

Parts of the *Aulos*

As parts (μέρη) of the *auloi* (not the σύριγγες) are mentioned the γλῶττα, the τρυπήματα, the βόμβυκες, the ὄλμοι, and the ὑφόλμια⁶⁴⁸. According to Pollux, the original *aulos* had four finger-holes, before Diodoros of Thebai made it πολύτρητος (multi-holed), πλαγίας ανοίξας τῷ πνεύματι τὰς ὁδοὺς⁶⁴⁹.

The ὄλμος seems to refer to the bulbs or bulb+cup configuration which is discernible near the mouth end of the *aulos*, in iconography⁶⁵⁰. Hesychios⁶⁵¹ describes it as a ?cup (κοῖλον) of either a semi-spherical (seemingly) or a cylindrical geometry (καὶ κύλινδρος). Photios⁶⁵² confirms

⁶⁴⁵ Athen., *Deipn.*/ 176 F.

⁶⁴⁶ See Landels, 1960: 208-19, for its history, structure, technique and usage.

⁶⁴⁷ For details see Poll., *On.*, δ. 85-94/ Bethe, 226.4 - 228.25.

⁶⁴⁸ Poll., *On.*, δ. 70/ Bethe, 222.12 f.

⁶⁴⁹ Poll., *On.*/ Bethe, 224.17-9. Compare Horatius, in Landels, 1960: 100 f.

⁶⁵⁰ see under Depictions, above.

⁶⁵¹ Hesych., *Lex.* s.v. ὄλμος.

⁶⁵² Phot., *Lex.* s.v. ὄλμος.

that it was a part of the *aulos*, but in saying *ρέγκειν δὲ τοὺς ὄλμους οἴμοι τῶν κακῶν*, seems to refer to the body of the *aulos*⁶⁵³. The *Souda*, however, points towards a hemispherical shape: *ὄλμειος, στρογγυλὸς λίθος, εἰς ὃν κόπτουσιν ὄσπρια*, presumably the wooden, stone or metallic mortar which still today is used for that same purpose, *καὶ ὁ τρίπους τοῦ Ἀπόλλωνος*, most probably referring to the cup-shaped seat of the tripod⁶⁵⁴.

The *ὑφόλμιον*⁶⁵⁵, is defined by Hesychios as *μέρος τι τοῦ αὐλοῦ πρὸς τῷ στόματι, ἢ (ἢ Wagener) αἱ γλωττίδες. καὶ ὑπόθεμά τι*, "part of the *aulos* near the mouth, or the tongues"⁶⁵⁶. West⁶⁵⁷ gives the alternative interpretation, "where the tongues are", for the latter clause of the above definition. Most probably it corresponds to the bulb(s), which in iconography, seem to be connected to the cup. However, the cup, which some of the surviving *auloi* possess⁶⁵⁸, does not seem to be there in any of the classical depictions, at least, of the instrument, unless what we interpret as a reed is in fact a cup, the reed being hidden inside the bulb⁶⁵⁹.

The term *ὑφόλμιον* is attested in Pherekrates⁶⁶⁰, and also in Eupolis⁶⁶¹. Ptolemaios⁶⁶² wording, *κάπι τῶν αὐλῶν οἱ διὰ τῶν ἐγγυτέρω τοῦ ὑφολμίου, τουτέστι τοῦ πλήττουτος, τρυπημάτων ἐκπίπτουτες τῶν διὰ τῶν ἀπωτέρω*, can be taken to refer to either "cup" or "bulb"⁶⁶³.

The materials used in the construction of the *αὐλοί* are⁶⁶⁴: *κάλαμος* (reed), *χαλκός* (copper), *λωτός* (lotus wood), *πύξος* (box-tree wood), *κέρας* (horn), *ὄστοῦν ἐλάφου* (deer bone), or *κλάδος δάφνης τῆς χαμαιζήλου*

⁶⁵³ Compare Hesychios' *κύλινδρος*. According to Palmer, in Landels, 1960: 238 n. 98, the *ὄλμος* of Ἰλιάς, ια. 145-147, may have been a hollow log.

⁶⁵⁴ *Holmeios lithos* can be taken to be "the *lithos* used in a *holmos*", in which case *holmos* is again the cup; unless *holmeios* means *holmos*-like.

⁶⁵⁵ merely mentioned by Photios.

⁶⁵⁶ tr. Howard, 1893: 28 n. 2.

⁶⁵⁷ West, 1992b: 85 n. 21.

⁶⁵⁸ e.g. Korykeion Antron B.

⁶⁵⁹ it is not totally inconceivable that the reeds were actually fully inserted in the bulbs of early *auloi*. However, B. M. Vase E 271 (in Wegner, 1963: 47 Pl. 42) of ca. 440 B.C., seems to depict a reed in profile, which means that it was external. Possibly, the terms *ὄλμος* and *ὑφόλμιον* are relatively late.

⁶⁶⁰ Pher., Fr./ Kock, No. 242; a mere word.

⁶⁶¹ Eup., Fr./ Kock, No. 289.

⁶⁶² Ptol., Ἀρμ., α. 3 /Düring, 9.3.

⁶⁶³ Barker, 1989: 282 n. 34, accepts the identification of the *ὑφόλμιον* with the "bulb", and the *ὄλμος* with the "cup".

⁶⁶⁴ Poll., *On.*, δ. 71/ Bethe, 222.17-19.

(laurel branch with its pith extracted). The maker of the *aulos* is called *αύλοποιός*; it is not clear whether the *αύλοτρόπης* and the *γλωττοποιός* are one and the same person with the *αύλοποιός*. It is possible that the manufacture of reeds and the boring of the finger holes required special expertise.

Aristotle⁶⁶⁵ offers information of special significance on the shape of the *aulos* reeds: *Τὰ μὲν σκύλια καὶ αἱ βατίδες ἴσχουσι τὰ ὄστρακώδη, ἐν οἷς ἐγγίγνεται ὠώδης ὑγρότης· τὸ δὲ σχῆμα τοῦ ὄστράκου ὅμοιον ταῖς τῶν αὐλῶν γλώτταις, καὶ πόροι τριχώδεις προσγίγνονται τοῖς ὄστράκοις.* That is, the shape of the shell (pouch) which contains the eggs of the dogfish or the ray (also known as skate) is similar to the *γλώτταις* of the *auloi*. Since it is rather unlikely that evolution should have changed much the structure of these egg-cases since antiquity, an examination of them was thought to be rather constructive. Preserved specimens in the Museum of the Department of Zoology, University College London, were examined by the present writer, frontal and profile sketches were drawn⁶⁶⁶, and dimensions recorded. The formal name of the dogfish is *Scyllium canicula*⁶⁶⁷. The egg-case examined in the Museum belonged to the species *Scyliorhinus canicula*⁶⁶⁸. The length of the egg-case was about 5 cm, its maximum width, at the centre, about 1.5 cm, and its maximum depth, towards the "top", about 1 cm. In the same vase there were another two, smaller, egg-cases, about 4 cm in length each. The variation in the size of the egg-cases is therefore not a good guide as regards the size of the *aulos* reeds - after all, Aristotle is most probably thinking in terms of shape rather than size. In the absence of a specimen of the egg-case of the skate, a sketch was provided by the curator⁶⁶⁹. The two shapes are very similar: essentially a pouch, deeper towards its "top" end (because of more matter concentration in that region) and gradually coming to a tip at the bottom (see profile), and "waisted" towards its lower end (see frontal view)⁶⁷⁰.

⁶⁶⁵ Ar/tel., *Περὶ τὰ Ζῶα Ἱστορία*, στ. 10/ 565 a 25/ Peck (Loeb), 258/ Jan (Teubner), 35.

⁶⁶⁶ see Fig. 133 a-b.

