

# Asbestos between science and myth. A 6,000-year story

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## KEY WORDS

Asbestos; history; mythology

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Asbesto; storia; mitologia

## SUMMARY

*Asbestos was used in making pottery in Eastern Finland from around 4000 B.C. In the ancient era and in the Middle Ages, magic properties were frequently attributed to this mineral. In the first century A.D., the Latin encyclopaedist Pliny the Elder reported in his Historia Naturalis that asbestos protects against all poisonings, particularly that of magicians. Moreover, asbestos was often found in places of worship, in Rome as well as in Athens and in Jerusalem. In the Middle Ages asbestos was identified with some animals, such as the salamander and certain white rodents. With such appearance, the mineral had a huge success in Western as well as in Eastern literature and the fine arts. Marco Polo (1254-1324) in the Milione tried to deny that asbestos was a salamander. Despite its noxious effects, asbestos continues to be used in much of the world. In the 21<sup>st</sup> century it seems to be maintaining its quality as a magic stone.*

## RIASSUNTO

**«Asbesto tra scienza e mito. Una storia di 6.000 anni».** *Asbesto è stato usato nella Finlandia orientale nella fabbricazione di ceramica dal circa 4.000 anni a.C. In epoca classica e nel Medioevo venivano frequentemente attribuite al minerale delle proprietà magiche. Nel I secolo l'enciclopedista latino Plinio il Vecchio riferisce nella sua Historia Naturalis che l'asbesto protegge contro tutti i veleni, particolarmente quelli dei maghi. Inoltre l'asbesto si trovava spesso in luoghi di culto sia a Roma che ad Atene e a Gerusalemme. Ciò contribuiva a conferire al minerale significati religiosi. Nel Medioevo l'asbesto fu identificato con alcuni animali, come la salamandra ed alcuni roditori. Sotto tali aspetti il minerale acquistò una grande fortuna sia nella letteratura che nell'arte d'Occidente e d'Oriente. Marco Polo nel Milione cercò di sfatare l'idea che l'asbesto fosse una salamandra. Malgrado i suoi effetti dannosi l'asbesto continua ad essere usato in una grande parte del mondo. Sembra quindi che nel XXI secolo esso continui a conservare il suo significato di pietra magica.*

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Pervenuto il 29.7.2014 - Revisione pervenuta il 3.12.2014 - Accettato il 9.12.2014

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The term asbestos indicates a group of fibrous silicates that includes actinolite, amosite, anthophyllite, chrysotile, crocidolite, and tremolite. Some varieties of asbestos have been extensively used in the industrial civilization since the last decades of 19<sup>th</sup> century. Currently, 55 countries have banned the use of asbestos, due to its noxious effects on health. However, chrysotile continues to be produced and used in many parts of the world (19).

Asbestos use may be traced back to the prehistoric age. In southeastern Finland, in the Savo area, antophyllite was used in pottery from about 4,000 B.C. (14, 15). From the Savo area asbestos was carried to all parts of Finland and to adjacent areas in Russia (15). During the Bronze Age, the use of asbestos is documented in large parts of the Scandinavian peninsula (15). The use of asbestos, mainly antophyllite, continued in Finland for about 4,000 years; in Sweden and Norway asbestos was used until the 5<sup>th</sup>-6<sup>th</sup> century A.D. (15).

Asbestos clothes have been found in ancient burial sites in Southeast Asia (6). In Thailand, asbestos artefacts have been found in Neolithic, Bronze Age and early historical sites (6).

Asbestos was well known in the classical world. In the Mediterranean area, the mineral was mined in Greece and Cyprus. Theophrastus, a Greek philosopher and naturalist (371-287 B.C.), described the singular features of a stone that some researchers have identified as asbestos (5). However, such identification remains doubtful. Caley and Richards maintain that the principal argument against such identification is that asbestos does not occur at Scapte Hylle, the place quoted by Theophrastus (5). The stone described by Theophrastus, both due to its appearance (similar to rotten wood), as well as its location, could be fibrous lignite. In the 1<sup>st</sup> century B.C. Strabo, a Greek geographer (circa 63 B.C. - circa 19 A.D.), described a stone that could be combed like wool and woven (18). Napkins made of this stone could be placed in the fire and cleaned.

