PISTACIA SPECIES IN RELATION TO THEIR USE AS VARNISH AND "INCENSE" (*snṯr*) IN PHARAONIC EGYPT

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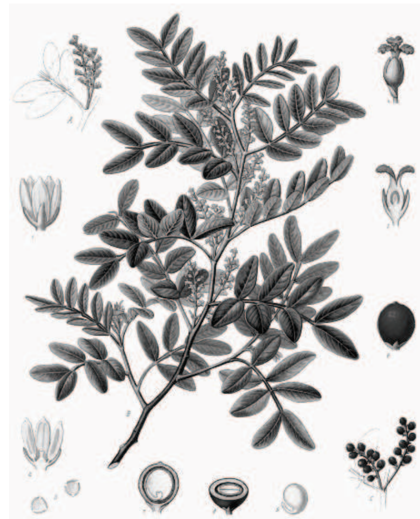

Pistacia lentiscus L. (Chios mastic – Koehler, 1887).

Abstract: Chemical analyses of ancient *Pistacia* resins found in pharaonic contexts have so far failed to go beyond the genus level, to reach the species level. This failure hinders the identification of the precise identity of the *Pistacia* species brought during this period to the Nile Valley, and the subsequent historical and economic conclusions which would result from such exact identifications particularly in relation to foreign trade. The general purpose of the present study is to synthesize the current state of research so as to stimulate the future solving of this problem. The study thus reviews the four *Pistacia* species discovered in ancient Egyptian contexts, as well as six other species and variants which should have been available to ancient Egyptians. It examines the problems attached to the chemical identification of ancient *Pistacia* remains and introduces into the research recent progresses in chemical analyses developed for agronomic purposes, such as made by Assimopolou & al. (2005) to distinguish *P. terebinthus* L. from *P. lentiscus* L. as well as Usai (2006) to chemically distinguish varieties of *Pistacia terebinthus* L. Experimental archaeology is also suggested to clarify the colorimetric degradation of ancient varnishes on ancient Egyptian objects such as funerary coffins. The author sustains Loret's (1949) theory that the *snṯr* product, used as varnish or "incense material" by ancient Egyptian, was composed of "the oleoresin issued from several *Pistacia* spp. of diverse geographical origins", although contesting his generic term "*résine de térébinthe*" which cannot be applied to all *Pistacia* species available. The author points out however that Loret did not take into account the possibility that the *Pistacia* resin found in *snṯr* was probably only the main base, sometimes perhaps used as diluting agent, for a more complex mixture of fats and "incense" plants, the identities of which remain to be identified. Finally the new suggestion that ancient Egyptian sarcophagi had a fragrance, and the question of whether it was purposefully made in relation to ancient Egyptian religious and funerary practices, are introduced.

PISTACIA SPECIES ATTESTED FROM ANCIENT EGYPTIAN CONTEXTS

Remains of four *Pistacia* species identified to the species level were found[2], or are suggested to have been found, from ancient

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[2] See the *Codex* (Vartavan and Asensi Amoros, 1997): 206-207 for details concerning these findings.

Egyptian contexts[3]. In view of the extreme scarcity of the recovered remains, these four species are all in need of further evidence to establish clearly their presence and uses in pharaonic Egypt.

Thus, kernels[4] and wood fragments of *Pistacia atlantica* Desf.[5], the "Mount Atlas mastic" or "terebinth tree", were discovered respectively by archaeobotanists Kislev (1988) and Werker (1988) from the temple of Timna (Sinai - New Kingdom) and attest of the presence of this species in relation to ancient Egypt. Identifications of remains of *P. vera* L.[6], the "pistachio tree" were found in Tell el Da'aba (Second Intermediate period) and Dakhla oasis (Roman) by Tanheiser (in press, and 2002).

P. lentiscus L., the "Chios" or "Chia[n] mastic" and *P. terebinthus* L., the "turpentine tree" - equally called the "terebinth tree" - are in contrary in serious need of confirmation; although, despite their poor archaeological record[7], the species' geographical distribution makes it highly probable that some of their aerial parts or exudes crossed the Egyptian frontier at one point or another in time

[3] Serpico and White (2001: 34) state that "*there are four Mediterranean Pistacia species which are likely to have been known by the ancient Egyptians: Pistacia atlantica Desf., P. terebinthus L. (including ssp. terebinthus and ssp. palaestina (Boiss.) Engler in DC), P. khinjuk Stocks and P. lentiscus L.*". This statement, found again in Stern & al. (2003: 458) is clearly based on the geographical distribution of Mediterranean species as found in florae; it is surprising that in both cases authors did not make use of the *Codex* (Vartavan, 1997) to support this statement with the scientific findings - on the Egyptian territory - of ancient Egyptian *Pistacia* remains. The authors implicitly exclude the possibility that *P. vera*, the pistachio tree, could be among the list of species known by ancient Egyptians. The tree's geographical and historical distribution is indeed still little known but this taxon's good oleoresin should not be dismissed so easily, as pistachio was at the latest known by the Assyrians during Ashurnasirpal's reign (883-859 BC – Oppenheim, 1969: 558-561).

[4] The fruits remains discovered in Timna temple were probably used for their oil, as *P. atlantica* fruits are hardly palatable (Musselman, pers. com.); the oil could have been used to make *snṯr* (see below about this "incense").

[5] *P. mutica* Fisch et Mey (as cited by Loret, 1949: 53) is a subsp. of *P. atlantica* and more precisely of *Pistacia atlantica* Desf. subsp. *mutica (*Fisch. & C. A. Mey.) Rech. f. It is found in present Armenia, particularly in the Ararat Valley.

[6] Two other finds of pistachio remains, both New Kingdom, one from Badari, the other from an unsecured context, are recorded (*Codex*: 207) and stored in Dokki's museum in Cairo.

[7] Two finds of *P. lentiscus* resins are recorded in the *Codex* (p. 205): one from Sit-Hat's tomb (12th dyn.) and the other from Hekaemsaf's tomb (26th dyn.). Save an omission, only three finds suggested but not demonstrated to be of *P. terebinthus* L. are recorded from ancient Egypt: Resin from a tomb in Matarieh (Dyn. 26) analysed by Lucas, and another of unknown date and provenance examined by Reutter; see Codex (206). There is also a resin found from a 6th Cent. BC. Naucratis small jar and presented as "Chios turpentine" by Holmes (1888). The identifications of *P. terebinthus* and *P. lentiscus* provided in Colombini and al. (2000) cannot be accepted beyond the genus level (see footnote 25 below).

PISTACIA SPECIES AND VARIANTS FOUND WITHIN THE ECONOMIC OR TRADING RANGE OF ANCIENT EGYPT BUT NOT YET ATTESTED FROM ANCIENT EGYPTIAN CONTEXTS

P. khinjuk Stocks – the "East Indian" or "Bombay mastic" - is present on the Egyptian territory (Sudanese border and southern Sinai, see Täckholm, 1974: 339; Boulos, 2000: 75) although today rarely found. Two varieties are said to occur in Egypt: *P. khinjuk* var. *glabra* Schweinf. ex. Engl. in DC which is found in the sheltered cliffs of the Desert east of the Nile except that of Sinai; as well as Gebel Elba and the surrounding montainous region; and *P. khinjuk* var. *macrophylla* Boiss. which is also found in sheltered cliffs in the Eastern Desert. The species is also found in Jordan, Anatolia, Iraq, Iran, North West Arabia and beyond; it is however not found today in Israel but in north Syria[8]. No archaeobotanical find of this species from Ancient Egypt is yet known. The mastic of this species used to be sold in Indian markets as *Mustagirumi*, i.e. "Roman mastic[9]". The author believes that this species should be fully chemically documented when identifying ancient Egyptian resins.

P. eurycarpa Yalt. is another seventh species found within the trading sphere, albeit admittedly stretched, of Egypt; hence in northern Syria, South-East Turkey, Iran and possibly Armenia. This species also produces a *pinene* containing oil (Demirci & al., 2001), but its potential presence or use in ancient Egypt needs to be demonstrated.

