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ASBESTOS AND SALAMANDER,

AN ESSAY IN CHINESE AND HELLENISTIC FOLK-LORE.

BY

BERTHOLD LAUFER.

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ASBESTOS AND SALAMANDER,

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BERTHOLD LAUFER.

It is my object, not to write a history of asbestos and its application with reference to human culture, but to unravel the curious traditions entertained by the Chinese regarding this marvellous production of nature, and to correlate their notions of it with the corresponding thoughts of the ancients, the Syrians and Arabs, and of mediæval Europe. Without due consideration of the Western folk-lore, the Chinese traditions, the elements of which are thoroughly based on Occidental ideas, would forever remain a sealed book. We are indebted to A. WYLIE [1] for a most scholarly study, *Asbestos in China*, which contains an almost complete array of Chinese sources relative to the subject; in fact, without his energetic pioneer-labor, the present investigation could not have been carried to the point to which it has now attained. My obligations to him for his able research-work are acknowledged in each and every case. The present state of science, however, has permitted me to go far beyond the results which Wylie was able to reach a generation ago. WYLIE [2] merely noted in the most general way that the accounts

[1] *Chinese Researches*, section iii, pp. 141—154 (Shanghai, 1897).

[2] *L. c.*, p. 149.

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of the Chinese corroborate the statements of ancient classical writers, mainly emphasizing the point that the Chinese, in the same manner as the ancients, mention handkerchiefs or napkins woven from asbestos. No attempt, however, was made by him to explain all the curious lore that was lavishly accumulated on top of this subject. Here WYLIE [1] merely offered the remark, "The speculations of native writers as to the material of which it was made will probably not be thought equally worthy of credit with the bare recital of facts which came under their notice. In early times they appear not to have suspected that it was a mineral product, but have contented themselves with applying to the animal and vegetable kingdoms respectively for a solution of the difficulty." From the viewpoint of comparative folk-lore and Chinese relations with the West, these speculative theories which partially take their root in Hellenism certainly present most attractive material for study. Further, Wylie's representation of the matter suffers from various defects. It is not well arranged in chronological or any other order, and the sources are not sifted critically. Moreover, as admitted by himself, he did not succeed in identifying most of the geographical terms to be found in the Chinese texts. [2] At present this task is greatly facilitated, chiefly thanks to P. Pelliot's learned researches, which form the basis of many an important conclusion reached on the following pages. The geographical point of view is indispensable in this case, as only in this manner is it possible to trace the routes over which ideas have wandered.

By "asbestos" we understand the fibrous varieties of tremolite, actinolite, and other kinds of amphibole, the fibres of which are sometimes very long, fine, flexible, and easily separable by the fingers,

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[1] *L. c.*, p. 144.

[2] Also HIRTH (*China and the Roman Orient*, p. 252) confessed that he was unable at the time when he wrote (1885) to identify these names.

and look like flax. The colors vary from white to green and wood-brown. The name "amiantus" is now applied usually to the finer and more silky kinds. Much that is called asbestos is chrysotile, or fibrous serpentine.[1] Asbestos, then, is a term of generic character, applied to the peculiar fibrous form assumed by several minerals, and not a name given to any one particular species; the asbestiform condition being simply a peculiar form under which many minerals, especially serpentine, occasionally present themselves. The varieties of asbestos are very numerous. They are all silicates of lime and magnesia or alumina, and commonly occur in crystalline rocks of metamorphic origin. The most valuable property of asbestos, its infusibility, is due to the large proportion of magnesia in its composition, which, like lime, has proved absolutely infusible at the highest temperatures attainable in furnaces or otherwise. Under the blowpipe a single fibre will fuse into a white enamelled glass or opaque globule, but in the mass some varieties have been known to resist the most intense heat without any visible effect. Chrysotile, however, if exposed for some time to long-continued heat, will lose somewhat of its tenacity and silkiness, and become rough and brittle.[2] The word "asbestos," then, in its present loosely-defined significance, is rather a commercial than a mineralogical term, and covers at least four distinct minerals, having in common only a fibrous structure and more or less fire and acid proof properties.[3] It will be well to keep this in mind, as it cannot be expected that the Greek, Roman, Arabic, and Chinese writers, in their accounts of asbestos, should have in their minds a uniform and well-defined mineralogical species.

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[1] E. S. Dana, *System of Mineralogy*, p. 389 (New York, 1893).