Relevant information about asbestos may be found in the *Historia Naturalis* (Natural History) of Pliny the Elder, a Latin encyclopaedist of the 1<sup>st</sup> century (23-79 A.D.) (28). "Amianthus (asbestos) - Pliny reports - similar to alum, is unassailable by

fire. It protects against all poisonings, particularly against that of the Magi". In another passage of his *Historia* Pliny says: "(A linen) that does not burn has already been discovered, too. They call it *vivum*, and we have seen napkins made of that material burn in the brazier of the banquets and then come out, every trace of dirt burnt, returned from the fire whiter than water could have made them. Regal shrouds are made from this material, so that the body's ashes can be kept separate from the ashes of the fire. This fibre, which grows in the desert of India where it never rains and venomous snakes live, is burnt by seasonal fires and is used to the burning heat; it is rare to find and difficult to spin, because the thread is short; finally, its brownish colour gets brighter in the fire. When found, this material attains the value of the most precious pearls. It is called asbestinon by the Greeks because of its natural properties. Anaxilaus attests that a tree wrapped in that linen can be cut down with muffled and inaudible blows. Therefore, this type of linen has to be assigned the first place amongst all the linens of the whole world".

The use of asbestos in the Roman period is documented by archaeological findings. Since the 17<sup>th</sup> century asbestos clothes were discovered in some tombs in Italy (35, 21). Recently, the catalogue of Roman asbestos pieces was enriched by further findings (31, 11). A large asbestos cloth found in a Roman tomb is shown in figure 1.

Pliny appears to be astonished and fascinated by the properties of asbestos. The same astonishment and fascination may be found in the works of many authors, who drew inspiration from Pliny's *Historia* in the following centuries.

In the 1<sup>st</sup> century A.D., the features of asbestos were also illustrated by Dioscorides, a Greek physician and pharmacologist. Dioscorides wrote *ΠΕΡΙ ΥΛΗΣ ΙΑΤΡΙΚΗΣ*, better known by the Latin title *De Materia Medica* (12). This work was a fundamental text of pharmacology until the Renaissance. With asbestos - Dioscorides said - webs are woven for exhibition purposes; the webs, in fact, when thrown into the fire, make flames, but come out undamaged by the flames and brighter.

In the classical age, asbestos was often associated with places of worship. In this way, the mineral al-



**Figure 1** - This large asbestos cloth was found in the necropolis of the Via Triumphalis, in 1957. Vatican City Museum picture

so took on a religious meaning. In the 2<sup>nd</sup> century, Pausanias, a Greek traveller and geographer, reported in his description of Greece that on the Acropolis in Athens there was a great bronze statue of Athena (26). A gold lamp was kept continuously alight in honour of the goddess. The lamp had a wick made of Karpasium linen, the only type of linen that may resist fire.

The use of asbestos in Christian places of worship is documented by the *Liber Pontificalis*, a book in which the biographies of the first Popes are collected (22). The book reported that an asbestos wick was placed on the candle in the middle of the Lateran Baptistery in Rome. The Baptistery was built in the 4<sup>th</sup> century.

According to an apocryphal gospel, the *Protoevangelium* of James, different materials were used

to make the curtain of the Jewish Temple in Jerusalem (30). Seven threads, namely gold, asbestos, fine linen, silk, hyacinth, scarlet and purple threads were assigned to seven Jewish virgins to weave. The Virgin Mary, according to the *Protoevangelium* account, received scarlet and purple fabrics, a fact depicted in the mosaics of the Basilica of Santa Maria Maggiore in Rome, dating from the 5<sup>th</sup> century.