P. palaestina, found today in neighbouring Palestine or Israel and which was very probably known to the ancient Egyptians, is in fact a subspecies of *P. terebinthus* L. (*P. terebinthus* L. subsp. *palaestina* (Boiss.) Engl.). It is important to recall that "*Chios turpentine*" is not obtained from the "*Chios Mastic*" (*P. lentiscus*) but from *P. terebinthus*, the turpentine, as this similitude in name is often a source of confusion because oleoresins from *Pistacia* spp. are often referred by non specialists as "resin" or "mastic" in the literature.

Three additional species should be taken into consideration, as there exudes may appear one day in ancient Egyptian contexts:

P. aethiopica Kokwaro, found in Ethiopia, which seems to be a variety of *P. lentiscus* (*P. lentiscus* var. *emarginata* Engl.) but could equally be a variety of *P. atlantica* Desf. (Parfitt and

[8] See the online *Flora of Israel*, as well as the Germplasm Resources Information Network (GRIN - USA). "*Pistacia khinjuk is rarely a dominant species in the environments where it occurs. It thrives in dry steppe-forests or steppe formations, mostly in stony places and in rocky mountain terrains. In Iran, due to extensive destruction of trees, this species is now only found in very inaccessible places such as rocky cliffs that are otherwise unsuitable sites for trees*" (Merhnedjad, 2003: 58).
[9] *Encyclopaedia Britannica* (1911), available online at: http://www.1911encyclopedia.org/Mastic".

Badenes, 1997: 1).

P. falcata Becc ex. Martelli (Loret, 1949: 52), found in Ethiopia, Erythrea, Somalia and Saudi Arabia.

P. saportae Burnat which is found in mid and northern Israel today, a hybrid between *Pistacia lentiscus* and *Pistacia terebinthus* (Werner & all. 2001).

Altogether, at least ten *Pistacia* species and variants may have existed within the economic and trading range of the ancient Egyptian civilisation. Other *Pistacia* spp. exist but their geographical distribution, in the Far East or beyond, imply, against all evidence, that they were not employed in the economy of Ancient Egypt[10].

PROBLEMS INHERENT TO THE IDENTIFICATION OF ANCIENT *PISTACIA* REMAINS AND POSSIBLE PATHS FOR FUTURE SOLUTIONS

A major European Community funded project[11] (Vargas & al. 1997) on sixty six varieties of pistachio trees (*P. vera*) from eleven countries showed that this well known and economically important species was little known – whether in relation to its distribution, soil adaptation or characteristics. Natural characteristics - such as flowering period, vigour, juvenile period, and interestingly fruits characteristics (weight and oil productivity, etc...) which were discovered to vary considerably (see Vargas & al. 1997: 94-118). This lack of knowledge is even truer for the nine above mentioned species and variants.

Flamini & al. (2004: 572-576)'s study of leaves, galls and ripe fruits of the subspecies *palaestina* of the turpentine tree showed qualitative and quantitative differences in the oils found. Components for chemical distinction of *P. terebinthus* and *P. lentiscus* have been recently identified by Assimopolou & al. (2005); whereas Usai's study (2006) of the chemical components of aerial parts of turpentine trees (*P. terebinthus* L.) from various locations including Sardinia (mainly), Spain and Turkey, succeeded not only in showing different percentage value of the oils, but also that some components were present or absent in either species. These analyses and chemical differentiations allowing the author "*to conclude that the oil originating from P.*

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[10] The Anacardiaceae family includes 76 genera with over 600 species including such important species as the mango (*Mangifera indica* L.) or the cashew tree (*Anacardium occidentale* L.). Aside from these edible plants, the family includes many poisonous species causing dermatitis, including while manipulating their wood - as well known by cabinet makers. There are over ten to twelve *Pistacia* species the phylogeny of which is a subject of debate (see Parfitt and Badene, 1997; also Al Saghir, 2006).

[11] CAMAR CT 90-0023 (1991-1995). The report is available online at : http://ressources.ciheam.org/om/pdf/b16/97606103.pdf

terebinthus, growing wild in Sardinia, was recognizable different from other P. terebinthus oils originating from plants collected in Spain and Turkey". A discovery which could have important archaeological implications as it opens promising paths not only to distinguish oleoresins of *Pistacia* species, but to identify the geographic provenance of different resins of a single species.

So far chemical analyses of ancient Egyptian *Pistacia* resins found from archaeological contexts have failed to reach the species level – remaining at the level of the genus despite the availability of considerable resinous material, such as found in eighteenth dynasty Canaanite amphorae and bowls in Amarna (see for example Serpico & White (2000), Stern & al. (2003), or in mummies' embalming materials (see Tchapla & al., 2004, Hamm & al. 2004), or from objects (coffins, shabtis as well as one piriform pottery jar, see Serpico & White, 2001; also a jar, see Charrié-Duhaut & al., 2007)[12]; not least the "ton" of *Pistacia* resinous material (Peachey, 1995) recovered from the Ulu-Burun shipwreck (Serpico, 2001; Serpico, s.d.), supposedly departing for Egypt[13].

The principal obstacle cited is that "*the composition of the archaeological resins is more complex than that of modern Pistacia resin, due to degradation and generation of new components*"[14]. However, Usai's progresses in the analyses of *Pistacia* oleoresins and perhaps future improvements with the techniques and methodologies of chemical analyses open perspectives for the identification of ancient resins at species level.

The remaining moot question is whether chemists involved with these analyses are equipped with sufficient reference material and

[12] Serpico & White (2001: 34) state that *Pistacia* resin can be readily distinguished from other resins and gum resins such as pine, cedar, frankincense and myrrh by the presence of the diagnostic moronic, oleanonic, masticadienonic and/or isomasticadienonic acids.

[13] The presence of a gold scarab with the name of Nefertiti among the goods transported should logically indicate that the vessel was *coming* and not *departing* from Egypt, perhaps after a stop along the Levant where the Caananite *Pistacia* filled containers were embarked.

[14] « [Follows] *Experimental heating alters the relative abundance of the triterpenoid composition of modern Pistacia resin. One component, the triterpenoid 28-norolean-17-en-3-one, is produced by such heating; however, an increase in its relative abundance in ancient samples is not matched by the archaeological evidence for heating. It is therefore not possible to use this component reliably to identify heated resin*" (Stern & al. 2003: 457). Mills and White (1977: 12) had already stated: *""[resins]'s composition are complex and varied and are sometimes not known in detail. Further, they often change considerably with time due to oxidation or polymerization...Then there is the fact that there are enormous numbers of different resins...*". In this respect Mills and White (1977: 13) stated: ""*As we are here primarily concerned with the solid residues of resins, the mono- and sesqui-terpenoids will not be further discussed [The majority of resins are terpenoids, a class which is further divided up into mono-, sesqui, di- and triterpenoids which have 10, 15, 20 and 30 carbon atoms per molecule respectively]. The main group of diterpenoid resin producers is the natural order Coniferales - the conifers - which is divided into several families. The second main group of diterpenoid resins comes from trees of the sub-family Caesalpinioideae of the enormous Leguminosae family. Triterpene resins originate from several Angiosperm families important among which are the Burseraceae (elemis), Dipterocarpaceae (dammars), and Anacardiaceae (mastic and related resins)*".

botanical knowledge[15] to secure their identifications as something other than "mastic[16]" (Colombini, & al. 2000, Hamm & al. 2004: 241) without any suggested exact species, or conclude for lack of sucess that it is best to use generic terms such as "*Pistacia* resin" for the resins identified[17]. In this respect a partnership with centres

