, the sandal noose. Whatever it may be called by some, it is tied with the so-called crossed noose [Chapter 3]. First tie the crossed noose. Then, so that the sandal noose may be produced, pull the loose loop of the crossed noose up from below through the middle of the loop opposite the ends. Thus the knot of the noose is on one side and the ends on the other. In the knot itself, three loops are seen, two on each side, and the third in the middle.

This noose is useful for extension in the reduction of an ankle. One
loop is put round the broad tendon behind the ankle. The second loop is arranged on the front part in the area of the tarsus, and the middle loop, that is, the third, is placed in the area of the sole, and the ends of the noose are then attached to the source of the traction.

This noose is adapted not only for the ankle, but also for the reduction of a dislocated jaw. One loop of the noose is placed on the patient’s forehead, a second on the nape of the neck. The middle loop is inserted in the mouth under the jaw, and the ends are carried up past the temples above the patient’s head and secured to something to hold them or pull them up.

The sandalios or boukolikos brokhos should be classified as a sling rather than as a knot or noose. It is an adaptation of the chiestos brokhos (Chapter 3), and resembles the modern bandage called Barton’s handkerchief or cravat of the heel. See H. R. Wharton’s Minor Surgery and Bandaging, 3rd edition, 1896, p. 40, Fig. 35. Öhrvall, having failed to identify the chiestos brokhos correctly, inevitably goes astray in his interpretation of the sandalios brokhos.

CHAPTER V: THE DRAKON BROKHOS

5. How the noose called the serpent is tied.

For the tying of the so-called serpent, the middle is placed on the back of the ankle in the area of the broad tendon. The ends are carried past the lateral parts toward the front on the tarsus, and exchanged according to a crosswise arrangement. Then they are carried to the sole.
of the foot and exchanged again. From the sole they are placed on the
turns encircling the ankle, either up from below or down from above,
and then they are attached to the source of the traction. This noose is
useful for extension in the reduction of a [broken] ankle.

The drakon brokhos, like the sandalios brokhos, is really a sling
rather than a knot or noose. Öhrvall observes that it is impossible to
misunderstand Heraklas's directions. Hence he does not provide an
illustrative diagram of the drakon brokhos. Gerdy's extension knot,
illustrated in E. L. Eliason's Practical Bandaging, 3rd edition, 1924,
Figs. 116B and 116C, is very much like Heraklas's drakon brokhos.

CHAPTER VI: THE HAPLOUN HAMMA BROKHOS

6. How the noose called single knot is tied.

The noose called single knot is also called perinaios by some. What­
ever it is called, the knot is considered suitable for the purpose [for treating the perineum?]. A cord is procured and a single knot is made in it. Then the loops of the cord are pulled up and the ends allowed to re­main free. Then the member to be restored is placed between the upper
loops, and one loop is passed through the other loop and carried toward
the ends and attached, with a knot shared by the ends, to the source of
the traction. In function this also is a noose of unequal tension.

6. HAPLOUN HAMMA BROKHOS

1. Pull loops up

2. Place patient's limb at "A"

3. Nameless construction
APPENDIX B

Heraklas takes it for granted that his readers will know what he means by a *haploun hamma*, or single knot. Although his directions are for the most part quite clear, it is not self-evident what he means by the loops of a *haploun hamma*, for one does not normally think of an overhand knot as having loops, plural, other than the main loop of the knot. Öhrvall’s interpretation of the *haploun hamma brokhos* is incorrect, in my opinion. Miller’s interpretation (Figs. 1-3) is much more plausible.

CHAPTER VII: THE LYKOS BROKHOS

7. *How the noose called wolf is tied.*

Two cords sufficient in length and folded double are procured, and the ends are placed at the same point, and the loops opposite each other. Then the ends of one of the cords are pulled up from below, and those [of the other] are drawn down from above. Thus the knot of the noose appears in the middle, and the two ends on each side. In function this is a noose of equal tension. It is adapted not only for traction in setting bones, but also for binding the peritoneum in the reduction of intestinal hernia, and for binding hemorrhaging vessels.

It is customary for us to hang simple linen cords to the loops of the noose, and most physicians call these cords relaxing cords. We do not use the relaxing cords aimlessly, but in order that, when we wish to relax the ligature, we may do so, not by means of the loops of the noose, but by means of the relaxing cords.

