

*The identity of the Amiantos or Karystian stone
of the Ancients with Chrysotile.*

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FLEXIBLE mineral fibres appear to have been well known to the Greeks, who spun them into thread, which they wove into cloth or employed as wicks for lamps.

Pausanias, who lived in the second century of the present era, tells us that Kallimachos made for the statue of Minerva in the Acropolis at Athens a lamp of gold, the wick of which was of 'karpasian flax', which he states is the only flax inconsumable by fire.¹ Some have interpreted the words 'karpasian flax'—*λίνον καρπάσιον*—as meaning mineral flax from the Karpasos, the north-eastern promontory of Cyprus, but apart from the fact that there is no record of the occurrence of asbestiform minerals in that locality, it seems clear that the word *καρπάσιος* is derived from *κάρπασος* (feminine in the singular, but neuter in the plural *κάρπασα* or *κάρβασα*), which properly signifies cotton, being identical with the Sanskrit *kaṅgāśā*, though it has been used for a fine variety of flax produced in Spain, as well as for other European plants. The mineral used in the sacred lamp was therefore presumably similar to cotton in softness and fineness. Nothing is said as to the locality from which it was obtained, but it was probably the produce of the quarries near Karystos, at the southern end of Euboea, which appear to have been the best known source of flexible mineral fibres in ancient times. They were in fact generally referred to as the Karystian stone (*ὁ Καρύστιος λίθος*).

¹ Καὶ οἱ λίνον καρπάσιον θρυαλλίς ἔνεστιν, ὃ δὴ περὶ λίνον μόνον οὐκ ἔστιν ἀλώσιμον. Pausanias, 'Ἑλλάδος Περιήγησις, Ἀττικῆ, chap. 26.

Strabo, who wrote in the beginning of the first century, tells us that in Karystos occurs the stone which is carded and woven to form handkerchiefs¹; and, like almost all ancient writers who refer to asbestos, he states that the fabrics formed of it were cleansed by casting them into the fire.

Solinus states that Karystos possesses, among other marvels, cotton which stands fire.²

The quarries near Karystos appear, however, to have become exhausted, for we read in Plutarch (50-139 A.D.) that, at the time when he wrote, it was not long since the quarry had ceased to yield soft tissues (*μηρύματα*) of stone which could be drawn out into the form of thread³; and after referring to their use in making handkerchiefs and nets, he states 'that they, the *μηρύματα*, have now disappeared and scarcely more than fibres or slender hairs are embedded in the rocks of the quarries.'⁴

The rocks round the modern town of Karystos consist of crystalline schists, while one and a half hours to the east are two exposures of serpentine⁵, so it is not improbable that the asbestos was really chrysotile, the fibrous variety of serpentine.

The only other locality, from which mineral textile fibres are said to have been obtained in ancient times, is the island of Cyprus. One of the earliest writers on minerals was Sotakos (*Σώτακος* or *Τάκος*), who is several times referred to by Pliny. In an extract from his book *Περὶ λίθων*, which has been preserved to us by Apollonius Alexandrinus Minor, he states that 'the stone called the Karystian has woolly and skin-like growths from which handkerchiefs are spun and woven, and they also twist wicks from it.'⁶ After describing its incombustible character, he

¹ 'Ἐν δὲ τῇ Καρύστῳ καὶ ἡ λίθος φύεται ἢ ζαινομένη καὶ ὑφανομένη, ὥστε τὰ ὑφάσματα (v. l. ὑφή) χειρόμοκτρα γίγνεσθαι. Strabo, *Γεωγραφικῶν*, Bk. x, chap. 1, par. 6.

² 'Carystos aquas calentes habet (Ellopias vocant), et Carystias aves quae flammam impune involant, carbasa etiam quae inter ignes valent.' An editor has unnecessarily altered 'valent' to 'lavant'. C. Julius Solinus, 'Polyhistor,' chap. 11, par. 15.

³ Καὶ μετάλλων ἴσμεν εξαμαυρώσεις γεγονέναι καινὰς ὡς . . . τῆς τ' ἐν Καρύστῳ πέτρας, χρόνος οὐ πολλὸς ἀφ' οὗ πέπυται μηρύματα λίθων μαλακὰ νηματώδη συνεκφύρουσα. Plutarch, *Τὰ Ἠθικά*, *Περὶ τῶν ἐκλειοιπύτων χρηστηρίων*, Bk. ii, 484 a (edition 1796, vol. iv, p. 772).

⁴ Νῦν δὲ ἡφάνισται, καὶ μόλις οἶον ἴνες, ἢ τρίχες ἀραιαὶ διατρέχουσιν ἐν τοῖς μέταλλοις (loc. cit.). Literally, 'run through in the quarries.'