⁶⁶⁷ see Wilson, 1937 Fig. 101, for a photograph of the dogfish egg-case.

⁶⁶⁸ whose egg-cases, according to the Museum Curator, are identical to those of the *scyllium*. Through the transparent membrane the embryo was clearly seen.

⁶⁶⁹ see Fig. 133 c, reproduced from Thomson, 1892: 424 f. Diagr. xxvi top right.

⁶⁷⁰ Compare the depictions of *auloi* reeds in profile - they look very much the same, and also the double reeds of certain modern Oriental pipes (not, however, played as a pair), such as the Armenian *duduk*, and the Chinese *guanzi*; see below, under Parallels.

There is however a problem: Aristotle's use of the word γλῶτται can be regarded as referring either (1) only to the vibrating portion of the reed (presumably the portion which is kept inside the mouth), or (2) to the entire reed-mechanism, if there was (even only occasionally) one⁶⁷¹.

In a photograph of the egg-case of a ray or skate (family *Rajidae*) given by Wheeler & Jones⁶⁷², the shape of this pouch is symmetrical, with its maximum width at the centre, and is reminiscent of the geometry of the "bulbs". Could it be possible that in "γλῶτται" Aristotle includes the bulbs, using thus the term rather loosely?

Theophrastos, in an extended passage⁶⁷³, discusses the plant κάλαμος, and gives useful information on the use of one particular species of the plant in the manufacture of the γλῶτται of the *auloi*⁶⁷⁴. Two γένη of κάλαμος are discussed in some detail: the ἀύλητικός (which is of our concern here), and the ἕτερος⁶⁷⁵. Each of these two γένη is sub-divided into two types⁶⁷⁶.

Thus, the ἀύλητικός is said to become either a ζευγίτης or a βομβυκίας. The former (ζευγίτης) is produced when the lake has ample water, and the water level is maintained over at least two years. In the first year the cane grows in height (ἀυξάνεσθαι εἰς μῆκος); in the second, the cane grows further and hardens (ἀδρύνεσθαι)⁶⁷⁷. The latter (βομβυκίας) is produced when the water withdraws at some stage during the growth. Landels⁶⁷⁸ is not in favour of the thesis that the βομβυκίας might have been used for the body of the pipes. However, its less-than-the-ζευγίτης mature growth, which would mean thinner walls, might have made it a good candidate for the resonators⁶⁷⁹.

⁶⁷¹ compare Paquette, Pl. I B p. 11, where a tube-ligature-vibrator system is a possibility.

⁶⁷² Wheeler & Jones, 1980: 220.

⁶⁷³ Theophrastos, *Περὶ Φυτῶν Ἱστορίαι*, δ. 11/ Loeb, 366-378. Compare Plinius' paraphrase of Theophrastos in *Naturalis Historiae*, xvi. 66, §§168-72/ Loeb Vol. 4, 497-499.

⁶⁷⁴ not the pipes themselves as some scholars have it, e.g. Στεφανῆς, 1988: 53.

⁶⁷⁵ to which the former is contrasted. Other γένη καλάμου are briefly discussed later; see Theophr., *Περὶ φυτῶν Ἱστορίαι*/ Loeb, 374 ff. See Appendix 8. Compare Landels, 1960: 71.

⁶⁷⁶ a "type" merely being the result of ambient conditions during its growth: presence or absence of ample water; rich or poor soil; inside the water or by its side.

⁶⁷⁷ "it fills out and thickens in texture"; Landels, 1960: 72.

⁶⁷⁸ Landels, 1960: 72.

⁶⁷⁹ Reed *auloi* existed: The Alkaios Fragment in the *Παλατίνη Ἀνθολογία*, ιστ. 7/ Loeb, Vol. 5, undoubtedly refers to the double-pipe species of *aulos* when it says |... ἐν δὲ

Presumably it is the ζευγίτης which is used for the construction of the *auloi* γλῶτται, the ζεύγος of the pipe-pair (hence, undoubtedly, the term ζευγίτης). The ζευγίτης⁶⁸⁰ is further sub-divided into two types, the "θῆλυσ" and the εύνουχίας⁶⁸¹. Of the ζευγίται, those which do not blossom at all, are known as εύνουχίαι, and it is these which provide the best quality γλῶτται. It is this significant distinction between the blossoming and the non-blossoming ζευγίται, which here justifies the use of "θῆλυσ" as a classification term.

The second γένος of κάλαμος mentioned by Theophrastos is the ἕτερος. This is divided into three types: the χαρακίας [A and B], and the πλόκιμος. Rich soil (εὔγειον χωρίου) favours the formation of a κώμυς (bundle⁶⁸²) of ἰσχυροί and παχείς χαρακίαι [type A] (fit for a stake⁶⁸³), with deep and entangled roots. The χαρακίας [type B] also grows (ἐνίστε) near the ἀύλητικός, therefore, in deep water, only it is then taller than type [A], and σκωληκόβρωτος. On the other hand, the ἕτερος grows into a λεπτός and παχὺς πλόκιμος (for plaiting⁶⁸⁴), found on the πλοάδες (floating islands⁶⁸⁵), the islets in the lakes or rivers.

Theophrastos further tells us where, in his days (c. 300 BC), one could get hold of the ἀύλητικὸς κάλαμος. Four areas are named, all four in the same neighbourhood; lake Kopais in Boiotia⁶⁸⁶: (1) at Hytroi, in Pelekania (between the river Kephisos and the river Melas), where the lake forms βαθύσματα; (2) at the ?meeting point of the lake with the river Probatia, flowing from Lebadeia; (3) about the Oxeia Kampe, where Kephisos meets the lake, near the εὔγειον χωρίου Hippia; (4) at Boedria, to the north of Oxeia Kampe. In general, the reed cane grows best (κάλλιστος)

Λυαίου | νηῶ φορβειᾶν θήκατο καὶ καλάμους|. The φορβειά was used only when playing the end-blown, double-reed double-pipes. It is also conceivable that, due to the immature growth of the cane, the knots were close together, making the stalk look like a caterpillar.

⁶⁸⁰ identified with the modern *arundo donax*; Landels, 1960: 71.

⁶⁸¹ θῆλυσ is not a classification term used by Theophrastos, but a word to describe the look of the ζευγίτης. Compare Dioskourides, *Περὶ ὕλης ἰατρικῆς*, α. 85/ Wellmann, 81. 4-17, where a θῆλυσ τις κάλαμος is mentioned, from which αἱ γλῶτται τοῖς ἀύλοις κατασκευάζονται. To this are contrasted the νάστος, suitable for the making of arrows, the συριγγίας, with much flesh (or "pith"; Gunther, 1959: 60) and very knotty, fit for the writing of books, the δόναξ/κύπρια, thick and hollow and growing about rivers, and the φραγμαίτης, "known to everybody": thin, whitish. See Appendix H for more details.

⁶⁸² Liddell-Scott-Jones.

⁶⁸³ Liddell-Scott-Jones.

⁶⁸⁴ Liddell-Scott-Jones.

⁶⁸⁵ Liddell-Scott-Jones.

⁶⁸⁶ see Fig. 134, from Knauss, 1987: 183 Abb. 6.8. See also Knauss & Others, 1984 Pl. 1; Knauss, 1990: 50 Fig. 2.16.

where the Kephisos meets χωρία εὐγεια, βαθύγεια and ἰλώδη, and there is βάθυσμα of the lake.