VII. LYKOS BROKHOS

![Diagram of the lykos brokhos knot]

**INTERLOOPED BIGHTS**

The *lykos brokhos* is structurally identical with the square knot (Heraklas’s Chapter 8), but serves to join the bights or middle parts of two cords, whereas the square knot joins the two ends of a single cord.
APPENDIX B

The distinction is fundamental, and Heraklas, in insisting on it, displays the characteristic acuteness of his intellect. The *skhasteriae*, or relaxing cords, mentioned by Heraklas are attached on each side of the knot and pulled in the directions shown by the arrows in the accompanying sketch.

Heraklas calls the wolf an *ισότονος* noose. The *ertos*, *nautikos*, and *chiestos brokhoi* (Chapters 1, 2, and 3), he says are *ἀνισότονος*. These words are not very satisfactorily glossed by Liddell and Scott; and Bussemaker and Daremberg, the French translators of Oribasius, had trouble with them. I have followed their example, however, and used the phrase "of equal (or unequal) tension." I have done so with misgivings, and for lack of a more precise English equivalent.

Heraklas has in mind the fact that some nooses, after being applied to a patient’s limb, are intended to be pulled in one direction, or on one side of the limb only. Others, such as the *lykos brokhos*, have ends or loops that have to be pulled on both sides of the limb. Liddell and Scott’s definitions of *ισότονος* and *ἀνισότονος* are "pulling evenly" and "unequally stretched," phrases that are neither grammatically parallel to each other, nor wholly satisfactory in the context of Heraklas’s descriptions.

**CHAPTER VIII: THE HERAKLEOTIKON HAMMA**

8. How the Hercules knot is tied.

**XIII. HERAKLEOTIKON HAMMA**

*Square Knot*

*For the Hercules knot, a cord is procured, and two knots, separated from each other, are formed in this cord. In this way the Hercules knot is produced: a loop on one of the two sides, two ends on the other. This*
APPENDIX B

is a noose of equal tension. If we cut the loop in the middle opposite the ends, we find that a wolf [Chapter 7] is produced.

The difference between the Herakleotikon hamma and the lykos brokhos (Chapter 7), mentioned above, is implicit, I surmise, in the words ἁμψα (knot) and βρόχος (noose). The former suggests a knot that cannot slip, that is pulled tight and remains so. The latter suggests a knot that encloses an object and draws up tighter the harder it is pulled. Heraklas uses the word ἁμψα for one other knot: the haploun hamma, or overhand knot, which also remains fixed once it has been pulled tight.

If the cord is cut at point A in the diagram, the result is a lykos brokhos, or wolf, as Heraklas observes.

CHAPTER IX: THE HAPLOUS KARKHESIOS

9. How the single karkhesios noose is tied.

The single karkhesios, of equal tension in its function, is tied as follows: a cord, folded double, is procured, and the ends are held in the left hand, and the loop, having been folded back with the right hand, is placed on the ends. Then the slack parts of the cord are exchanged in a crosswise fashion, and the loop that has been placed on the ends is
pulled down from above through the middle of the crossed parts. Thereupon the knot of the noose is seen in the middle, and a loop on one side and two ends on the other.

The single karkhesios is a familiar knot known in every quarter of the globe, and called in English by a variety of names: true-lover’s knot, true-love knot, dalliance knot, Englishman’s loop knot, fisherman’s loop knot, and (among mountain climbers) middleman’s knot. Heraklas’s directions for tying it are clear and precise, and as a result (or perhaps because everyone in the sixteenth century knew it), one of Primaticcio’s drawings is very nearly correct—the one that shows how it looks before being put round a patient’s limb. The other drawing, which purports to show it on a man’s ankle (see page 137), is an entirely different knot, and bears no resemblance to the true-lover’s knot.

This discrepancy is extraordinary, in fact unaccountable from a twentieth-century point of view, but it is not unique. The same sort of pragmatic blindness is revealed in Primaticcio’s drawings for Chapters 3, 8, 10, 11, 12, 13, 15, and 16. His drawings for Chapters 10, 11, and 12 (the double karkhesios) show six altogether different knots. He was more interested in anatomy, clearly, than in surgeon’s slings and nooses.