[2] R. H. Jones, *Asbestos, its Properties, Occurrence, and Uses*, pp. 13, 22, 23 (London, 1890).

[3] G. P. Merrill, *Notes on Asbestos and Asbestiform Minerals* (*Proc. U. S. Nat. Mus.*, Vol. XVIII, 1895, p. 281).

Asbestos in Classical Antiquity.—It is possible that Theophrastus (372—287 B.C.) [1] makes mention of asbestos, although this name does not appear in his writings. He states, "In the mines of Scaptesylae is found a stone, in its external appearance resembling rotten wood, which is kindled by oil poured over it; when the oil is consumed, the stone itself ceases to burn, as though it were not affected by fire." Theophrastus discusses in this connection the different effects which the action of fire may bring about upon stones; but while he may have had asbestos in mind, this conclusion is by no means forcible. Others hold, for instance, that he speaks here of bitumen,[2] and this view seems more probable.

Strabo (circa 63 B.C.—A.D. 19; x, 1, § 6) states that "in the quarries near Carystus, at the foot of Mount Ocha in Euboea, is extracted a stone which is combed like wool, and spun and woven; of this substance, among other things, are made napkins (χειρόμακτρα) which, when soiled, are thrown into the fire, and whitened and cleaned, in the same manner as linen is washed." [3]

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[1] *De lapidibus*, 17 (opera ed. F. Wimmer, p. 343).

[2] John Hill, in his still very useful work *Theophrastus's History of Stones with an English Version, and Critical and Philosophical Notes* (p. 40, London, 1746), makes the following interesting comment on this passage: "It is much to be questioned whether this was the true original reading, and genuine sense of the author; in all probability some errors in the old editions have made this passage express what the author never meant to say. The substance, and indeed the only substance described by the other ancient naturalists as resembling rotten wood, is the gagates or jet before mentioned among the bitumens; but that has no such quality as the author has here ascribed to this stone of Scaptesylae. The ancients, it is to be observed, had a common opinion of the bitumens, that the fire of them was increased by water, and extinguished by oil; and very probably this was the sentiment originally delivered here by the author, however errors upon errors in different copies of his works may since have altered the sense of them. The stone itself was probably a bitumen of the lapis Thracius kind, as the place from whence it has its name was a town of that country."

[3] Compare F. de Mély, *Lapidaires grecs*, p. 14. Carystus (now Castel Rosso) was a city situated at the southern extremity of the island of Euboea, south of the mountain Ocha (now St. Elias). It was there that in 490 B.C. the Persian expedition under Datis and Artaphernes landed (Herodotus, vi, 99). At the time of Plutarch the mine was exhausted (see below). Celebrated was the marble of Carystus (mentioned also by Strabo),

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Dioscorides (v, 156) of the first century A.D., who designates asbestos by the name "amiant," [1] says that this stone is found on Cyprus, and resembles alum, that may be cleft (στυπτηρίᾳ σχιστῇ). [2] Being flexible, it is made by traders into tissues for the theatre. Thrown into the fire, they flame up, but come out more resplendent without having been attacked by the fire. [3]

Apollonius Dyscolus, who lived in the first half of the second century A.D., has the following interesting notice on asbestos: [4] "Sotacus, in his treatise on stones, [5] says in regard to the stone called Carystius [6] that it has woolly and downy excrescences, and that napkins are spun and woven from this mineral. It is twisted also into lamp-wicks which emit a bright light and are inexhaustible. [7] When these napkins are soiled, their cleaning is performed not by means of washing in water, but brush-wood is burnt, the napkin

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the quarries of which are still preserved (see Lenz, *Mineralogie der alten Griechen und Römer*, p. 59).

[1] Greek ἀμίαντος ("undefilable"), from μιαίνω ("to soil, defile").

[2] Regarding alum see M. Berthelot, *Collection des anciens alchimistes grecs*, Vol. I, p. 237.

[3] F. de Mély, *l. c.*, p. 24. The Arabic version (L. Leclerc, *Traité des simples*, Vol. II, p. 414) says that it resembles the alum of Yemen, and speaks of tissues without reference to theatrical use. J. Yates (*Textrinum Antiquorum*, p. 359) remarks that the epithet ἱμαντώδους may have referred to that variety of asbestos which is now called mountain-leather and commonly found with the fibrous asbestos.