The construction of *auloi* γλῶτται is called ζευγοποιία, and here is Theophrastos' description of the essential process: (1) the ζευγίται κάλαμοι (preferably the εὐνουχίαι) are cut either in mid-summer or late September (according to the type of γλῶτται required; see below); (2) without removing the λέμμα (rind, husk⁶⁸⁷), the ζευγίται are exposed to the open air during winter; (3) in spring the κάλαμοι are scraped, and placed out in the sun; (4) in summer, they are cut into segments just above the knots, so that each μεσογονάτιον has a knot at its upper end (the end towards the growth)⁶⁸⁸. The μεσογονάτια are classified as μαλακὰ and σκληρὰ, according to whether they came from the upper or the lower part of the κάλαμος: σκληρότατα ζεύγη from the top end, and μαλακώτατα ζεύγη from the root end⁶⁸⁹.

Those from the central part (μέσα) of the κάλαμος will form the best ζεύγη. The μεσογονάτια are left for a further while in the open air; (5) the μεσογονάτια are collected, and the ζεύγη are constructed. Each μεσογονάτιον will produce one ζεύγος, the two γλῶτται of an *aulos*-pair; this is significant, for γλῶτται coming from different μεσογονάτια οὐ συμφωνεῖν. The μεσογονάτιον is cut into two pieces, presumably across its length⁶⁹⁰, probably somewhere in the middle, for the στόμα of ἑκατέρα γλῶτται (the mouth of each of the two γλῶτται) is formed by the transverse section. The expression τὸ στόμα τῆς γλώττης ἑκατέρας suggests two

⁶⁸⁷ Liddell-Scott-Jones.

⁶⁸⁸ The cut portions are two palms or over in length: τὰ μήκη ... οὐ ... διπλασίτων ἐλάττω. Undoubtedly, this intermodal length is dictated by the nature of the ζευγίτης κάλαμος. One παλαστή (palm) equals four δάκτυλοι, that is, about 8 cm; *Oxford Classical Dictionary* s.v. measures.

⁶⁸⁹ In an orchestral oboe, "hardness or softness of cane affects tone, attack and general response. Reeds made from hard cane usually last longer, are better for staccato playing, and though may sound bright and 'tinny' initially, often mellow beautifully. Reeds made from over soft cane sometimes sound good briefly, but won't project or last, soon losing tone and becoming weak and wooly, with no 'guts' (body) or power (volume)"; Whittow, 1991: 115 f. It should be pointed out that the aesthetic terms used here may or may not reflect ancient judgement.

⁶⁹⁰ Landels, 1960, considers other possibilities, such as a longitudinal split into three strips, each of which is used to form one γλῶτται. This is the way oboe reeds are made today (see Baines, 1957: 76-90; Whittow, 1991: 102-111). The possibility of a single reed, of the clarinet type, is also investigated, Landels, 1960: 82. See also, Μαζαράκη, 1972, for a discussion of Becker's thesis for the single reed.

γλῶτται and two στόματα, one for each γλῶτται⁶⁹¹. Essentially, two tubes of smaller length are produced (a palm's length each maximum, about 8 cm; see above)⁶⁹², which become the ζεῦγος: it is significant that this rule be followed, otherwise the two γλῶτται οὐ πάνυ συμφωνεῖν⁶⁹³.

It was said earlier that the ζευγίται κάλαμοι were collected either in mid-summer (June - July = Σκιροφοριῶν - Ἑκατομβαιῶν), or towards the end of September (Βοηδρομιῶν). The picking time was important: from the reed of the summer collection were made the γλῶτται required in the style of μετὰ πλάσεως αὐλεῖν, while, from the autumn reed were prepared the γλῶτται adequate to the ἀπλάστως αὐλεῖν (performing) style. Obviously, there must have been a connection between the physical characteristics of the reed at the time of cutting (presumably girth, degree of hardness, amount of sap) and its subsequent mechanical behaviour as an *aulos* γλῶτται, in order to comply with the different musical requirements of the two styles. It is interesting that style of playing seems to be indifferent to the method by which reed is processed for the manufacture of γλῶτται. In other words, there is only one method of γλῶτται making, the one described by Theophrastos, for either of the two styles⁶⁹⁴.

⁶⁹¹ so, two modern oboe "tongues" comprise the γλῶτται. Landels, 1960: 85, points out that "if two γλῶτται [read tongues!] make one στόμα it is a little awkward to say 'the στόμα of each γλῶτται [read tongue!]'".

⁶⁹² but the length of the finished γλῶτται need not have been as much as this; possibly shorter. After all, internodal distance was a given factor, over which humans had no control. Internodal distance in a particular type of reed apparently depends on the amount of sun-shine to which the plant is exposed during its growth: little sun produces long internodal sections. This quality of cane is not suitable for modern orchestral reed-instruments: "Knots further apart means it's been 'searching sun' - a *bad* sign"; Whittow, 1991: 115. Therefore, the 8 cm magnitude of each half μεσογονάτιον may not be regarded as evidence for the size of the γλῶτται.

⁶⁹³ The expression τὸ στόμα τῆς γλῶττης, and not τὸ στόμα τῶν γλωττῶν, suggests that each ζεῦγος comprises two γλῶτται; that is, each of the two pipes possesses one γλῶτται. It is unlikely that by γλῶτται are meant the two "tongues" of the modern double reed, for the construction of which, according to Baines, 1957, a different procedure than that described in Theophrastos is followed. Contrast West, 1992b: 84, with discussion below. Another factor that may be of significance, and connected here with Theophrastos' statement that the γλῶτται must derive from the same μεσογονάτιον, is the fact that, "while growing, one side of the cane only will get sun. The cells on this side grow faster, are larger (making its diameter slightly asymmetrical), and the other side is, therefore, denser"; Whittow, 1991: 115.

⁶⁹⁴ Theophrastos informs that it was the famous αὐλητῆς Antigenidas of Thebai who introduced the new *aulos* style. Of him it is known that he partook in the wedding of Kotys with Iphikrates' daughter in 387 B.C., and also in the festivities organised by Philippos a little before the siege of Methone in 353 B.C.; Στεφανῆς, 1988: 51-53. Any associations of his with either Alkibiades or Alexandros or Pyrros is mistaken; *ibid.*

Theophrastos does not say whether "summer" and "autumn" are those of the same calendar year or not. This is of no serious consequence, for as long as the stages of reed manufacture are followed, the final product should be adequate for the appropriate use. One question, however, arises: which should be Step One for the reed collected in the summer? Theophrastos' process begins with winter; where and how should the reed be kept during the hot months from July to, say, October? For, if it was laid out in the sun, the reed meant for the "ἀπλαστον" αὔλημα would have been exposed to the sun over two consecutive hot (Hellenic) summers, the first in its rind, the second bare. On the other hand, the reed intended for the "πεπλασμένον" αὔλημα would undergo an exposure cycle of three seasons before it is cut into μεσογονάτια, sometime in the summer; thereafter the μεσογονάτια remained in the summer sun for a further χρόνον τινά. Thus, what is the significance of an early as opposed to a late crop (a difference of about three months)? How should the internal condition of the reed affect the style of playing? Theophrastos further adds that the reed destined for ἀπλάστως αὐλεῖν (old style) may be used only after several years (συχνοῖς ἔτεσιν ὕστερον), while that which will be used in μετὰ πλάσματος αὐλεῖν (new style) may be used only after three years (τρίενον). It is not however clear whether this "maturing" period occurs before or after the division into μεσογονάτια; the way Theophrastos words it, ὅταν συλλέξωσι τιθέασιν ὑπαίθριον τοῦ χειμῶνος..., suggests that the maturing (as opposed to the initial, "drying") period should refer to the μεσογονάτια and not the collected cane. This proposition is contrasted by modern practice, according to which (1) the cane is grown for two years; (2) then cut, stacked in bundles and left to "mature" in the sun over three summers; (3) graded in diameter and sawn into short sticks between the knots; and finally (4) sent off to reed makers⁶⁹⁵. Was the ancient Hellenic γλῶτται making process then the reverse of the modern one? On the other hand would the order of the "maturing" phase affect the mechanical-acoustical behaviour of the γλῶτται? Would it not suffice if the reed were adequately hardened, irrespective of that factor? In our days, for example, insufficiently matured cane provided to reed-makers by plantations may improve with respect to hardness if stored in a warm dry place for several years⁶⁹⁶.