CHAPTER X: THE DIPLOUS KARKHESIOS (1)

10. How the double karkhesios is tied.

With respect to its function, the double karkhesios is a noose of equal tension, and much more tightly knit than the single karkhesios [Chapter 9]. It is tied as follows: A doubled cord is procured, and the ends are held in the left hand, and the loop is allowed to hang free. Then in the opposing slack part of the cord a small loop is tied and placed in the left hand. Through the middle of this little loop the other slack part of the cord is pulled up, and then the knot is turned over by means of the loops and placed in the left hand. Again, the knot having been turned over, another little loop is tied in the opposite slack part of the cord and placed on the knot. Finally the loop that is hanging free is pulled up from below through the middle of the knot. Thereupon, once again, the knot of the noose is found in the middle and a loop on one side and the two ends on the other.
Chapters 10, 11, and 12 show three ways of tying the double kar­kheshios, and all of them produce the ingenious knot known variously as the jug sling, the jar sling, the bottle sling, and the hackamore. The first way is less involved than Heraklas’s rather elaborate instructions would seem to indicate, for the starting point in the process is a chiestos brokhoi (Heraklas’s Chapter 3) or overhand running knot.

It is important to note, in following Heraklas’s instructions, that he means the middle or bight of the slack part, and not the entire slack part, end and all, when he says that “the other slack part of the cord” is pulled up through the “little loop.” The instructions in this chapter, therefore, are exactly like the instructions that troubled Öhrvall in Chapter 3 and led him to identify the chiestos brokhoi as a mere overhand knot.

Heliodorus, Heraklas’s contemporary, prescribes the karkhesios “or some other isotonos noose” in fifteen of the thirty-five chapters on the machines used by ancient physicians for exerting traction and achieving extension in the reduction of dislocations (Oribasius, Book XLIX, Chapters 8, 9, 10, 12, 13, 17, 21, 24, 25, 28, 29, 30, 31, 33, and 35). He does not say, however, whether he means the single or the double variety of the knot.

120
APPENDIX B

Both Primaticcio and Bussemaker and Daremberg assume that he means the single variety. Primaticcio, in his drawings of Heliodorus's machines, always depicts them in the same way that he depicts the single karkhesios round a man's ankle in Heraklas's Chapter 9. See page 138 below.

Bussemaker and Daremberg, in their translation of Heliodorus's chapters, provide cross-references to Heraklas's Chapter 9 (the single karkhesios), and not to Chapters 10, 11, or 12 (Œuvres d'Oribase, IV, 1872, 333-458). It is apparent, however, from Heliodorus's phrase "or some other isotonos noose," that either the single karkhesios or the double karkhesios, or even the lykos brokhos (which Heraklas calls a noose of equal tension), would have served his purpose acceptably. Heliodorus and Heraklas themselves, I suspect, used the double karkhesios. It is a better knot than the single karkhesios (it would hold the patient's limb more securely, and with a more uniformly distributed pressure on the tender skin and flesh), and the fact that Heraklas devotes three chapters to it implies a certain legitimate satisfaction, which Heliodorus probably shared, in knowing how to tie it.

CHAPTER XI: THE DIPLOUS KARKHESIOS (2)

11. How the double karkhesios is tied from the single karkhesios.

The double karkhesios is customarily completed in various ways, sometimes being tied by itself and sometimes from a single karkhesios. There is also a way by which it is completed while being put round. Having shown with due regard for reason how it is tied by itself, we now wish to explain how it is brought to completion from a single karkhesios. First, therefore, tie the single karkhesios, and separate the loops from each other. Then, placing the lower loop on the upper loop, separate the loops from each other and pull the loop that is opposite the ends up from below through the space between the separated loops. In this way, again, the knot of the noose is found to be in the middle, and the two ends on one side and a loop on the other.

Heraklas's directions for tying the double karkhesios from the single karkhesios would be difficult to follow if the final result were not known in advance. But Öhrvall and Miller, having solved Chapter 10, find Chapter 11 reasonably intelligible. The chief stumbling block is Hera-
klas's second injunction to separate the loops. These are, in fact, knots rather than loops; and they should be enlarged, so as to overlap, rather than separated. The overlapping parts of the loops should be separated, not the loops themselves. See Figs. 1 and 2.