Religious meanings may be traced in the works of the Christian Fathers of the Church. According to Basil the Great (339-379), the three boys who, according to the biblical story (Daniel 3, 1-97), were placed in the fire in Babylon without burning, had the nature of asbestos, thanks to fasting (3). Augustine of Hippo (354-430) quotes asbestos in the *Civitate Dei* (2).

In the ancient era and in the Middle Ages the idea that asbestos was a salamander was very popular. The diffusion of the legend was aided by the *Physiologus* (the Naturalist), a text written in Greek in the 2<sup>nd</sup> century, or perhaps later, in Alexandria, Egypt (9). The *Physiologus* described a series of animals, plants and stones. The focus was on the moral qualities of the animals, which took on the relevant symbolic meanings. The *Physiologus* reported that if the salamander enters a burning kiln, the kiln fire dwindles; if the salamander enters the heating room of a bath, this fire dwindles too. Since the salamander extinguishes the fire thanks to its natural property – the author of *Physiologus* asks – how can some people doubt that the three boys thrown into the kiln extinguished its fire without suffering any harm? In the Middle Ages the *Physiologus*, which was translated into many languages, was often enriched by precious illustrations.

In some Provençal and Italian love poems of the 12-14<sup>th</sup> centuries, the poet declares that his condition is similar to that of a salamander (21): he stays in the fire without burning. So Francesco Petrarca (1304-1374) in a *canzone* (No. 207 in the *Canzoniere*) says that he lives in the flames (of love), like a marvellous salamander (27).

At the beginning of the 13<sup>th</sup> century, the German poet Wolfram von Eschenbach (circa 1170-circa 1220) in his poem *Parzival*, when describing

some armour, tells of a surcoat that had been wrought in the middle of the flames by some salamanders (34).

In Medieval bestiaries, thanks to the asbestos-salamander equation, asbestos took on a deeply religious meaning. According to Cloquet, in the Middle Ages the salamander was the king of fire, and through such regal status, was the symbol of Christ (8).

In medieval literature, the expression “*lana terrae Abrahæ*” (wool of Abraham land) is sometimes encountered. For instance, it appears in the *Descriptio Fratris Oderici de Ordine Minorum de Partibus Infidelium* (Description by Friar Odericus of the Minor Order of the Lands of Unfaithful), 1330, by Odorico of Pordenone (about 1265-1331) (25) (figure 2). A missionary friar, who had spoken against Muhammed, was thrown into the fire, but remained unharmed. The Qadi (Muslim judge)

said this happened because the friar’s clothes were made with the wool from Abraham land. This wool may resist fire. The origin of the wool from Abraham land may be traced back to the legend of Abraham in Jewish post-biblical literature (13). Because of his fight against idolatry, Abraham was condemned to be burnt by King Nimrod, but he remained unharmed. The legend is also reported in the Quran (33).

While in the Western world the features of asbestos were attributed to the salamander, in Japan another animal, the fire-rat, showed asbestos-like properties. The legend appears in the *Taketori Monogatari* (The Bamboo-Cutter Tale), 10<sup>th</sup> century, that is considered the most ancient tale in Japanese literature (20). An old man, Taketori no Okina, found a beautiful princess, Kaguya, in a stalk of bamboo. Five princes ask for Kaguya’s hand in marriage. Kaguya assigned very difficult



Figure 2 - The story of the friars described by Odoricus of Pordenone is illustrated in a series of frescoes dating from the 15<sup>th</sup> century. Saint Francis Church, Udine, Italy (by courtesy of Udine – Civici Musei di Storia ed Arte)

tasks to the suitors. The third prince, the Right minister Abe no Mimuraji, had to find the robe of the fire-rat. The robe did not burn, even if placed in the fire. It could be found in Morokoshi (China). However, the robe that the prince brought proved to be a fake. Placed in the fire, it curled up and burnt. The vicissitudes of the splendid princess Kaguya had enormous success in literature as well as in the fine arts of Japan. In particular, a number of illustrations and pictures have for centuries depicted the story reported in *Taketori Monogatari*.