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[15] Unlike indicated in the abstract of Colombini & al. (2000) "mastic resin" is not also for *P. terebinthus* L. which is turpentine; moreover in this same study *P. lentiscus* L. is spelt "*P. lentisca [sic.]*", throughout the article not a single time with the name of botanists (L., etc..), a comment also valid for the other species "characterized"; the same is found again on page 21 and 22, although this time "*P. terebinth"* for *P. terebinthus* is also found. It is clear that the authors have little botanical knowledge and rigour. The provenance and identity of the "Mastic resin" [i.e. "turpentine"] of the *P. terebinth[us]*, i.e. the "Archaeological Museum of Papyrus, Syracuse" is moreover dubious. Is this modern or ancient material, as moreover some ancient pine resin is provided by the Institute of Egyptology of the University of Pisa? What is thus the valour of the analysis of either "mastics" found in Table 1 (p. 23)? Hence the final conclusion "*In summary, the main components found in the balm of Merneith's mummy [7th century B.C.] are mastic resin...[etc.]*" only means that a *Pistacia* sp. was found and identified, and certainly not *P. lentiscus* or *P. terebinthus* as indicated in the abstract of the study. This study is the type result of what may happened when chemical analyses of ancient Egyptian plant products are undertaken without the minimum support of botanists/archaeobotanists (as confirmed in the study's acknowledgments where none appear). The modern material should have been, as for for the pine resins provided by the Botanical Garden of Pisa, obtained from similar institutions (see p. 21 where the provenance and place of purchase from what seems retailers are detailed). Similar remarks ma be made about the recent study of Koller & al. (2005). Aside from the fact that the study's abstract and keywords do not indicate that a Ptolemaic *Pistacia* resin was identified, the authors employ the most unused vernacular term of "pistachio turpentine"– seemingly translated from the German "terpentin-pistazie" – to qualify *P. terebinthus* L., once again a wrongly spelt latin denomination in the form of "*Pistacia atlanticus* [sic]" is to be found. In view of the obvious lack of reference material the authors used – only one exude of "Chios turpentine" was analysed (see p. 619) – their suggestion that the resin found in the Ptolemaic embalming material was *P. terebinthus* L. cannot be accepted, although eventually correct. Concerning "cedar" which is the main object of the study, aside again from the further erroneous "*Cedrum* [sic] *atlantica*" latin denomination suggested for the New Kingdom exudate they analysed, the authors – highly critical of their colleagues's work and conclusions (p. 622-624) and perhaps rightly so – seem to not read the *Journal of Egyptian archaeology* as they would otherwise have mentioned Asensi Amoros and Vozenin-Serra's (1998)'s first identification of cedar as embalming material. Study which demonstrated precisely, and for the first time, what the title and content of their study is grandly concerned about; namely that Herodotus's statement that ancient Egyptian used cedar as embalming material was true.

[16] Concerning mastic, Baum (1994:22) states, following a seemingly learned and extensive botanical description of the *Pistacia* genus (as of all other taxa treated in her article) : « *L'écorce des tiges de P. atlantica, P. khinjuk, P. vera et surtout de P. lentiscus secrète le mastic* »; "mastic" proper is only *P. lentiscus*, whereas *P. atlantica* is sometimes referred as "Mount Atlas mastic"; it is possible however that the author only meant "[oleo]resin" in this instance.

[17] "*Pistacia resin has been called "mastic", "Chios turpentine" or "terebinth" depending in part on the Pistacia which supplied it. Due to this confusion and to problems in establishing the resin producing capabilities of the different species, it may be preferable to avoid these misleading terms and refer to the exudate simply as pistacia resin* (Serpico & White, 2001: 34)". A similar statement was already found many years before in Serpico & White (2000: 886): "*However, it has been argued that P. terebinthus produces little resin (Mills & White, 1989) and even today there is often confusion between the two [species, i.e. P. terebinthus and P. atlantica*]. There is in fact only "confusion" in the mind of the authors as each term (see the Annex below describing each species and others) refers to a particular species, although admittedly the term "terebinth" can be also linked to *P. atlantica*. Moreover to remain with the generic term "*pistacia [sic] resin*" does not allow identifying the exact species, which in turn does not make progress our

specialising with the ancient Egyptian environment and vegetal economy, and/or equipped with an exhaustive reference collection of modern plant material, is a vital requisit to avoid restricted conclusions which are of little use for economic botanists, archaeobotanists and historians; and even to avoid erroneous identifications. The author is not aware to date of a complete reference collection incorporating, to the minimum, the resins of all the above mentioned *Pistacia* species[18]. It is in fact most certain that the chemical analyses of ancient resins cited in the present study were conducted without this minima, if not because no mention of exhaustive reference collections of resins are made in them[19]. In fact save an omission, the author has never seen any chemical report of ancient Egyptian resinous material which clearly states that its authors obtained *P. khinjuk's* resin for comparison – with the obvious question raising in relation to the validity of chemical analyses so far carried, as this species was most probably found on Egyptian territory during pharaonic times, and was most probably used at one or more points in time[20]. Once this species's resin and others collected, more differential criteria between these modern resins could perhaps be available (see below). It seems thus reasonable to suggest that identifications of ancient Egyptian resins be started anew – if not in view of the fact that since over a century no chemical identification has so far succeeded to identify to species level, and on a scientific basis, a pharaonic *Pistacia* resin.

Where identification "procedures" are concerned, we are to understand - as it is almost never explained despite extensive chemical information provided - that the chemicals identified from ancient resins are compared with data available either from the little reference material obtained, or from reference manuals, such as for example the much used books of Mills and White (1977 or 1987). Chemists are however very rarely botanists, with the result that when, for example, Mills and White (1989: 38) state: "*P. atlantica* Desf. is the true turpentine tree or terebinth", this is wrong as *the true* turpentine tree is <u>unequivocally</u> *P. terebinthus* L.; although admittedly *P. atlantica* can also be referred *as* "terebinth".

knowledge of the economic flora of Ancient Egypt as these species have various geographical origins, and many different properties and uses.

[18] Any reference collection should first specialize on a single taxon, thereafter expand on other resin producing species for sake of exhaustivity. Our YSU Armenian Egyptology Centre has since October 2007 started the « *Plant and Products of Ancient Egypt Reference Collection* » which will include modern material of all the plant species found in ancient Egyptian contexts and many others. This collection has a dedicated technician to curate it and plants are identified by the undersigned. At the time of writing <u>all</u> the resins from the *Prunus* species recorded from ancient Egypt have been collected and *Pistacia* resins are in the process of collection.

[19] The simple end of chapter mention "*Modern Pistacia lentiscus resin was obtained from Chios.*" found in Stern & al. (2003: 462) confirms this, as it should have been indicated that all or at least diverse resins had been obtained. The mean of acquisition is moreover not indicated. The sources and provenances of the "modern" resins in Fig. 1 are no more indicated.

[20] Obviously, this also true for the other *Pistacia* species found in Ethiopia and elsewhere, and mentioned at the beginning of this study.

Or again on the same page: "*The source of the second resin, Chios turpentine, has been subject to a certain confusion owing to variations in botanical nomenclature. It is in fact P. atlantica Desf*…"; again this not correct, "Chios" or "Chia[n]" turpentine" is the product of *P. terebinthus* L. Hence examination of their conclusion (p. 42)[21] makes is quite clear, in view of their description, that it is Chios's *P. terebinthus* L. which is meant. Thus the species found in the Ulu-Burun shipwreck is "*almost certainly*" the "terebinth tree", i.e. *P. terebinthus* L. and not *P. atlantica* Desf. which are two distinct species - and the latter not a subspecies of the former. This confusion in the Latin denomination of the identified species from this wreck is repeated in Serpico & White (2000: 885) when they again state: "*The most likely source, [for the Pistacia species discovered in the Ulu-Burun resin cargo] is Pistacia atlantica Desf., which occurs in Syria/Palestine*…".

The author knows of dozens of similar mistakes which it would have been too fastidious to here report, and he witnessed in one instance chemists involved in the identification of ancient "mummy balms" who made use of the very little and non exhaustive reference collection in their possession to make private analyses and obtain further data. Data which was thereafter compared to the chemical signatures obtained from ancient Egyptian materials. In both cases, the above minima of reference species are obviously not mentioned, or obtained as this requires special collection in the field (here Africa, Western Asia, Anatolia or the Agean), obtained from botanists and/or botanical gardens so as to be certain of the resins' exact provenance and identity. As obtaining resins from markets[22] or unverified sources, i.e. without attaching the aerial parts of the plant for later verification of the taxon, is a highly dangerous procedure as an exude sold under a

[21] "*The analytical results leave no doubt as to the identity of the resins as from a Pistacia sp. and almost certainly that from P. atlantica known in recent centuries as Chios turpentine. While mastic resin [the authors mean P. lentiscus L.] has a very similar chemical composition and was indeed known in antiquity being referred to by Herodotus, its source is confined to the island of Chios...Its form moreover is quite different, consisting of small dry tears or droplets which show no tendency to run together into a mass. Chios turpentine, by contrast, is collected as a viscous but semi-fluid material which flows like pitch eventually to fill the form of any vessel into which it is placed* Mills and White (1989: 42)".