A method of tying the double karkhesios not mentioned by Heraklas is shown in Fig. 4 and illustrates the structural relationship between the single and the double karkhesios. Compare Fig. 4 on this page and Fig. 2 on page 118. Both methods begin with the same configuration, but, as the arrows show, the loop or bight is passed through the center of the crossed parts in different ways.

CHAPTER XII: THE DIPLOUS KARKHESIOS (3)

12. How the double karkhesios is formed while being put round.

Since it often happens that the ends of the noose are broken as a result of excessive tension on the taut parts, the traction not yet being ready, we complete the karkhesios noose as we put it round in order that the ends of the noose that remain free may not be relaxed. We grasp the end of the cord with the left hand, and then, with the slack part, we form three loops round the limb to be set, separated a sufficient distance
from each other. After this we place the first loop on the last, and then we pull up the middle loop through the space between them, twisting it once or twice. In this way the knot of the noose is formed round the limb itself, with two ends on one side and a loop on the other.

Heraklas’s directions for tying the double *karkhesios* round the patient’s limb (i.e., in situ) pose a problem. Öhrvall does not attempt to interpret the chapter, and Miller’s solution, published in my book *The Art of Knotting and Splicing*, produces an unsatisfactory sort of pseudo-*karkhesios*. Both Öhrvall and Miller postulate a lacuna in the manuscript, and in fact three loops manipulated exactly as Heraklas prescribes seem to produce a single *karkhesios* or true-lover’s knot rather than a double *karkhesios*.

This, however, cannot have been Heraklas’s intentions, for the single *karkhesios* when tied in the way shown in Figs. 1 and 2 cannot be adjusted and made use of until the object round which it is tied has been
removed. There would be no point in tying a single karkhesios round a patient’s limb by this technique.

I devoted an afternoon to the problem on Washington’s Birthday, 1965, and reached the conclusion illustrated in Figs. 3 and 4. As in the case of Heraklas’s Chapter 2, where the loops have to be passed round the patient’s limb in a particular way in order to produce a nautikos brokhos or clove hitch in situ, so here, I believe, the loops prescribed by Heraklas have to be passed round the limb in a particular way in order to produce the double karkhesios in situ.

To explain so complicated a procedure verbally would perhaps be an impossibility. One wonders if Heraklas did not rely on diagrams of some sort, and if so why Nicetas did not include them in his codex.

CHAPTER XIII: THE FOUR-LOOP PLEINTHIOS

13. How the noose called the four-loop plinthios is tied.

For the tying of the plinthios noose, a cord forming a circle, that is, having no ends, is procured and placed round both hands on the space between the thumb and the little finger. It is also placed round the index finger, so that six loops are produced, three on each hand, on the little finger, on the index finger, and on the thumb. After that the loops are transferred from the thumb to the ring finger and from the little finger to the index finger, and then, with the aid of the thumb, the loops just placed on the index finger are pulled down from above through the space between the first fingers and placed on the index fingers. As a result the knot of the noose appears in the middle in the form of a rhomboid, with two loops on each of the two sides.

In its function, this is a noose of equal tension, and it seems to be useful not only for extension but also for the setting of fractures of the chin. Sometimes, in fractures of the chin, when we see the fractured parts becoming distorted from the outside, the rhomboidal knot of the noose is placed round the chin, and the loops are carried up past the cheeks and knotted to each other in the area of the top of the head.

The four-loop plinthios is as interesting ethnologically as the karkhesios. Both Öhrvall and Miller, working independently of each other, equated it with the string figure called “The Sun Clouded Over,” which W. E. Roth pictures in his “North Queensland Ethnography.”
I. POSITION 1: PICK LOOPS FROM PALMS WITH INDEX FINGERS

2. OPENING "A": TRANSFER THUMB LOOPS TO RING FINGERS

3. TRANSFER LITTLE-FINGER LOOPS TO INDEX FINGERS

1902, Plate X. See Öhrvall’s “Något om knutar i antiken, särskilt hos Oreibasios,” Eranos, XVI (1916), 75-76, and L. G. Miller, “The Earliest (?) Description of a String Figure,” The American Anthropologist, XLVII (1945), 461-462.