After the *Taketori* a fire-resistant robe was found in China. This corroborates the fact that asbestos and its properties were known in China at the beginning of the Christian era (21) or before (24). The *Shih I Chi*, composed circa 300 A.D., reports the use of asbestos wicks, that could date back to Han or the pre-Han period (24). Regarding the origin and the nature of the fabric resistant to fire, Ko Hung in 300 A.D. listed three types of fabrics (24). The first type was derived from the flowers of inflammable trees, the second type, inferior in quality was obtained from the bark of the said trees. The third type was said to be the hair of certain white rodents. These animals were covered in long hair; they went into the fire without burning. The hair could be plucked and woven.

Various other Chinese authors of this period reported stories of fire-resistant rats. This clearly indicates the source of the legend that appears in the *Taketori Monogatari*. In some later Chinese works, however, asbestos was correctly recognized as a mineral. Probably, the most ancient text of this type is the *Tung Ming Chi*, plausibly datable to the 5<sup>th</sup> or 6<sup>th</sup> century (24).

The Italian traveller, Marco Polo (1254-1324) in the *Milione* (Travels of Marco Polo) gave a description of asbestos, that was present in Central Asia (23). Marco Polo also wished to disprove the belief that asbestos was a salamander.

“Chingitalas is a province which is on the Northern borders in the desert, and in length six days’ journey. It is ruled by the Grand Khan. Here there are many cities and numerous strongholds; here there are three kinds of people, who are idolatrous, and who worship Mohammed, and Nestorian Christians. There are in this district moun-

tains where there are good veins of steel and andanicus; and in these mountains there is another vein, from which salamander is produced. Salamander is not an animal, as it is said, that lives in fire, because no animal can live in fire; I will tell you how salamander is produced. One of my companions called Zuficar – he is a Turkoman – stayed in that place on behalf of the Grand Khan lord for three years, and made these salamanders; and he told this to me; and it was a person who saw them many times, and I too saw some of them completed. And it is true that that vein is extracted and tightened together, and it is spun like wool; and then they dry it and crush it in large mortars of copper; then they wash it and the earth which is attached falls away, and some woollen like threads remain; and this is spun and tablecloths are made from it. The tablecloths produced are brown; put in the fire they become white like snow. And every time they get dirty, they are put in the fire and become white like snow. And these are the salamanders, and the rest are yarns. I tell you too that in Rome there is one of these tablecloths that the Grand Khan sent as a great gift so that the sudarium of Our Lord be laid inside”.

In some maps of Asia, made in the 17<sup>th</sup> century, a site with a name very similar to that mentioned by Marco Polo is reported (32) (figure 3).

The myth of the salamander did not disappear after the claims by Marco Polo. For instance, we find this animal living in the fire also in the 17<sup>th</sup> century in some esoteric texts, such as the “Atalanta Fugiens” (figure 4).

In the 16<sup>th</sup> century a more scientific approach to the asbestos issue emerged. George Bauer, a German physician and naturalist (1494-1555), considered the founder of modern mineralogy and better known by his latinized name of Georgius Agricola, came on the scene. In particular, his work *De Re Metallica* was for a long time the fundamental text on mining and metallurgy. A description of asbestos is given by Agricola in *De Natura Fossilium* edited in 1546 (1). The author listed the various names given to this mineral: amiantus, asbestos, bostrychites, polia, corsoides, spartopolios, linon, vivum, carystium, alumen. Agricola reported that asbestos mines were to be found in Noricum, Arca-