[22] As we close this manuscript, the following remark by Dietemann (2001b: 2092) did not escape our attention: "*A spectrum of commercially available mastic is depicted in Figure 7. This mastic [Pistacia lentiscus L.] is made up of many more compounds than fresh mastic [collected directly from the tree] most of them oxidised and appearing at higher masses than the nominal primary components. In addition, in the oligomer mass rang, the distribution is much broader and less distinct in commercial mastic. In fresh mastic the dimmers are more pronounced…This spectrum is representative of commercially available mastic. It is obviously in an advanced stage of oxidisation… although nominally and for conservation purposes, it is considered "fresh". One reason may be that the resins are irradiated with daylight and the autoxidation is started when it is still on the tree"*. The author wonders if the above statement does not open the question of the state of freshness of the oleoresins transported to Egypt and how this freshness would affect later modern chemical analyses of these ancient resins? Baum (1994: 24) rightly drew attention on the very rare mentions of "dried" (*šw*) and "fresh" *snṯr* debarked in Egypt.

name, can in fact be that of another species. The same applies for an exude collected in the field by a non-botanist as many plant species can only be distinguished by qualified botanists, and sometimes with difficulty. Hence the century long debate concerning *Pistacia*'s species and subspecies, for which extensive chemical, or DNA, research is still required, and for which there is no definite consensus for some of the species. The possession of a reference collection moreover, or its derived spectra, does not make one a botanist, and interpretation of chemical analyses of ancient Egyptian resins, should be systematically developed in conjunction with the expertise of botanists on the one hand, and Egyptologists on the other.

PISTACIA VARNISHES IN ANCIENT EGYPT AND RELATED PROBLEMATICS

The above would have been of no more concern to the ancient Egyptian cabinet makers or artists, as it would be to such modern professionals. Their concern would have been to obtain some resin for use as "varnish" or as "incense". Whether they distinguished themselves the exact *Pistacia* species from which originated the resin is highly improbable – such capacity may have been reserved to the most knowledgeable of men, like perhaps royal artists; a possibility remaining to be demonstrated. In this respect Loret's comment about the extreme difficulty of distinguishing the aerial parts of *P. terebinthus* L. and *P. atlantica* Desf. is pertinent:

"*Ce térébinthe [P. terebinthus] porte le même nom "بطم "* (*bŭtŭm* or *bătŭm*) *que le P. atlantica et s'en distingue à peine, au point que la plupart des voyageurs, mêmes botanistes, prennent facilement l'un pour l'autre et que l'on ne distingue le P. atlantica que « par l'examen du bord de ses feuilles, qui grossi vingt fois, est parfaitement velu » [Loret cites the botanist G. Lapie] ».*

Since the visible parts of these species are so similar, it is unlikely that the resins of either taxa could be distinguished by eye by most ancient Egyptians, most of whom moreover would never have seen either tree species – unless perhaps if they were grown in some gardens, as *P. lentiscus* today in Egypt.

Chios mastic oil or "mastic" (*P. lentiscus*) is used today in high grade varnishes, as is pistachio oil (*Pistacia vera* L. - Komarov, 1968). Despite all the author's efforts no data could however be found of the use of Mount Atlas mastic resin for varnishing[23], nor of turpentine oil (Chios turpentine - *P. terebinthus*) but this is less surprising for the latter in view of the chemical properties of this

[23] Despite the fact that Serpico and White (2001:34) suggest that *Pistacia atlantica* was the main source of resin – for varnishing in the context of their study.

highly liquid and volatile sap[24]. In respect to other natural varnishes, resins such as obtained from the almond tree (*Prunus dulcis* (Miller) D. Webb.)[25], pine trees (*Pinus* spp.)[26], cedar (*Cedrus* spp.)[27] or fir (*Abies* spp.) could have been used and should be taken into account[28] as ancient Egyptian could have more or less easily obtained them.

Serpico and White's (2001: 35) following remark is surprising "*As such it [Pistacia resin found in Amarna amphorae] would be transparent and of little colour. In fact, resin from Pistacia lentiscus* L*. was widely used in the eighteenth and nineteenth centuries as clear varnish on oil paintings because of its transparency*". The author has never seen transparent resins with little colour. Unless redistilled – as for modern turpentines – spread varnishes would not be this way. The colour of the oil of the Mount Atlas mastic (*P. atlantica* Desf.) is yellow, equally that of the Chios mastic's "mastic" (*P. lentiscus* L.), whereas pistachio (*P. vera*) oleoresin is light brown and turpentine's (*P. terebinthus*) oleoresin and oil ranges from yellow to brown.

How these various natural resinous varnishes react when applied over wooden and other surfaces is a good case for experimental archaeology[29] – not least how they mutate in colour or texture with time, or under various climatic conditions and temperatures[30]. Data

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[24] Unless mixed with mastic (see Felter, H. W. and John Uri Lloyd, J. U. King's American Dispensatory; 1898. Available online at: http://www.henriettesherbal.com/eclectic/kings/pistacia-lent.html) or used as a medium. "Turpentine*" "is issued from certain trees, (Pinus sylvestris, etc..) and from the terebinth tree, Pistacia terebinthus, It was to the product of the latter, now known as Chian turpentine, that the term was first applied. The terebinth tree and its resin were well known and highly prized from the earliest times. The tree is a native of the islands and shores of the Mediterranean, passing eastward into Central Asia; but the resinous exudation found in commerce is collected in the island of Chios. Chian turpentine is a tenacious semi-fluid transparent body, yellow to dull brown in colour, with an agreeable resinous odour and little taste. On exposure to the air it becomes dry, hard and brittle. In their natural characters, turpentines are soft solids or semi-fluid bodies, consisting of resins dissolved in turpentine oil, the chief constituent of which is pinene. They are largely used in the arts, being separated by distillation into rosin or colophony (see Rosin), and oil or spirit of turpentine* (*Encyclopaedia Britannica*, 1911)".

[25] The author has seen in Spain furniture varnished with diluted almond resin, with satisfactory results. Such use may however be rare.

[26] Serpico and White (1996) had already suggested pine or cedar for resinous material found in Djer's tomb.

[27] Several finds of these species are known, see *Codex*.

[28] See Lucas (1962: 359) for a number of other species for "black" varnishes; the suggestion of some of these species from Asia seems far-fetched.

[29] Lucas (1962: 360-361) had already experimented the varnishing of objects with ancient Egyptian and modern oleoresins – but without apparently testing *Pistacia* oleoresins.

[30] Serpico and White (2001: 35) state that a polychrome shabti of the 19th dynasty (British Museum 8652) shows evidence of heating which may have cause the resin to darken. They also state that "*the deposition of the resins on some coffins suggest that the ancient Egyptians did use heated, yellowed resin*" and says that heated *Pistacia* resin was found on Denytenamun's coffin. Another coffin – BM EA 29580, also shows evidence of heating. Furthermore a number of objects are listed where was found a black varnish derived from

gathered by the author from cabinet-makers and persons[31] who have been involved with natural varnishes indicate that they turn yellow with time – as this is the case for *Pistacia lentiscus* L. (Chios mastic) as demonstrated scientifically by Dietemann (2001a, 2003) or Dietemann & al. (2001b). Seemingly unknown is also how these varnishes react with natural paints or dyes used to paint for example 21st century coffins – a subject of concern since our visual perception of the original colorimetry of the coffins seems to be altered by the timely degradation, and perhaps inter-reactions, of paints and varnishes[32]. Identification of these substances and their subsequent reactions to varnishing with *Pistacia* or other resins is thus another very interesting case for experimental archaeology – with applications in conservation. Again much reference material would be necessary for such research.

Ancient Egyptian craftsmen and artists may have known that the oils obtained from varieties of a same species yielded different results[33]. One of the British Museum coffins[34] studied by Serpico and White (2001: 34) had its *Pistacia* varnish mixed with either vegetable oil or animal fat – as inferred from traces of lipid matter;

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strongly heated *Pistacia* pitch. Darkening of varnishes may have indeed occurred during the heating of varnishes to make them more usable, as experimented by Lucas (1962: 360-361) with ancient and new oleoresins. *Pistacia* varnish was also found smeared at the back of the head of a Third Intermediate Period mummy (BM EA 74 303), as well as within the chest; in this case one may perhaps refer to this resinous coating as "embalming material" rather then varnish, although a "varnishing" effect was perhaps also looked for.