⁶⁹⁵ Baines, 1943: 76 f. Whittow, 1991: 112-117.

⁶⁹⁶ Baines, 1943: 77.

Theophrastos further informs that the old-type γλωτται required a fair amount of προκαταύλησις, meaning presumably the time expended by the αὐλητής to wet, warm up the "dormant" γλωτται by blowing down though them until they became elastic enough, their στόμα widened so that the required (?critical) amount of air flow was established, and began vibrating⁶⁹⁷. The expression συμμύειν δὲ τὸ στόμα τῶν γλωττῶν, ὃ πρὸς τὴν διακτηρίαν εἶναι χρήσιμον in connection with the old-type γλωτται is a little problematic; taken in conjunction with the expression καὶ κατασπάσματα τὰς γλώττας ἴσχειν (provide ample vibrations⁶⁹⁸) in connection with the new-type γλωτται, it has been proposed that the στόμα of the old γλωτται was much narrower⁶⁹⁹ than that of the new one, because a wider aperture was required for the μετὰ πλάσεως αὐλεῖν ("artificial", "forced" style⁷⁰⁰). A wide γλωτται mouth⁷⁰¹ would allow the control of breath flow through it by a compressing or releasing action of the lips, affecting thus dynamic and tonal nuance: "the player has the use of notes above and intermediate between those theoretically determined by fingering, and can even perform controlled 'slides' between adjacent notes. Little of this would have been possible with the tightly closed, inflexible reeds of the previous era"⁷⁰².

Landels⁷⁰³ interprets performing μετὰ πλάσματος in two different ways: (1) manipulation of the γλωτται by lip pressure to vary the intonation of a note⁷⁰⁴ by about a semitone, therefore providing means for enunciating the Aristoxenean χροαί, in the lips of a skilled player, and

⁶⁹⁷ compare Barker, 1984b: 187 n. 6.

⁶⁹⁸ Landels, 1960: 243 f. n. 125. Compare Howard, in Landels, 1960: 77.

⁶⁹⁹ Landels, 1960: 76, believes that the closed up type of στόμα would result in small γλωτται pitch range; also, the production of harmonics or any adjustment of intonation would be difficult. This kind of γλωτται would be easier to play, therefore requiring less skill in embouchure technique. Due to the "συμμότης" of the "tongues" of the γλωτται their amplitude of vibration would be smaller, resulting thus in a less powerful sound, but more brilliant; *ibid.* In an orchestral oboe, too open a reed will often make middle G# "wild, top C#" likely to drop an octave, and top notes hard to get. Too closed a reed will have a small sound and may squawk on low notes"; Whittow, 1991: 88.

⁷⁰⁰ Landels, 1960: 73.

⁷⁰¹ Howard in Landels, 1960: 77, believes that reed cut earlier has a stronger tendency to return to its original shape, thus opening up at the στόμα with a little playing. Whittow, 1991: 115: "Narrower cane makes more open reeds, wider cane more closed reeds, affecting sound and pitch".

⁷⁰² Barker, 1984b: 187 n. 5, and 1989: 103 n. 17. West, 1992b: 84, does not venture to interpret κατασπάσματα; it is not clear what is meant by "the tongue being flexible enough to take down-bends". However, reference is made to Barker, as above.

⁷⁰³ Landels, 1960: 73-74.

⁷⁰⁴ Compare Barker, above.

(2) production of harmonics (overtones/ partials). For both functions flexible and delicate γλῶτται would be required: this was ensured by cutting the cane at an earlier stage of its growth. There is evidence for the manipulation of the reeds by the lips, compressing or releasing the γλῶτται⁷⁰⁵: ἐν δὲ ταῖς συγκροτητικαῖς γλῶτταις ἡ φωνὴ γίνεται σκληροτέρα καὶ λαμπροτέρα, ἂν πιέση τις αὐτὰς τοῖς χεῖλεσι, διὰ τὸ φέρεσθαι τὸ πνεῦμα βιαιότερον; and later⁷⁰⁶ καὶ γὰρ ἂν πιέση τις τὰ ζεύγη, μᾶλλον ὀξύτερα ἢ φωνὴ γίνεται καὶ λεπτοτέρα. It therefore seems that the salient point in the definition of the two *aulos* styles was the opening of the στόμα of the γλῶτται: in a new-type γλῶτται, with its wide mouth, this opening could be varied at will by lip action. A tighter grasp on the γλῶτται would produce a λαμπροτέρα (brighter), ὀξύτερα (more penetrating), λεπτοτέρα (thinner), and σκληροτέρα (harder) φωνή (sound), while a looser embouchure would ensure a sound of a lower, softer, more mellow nature.

Variation in sound quality seems, therefore, to have been a significant aspect of the 4. Ct BC style, μετὰ πλάσεως, and not only "playing in a plain style, without elaborate ornamentation"⁷⁰⁷. Thus, if compression of the γλῶτται causes both pitch rise and sound quality change, it is wondered whether this technique was extensively used in intoning without finger movement, as was suggested earlier. After all, slightly shifting the γλῶτται in or out of the mouth can cause a substantial tonal variation, without the accompanying quality change⁷⁰⁸.

The verb συμμύω has two relevant shades of meaning⁷⁰⁹: (1) shut up, close, e.g. of wounds or shell-fish, or of flowers, which συμμύει at night and ἐκπετάσσεται during the day⁷¹⁰, and (2) close up after a blow, e.g. of shields whose wood, willow and vine συμμύει γὰρ πληγέντα⁷¹¹; it is also used in connection with green wood⁷¹². It seems therefore that wood which is said to συμμύει behaves in an elastic way, its parts returning to their original position after an "attack". Thus, it is conceivable that the cane which was cut in late September (as opposed to mid-summer), and

⁷⁰⁵ Ps.-Ar/tel., Fr. *Περὶ Ἀκουστικῶν*, in Porphyrios, ... *Hypomnema*/ Düring, 71.16-18.

⁷⁰⁶ Ps.-Ar/tel., Fr. *Περὶ Ἀκουστικῶν*, in Porphyrios, ... *Hypomnema*/Dür., 75.30 f.

⁷⁰⁷ Barker, 1984b: 187 n. 5.

⁷⁰⁸ see further under Experiments, below.

⁷⁰⁹ see Liddell-Scott-Jones.

⁷¹⁰ Theophr., *Περὶ Φυτῶν Αἰτιῶν*, β. 19. 1.

⁷¹¹ Theophr., *Περὶ Φυτῶν Ἱστορίαι*, ε. 3. 4/ Loeb Vol. 2, 434.

⁷¹² Theophr., *Περὶ Φυτῶν Ἱστορίαι*, ε. 6.3.

with which the old-style γλωτται were made, further hardened over another summer while still in water, and it was this "maturing in a hot and moist atmosphere" which provided the cane with the "συμμότης" required (or used by habit) in the ἀπλάστως αὐλεῖν⁷¹³. The reeds of the two Armenian *duduks* in the writer's possession, one small, one larger, both have scraped reeds.