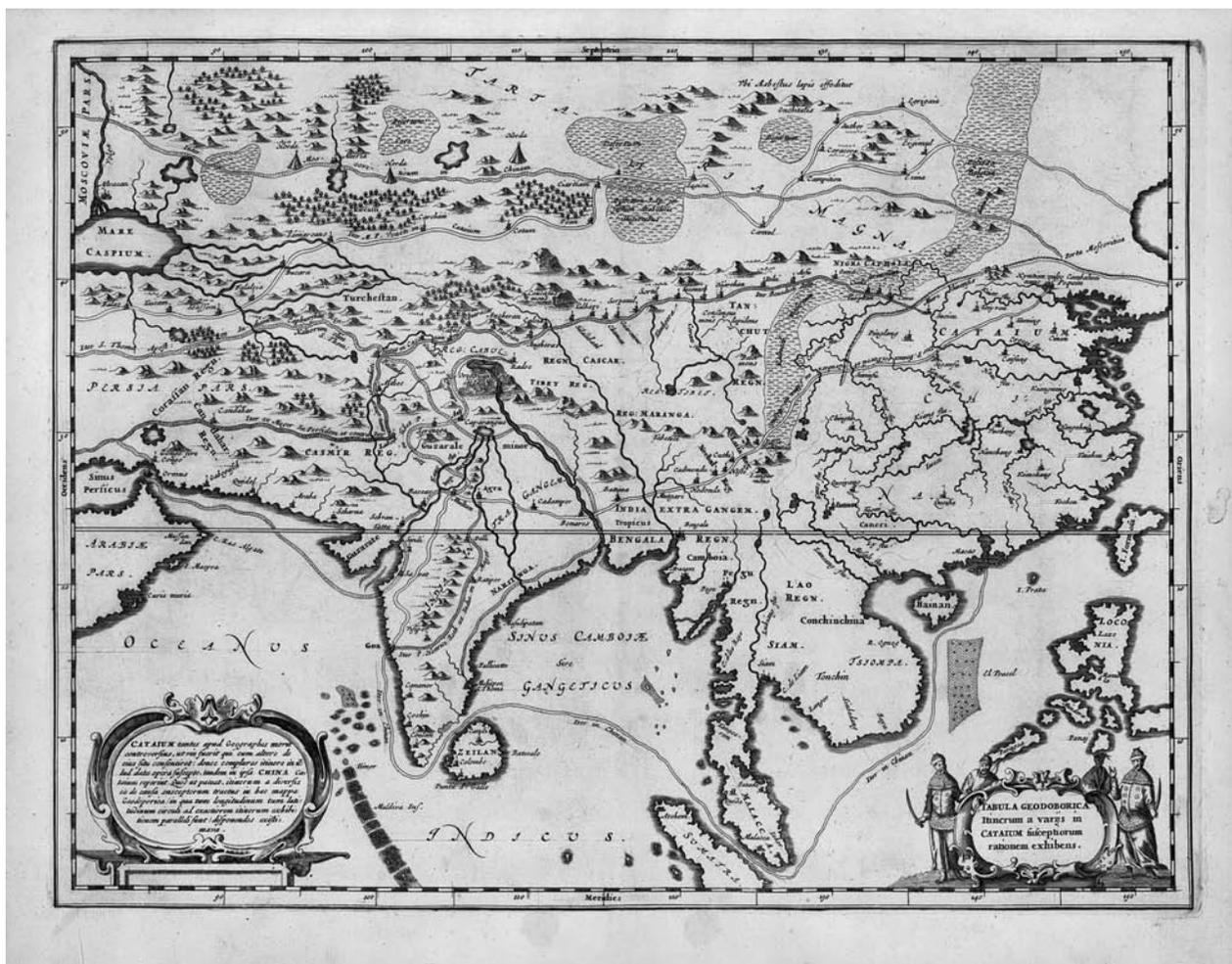


Figure 3 - In this map of Asia, engraved in The Netherlands in 1667, a site named Gnychitalis is shown, with the indication “ubi Asbestos lapis effoditur” (where asbestos stone is extracted). Image taken from *The Agile Rabbit Book of Historical and Curious Maps*, published by the Pepinpress, [www.pepinpress.com](http://www.pepinpress.com)