[31] A thread on Yale University's EEF list on the topic of the yellowing of natural varnishes on 21st dynasty coffins sparked the following response from Mr Reg Clark, Esq., currently an Egyptology student at Swansea University: "*I was working as a designer in the furniture industry at the time and mentioned that we had an ongoing problem with the rapid yellowing of traditional varnishes which we had applied as a protective top coat on our hand-painted furniture, especially on items which were in darkness or shade. For example, the varnish on the back of a cupboard door could turn noticeably yellow in six months whereas the front remained apparently unchanged, obviously it wasn't entirely unaltered but the difference in the two was remarkable. Incidentally, this effect is also noticeable on pigmented traditional paints, white oil based paint too can turn yellow…*" (EEF e-mail dated October 19, 2007). What Mr Clark witnessed is scientifically explained in Dietemann & al. (2001: 2095) in relation to their study of mastic and dammar: "*Varnish Yellowing: Yellowing occurs predominantly in darkness; yellowed varnishes are bleached when exposed to light even for short time. The process leading to this yellowing and bleaching are not well understood…)*. It is regrettable that in this highly interesting article not a single mention of the *Pistacia* species from which the "mastic" was obtained is mentioned with precision. However Dr Dietemann's thesis (2003) reveals that he took the trouble to travel all the way to Chios island and we are to conclude that this "mastic" is *P. lentiscus* L. Mr Clark's comment is voluntarily cited along and even prior P. Dietemann's scientific work, to further underline that the point of view of the cabinet maker was that experienced by ancient Egyptians, who did not beneficiate of the scientific data in our possession and acted empirically as well as intuitively (as already pointed out in the text).

[32] See for example Green (2001) on this topic; as well as E. Loring's convincing preliminary experiments reconstructing the original colours of Asetemachbjt/Isemkhebe's 21st dynasty coffin (http://www.cesras.org/Ding/CoffinsCAI/Asetemachbjt-D1.html).

[33] As their respective chemical components were different, as demonstrated by the above mentioned chemical analyses.

[34] Henutmehyt – British Museum 48001A.

whereas the *Pistacia* varnish of a polychrome shabti box[35] had been mixed with a resin of the Pinaceae family – a family which includes *Pinus*, *Cedrus* and *Abies* species. Furthermore a *Pistacia* pitch was found mixed with bitumen on a canopic chest[36] and a coffin[37] to obtain a black colour coating. Such mixes are not surprising as ancient Egyptian craftsmen no doubt experimented with available products – which today complicates the task of chemical identification.

The author previously thought that the theory that the "*yellow ground-colour*"[38], which was seemingly applied over a white gesso prior to applying colours, could be a *Pistacia* varnish seemed improbable as such varnish – no doubt expensive in ancient Egypt as imported from the far – would not only been used for the glossy finishing they would bring to the varnished surface but also as protective agent. Research by Collinart (2001)[39], as well as Serpico and White (2001: 33)[40] have clarified the question and seem to sustain this assumption. Coffins were no doubt costly items which were stored for some time prior to burial. The vivid colours of the deceased's last dwelling had to be preserved, and not left exposed to outside damage or abrasion, until the day of the funerals and through time in his tomb; in relation to the common concepts of Egyptian religion. The above however requires further investigation, perhaps such as the peeling and electron microscope examination of vertical cuts to verify which of the coatings, paints or varnishes was applied first on objects. We can surmise that *Pistacia* varnishes were treated with a minimum of respect by ancient Egyptian cabinet makers when and where they could obtain some; whether or not these resins were brought in quantities such as indicated by the number of Canaanite amphorae found in Amarna.

Analyses in fact revealed many of these amphorae and sherds' *Pistacia* content to have been burned as "incense" (Serpico and White, 2000: 894, Serpico and White, 2001: 36) with twenty one *Pistacia* resin coated amphorae and sherds bearing the term *snṯr*[41] .

The purpose of varnishing was according to Serpico and White not aesthetic, or at least not exclusively so, but religious. If it is true

[35] British Museum EA 24711.
[36] Nebi's; British Museum EA 35808.
[37] Tamyt's; British Museum EA 6661.
[38] This topic is discussed by Niwinski (1988: 60).
[39] Collinart (2001)'s study of the yellow colour of fifty objects, mostly stelae and coffins showed that « *four types of mineral were utilized to provide yellow colour from the Old Kingdom to the Ptolemaic Period*" (Collinart, 2001: 4).
[40] Serpico and White (2001:33) indicate that the "yellow" varnish was set "*over the black background*", as well as "*over the yellow painted decorations which in turn is over the blackened areas*".
[41] Including one found in Panhesy's official residence now in the British Museum (No. 58858) and another from the North Suburb House (BM EA 63529); see Serpico & White (2000: 890).

that religion and art are at often not so easily distinguished in the ancient Egyptian civilisation, the Ramesside letter they cite is linked to aesthetic purposes as the notion of "decoration" is clearly stated[42]:

"*Now I am decorating the inner coffin and the lid. The snṯr which you brought has run out a long time ago. Please send snṯr, mny, and wax [mnh] so that I may prepare varnish*[43]".

The production of oleoresins involved time and their acquisition no less, as they were not produced in Egypt but imported from afar; not least financial means, as indicated in a Deir El-Medineh craftsman's letter.

"*And you shall make arrangements to procure this fresh snṯr which I mentioned to you in order to varnish the coffin of your mother. I will pay its owner for it*[44]".

That is, against any new evidence which would show local production in the Mediterranean or Red Sea zones of Egypt. In this respect, the author wondered independently if *P. khinjuk* could not be equal suppliers of *snṯr*? Loret's (1949: 59) remarks on the various provenance of *snṯr* mentioned in the texts, including from very precise station in the eastern desert[45], rightly pointed out towards a *Pistacia* species such as *P. khinjuk* – which is found on the opposite shore, in Sinai -, as *P. terebinthus* is seemingly not found Egypt (see Boulos, 2000: 76). He equally wondered whether *snṯr* could have been a generic term qualifying a product which could be made with the oleoresin obtained from diverse *Pistacia* species – from whichever provenance? A resin which could thus be equally burnt during the cult.

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[42] Even if Theban tomb scenes show what appears to be priests presiding over the varnishing of a coffin (Davies 1933: pl. V and XXVII; Davies, 1998: 35).

[43] The Chief Carpenter to the vizier's scribe, reign of Ramses IX. (Černy and Posener, 1986 : 21-22). The text makes it quite clear that varnish is composed of several substances.

[44] Wente, 1990: 153.

[45] Loret (1949: 50) states "*Il semble que le centre de propagation du sonter [=snṯr] ait été la Syrie, tant il est fait souvent allusion au sonter Syrien. Puis l'Egypte vient immédiatement après, non pas l'Egypte iliaque, mais l'Egypte désertique. A l'est du Nil, deux stations sont bien nettement localisées : l'une au nord du désert arabique, est le grand désert de « Ker-Aha » ; l'autre au sud du même désert, doit se trouver à la hauteur de El-Kab et être parcourue par les nomades Maza. A l'ouest du Nil, c'est-à-dire dans le désert Libyque, les précisions nous manquent ; nous savons seulement que du sonter provenait des régions en bordure occidentale de la vallée du Nil, ainsi que de telle ou telle oasis non spécialement nommée. Poursuivant notre route vers le sud, nous rencontrons tout d'abord le sonter du pays des Maza, dans le désert Nubien entre le Nil et la mer. Il est probable que cette station se relie, par le Val du Natron d'El-Kab, au territoire qu'habitent les Maza du désert de Koptos. Enfin les mentions du sonter deviennent de moins en moins fréquentent et de plus en plus insignifiantes. Plusieurs passages du Livres des Pyramides nous apprennent l'existence d'un sonter de Nubie (qui peut être celui des Maza), et pour terminer deux textes seulement nous parlent d'un sonter de Somalie mais en de termes tels que nous devons en conclure à une indifférence absolue des Egyptiens vis à vis de ce produit lointain ».*

It is in fact likely that most ancient Egyptians remained at the level of the genus for the meaning of the term; although they perfectly knew that there were different species, varieties and qualities of *snṯr*. This in a somewhat similar way as many non-botanically orientated persons say "corn" to mean different type of "wheats" or even "cereals". Or as ancient Egyptians knew that there were different varieties of barley – and could gave them different names[46] - but in most cases refer to it as simply "barley". The various geographical sources of *snṯr* cited by Loret, in effect situated at all cardinal points : Syria, north and south of the Eastern desert, Nubian Desert, i.e. Sudan and Red Sea areas, Somalia, Western Libyan Desert, oasises in the same[47], indicate that we are dealing no with one but with different *Pistacia* species.