[4] *Historiae mirabiles*, XXXVI (*Rerum naturalium scriptores Graeci minores*, ed. Keller, Vol. I, p. 52).

[5] A work which is lost now. Sotacus lived in the third or perhaps even toward the close of the fourth century B.C. He is chiefly known to us from quotations in Pliny who cites him on seven occasions. Judging from the exact definitions of localities which he gave in order to determine stones and jewels according to their origin, he appears to have travelled a good deal in Hellas and on the Greek islands. The then known world from India to Britannia and Aethiopia supplied him with material for observations; and his definitions, as we see from Pliny, were accepted as models by subsequent scholars. He dealt also with the employment of the single stones, particularly in medicine and magic (compare F. Susemihl, *Geschichte der griechischen Litteratur in der Alexandrinerzeit*, Vol. I, pp. 860—861).

[6] That is, stone from Carystus (see the above citation from Strabo).

[7] Hence arose the name asbestos (ἄσβεστος) which means "inextinguishable."

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in question is placed over this fire, and the squalor flows off;[1] while the cloth itself comes forth from the fire brilliant and pure, and is again utilized for the same purposes. The wicks remain burning with oil continually without being consumed. The odor of such a wick, when burnt, tests and detects the presence of epilepsy in persons.[2] This stone is produced in Carystus, from which place it received its name; in great abundance, however, on Cyprus, as you go from Gerandrus to Soli,[3] under rocks to the left of Elmaeum. At the time of the full moon the stone increases, and again it decreases with the waning of the moon."[4]

PAUSANIAS (I, 26) narrates that the golden lamp made by Callimachus for the temple of Athene Polias in the Acropolis of Athens, which was kept burning day and night, had a wick of Carpasian flax (λίνου Καρπασίου), the only kind of flax that is indestructible by fire.[5] PLUTARCH (*circa* A.D. 46—120), in his *De oraculorum defectu*,

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[1] This is a correct estimation of the process. The throwing into the fire of asbestine cloth, narrated in so many texts, Western and Eastern, is of course not to be taken literally; the cloth was simply put over a charcoal fire. There is no reason to accede to the opinion of J. T. DONALD (*Some Misconceptions concerning Asbestos, Engineering and Mining Journal*, Vol. LV, 1899, p. 250) that these stories "are to a large extent mythical; certainly, if true, the articles in question were not made of asbestos."

[2] PLINY (XXVIII, 63, § 226) says the same about the smell arising from burnt goat's horns or deer's antlers (morbum ipsum deprehendit caprini cornus vel cervini usti nidor).

[3] A city on the north coast of Cyprus.

[4] A similar observation is referred by PLINY (XXXVII, 67, § 181) to the selenitis ("moon-stone"), which contains an image of the moon, and reflects day by day the form of this luminary while waxing and waning, if this is true (selenitis...imaginem lunae continens, redditque ea in dies singulos crescentis minuentisque sideris speciem, si verum est). According to DIOSCORIDES (V, 159), the selenitis is found at night at the time of the waxing moon, and, pulverized, the stone is administered to epileptics. It thus seems that the last clause of Apollonius, as well as his reference to epilepsy, were inspired by traditions pertaining properly to selenitis. The latter, in my opinion, denotes a variety of mica, and it will be seen that the Chinese also know of a stone in which notions of mica and asbestos are blended. Ibn al-Baiṭār, in his Arabic rendering of Dioscorides' Materia Medica, translated the Greek *amiantos* by *al-ṭalk* (that is mica, not our talc).

[5] Asbestos from the vicinity of Carpasus, a town in the north-east corner of Cyprus, now called Carpas.

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mentions napkins, nets, and kerchiefs of this material, but adds that it was no longer found in his time, only thin veins of it, like hairs, being discoverable in the rock.[1] There was further asbestine cloth for enveloping the ashes of cremated bodies, as stated by Pliny. As in other matters, so likewise on asbestos we owe to Pliny the most detailed notes.