The first part of Heraklas’s description coincides with what ethnologists, in their analyses of primitive string figures, call “Position 1” and
“Opening A.” See Kathleen Haddon’s *Artists in String*, n. d., pp. 155-156. Neither Heraklas’s nor Miss Haddon’s descriptions are unmistakably clear in and by themselves. I have therefore provided five diagrams for the benefit of the neophyte as well as for the reader who has forgotten what he once knew about cat’s cradles.

XIII. PLINTHIOS BROKHOS

4. WITH THUMBS REMOVE LOWER LOOPS FROM INDEX FINGERS

5. A CAT’S CRADLE: "THE SUN CLOUDED OVER"

The more or less circular pair of loops in the center of the completed figure (Fig. 5) gets smaller and smaller, and finally seems to disappear, when one pulls on the four loops at the corners. Hence the aboriginal name “The Sun Clouded Over,” cited by Roth, is extremely apt. And so is the Greek πλινθος, for a πλινθιον is a small brick (i.e., a rectangular object), and the word πλινθον (the diminutive of πλινθος) denotes any of several square or rectangular objects.

126
14. How the interlooped noose is tied.

For the tying of the interlooped noose, a cord is procured, and the end is placed on the part of the hand between the thumb and the index finger. The slack part of the cord is rolled round the metacarpus from without, carried to the inner part, placed over the thumb, and held between the little finger and the ring finger. The end is pulled by the right hand, the middle part by the little finger and the ring finger. Thereupon two loops are seen, and between the two loops a running knot. This noose is useful in surgery for placing the body in position. The patient's hands are placed in the loops, and his body is secured by means of the rest of the slack part of the cord.

The *epankylotos brokhos* is the parlor magician's Tom Fool knot, and Heraklas explains one of the parlor magician's ways of tying it. When he says "the end is pulled by the right hand," he means, of course,
APPENDIX B

a bight or loop in the end, not the whole cord, end and all. Compare his comparable instructions in his descriptions of the chiestos brokhos (Chapter 3) and the double karkhesios (Chapter 10), which have to be similarly interpreted. Figs. 1 and 2 are intended to make his meaning clear.

The Tom Fool knot can be used to handcuff a prisoner, and it is for the purpose of immobilizing a patient’s hands during an operation that Heraklas recommends it.

CHAPTER XV: THE OTA BROKHOS

15. How the noose called the ears is tied.

For the tying of the ears, first tie the noose called interlooped [Chapter 14]. Make one loop intentionally larger and in it make the crossed noose [Chapter 3], in order that two loops may be seen, and that the double slack part of the cord may be found between the two loops.

This noose is useful for reducing dislocations of the jaw and for articulating the epiphyses of the head. The loops are placed beside the patient’s temples, and the double slack part on the forehead between the loops, and then the bandage called the rabbit is put on. After the bandaging the ends of the ears are brought up above the patient’s head and attached to something to hold them or to pull them up.

The ota brokhos has no name in English. Öhrvall, having failed to identify the chiestos brokhos, or overhand running knot (Chapter 3), is unable to understand the “ears.” For it is manifestly impossible to tie an overhand knot (Öhrvall’s interpretation of the chiestos brokhos) in one of the loops of a Tom Fool knot. It is quite possible, however, to tie an overhand running knot in one of the loops of a Tom Fool knot.
APPENDIX B

The accompanying diagram illustrates Miller’s solution to the problem. I have no doubt that it is correct.

The bandage that Heraklas calls the rabbit is described by Heliodorus, Heraklas’s contemporary, in Book XLVIII, Chapters 26 and 27, of Oribasius. Heliodorus’s name for it is “the rabbit bandage with the ears.”

CHAPTER XVI: THE DIANKYLOS BROKHOS

16. How the noose called two-looped is tied (by some incorrectly called the strangler).

The noose called two-looped is made from two crossed nooses [Chapter 3] separated from each other. It is convenient for putting the body in position when treating an ailment of the buttocks. For this purpose, the forearms having been placed under the thighs, the forearms are contained by the crossed nooses. The double slack part of the cord between the nooses is carried up round the patient’s neck and in this way the proper position of the body is achieved.