West⁷¹⁴ takes ζεῦγος to refer to the "twin blades of the double-reed mouthpiece", and not to the two γλωτται of the pipe-pair. The reason is that the word "implies a matching pair of things working together". However, since the two γλωτται of the pipe-pair are working together towards the same goal, that is the production of the melody, could they not be conceived as a ζεῦγος and be called thus⁷¹⁵? After all, there is no evidence that the ancient Hellenic γλωτται comprised blades, like the European Medieval or modern double-reeds⁷¹⁶: all our information points towards a tubular, half-palm, maximum, piece of cane, whose mid-μεσογονάτιον end was probably squeezed up, perhaps by the use of a clamp⁷¹⁷ unlike the European double-reed produced "by bending double a long strip of the material. This mode of construction can be traced in actual specimens back to the sixteenth century ... and by inference to the Middle Ages; but not to antiquity, and it seems quite unknown outside the West"⁷¹⁸.

Should any special significance be attached to Theophrastos' words τὴν μὲν [γλωτταιν] πρὸς τῇ ῥίζῃ ἀριστερὰν εἶναι, τὴν δὲ πρὸς τοὺς βλαστοὺς δεξιάν? No further qualification is given, so that one is left wondering whether the right and left pipes are here referred to⁷¹⁹. Is this aspect connected with the fact that the upper knot was left on each μεσογονάτιον when the reeds were cut into sections? Two possibilities may be suggested

⁷¹³ There is no evidence whether any scraping was operated on the reed to make it thinner for the purposes of either style. In modern practice, oboe reeds undergo substantial scraping and gauging, which helps to achieve flexibility of pitch; Landels, 1960: 73. See also Whittow, 1991: 95-101, "Scraping".

⁷¹⁴ West, 1992b: 84.

⁷¹⁵ compare ζεῦγος of animals working together in agricultural tasks, such as plowing.

⁷¹⁶ see Baines, 1943: 191-193.

⁷¹⁷ compare surviving Ptolemaic double reeds in Baines, 1957:193 Fig. 41, and all the Oriental double reeds, including the *duduk* and the *guanzi*. Tintori, 1971: Pl. 35 No 5 last row, provides a good photograph of the Bruxelles Conservatoire reeds found in Egypt; here reproduced as Fig. 131.

⁷¹⁸ Baines, 1943: 193.

⁷¹⁹ for an alternative explanation see Howard, 1893.

as regards the remaining knot: (1) the knot was part of one of the two γλωτται; (2) the knot was removed at a later stage in the manufacture of the γλωτται.

In the first instance, a differentiation in the structure, and thus possibly in their sound producing properties, may have been intended. The bore exhibits a minimum at a knot, thus creating a kind of "throttle"; would this have been of significance? Would it also be possible that one γλωτται was longer than the other; the "left" longer than the "right"⁷²⁰? However, the γλωτται need not have been unequal; the section which created the στόματα could be made nearer the knot, and not halfway along the length of the μεσογονάτιον. Some of the lower part of the μεσογονάτιον would thus have been discarded. It may just be possible that a narrower exit into the pipe caused a different rate of flow of breath-air through that pipe, with some acoustic repercussion; one pipe louder than the other, perhaps?

In the latter case, the knot may be thought of as left on the μεσογονάτιον only temporarily, either to mark the direction of growth, so that during the manufacture of the γλωτται, the "left" could easily be distinguished from the "right", or to enhance by its presence the flow of sap out of the μεσογονάτιον, thus speeding up the drying process⁷²¹.

Modern botany distinguishes several types of cane. The family is called *Agrostideae* or *Graminaceae*⁷²²; sub-family, *Festuceae*⁷²³; tribe, *Arundineae*⁷²⁴. There are several genera; only two are to be found in Hellas: the *Arundo* and the *Phragmites*. The genus *Arundo* is subdivided into twelve species, two of which only are found in Hellas today: the *Arundo Donax*, and the *Arundo Plinii*⁷²⁵. The obvious difference between the two species is one of magnitude: the *Arundo Plinii* is shorter

⁷²⁰ The presence of a knot has also been regarded as evidence for a single reed; see Landels, 1960: 82; Becker, in Μαζαράκη, 1972.

⁷²¹ If one γλωτται were longer than the other, or if one's exit was more constricted than that of the other, would this mean a different positioning of the finger-holes on each of the two pipes? See, e.g., the Elgin and Louvre Pairs.

⁷²² Καββάδας, p. 579.

⁷²³ Καββάδας, p. 4158.

⁷²⁴ Tutin and Others, 1980: 252. See Appendix 8 for Theophrastos' and Dioskourides' species of cane, the modern botanical classification, proposed identifications of ancient with modern names, and a comparison of the properties of the different species, ancient and modern.

⁷²⁵ Presumably the same as the *Arundo Mauritanica* of Hagers, 1977: 280.

and thinner than the *Arundo Donax*. Furthermore, two varieties of the *Arundo Donax* are encountered in Hellas today: the *Arundo Donax Variegata*, and the *Arundo Donax Macrophylla*⁷²⁶. The difference between the two varieties is to be found in their leaves: white lines on the leaves of the *Variegata*, wide turquoise leaves on the *Macrophylla*⁷²⁷.

Of the other genus, the *Phragmites*, only one species is met with in Hellas today: the *Phragmites Communis*⁷²⁸. Varieties of this are the *Phragmites Communis Stenophylla*⁷²⁹, and the *Phragmites Communis Flavescens*⁷³⁰. A variety named *Phragmites Australis* [= *Communis*] *Isiaca* is also mentioned⁷³¹.

The present writer feels unhappy with the identification ἀύλητικός κάλαμος = *Arundo Donax*. The *Arundo Donax* grows not in deep water but on the banks and the islands. If Theophrastos' δόναξ is the same with Dioskourides' δόναξ- (1) found on the banks of rivers and lakes, and (2) known to everybody - then the modern *Arundo Donax*, which complies with both of the above pieces of information, must be the ancient δόναξ. After all, Theophrastos' δόναξ, "Θ-δόναξ", is distinguished from the *auletikos*. Undoubtedly, the Θ-δόναξ grew about the lake irrespective of whether the water remained or not in it. The absence of water seems to have affected the growth of the *auletikos* only. It is difficult to believe that the growth of the common *Arundo Donax* should be dependent on the amount of water around it. Also, Theophrastos would not have gone into the trouble of naming three places in the Kopaïs area where the *auletikos* could be found; surely, had it been the *Arundo Donax*, this would have been found everywhere, not only there. Dioskourides, too, differentiates between the *auletikos* (undoubtedly identical to his θῆλυς τις) and the Δ-δόναξ. The *auletikos* must, therefore, be another kind of cane, or at least a variety, which under the special water conditions described by Theophrastos, acquired a significantly different body structure.

726 Καββάδας, p. 579.

727 Καββάδας.

728 Undoubtedly identical to the *Phragmites Australis* of Davis, 1985: 562, and Tutin, 1980: 252. Another is the *Phragmites Vulgaris* of South Africa; Hagers, 1977: 628.

729 Davis, 1985: 562; Halacsy, 1904: 361; Καββάδας, p. 4158.

730 Rachinger, 1943: 771; Καββάδας, p. 4158.

731 Tutin, 1980: 252. This is described as a large variant of the species. Is it a third variety, or is it to be identified with either of the the other two varieties?

According to Aristotle⁷³²,

Δεῖ δὲ καὶ τῶν ἀλύων εἶναι τὰς γλώττας πυκνὰς καὶ λείας καὶ ὀμαλὰς, ὅπως ἂν καὶ τὸ πνεῦμα διαπορεύηται δι' αὐτῶν λείον καὶ ὀμαλὸν καὶ μὴ διεσπασμένον· διὸ καὶ τὰ βεβρεγμένα τῶν ζευγῶν καὶ τὰ πεπωκότα τὸ σίαλον εὐφωνότερα γίνεται, τὰ δὲ ξηρὰ κακόφωνα· ὁ γὰρ ἀήρ δι' ὑγροῦ καὶ λείου φέρεται μαλακὸς καὶ ὀμαλός. δῆλον δέ· καὶ γὰρ αὐτὸ τὸ πνεῦμα, ὅταν ἔχη νοτίδα, πολὺ ἤττον προκόπτει πρὸς τὰ ζεύγη καὶ διασπᾶται· τὸ δὲ ξηρὸν μᾶλλον ἀντιλαμβάνεται καὶ τὴν πληγὴν ποιεῖται σκληροτέραν διὰ τὴν βίαν.