⁵ Friedrich Teller, 'Der geologische Bau der Insel Euboea.' *Denkschr. k. Akad. Wissensch. Wien, Math.-Naturw. Classe*, 1880, vol. xl, p. 153.

⁶ Ὁ Καρύστιος λεγόμενος λίθος ἐπιφύσεις ἔχει ἐριώδεις καὶ χροώδεις, ἐξ οὗ νήθεται καὶ ὑφαίνεται χειρεκμαγεῖν, στρέφουσι δὲ ἐξ αὐτοῦ καὶ ἐλλύχρια. Apollonius Alexandrinus Minor or Dyskolos, *Περὶ κατεφευσμένης ἱστορίας*, chap. 36. The word *χροώδεις* does

continues: 'This stone is produced in Karystos, from which it took its name, and there is much in Cyprus on the left hand of those travelling down from Gerandros as if going to Soloi, under the rocks or cliffs of Elmaion.'¹

Dioscorides (first century A. D.) refers to the occurrence of the 'amiantos stone' (*λίθος ἀμίαντος*) in Cyprus. He states that it resembles alum-shale², and is woven into incombustible fabrics.

Pliny the Elder (23-79 A. D.), who apparently drew his information from the same source as Dioscorides, states that amiantos resembles alum-shale and does not suffer by fire.³ Elsewhere, in the portion of his Natural History devoted to plants⁴, he describes an incombustible fibre under the name of asbestos. He states that it grows in Indian deserts scorched by the sun where no rain falls.

In modern times travellers from the sixteenth century onwards have referred to the existence of abandoned mines of asbestos in Cyprus near the village of Paleandros or Pelendria to the south-east of Mount Troodos, and some mention a village or district known as Amianto.⁵ The mineral is stated to be dark green in colour and shining, thus resembling chrysotile more than the asbestos of mineralogists. Gaudry (*loc. cit.*) also refers to the occurrence of asbestos, and Bergeat⁶ expressly mentions that the serpentine is penetrated by veins of chrysotile, though he does not refer to the fact of their having been worked.

In the map of the island surveyed by Lord (then Captain) Kitchener the stream flowing southward to the east of Pelendria is named Amiantos, and a locality on it is described as Mylos tou Amiandou (the Mill of the Amiandos), probably the site of a former watermill. There is apparently no village or district known as Amiandos or Amianto.

not appear to occur elsewhere; it has been translated 'coloured' instead of 'skin-like'.

¹ Γίνεται δὲ ὁ λίθος οὗτος καὶ ἐν Καρυστῶ μὲν, ἀφ' οὗ καὶ τοῦνομα ἔλαβεν. Πολλὸς δὲ ἐν Κύπρῳ καταβαινόντων ἀπὸ τοῦ Γεράνδρου ὡς ἐπὶ Σόλους πορευομένοις ἐν ἀριστερᾷ, τοῦ Ἐλμαίου ὑποκάτω πετρῶν (*loc. cit.*).

² Λίθος ἀμίαντος γεννᾶται μὲν ἐν Κύπρῳ στυπητήριά σχιστῆ ἑοικώς. Dioscorides, *Περὶ ἕλης ἰατρικῆς*, Bk. v, par. 156.

³ 'Amiantus, aluminis similis, nihil igni deperdit.' Caius Plinius Secundus, 'Historia Naturalis,' Bk. xxxvi, chap. 31.

⁴ *op. cit.*, Bk. xix, chap. 4. See also Bk. xxxvii, chap. 54.

⁵ J. A. Gaudry, 'Géologie de l'Île de Chypre,' *Mém. Soc. Géol. de France*, 1862, sér. 2, vol. vii, p. 269; Eugen Oberhammer, 'Die Insel Cypren: Part 1, Quellenkunde und Naturbeschreibung,' München, 1903, p. 188.

⁶ Alfred Bergeat, 'Zur Geologie der massigen Gesteine der Insel Cypren,' *Mun. petr. Mitt. (Tschermak)*, 1892, vol. xii, p. 293.

I am indebted to Professor Wyndham Dunstan for the opportunity of examining some of the mineral from the ancient mines on the south-east of Mount Troodos. It is similar in appearance to the Canadian chrysotile, the principal asbestos of commerce, and like it has its fibres at right angles to the veins in which it occurs, but it is shorter in staple than most specimens from the quarries at Thetford or Black Rock. It is pale green in colour, but shows no perceptible pleochroism. It has an extinction parallel to the fibre, the light vibrating in that direction having the least velocity. After drying in a hot air bath it is strongly stained by rhodamine.