A conclusion already reached by Loret in 1941 (Loret, 1949: 59)[48] where he clearly states that *snṯr* could be composed of a number of *Pistacia* spp. which he subsequently lists. Thus not only made of *Pistacia*[49], or of one single species[50], although the Amarna or any imported batch to be discovered in the future could indeed be composed of the resin of a single taxon. Baum (1994: 24-25) rejected Loret's conclusion, favouring a *Boswellia* species (frankincense otherwise known as olibanum) for *snṯr* when she stated : "*En revanche, l'hypothèse selon laquelle les Pistacia seraient les producteurs uniques de snṯr - dont ils ne possèdent pourtant pas toutes les qualités - est discutable*" ; or : "*On est en fait amené à se rallier à l'avis de Steuer et à reconnaître que la majorité des caractéristiques de snṯr s'harmonisent avec celles de l'encens ou oliban suintant des Boswellia*".

This rather suddenly brought conclusion was based on the texture and aspect of the product as described in texts. Descriptions found in texts can in fact equally be applied to *Pistacia* oleoresins. S*nṯr* is clearly used in varnish making (see the carpenter's text above), whereas the author is not aware of frankincense ("oliban" in French) employed as varnish among the many recorded uses of this extraordinary tree. Finally, *P. lentiscus* also has antimicrobial properties, *P. atlantica* also is masticatory and *Pistacia* species

[46] See Vartavan (1987).

[47] Although Loret (1949: 54) rightly points out that the product was more likely brought *through* oasises by nomads faring from Cyrenaic (Libya).

[48] Loret (1949 : 59) "*Pour trouver un nom pratique au sonter, rappelons nous que, selon les régions d'où il provenait, il répondait aux espèces ou variétés botaniques suivantes* : [follows a list of six Pistacia species *: P. khinjuk*, *P. lentiscus* var*. emarginata*, *P. falcata*, *P. terebinthus*, *P. lentiscus*, *P. atlantica*] ».

[49] As understood by Serpico and White (2000: 885) when they state: "*Although the analysis of the Ulu-Burun resin strengthens Loret's theory that snṯr was pistacia [sic] resin, more direct confirmation is necessary".*

[50] Loret's common denomination (above footnote) misled Serpico and White (2000: 885) to believe that "*This species* [*P.* atlantica] was *overlooked by Loret who believed* [the precise species] *P. terebinthus* L. *to be the main source* [of "sonter"]. Thus Loret did not "overlook" *P. atlantica* as he considered sonter to be composed of various *Pistacia* resins of various provenances, including this species.

also all have adhesive properties. It is moreover most improbable that enough frankincense resins could be obtained from Pount or the Arabic peninsula to satisfy the considerable religious needs of ancient Egyptians. On another hand, textual sources clearly indicate that *snṯr* was primarily obtained in large quantities from Syria, where *Boswellia* species do not grow. And in any case the resin found in the Amarna and British Museum sherds and amphorae, and labelled "*snṯr*", revealed this resin to be a *Pistacia* exude, with so far no traces of *Boswellia* resin. Thus Steuer's and in particular Baum's (1994: 38) conclusion that: "*En conclusion, snṯr serait l'encens ou l'oliban des Boswellia, Burseraceae des pays du sud*" is therefore not to be retained. Baum's suggestion that frankincense resin could be mixed with (p. 31) or replace *Pistacia* in the composition of *snṯr* – perhaps when available – is however interesting in relation to incense making (as *Boswellia* is according to the data available is as stated above not used as varnish), but needs to be scientifically demonstrated.

Where the author disagrees with Loret is with his idea of assigning a term which "*parvienne à satisfaire tout le monde*" [which would satisfy everyone] to translate *snṯr,* and in choosing "terebinth" for this purpose. Loret thus stated "*c'est par Térébinthe pris au sens large de l'arabe* بطم *que nous devons designer l'arbre qui fournissait le sonter en Egypte, en Syrie, en Nubie, et c'est par « résine de térébinthe » que nous devons rendre le mot égyptien*"(Loret, 1949:61). If it is true that *P. terebinthus* L. and *P. atlantica* Desf. are sometimes called "terebinth tree", this is not the case for *P. khinjuk*, the "Bombay Mastic", *P. lentiscus*, the "mastic", and the other above mentioned species, the exudes of which cannot obviously be called "*résine de thérébinthe*" since we are dealing, to start with, with "mastic" in two cases: *P. khinjuk* and *P. lentiscus*. Loret reached his main general conclusion starting from the point of view of the economic botanist and thus by examining the geographic distribution of the various species of *Pistacia* trees[51]; whereas the author reached it prior to reading Loret's study, once he had learnt that Amarna and British Museum resins belonged – in part at least - to the genus *Pistacia*, as well as by the natural difficulty of distinguishing them by eye; i.e. the point of view of the ancient Egyptian craftsman. There is in fact a contradiction between Loret's general conclusion – which the author's believes to be generally correct for the *Pistacia snṯr* found, i.e. that *snṯr* could be made of resin from various *Pistacia* spp. from various provenances, and his wish to assign to this product a generic appellation.

Moreover Loret seemingly did not consider the possibility that the *Pistacia* resin of which made the "*sonter*" could be a base to which other "incense" species were mixed. Serpico and White (2000: 891) rightly pointed out that "*it [Pistacia resin] may have been*

[51] As well as of the difficulty of for a start distinguishing the aerial parts of *P. terebinthus* L. and *P. atlantica* Desf. (see above in the text).

mixed with other volatile scented products, such as herbs and spices, which no longer remain detectable". This is highly probable, as modern burning incenses are complex mixes incorporating different plant species, generally one of them acting as burning agent, needing to be carefully dosed during incense preparation – otherwise it burns too quickly, or it stops burning. It is most likely that Ancient Egyptians composed *snṯr* this way, and had different recipes[52]. The oleoresins found in archaeological contexts are thus probably simply the *snṯr*'s base. Thus following their analysis of the *Pistacia* filled Amarna amphorae and sherds, Serpico and White's (2000: 894) conclusion is contradictory, partly erroneous and possibly completely erroneous, when they state: "*Thus the identification of pistacia [sic] resins in these amphorae…clearly resolves the botanical identity of snṯr…*".

First, *snṯr*'s botanical identity is not resolved by simply reaching the genus level with *Pistacia* species – as even if from the ancient Egyptian's point of view *snṯr* could be composed of *Pistacia* resins from different species, the oleoresins found have a true botanical source which remains to be identified as they are issued from one or more existing *Pistacia* species. Serpico and White (2001: 34) showed that *Pistacia* varnish could be mixed with either vegetable oil or animal, the possibility that *snṯr* was sometimes also a plant mix is real and its botanical identity if only *Pistacia* oleoresin was used, or "composition" if various plants were included, is not hence resolved as far as science is concerned. Only *snṯr*'s basic main element – i.e. a *Pistacia* resin issued from various *Pistacia* species from diverse geographical origins – seems now nearly certain. Progresses in the DNA research of *Pistacia* species[53] and chemical markers for the identification of resins, based on correctly gathered and identified modern reference material, will hopefully allow us to reach this certainty. It is also possible that *snṯr*, if meaning something like "incense" or "divine smell" in the minds of Ancient Egyptian, could have been at times in the course of Egyptian history something else than a *Pistacia* base mixed with myrrh or other fragrances, i.e. another ignitable resin from other plant species. This however needs to be scientifically demonstrated.