XVI. DIANKYLOS BROKHOS

NAMELESS CONSTRUCTION

The diankylos brokhos looks very much like the ota brokhos (Chapter 15), and has no name in English. Öhrvall, again, fails to solve Chapter 16 because, as in the case of Chapter 15, the solution depends on the correct identification of the chiestos brokhos (Chapter 3), which he misconstrues.

CHAPTER XVII: THE ANKHON BROKHOS

17. How the noose correctly called the strangler is tied.

The strangler, correctly so called, is tied with the single karkhesios [Chapter 9]. A single karkhesios is tied, and the loops are separated from each other. It is suitable for the same purposes as the one just
APPENDIX B

described [Chapter 16]. The forearms, again, are placed in the loops and bound tightly, and the doubled slack parts of the cord, which are arranged in the middle, are carried up behind the patient’s neck.

XVII. ANKHON BROKHOS

The ankhon brokos resembles both the ota brokos (Chapter 15) and the epankylotos brokos (Chapter 17). It is not a separate, distinct knot, structurally, but rather a single karkhesios (Chapter 9) with the two loops or overhand knots arranged at a distance from each other instead of tightly pressed against a patient’s limb.

CHAPTER XVIII: THE HYPERBATOS BROKHOS

18. How the noose called transposed is tied.

The noose called transposed is made with the noose called nautical [Chapter 2]. A nautical noose is tied and put round the forearms, and the loops of the noose are separated from each other. The ends are knotted behind the neck.

And these are the nooses that appear to be useful on a doctor’s rounds (διὰ τῆς περιοδοῦ).
APPENDIX B

Heraklas’s hyperbatos brokhos is a nautikos brokhos or clove hitch (Heraklas’s Chapter 2) with the hitches separated. Heraklas explains in Chapter 2 as well as here how to use it as a sling for the forearm. H. R. Wharton, Minor Surgery and Bandaging, 3rd edition, 1896, p. 395, pictures a forearm sustained by a clove hitch.

Heraklas’s final sentence indicates that his eighteen nooses could be used by themselves as well as in connection with the elaborate machines described by Heliodorus (Oribasius, Book XLIX, Chapters 1-35). Bussemaker and Daremberg render the phrase διὰ τῆς περιόδου as “hors de chez soi.”
APPENDIX C

MS. GREG 2248 C.1500

ΕΒΑΣΙΟΥ ΕΚ ΤΩΝ ΗΡΑΚΛΑΤΩΣ ΠΛΕΚΕΣ ΕΒΡΟΧΟΣΟ

·ΙΣΟΤΟΝΟΣ· ·Ε·

I  ERTOS BROKHOS  (CORRECT)

II  NAUTIKOS BROKHOS  (INCORRECT)

III  CHIESTOS BROKHOS  (INCORRECT)

IV  SANDALIOS BROKHOS  (INCORRECT)

III  CHIESTOS BROKHOS  (INCORRECT)

IV  SANDALIOS BROKHOS  (INCORRECT)
APPENDIX C

MS. GREC 2248 C. 1500

V. DRAKON BROKHOS (INCORRECT)

VI. HAPLOUN HAMMA BROKHOS (INCORRECT)

VII. LYKOS BROKHOS (INCORRECT)

VIII. HERAKLEOTIKON HAMMA (INCORRECT)

IX. HAPLOUS KARKHESIOS (INCORRECT)

X - XII. DIPLOUS KARKHESIOS (INCORRECT)
Orbasius de laqueis ex Heracleidio Video Florinio interprete
Qua ratione laquei Antolentis

I

ERTOS BROKHOS
(CORRECT)

II

NAUTIKOS BROKHOS
(INCORRECT)

III

CHIESTOS BROKHOS
(INCORRECT)
MS. LATIN 6866 C. 1540

I. Paeloralis laqueus, qui et sandalus diceretur quomodo migratur.

II. SANOALIOS BROKHOS (INCORRECT)

III. DRako laqueus qua via migratur.

IV. DRAKON BROKHOS (INCORRECT)

V. Qua ratione laqueus adhibetur quom simplici nudi descurt

VI. HAPLOUN HAMMA BROKHOS (INCORRECT)
MS. LATIN 6866 C. 1540

LVII
LYKOS
BROKHOS
(INCORRECT)

VIII
HERKLEOTIKON
HAMMA
(INCORRECT)

Simplux: Charchesium quern implicatur.