Good reeds are those which have substance (πυκνόν)⁷³³. Also, the smoother (λείας καὶ ὀμαλὰς), the better, for this eases the air flow past them. They work much better (εὐφωνότερα) when moist (βεβρεγμένα). The passage points rather suggestively to the double reed.

Also, according to Aristotle⁷³⁴

παχείαι δ' εἰσὶ τῶν φωνῶν τοῦναντίον, ὅταν ἦ τὸ πνεῦμα πολὺ καὶ ἀθρόον ἐκπίπτον· διὸ καὶ τῶν ἀνδρῶν εἰσι παχύτεραι καὶ τῶν τελείων ἀλύων, καὶ μᾶλλον ὅταν πληρώσῃ τις αὐτοὺς τοῦ πνεύματος. φανερὸν δ' ἐστίν. καὶ γὰρ ἂν πίεση τις τὰ ζεύγη, μᾶλλον ὀξύτερα ἢ φωνὴ γίνεται καὶ λεπτοτέρα. κἂν κατασπάσῃ τις τὰς σύριγγας, κἂν δ' ἐπιλάβῃ, παμπλείων ὁ ὄγκος γίνεται τῆς φωνῆς διὰ τὸ πλῆθος τοῦ πνεύματος, καθάπερ καὶ ἀπὸ τῶν παχυτέρων χορδῶν.

There is one point here which seems never to have been pointed out, as far as the present writer is aware. There is said to be a connection between the air mass rate of flow (πνεῦμα πολὺ καὶ ἀθρόον & παμπλείων ὁ ὄγκος τῆς φωνῆς διὰ τὸ πλῆθος τοῦ πνεύματος) and the σῦριγξ. Quite possibly then the σῦριγξ was a kind of air exhaust, perhaps an outlet on the side of the pipes, perhaps of controllable aperture, which reduced the air mass in the pipe body, thus dropping its pressure, while at the same time a συριγμός was produced, a hissing so familiar from all narrow exhaust pipes.

Ἐπίληψις of the σῦριγξ might therefore be interpreted as making use of the device, and κατάσπασις of the σῦριγξ as arresting the effect of συριγμός.

⁷³² Ar/tel., Fr. *Peri Akouston*, in Porphyrios, ... *Hypomnema* / Dür., 72.35 ff.

⁷³³ Compare Theophrastos' thick-walled, substantial ἀλύτικὸς κάλαμος.

⁷³⁴ Ar/tel., Fr. *Peri Akouston*, in Porphyr., ... *Hypomnema* / Dür., 75.27-33.

Under this light, Ps.-Ploutarchos' comment on Telephanes of Megara⁷³⁵ should make good sense: ἐπολέμησε ταῖς σύριγξιν, ὥστε τοὺς ἀύλοποιούς οὐδ' ἐπιθεῖναι εἶασεν ἐπὶ τοὺς ἀύλους not because he did not like high notes, but because he found ugly the συριγμός which was generated when the device was opened. The συριγμός, as we know, was exploited in the πυθικὸς νόμος, to describe the teething and gnawing of the dying Python⁷³⁶.

The fact that a tighter embouchure causes the pitch to rise is known to us today, too. Since the reed mouth aperture is reduced, the air mass flow of rate is increased, because the speed is increased and therefore the momentum of the flow (assuming a steady air mass rate), making the φωνὴ λαμπρότερα.

⁷³⁵ Ps.-Plout., *Περὶ Μουσικῆς*/ 1138 A.

⁷³⁶ Pollux.

APPENDIX 8

AULETIKOS KALAMOS

The *Kalamos* and Its Genera According to Theophrastos and DioskouridesTheophrastos (ca. 370-285 B.C.)¹

List One

1. αὐλητικός
[A]
[B] εὐνουχίας
2. ἕτερος
χαρακίας
[A]
[B]
πλόκιμος
3. δόναξ
4. τοξικός/κρητικός
5. λακωνικός
6. ἐπίγειος
7. ἰνδικός

List Two

1. αὐλητικός
2. ἕτερος
3. πυκνὸς τῆ σαρκί + πυκνὸς τοῖς γόνασι
4. μανός + ὀλιγογόνατος
5. κοῖλος: οὐδὲν ὡς εἰπεῖν ἔχει ξύλου ἢ σαρκός (συριγγίας)
6. στερεός + συμπλήρης μικροῦ
7. βραχύς
8. ἐπαυξής + ὑψηλός + παχύς
9. λεπτός + πολύφυλλος
10. ὀλιγόφυλλος + μονόφυλλος

¹ Lindsell in Raven, 1990: 159.

Dioskourides (fl. A.D. 54-79)

1. (ναστός): τὰ βέλη γίνεται.
2. θήλυς τις: αἱ γλῶτται τοῖς ἀύλοις κατασκευάζονται.
3. (συριγγίας): παχύσαρκος + πυκνογόνατος. Παρὰ ποταμοῖς
φυόμενος. Εἰς βιβλιογραφίαν ἐπιτήδειος.
4. (δόναξ/κύπριος): παχύς + κοῖλος.
5. φραγμίτης: λεπτός + ὑπόλευκος. Πᾶσι γνώριμος.

Modern Botanical Classification

Family:	Argostideae/Graminideae				
Sub-Family:	—	*	Festuceae		
Genus:	Arundo	*	Phragmites		
Species:	Arundo	Arundo	*	Phragmites	
	Donax	Plinii		Communis/Australis	
Variety:	Arundo	Arundo	*	Phragmites	Phragmites
	Donax	Donax		Communis	Communis
	Variegata	Macrophylla		Flavescens	Stenophylla

Identifications of Ancient With Modern Plants²

Species

Arundo Donax: cane thick, >1 cm (up to 3.5 cm; Tutin); hollow (persisting, and flowering in the second year; Tutin) + height 2 to 5 m or more (up to 4 m; Διαπουλής, Rechinger. Up to 7 m; Γεννάδιος. Up to 6 m; Tutin) + leaves wide: 2 to 5 cm, flat, long, all along the cane, whitish (2 to 5 cm wide; Διαπουλής, Rechinger. Up to 6 cm; Tutin) + tassel wide and thick, pyramidal, violet/pale green, silky at maturity (30-60 cm, oblong; Tutin). On the banks of rivers and lakes, or in any damp or irrigated area, at all altitudes throughout Hellas.

It seems, this type is the nearest to the *auletikos*. However, it is hard to accept that such a common species, growing throughout the Hellenic peninsula, was found *kallistos* only in Kopais. Also, the tussell of the *auletikos* is said to be the smallest (ἀνθήλη ἐλάττω τῶν ἄλλων) of all the *kalamoi*. The tussell of the *Arundo Donax*, 20-30 cm, is larger than that of the *Phragmites Communis*, 20-30 cm. The leaf of the *auletikos* is said to be *platyteron* and *leukoteron*. That of the *Arundo Donax* is maximum 60X6 cm; of the *Arundo Plinii*, maximum 50X5 cm; of *Phragmites Communis*, width range 1-3 cm. Therefore, the leaf size is not in opposition. It is said for the *auletikos* that its leaf is *leukoteron*. That of *Phragmites Communis* is described as greyish-green; of *Arundo Donax Macrophylla* and *Arundo Plinii*, whitish-green; of *Arundo Donax*, whitish. Leaf colour, therefore, too, is not in opposition.