An analysis¹ by Mr. G. S. Blake, of the Scientific and Technical Department of the Imperial Institute, gave the following result. The theoretical composition of the mineral and an analysis of a specimen from Broughton near Thetford, Quebec, are added for comparison.

	Near Mount Troodos, Cyprus.		Broughton, Quebec.		Theoretical composition.	
SiO ₂	...	40.54	...	40.57	...	43.48
Al ₂ O ₃	...	1.09	...	0.90	...	—
FeO	...	4.87	...	2.81	...	—
MgO	...	39.02	...	41.50	...	43.48
H ₂ O (+ 100° C.)	...	13.47	...	13.55	...	13.04
H ₂ O (− 100° C.)	...	1.13	...	—	...	—
		<u>100.12</u>		<u>99.33</u>		<u>100.00</u>

The mineral has therefore the composition of a somewhat ferruginous serpentine (H₄Mg₃Si₂O₉).

There can be little doubt that the material examined came from the locality referred to by Sotakos. Unfortunately, neither Elmaion nor Gerandros is referred to by other classical authors, and the names are no longer in use. Oberhummer² suggests that the former is the peak to the east of Mount Troodos, known as Adelphi or Madhari, and that Gerandros is represented by the mediaeval and modern Paleandros³ or Pelendria.

¹ Bulletin of the Imperial Institute, 1905, vol. iii, p. 281.

² loc. cit. and 'Studien zur alten Geographie von Kypros,' Abhand. aus dem Gebiet der klassischen Altertums-Wissenschaft, W. von Christ dargebracht, München, 1891, p. 102.

³ Possibly Paleandros represents a play on words on the original name of the village which had, it need scarcely be said, no connexion with γῆρας, old age. The form 'Paleandros' is used by G. Mariti, 'Voyage dans l'isle de Chypre,' 1791, vol. i, p. 27.

At the present day the natives of the island call the mineral *παμπακόπετρα*, or cotton-stone, which recalls the *κάρπασος* of the ancients. Amiantos is said also to be used.¹ The correct expression in modern Greek is *ἀμίαντος λίθος*, which is practically the form used by Dioscorides; but in the latter part of the eighteenth century the term 'caristia' was still employed.²

The modern use of both asbestos and amiantos in the sense of flexible mineral fibres appears to be due to Pliny, who unfortunately seems to have been much worse informed on the subject than his contemporaries or his predecessors. The employment of the word asbestos in this sense seems to have been quite unwarranted. It signifies 'unquenched by water', and in both ancient and modern Greek is appropriately applied to quicklime. At the time when Pliny wrote the usual term for flexible fibrous minerals was, as we have seen, 'Karystios lithos,' though 'lithos amiantos' appears to have been occasionally, but not always, applied to chrysotile from Cyprus. Amiantos means 'untainted', and may have been applied to the mineral because it was cleansed by fire, a recognized symbol of purification in religious rites. This is the accepted view, but I cannot help thinking it possible that the name was first given to the stream which still retains it, for it is an epithet that was frequently applied to water, and that it was afterwards transferred to the mineral found in the vicinity.

It is, as we have seen, probable that not only the mineral from Cyprus, but also that from Karystos was really chrysotile, and that in ancient as well as in modern times it was fibrous serpentine, and not fibrous tremolite, that was mainly employed for spinning and weaving.

The use of the word 'amiantos' in modern times presents some points of interest. In the Romance languages it has taken, to a large extent, the place of asbestos, while by the early German and French mineralogists³ it was restricted to the finer and more flexible forms which included what is now known as chrysotile-asbestos, and they would undoubtedly have described the mineral from Cyprus under that name. On the other hand, it was scarcely used at all in the language of English science till Mr. George P. Merrill, the mineralogist to the

¹ C. V. Bellamy and A. J. Jukes-Browne, 'The Geology of Cyprus,' Plymouth, 1905, p. 63.

² G. Mariti, loc. cit.

³ L. A. Emmerling, 'Lehrbuch der Mineralogie,' 1793, vol. i, p. 39; and R. J. Häüy, 'Traité de Minéralogie,' 1801, vol. iii, p. 247.

National Museum at Washington, applied it to the soft flexible varieties¹ of chrysotile which are commercially known as asbestos, and there is much to be said for this use of the word.

I am indebted to Mr. G. F. Hill, of the Coins and Medals Department of the British Museum, for valuable criticism and advice from the standpoint of Greek scholarship.

¹ George P. Merrill, 'Notes on asbestos and asbestiform minerals,' Proc. U.S. National Museum, 1895, vol. xviii, pp. 281, 292. He employs the form 'amianthus', but there is no philological warrant for the insertion of the *h*.