IX
HAPLOUS
KARKHESIOS
(INCORRECT)
APPENDIX D

MS. LATIN 6866 C. 1540

Duplex Charchesium, quomodo implectetur.

IX DIPLOUS KARKHESIOS (INCORRECT)

XI DIPLOUS KARKHESIOS (INCORRECT)

XII DIPLOUS KARKHESIOS (INCORRECT)

Duplex Charchesium quomodo implectur circunpendo.
Laercula qui alioquin quadruplex auriculis dicit eaque sit.

**XIII**
PLINTHIOS BROKHOS (INCORRECT)

Saequus Epangylotos (sic)
sup sumi myrteur) qua via
em appelit a quided
insert posse

**XIV**
EPANKYLOTOS BROKHOS (INCORRECT)

Rario eius saque quem auriculas mius par

**XV**
OTA BROKHOS (INCORRECT)
A P P E N D I X  D

M S .  L A T I N  6 8 6 6  C .  1 5 4 0

L a q u e n s  d u e s  h a b e n s  s m u s  q u e m  n o m m u l t a  m i n u s  p r o p r i é
S r a n g u l a n s e m  d e x e r ã e  g u o m o de  i n v e n t æ r

XVI
D I A N K Y L O S  B R O K H O S
( I N C O R R E C T )

XVIII
H Y P E R B A T O S  B R O K H O S
( I N C O R R E C T )

Q u o m o de  a d b i b e a s r  l a q u e n s  i n r e p i b a t ó s ,  id e n
t o m e n  t r a x i t  a b  s e c o  g .  s u p r æ s t r æ t u s.

XVII
A N K H O N  B R O K H O S
( I N C O R R E C T )

141
Oribasius de laqueis ex Heracle Vi-
DO VIDIO FLORENTINO INTERPRETE.

Quae ratio sit laquei attollentis.

Quomodo laqueus Nauticus debet adhiberi
Laqueus quomodo implicetur.

Pastoralis laqueus, qui & Sandalius dicitur, quomodo injiciatur.

Draco laqueus, quâ viâ injiciatur.

Qua ratione is laqueus adhibeatur, quem simplicem nodum dixerunt.
Lupus laqueus, quomodo nectatur.

Nodi Herculei ratio.

Simplex charchesius, quà via implicetur.
Duplex charchesius quo modo implicetur.

Duplex charchesius, quo modo ex simplici fiat.

Duplex charchesius, quomodo implicetur circumponendo.
Plinthij, quod alioquin quadruplex circulus dicitur, quæ ratio sit.

Laqueus Epangylotus (itæ enim appellatur, quoniam sinus super sinus inijcitur) quá viâ inferi possit.
Ratio eius laquei, quem auriculas nuncupant.

Laqueus duos habens sinus (quem nonnulli minus propriè strangulantem dixerunt) quomodo inijciatur.

+ Ratio laquei, quem strangulantem propriè nuncupant.

+ Quomodo adhibeatur laqueus ωιωγας εδ ενημ nomen traxit ex eo, quod supra feratur.
APPENDIX F

BUSSEMAKER AND DAREMBERG’S IDENTIFICATIONS
(DRAWINGS BY P. LACKERBAUER)

16. Lacs à deux anses ou étrangleur (Chapter 16): From MS. Grec 2248. Incorrect.
APPENDIX F

ÖHRVALL'S IDENTIFICATIONS (DRAWINGS BY E. ÖHRVALL)

1. Lärkhuvud.
2. Enkelt taljerepsstek (Chapter 1). Incorrect.
3. Dubbelt taljerepsstek.
4, 5. Sjömansknut (Chapter 2). Correct.
6, 7, 8. Öfverhandsknut (Chapter 3). Incorrect.
9, 10, 11. Pålagningsn (Chapter 4). Incorrect.
12, 13. (Chapter 5). Incorrect.
15. Käringknut.
16. Råbandsknut (Chapter 8). Correct.
17, 18, 19, 20. Kärleksknut (Chapter 9). Correct.
27. Trådfigur (Chapter 13). Correct.
29, 30. Öfverhandsknut med öglor (Chapter 14). Correct.