Arundo Donax Variegata: a variety with white lines along the leaves (found in Messenia).

Arundo Donax Macrophylla: with leaves wide and whitish-green or blue-green.

Arundo Plinii: cane thinner than that of *Arundo Donax* + ἀπεξυλωμένη κάλαμος + height smaller than that of *Arundo Donax* (height up to 1.5 m; Διαπουλής, Rechinger. Up to 3 m; Tutin) + tussel elongated and rich (thin; Διαπουλής), 20 to 50 cm long + leaves whitish-green, 1.5 to 3 cm wide (1 to 2 cm; Διαπουλής). Near the sea or rivers, sandy areas, in low altitude: N.

² Source of information: Καββάδας.

Hellas, Euboia, Crete (on rocky hills of Thrake, Epeiros, Euboia, Crete; Διαπουλής). Therefore, this cannot have been the *auletikos*: the latter is not said to be found near the sea.

Phragmites Communis: cane thin, up to 1 cm (0.5 to 1.2 cm; Tutin); easily bent ("not overwintering"; Tutin) + height 1 to 4 m, occasionally 8 m (up to 3 m; Διαπουλής. 80 cm to 3.5 m, occas. 10 m; Tutin) + tassel wide, bushy, upright, 15 to 30 cm long, πυρρόχρους, occasionally violetish.(minimum 8-20-30, maximum 50 cm, oblong to ovoid, purplish-green; Tutin) + leaves whitish, 1 to 3 cm wide, narrower at the bottom (up to 50X5 cm, greyish-green, sword-like, rough on the edges; Tutin). On the banks of rivers, ditches and irrigation canals, marshes and swamps throughout Hellas in any altitude. Therefore, this cannot have been the *auletikos*: the cane does not overwinter, unlike that of the *auletikos*.

Phragmites Communis Flavescens: with σταχύδια pale yellow, and narrower.

Phragmites Communis Stenophylla: cane short + leaves narrower and shorter, usually convolute. (A variant, adapted to dry or saline habitats, e.g. of dry sandy banks of large canals. While on the watery bed of the canal the plants are much taller and have broader flat leaves; Davis).

The genus *Calamagrostis*, (also of the family *Agrostideae*/*Graminideae*; sub-family *Agrostideae*) either of the two species, *Calamagrostis Montana* and *Calamagrostis Epigeios*, do not seem to be likely candidates for Theophrastos' *auletikos*: the former grows in rocky forested places in relatively high altitude; the latter (possibly Theophrastos' ἐπίγειος κάλαμος; Π.Φ. 'I, δ.11.13), on river banks or damp, high altitude, forested places (Peloponnesos and mainland Hellas; possibly, in Kerkyra, too).

The genus *Typha* (family *Tuphaceae*), with its three species, *Typha Angustata*, *Typha Latifolia*, *Typha Laxmanni*, is, too, an even more unlikely candidate, for the cane has no knots (*gonata*).

The genus *Calamus* (family *Palmaceae*), basically palm-like plants, cannot possibly be what we are here after.

Wimmer's Identifications³

κάλαμος	→	Arundo
αύλητικός	→	Arundo Donax
χαρακίας	→	Phragmites Communis
πλόκιμος	→	Saccharum Cylindricum
δόναξ	→	Arundo Donax
ποκίλος	→	Arundo Colorata
είλετίας ⁴	→	Arundo Arenaria
ινδικός	→	Bambusa Arundinacea (= bamboo)

Kabbadas' Identifications⁵

Θ-δόναξ	?Arundo Donax
Δ-δόναξ / κύπριος	? " "
Θ-ἐπίγειος	?Calamagrostis Epigeios
Θ-είλετίας	?Ἀμμόφιλον τὸ Ἀμμόφυτον
Θ/Δ-τύφη	?Typha Angustata
Θ-τίφη	Τριτικὸν τὸ μονόκοκκον
Δ-φραγμαίτης	?Phragmites Communis
φλεώς	" " (Sprengel)
Δ-καλαμαγρωστίς	Σόργον τὸ Χαλέπιον

Raven⁶ appears very sceptical in accepting Thiselton-Dyer's identifications; he calls the latter "unreliable"⁷. Raven⁸, in his fourth lecture, very interestingly points out the difference between what Edmund Leach calls the "primitive" and the "scientific" taxonomies. Paraphrasing Leach⁹, in a non-literate society, botanical and zoological discriminations are quite commonly extremely elaborate and actually yield more taxa than

³ in *Theophrastus Eresii Opera*.

⁴ Compare *τριηρικὸν αὐλήμα*.

⁵ Θ stands for Theophrastos and Δ for Dioskourides.

⁶ Raven, 1990.

⁷ Raven, 1990: 133, 141, 147. For Theophrastos' and Dioskourides' identifications, see entries of plants in Liddell-Scott-Jones' Greek-English Lexicon. Compare Amigue's criticism (in Raven, 1990: 133). See, however, Stearn's criticism of Raven, in turn (in Raven, 1990: 133 f.).

⁸ Raven, 1990: 169.

⁹ quoted in Raven, 1990: 169.

are distinguished by modern scientific classifications. As one peruses over Theophrastos' list of *kalamoi* on the one hand, and the modern taxonomic system on the other, with its far fewer members, one tends to agree with Leach, above.

1874 "Theophrastus' *Kalamoi*" *Journal of the Royal Horticultural Society* 1: 1-10

1875 "Theophrastus' *Kalamoi*" *Journal of the Royal Horticultural Society* 2: 1-10

1876 "Theophrastus' *Kalamoi*" *Journal of the Royal Horticultural Society* 3: 1-10

1877 "Theophrastus' *Kalamoi*" *Journal of the Royal Horticultural Society* 4: 1-10

1878 "Theophrastus' *Kalamoi*" *Journal of the Royal Horticultural Society* 5: 1-10

1879 "Theophrastus' *Kalamoi*" *Journal of the Royal Horticultural Society* 6: 1-10

1880 "Theophrastus' *Kalamoi*" *Journal of the Royal Horticultural Society* 7: 1-10

1881 "Theophrastus' *Kalamoi*" *Journal of the Royal Horticultural Society* 8: 1-10

1882 "Theophrastus' *Kalamoi*" *Journal of the Royal Horticultural Society* 9: 1-10

1883 "Theophrastus' *Kalamoi*" *Journal of the Royal Horticultural Society* 10: 1-10

1884 "Theophrastus' *Kalamoi*" *Journal of the Royal Horticultural Society* 11: 1-10

1885 "Theophrastus' *Kalamoi*" *Journal of the Royal Horticultural Society* 12: 1-10

1886 "Theophrastus' *Kalamoi*" *Journal of the Royal Horticultural Society* 13: 1-10

1887 "Theophrastus' *Kalamoi*" *Journal of the Royal Horticultural Society* 14: 1-10

1888 "Theophrastus' *Kalamoi*" *Journal of the Royal Horticultural Society* 15: 1-10

1889 "Theophrastus' *Kalamoi*" *Journal of the Royal Horticultural Society* 16: 1-10

1890 "Theophrastus' *Kalamoi*" *Journal of the Royal Horticultural Society* 17: 1-10

1891 "Theophrastus' *Kalamoi*" *Journal of the Royal Horticultural Society* 18: 1-10

1892 "Theophrastus' *Kalamoi*" *Journal of the Royal Horticultural Society* 19: 1-10

1893 "Theophrastus' *Kalamoi*" *Journal of the Royal Horticultural Society* 20: 1-10

1894 "Theophrastus' *Kalamoi*" *Journal of the Royal Horticultural Society* 21: 1-10

1895 "Theophrastus' *Kalamoi*" *Journal of the Royal Horticultural Society* 22: 1-10