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[52] As the author closes his manuscript the following excerpt from Baum (1994: 29) concerning *snṯr*, although applied by her to olibanum, comforts the assumption that *snṯr* was often used as a base for mixing with other fragrances : "*A Edfou, on ajoute snṯr s3q aux ingrédients de base, fondus, de l'onguent minéral divin;[...] si la masse obtenue…est trop visqueuse, trop moelleuse, il convient de l'épaissir ou de l'émulsifier (s3q) avec de l' 'ntjw sw. La recette du Kyphi fait état d'une part de snṯr et de miel...Enfin snṯr s3q entre, avec snṯr w3d et šw, dans la confection d'un onguent destiné au rituel d'ouverture de la bouche et, pour faire les "cinq boulettes d'El Kab", on mélange à du natron snṯr en doses (?) concentrées...[etc..]*"

[53] See the highly interesting and promising researches by Mehrnejad (2003), in the field of *Pistacia* genetics.

Finally, if *snṯr* used for incense may have been mixed with other plant products, *snṯr* used in or as varnish may have not. It is however to be wondered on another hand – and this has not been suggested before – whether some more complex varnishes' possible bases, i.e. *snṯr* plus possibly some fats or oils, was not also mixed with a further fragrant product[54] to exhale some kind of odour; perhaps even a perfume with some specific religious meanings? Indeed the turpentinous smell of the *Pistacia* resin <u>itself</u> was probably already regarded as some "*divine scent*" (*snṯr'*[55]*)*, and one indeed most appropriate in the context of a funerary activity in view of its antiseptic and air purifying properties. Yet the *Pistacia* resin's turpentinous smell is perhaps not very pleasant as "perfume" and this may have been why one or more fragrant additives were added. Bearing also in mind that the extracted *Pistacia* or "terebinth" oil composing *snṯr'* used in varnish may not only have been a binding or volatile burning base, but the diluting agent for the fats or waxes also present; wax incidentally mentioned in the above Ramesside letter. Hence the new questions of whether ancient Egyptian sarcophagi had a noticeable short or long lasting specific fragrance and whether it was purposefully made for funerary use[56] may be perhaps raised[57]?

[54] This would be probably very difficult to detect through chemical analyses, but such a possibility should be borne in mind during future chemical investigations of ancient varnishes.

[55] The author wonders if "divine scent" is not the correct translation of *snṯr'* , and if the etymology of this word is one derived from the verb "*sn*" (to smell) - and/or "*ssn*" (to breathe, smell) – and perhaps the noun "*sṯ(y), sṯi*" (odour, smell, perfume); a suggestion necessitating demonstration.

[56] Considering the volatility of turpentine, it would be interesting to know how long it could last. Although in view of its funerary use this may have had only some temporary importance. Answer to these questions could there again be brought by experimental archaeology.

[57] Just as we send this issue of the bulletin to print, we learn that the Ministry of Research of the Republic of Armenia has accepted our centre's project to reconstruct an ancient Egyptian sarcophagus using ancient Egyptian materials and technologies, including *Pistachia* varnishes.

ANNEX – DATA ON *PISTACIA* SPECIES FOUND OR THOUGHT TO HAVE BEEN IDENTIFIED FROM ANCIENT EGYPT

Pistacia atlantica Desf. = *P. mutica* Fisch et Mey.

MOUNT ATLAS PISTACHIO, MOUNT ATLAS MASTIC TREE, ATLANTIC PISTACHIO, ALSO « TEREBINTH TREE»

PLANT DISTRIBUTION AND TYPE

Not found in the Nile Valley, **but present in Sinai wadis** (Boulos, 2000: 76); also found in North Africa (Atlas in particular, Libya (Cyrenaic)), the Mediterranean (Canaries (Spain), Greece, Turkey (up to 1500 m)) Palestine, Lebanon, Israel (Mediterranean woodlands and shrub lands, semi-steppe shrub lands, shrub-steppes, deserts and extreme deserts (from 800 to 2400 m) and the Mediterranean maquis and forest (hard rock outcrops), as well as Armenia and Iran (where it seems to originate: "*posta*") as well as Pakistan. Flowers in February, March and April in Europe. Fruits with bluish metallic colour have fertile seeds inside; the red ones are empty. The Atlantic Pistachio is the largest tree in Palestine/Israel in recent history; the tree reaches 15 meters high (Atlas), perhaps 20 m, and can yield up to 2 kilograms of solid resin. Fruits - about 8mm long and 6mm wide - are made of up to 52% of an oil composed of oleic, linoleic and palmitic acids and the oil is composed essentially (72%) of unsaturated fatty acids. The oil in seed usually makes 20 - 40% of total weight (H.M. Arefi, *P. atlantica* breeder, public e-mail, April 12, 2006). Chemical components of this oil - yellow in colour - are analysed by Yousfi & al. (2003). The tree is said to reach 1000 years and develops an extensive root system allowing it to remain green even in years of drought, whereas it resists well below freezing point. Branches sprouts from the stump after being cut. Individual flowers are either male or female, dioecious, male and female trees must be grown if seed is required. The tree requires well-drained dry or moist soil, cannot grow in the shade. It can pollinate *P. vera* (Facciola, 1993). It is prone to fungal root rot. The leaves have often galls, produced by *Pemphigus utricularis Pass.* and contain 22% of tannin (Bown, 1995). *P. mutica Fisch et Mey* is a subsp. of *P. atlantica* and more precisely of *Pistacia atlantica* Desf. subsp. *mutica (*Fisch. & C. A. Mey.) Rech. f.

MAIN USE(S) OF PLANT

Cooking: The palatable raw fruits - awful in taste (Musselman, pers. comm.) have a turpentine flavour. Any fruit contains a single seed (Huxley, 1992). An excellent edible oil is obtained from the seed (Facciola, 1990). It has antiseptic properties (Davis, 1965). **Medicine**: expectorant, sudorific, heart stimulant (fruits); sterility, colic, tonic, digestive, gums strengthening, resolutive for furuncles (resin); expectorant, diuretic; asthma, chest diseases (galls). masticatory, to purify the breath (resin); stomach disorders (crushed nut of the fruit); cough, cold (external friction with oil from fruits); intestinal disorders (decoction of leaves and galls, in Morocco), antiseptic for wounds (resin). **Other uses**: depilatory. In Iraq, the seeds are used for tanning and for soap-making. The resin - the smell of which is similar to turpentine - is used today as glue, for lighting, in the photographic or cosmetic industry and in dentistry. In Algeria, the fruits are used as anti-diarrheic and fodder. Afids-caused exudations from the trunk (up to 1m in diameter) gives a red ink (tannin) used for skin tanning.

Pistacia lentiscus **L.**

MASTIC [PROPER], CHIOS MASTIC, CHIAN MASTIC

PLANT DISTRIBUTION AND TYPE

Found in Egypt, in the wadis of Wadi Batoum, south of Sollum (North Western Mediterranean coast; Boulos, 2000: 76); also grown in Egypt (Pooter & al. 1991). Present in the Mediterranean maquis, from Morocco to Libya (Cyrenaic) (Loret, 1949) and in Palestine at elevations of 300-500 m. (Zohary, 1972: 299); it is also found in Greece (Chios Island - medieval villages in the southern region of Chios called *Mastichochoria* (=Gum villages)). A shrub (called "*shinia*" in Greece) usually reaching three metres, rarely a tree reaching six. Also found in tropical East Africa (Boulos, 2000: 76). *P. lentiscus* L. var. *emarginata*, otherwise known as *P. aethiopica* Kokwaro, is found in Ethiopia, Somalia and further south-west in the great lakes region. Leaf type : compound, pinnate or bipinnate with smooth margins - often parasited by a red gall which cause leaves to mutate to contain its eggs. Winged petioles. Male and female are separate shrubs or trees. Flowers from March to May (July) in the West. Fruits - drupes circa 5 mm - are first yellow, thereafter red and black; one seed per drupe. Its bark and branches (not the wood) exudes from mid-summer to autumn a resin commonly called "mastic" with a strong agreeable odour and a mild and resinous taste; when chewed it becomes soft and can easily be masticated (Grive, 1984). Any tree produces a small quantity of such resin: mature trees (150-200 grams on average), but some trees may yield over a 1 Kg. Prefers light (sandy), medium (loamy) and heavy (clay) soils and requires well-drained neutral and basic soils, and can grow in very alkaline soil.