dia, Euboea, Scythia, India, and Egypt. The mineral could appear in different colours (white, grey, red, iron-like). The taste of asbestos differed from alum, being only slightly astringent. According to Agricola, asbestos was resistant to fire because its humour was more powerful than the heat of the fire. Agricola also made many references to classical authors mentioning asbestos. He also stated that pieces of asbestos were sold at a low price.

Apart from the terms for asbestos listed by Agricola, in the 16<sup>th</sup> century the mineral acquired a further original name: Pantagruelion asbestinon. This is due to the mocking spirit of François Rabelais (1483?-1553). The French writer devoted to the

miraculous plant the last chapter (Chapter 52) of the third book in his masterpiece *Gargantua et Pantagruel* (29). After having described the properties of the Pantagruelion, Rabelais solemnly concluded his description in verse and the third book with an invitation to Arabs and Indians: these peoples should no longer exalt incense and myrrh; one should rather praise the Kingdom of France from whence Pantagruelion arises.

In Italy, the Neapolitan apothecary and naturalist Ferrante Imperato (1550-1631) discussed the uses of asbestos in his work “Dell’historia naturale libri XXVIII” (Natural history XXVIII books, 1599), figure 5 (17). Also, numerous studies on as-



Figure 4 - The salamander living in the fire, as it is represented in the esoteric text *Atalanta Fugiens* by Michel Maier (by courtesy of Taschen, from Alexander Roob, *Alchimia & Mistica*, 2007)



Figure 5 - The properties and uses of asbestos shown in this Figure are reported by Ferrante Imperato in his *Historia Naturale* (by courtesy of the Museo Civico di Storia Naturale di Trieste)

bestos were published in Italy between the 17<sup>th</sup> and the 19<sup>th</sup> centuries (7).

In The Netherlands Anselmus Boetius de Boot (1550-1632) wrote *Gemmarum et lapidum historia*, published in 1647 (10). In this work de Boot reported that a liniment containing asbestos was useful in the treatment of some skin diseases.

In Japan Hiraga Gennai (1729-1779), a multifaceted genius, was a pharmacologist and a physician, a writer and a painter, an inventor and a student of Western studies (*rangakusha*). Gennai investigated the use of asbestos for clothes in his work *Kakanpu Ryakusetsu* (16). He promoted the use of asbestos also for the samurai's armour.

As a marvellous material, asbestos had a strong attraction for man. For its religious meanings, asbestos may be compared to other minerals included under the name of jade, that have been largely used for ritual purposes in Eastern Asia since the stone age. Besides, nephrite, the principal variety of jade, has the same chemical composition as asbestos (actinolite and tremolite).

The precious properties of asbestos have been appreciated throughout the centuries. However, it was only in the 20<sup>th</sup> century that the marvellous stone revealed the full strength of its magical power. In the 20<sup>th</sup> century asbestos became an indispensable material. Asbestos was the only defense against fire. Knowledge that asbestos might be dangerous was not lacking in the late 19<sup>th</sup> century. For instance, in the construction of the Burgtheater in Vienna, Austria, in 1880, there was a minimum use of asbestos, because the mineral was known to be noxious (4). Throughout the 20<sup>th</sup> century, evidence demonstrating the deleterious effects of asbestos progressively grew. Asbestos-related diseases were accurately identified and described. However, this did not interfere with the use of asbestos and world production progressively increased.

At present, the fact that many countries are extremely reluctant to abandon asbestos is attributed to economical and technological reasons. However, this reluctance could also indicate that the fascination with the magic stone is not exhausted.

NO POTENTIAL CONFLICT OF INTEREST RELEVANT TO THIS ARTICLE WAS REPORTED

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