1896 "Theophrastus' *Kalamoi*" *Journal of the Royal Horticultural Society* 23: 1-10

1897 "Theophrastus' *Kalamoi*" *Journal of the Royal Horticultural Society* 24: 1-10

1898 "Theophrastus' *Kalamoi*" *Journal of the Royal Horticultural Society* 25: 1-10

1899 "Theophrastus' *Kalamoi*" *Journal of the Royal Horticultural Society* 26: 1-10

1900 "Theophrastus' *Kalamoi*" *Journal of the Royal Horticultural Society* 27: 1-10

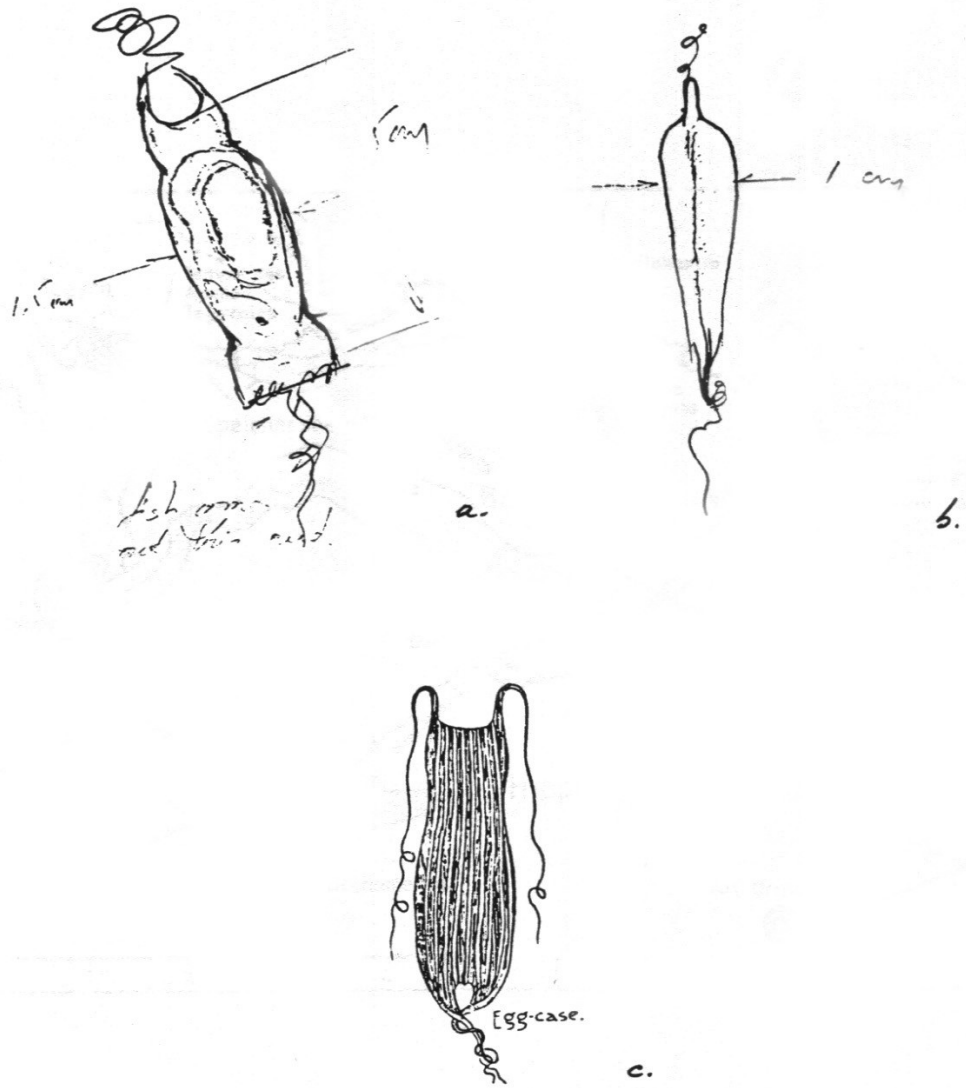


Fig. 133. Sketches of egg cases: a, of the dogfish (*Scyliorhinus Canicula*), front view; b, similarly, side view (drawn by the present writer from real specimens in the UCL Zoology Museum); c, of the skate, front view (from Thomson, 1892 Diagr. 26).

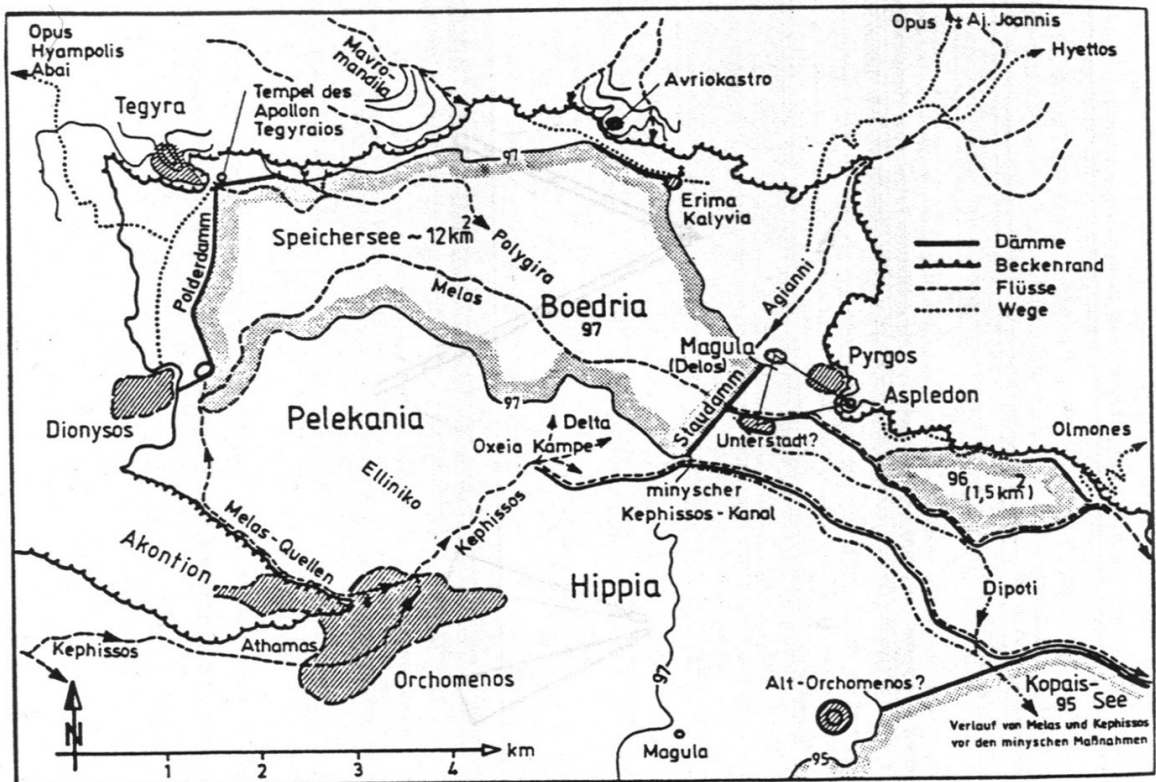


Fig. 134. Reconstruction of the lake Kopais area, as described by Theophrastos; from Knauss, 1987 Pl. 6.8.

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UNIVERSITY OF READING

TRAGOIDIA:
TOWARDS A DESCRIPTION OF *LEXIS* AND *MELOPOIIA*

A DISSERTATION SUBMITTED TO
THE FACULTY OF LETTERS AND SOCIAL SCIENCES
IN CANDIDACY FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY

DEPARTMENT OF CLASSICS

BY
STELIOS PSAROUDAKES

READING
SEPTEMBER 1994