MAIN USE(S) OF PLANT

Woodworking: The pink-reddish and yellow veined wood is used today by cabinet makers. Its yellow oil extracted from the fruits used to be burned for lighting. **Cooking**: The mastic, *mastika* (Greece) or "Chios mastix" (not to be confused with Chios turpentine which is from *P. terebinthus)* is edible (Polunin, 1987) and used for flavouring puddings, including Turkish delights (*loukoums* - Hedrick, 1972). It is also the basis of a Greek confectionery called '*masticha*' and a liqueur called "*mastiche"* (Facciola, 1990, Bown, 1995). **Medicine**: Oil is obtained by alcohol extraction of the mastic. The well known decongestive properties of this oil are used for varicose veins and heavy legs, internal and external haemorrhoids as well as trombophlébite. Strengthen the gums and used as breath sweetener. Also analgesic, antitussive, carminative, diuretic, expectorant, odontalgic, sedative, stimulant. It is mixed with other substances and used as a temporary filling for carious teeth, or internally can be used in the treatment of diarrhoea in children (Chiej, 1984). Externally it is applied to boils, ulcers, ringworm and muscular stiffness (Chevallier, 1996). Decoction of leaves is used to treat liver intoxications as the oil has a powerful antimicrobial activity (Flamini & al. 2004). Low doses of mastic gum - 1 g per day for two weeks - can cure peptic ulcers very rapidly. **Other uses**: It can be dried and used as a powder, or distilled for oil and essence (Bown, 1995). Cleans the skin and brightens the complexion. It is used in high grade **varnishes**, as a fixative in perfumes, tooth pastes, glue (especially for false beards), embalming, to seal the edges of microscope mounts or soap making. The leaves contain up to 19% tannin, they are often used as an adulterant of sumac, *Rhus coriaria (*Rottsieper, 1946). The oil is a powerful **insecticide** against *Mayetiola destructor* killing 100% of eggs in 24h (Flamini & al. 2004).

P. terebinthus **L. (=** ***P. terebinthus*** **L. subsp.** ***Terebinthus, = P. palaestina = P. terebinthus*** **L. subsp.** ***palaestina*** **(Boiss.) Engl.**

TEREBINTH [PROPER] OR TURPENTINE TREE, CHIOS TURPENTINE, CHIAN TURPENTINE, CYPRUS TURPENTINE

PLANT DISTRIBUTION AND TYPE

Not found in the Nile Valley. Present in the Mediterranean (Greece (Chios), Cyprus, France, Maroc, Portugal, Turkey, Syria, Israel, Lebanon, etc…) in maquis or dry open woods and usually in calcareous soils, at elevations between 600 to 800 m. It is also found along the Red Sea until Somalia (Loret, 1949); Libya (Cyrenaic). A deciduous tree growing up to 9m by 6m at a slow rate, odd numbered foliols (as opposed to *P. lentiscus*); mutating shape under gall infection; reddish dioecious flowers bloom from May to June/July; ovoid fruits (5 to 7 mm) in grapes are first white, then pink, thereafter red, and brown when mature ; seeds ripening from October to November. The fruit is about 7mm long and 6mm wide, it contains a single seed (Huxley, 1992). The plant can be used as a rootstock for *P. vera*. *P. palaestina Boiss.* is a subspecies of *P. terebinthus* L. (= *P. terebinthus* L. subsp. *palaestina* (Boiss.) Engl.). **The bark (not the trunk) yields the very fluid and yellow to brown (not sticky) oleoresin called**

"*Chios* or *Chian turpentine*" not to be confused with the *Chios mastic* which is the common name of *P. lentiscus*)), which is obtained from incisions made from mid summer to mid autumn and which when exposed to air thickens, becomes hard and brittle, and forms translucent yellow masses similar to mastic. The essential oil contents (dry weight basis) of young shoots, flowers, unripe and ripe fruits of the turpentine tree (*P. terebinthus* L.) were determined as 0.74, 0.70, 0.54 and 0.73% respectively (Couladis & al. 2002). Study of subspecies *P. palaestina* showed that the oil was rich in monoterpenes, and the main constituents were -pinene (63.1%) and myrcene (13.3%) in the leaves and -pinene (49.4%), sabinene (22.8%), and limonene (8.1%) in the galls (Flamini & al. 2004).

MAIN USE(S) OF PLANT

Food: Seeds - sweeter and oilier than almonds - may be eaten raw (tastes between pistachio and pine nuts) but breaking the kernel is apparently hard work. An edible oil is obtained from the seed (Rosengarten, 1984), source of the old "turpentine oil" (also extracted from *Pinus* spp.). The immature fruits (Arabic: 'atsjaar'), including the stems are preserved in vinegar and salt and are used as a relish to accompany wines served during meals (Facciola, 1990). Young leaves are cooked and used as a vegetable. Resin from the trunk is used as a vegetable and as a chewing gum (Hedrick, 1972; Kunkel, 1984). The ripe fruits of subspecies *P. palaestina* are used largely in the Middle East as a component of the so-called *Zaatar,* a mix of aromatic and food plants. **Medecine:** The resin is antiseptic, antispasmodic, cytostatic, expectorant and vulnerary (Pollunin, 1969). It is taken internally in the treatment of chronic bronchial infections, streptococcal, urinary and renal infections, haemorrhage, gallstones, tapeworm and rheumatism. Externally, it is used to treat arthritis, gout, sciatica, scabies and lice (Bown, 1995). Resin of subspecies *palaestina* is diuretic, laxative, stimulant and aphrodisiac, while decoction of the leaves is diuretic, antihypertensive and for jaundice (Flamini & al. 2004). **Dyeing:** A red dye is obtained from galls that are formed on the leaves by aphis (Pollunin, 1969). The plant is a source of tannin (Uphof, 1959). All parts of the plant are aromatic. **Material:** Its hard wood is used by cabinetmakers and for marquetry.

***Pistacia vera* L.**

PISTACHIO [TREE], TRUE PISTACHIO TREE

PLANT DISTRIBUTION AND TYPE

Not found in the Nile Valley. Present in Western Asia (Iran, Iraq, Syria) and in the Mediterranean maquis (Greece, Italy). Hilly and mountainous regions, especially on sandstone soils, with a temperature range from -17°c (sometime up to –25°) in the winter to 40°c in the summer, although a milder frost can damage its flowering. . A deciduous tree growing up to 10m in Western Asia (25 m for the Chinese variety - 6/8 metres in the Mediterranean and up to 1500 metres. Pistachio trees according to condition start to fruit between 7 to 10 years after plantation and continue to life and fruit about 80 to 100 years. One male plant for every five females is sufficient. Succeeds in dry soils (extensive water searching root system), does well in light calcareous soils, rows well on poor soils, and prefers long hot summers and low humidity. It is prone to fungal root rots (Huxley, 1992). The leaves, when bruised, smell like the fruit. Flowers in April or May depending on variety. Fruits epicarp is pink to pale yellow and has turpentine like smell when young, thereafter brown to dark. Physical characteristics and fruits properties of *P. vera* may vary considerably (see Vargas & al., 1997). On good years the tree may produce 50 to 100 lbs of fruits or 1.5 to 2.5 tons per acre (MOREK).

MAIN USE(S) OF PLANT

Food: *P. vera* and *P. khinjuk* - the latter also found, albeit rarely in Egypt - are the only *Pistacia* spp. with edible nuts (Parfitt & al., 1997: 6) although *P. atlantica* fruits are palatable, but awful in taste (see under that species). Seeds, rich potassium, copper and magnesium, are eaten raw, salted or roasted. They are used in confectionery, ice cream, cakes, pies, marmalades, etc...The seed is rich in oil (40% - 50%), protein 20%, and sugar 19%, including 5.2 mg of Vitamin E per 100g. The oil has a pleasant mild flavour, but it is not produced commercially due to the high price of the seeds. In Egypt, pistachios are used to make a *pistachio* couscous, which also includes as main ingredient almonds and chicken slices. **Medecine:** Seeds are sedative and tonic. The plant is used in China for the treatment of abdominal ailments, abscesses, amenorrhoea, bruises, chest ailments, circulation, dysentery, gynecopathy, pruritus, rheumatism, sclerosis of the liver, sores and trauma (Duke, 1985). **Other uses: Varnishes.** Male trees yield a small quantity of a high grade resin which is used in paints, lacquers, etc… (Komarov, 1968).

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