Pliny knew asbestos of two localities,—Arcadia and India. That found in the mountains of Arcadia is of an iron color.[2] He has the following notice regarding asbestine cloth: "An invention has been made of a kind of material which cannot be consumed by flames. It is styled 'live,' and I have seen at banquets table-cloths made from it and burning over a fire. When the dirt was thus removed, they came forth from the fire brighter than water would have cleaned them. Funeral garments are made of this stuff for the kings to separate the ashes of the body from those of the pyre. This substance is found in the deserts of India scorched by the sun, where no rains fall, in the midst of deadly serpents, and thus becomes accustomed to live[3] in the blaze. It is but rarely found, and difficult to weave owing to the shortness of its fibres. Its color is red by nature, and becomes white only through the action of fire. When found in its crude state, it equals the price of excellent pearls. In consequence of its natural properties it is called by the Greeks *asbestinon*.[4] Anaxilaus[5] is responsible for the statement that a tree enveloped by this linen is felled without the

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[1] Among the Greek alchemists the word "asbestos" assumed the significance "lime;" thus Zosimus wrote a treatise on the latter under the title "Asbestos" (M. Berthelot, *Origines de l'alchimie*, p. 185).

[2] Asbestos in Arcadiae montibus nascitur coloris ferrei (xxxvii, 54, § 146).

[3] *Vivere*; this description accounts for the above attribute "live" (*vivum*).

[4] That is, inextinguishable, inconsumable.

[5] A physician and Pythagorean philosopher who was banished by the Emperor Augustus in 28 B.C. on a charge of practising magic.

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blows of the axe being audible. Hence this linen occupies the foremost rank the world over." [1]

In another passage Pliny mentions amiantus as resembling alum (*alumen*) in appearance, [2] and losing nothing from the agency of fire. It resists all practices of sorcery, particularly those of the Magi. [3]

The notes of the ancients are very plain, but deficient in facts. They give us the localities where asbestos was found, state the kind of products made from it, and point out its power of resistance to fire. We hear nothing, however, about the mode of mining the mineral, or preparing, spinning, and weaving its fibres. [4] Above all, it should be borne in mind that no theory regarding the origin and nature of asbestos is handed down to us from classical antiquity. Pliny's idea that its fire-resisting quality is bred by the tropical sun of India, can hardly be regarded as such, and is no more than an expression of his personal opinion. Several authors, it is true, have ascribed to Pliny a belief in the vegetal origin of asbestos, but this is an unfounded assumption. Dana [5] peremptorily says that Pliny supposed asbestos to be a vegetable product. Bostock and Riley, [6] pointing to the word *mappa*, as boldly assert that "he

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[1] Inventum iam est etiam quod ignibus non absumeretur. Vivum id vocant, ardentesque in focis conviviorum ex eo vidimus mappas sordibus exustis splendescentes igni magis quam possent aquis. Regum inde funebres tunicae corporis favillam ab reliquo separant cinere. Nascitur in desertis adustisque sole Indiae, ubi non cadunt imbres, inter diras serpentes, adsuescitque vivere ardendo, rarum inventu, difficile textu propter brevitatem. Rufus de cetero colos splendescit igni. Cum inventum est, aequat pretia excellentium margaritarum. Vocatur autem a Graecis ἀσβέστινον ex argumento naturae. Anaxilaus auctor est linteo eo circumdatam arborem surdis ictibus et qui non exaudiantur caedi. Ergo huic lino principatus in toto orbe (XIX, 4).

[2] Aulus Gellius (*Noctes atticae* [*circa* A.D. 175] XV, 1) mentions a wooden tower for the defence of the Piraeus, which could not be set on fire by Sulla, because it was coated with alum.

[3] Amiantus alumini similis nihil igni deperdit. Hic veneficiis resistit omnibus, privatim Magorum (XXXVI, 31, § 139).

[4] Blümner, *Technologie*, Vol. I, 2d ed., p. 205.

[5] *System of Mineralogy*, p. 389.

[6] *Natural History of Pliny*, Vol. III, p. 136.

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evidently considers asbestos to be a vegetable, and not a mineral production." [1] Pliny indeed makes no statement whatever to the effect that asbestos is a plant or the product of a tree, as we hear, for instance, in China; neither is there any such testimony in any other classical source. On the contrary, all Greek authors distinctly speak of asbestos as a mineral. Moreover, Pliny most positively regarded both asbestos and amiantus as minerals; otherwise he would not have listed them, as we have seen, in his books XXXVI and XXXVII, which are devoted to mineralogy. For this reason I am convinced that throughout classical antiquity asbestos was considered as nothing but a mineral substance. This is most strongly corroborated by the fact that the ancients were familiar with at least three mines in their own dominion,—Carystus, Cyprus, and Arcadia; and the people who mine asbestos are assuredly familiar with its true nature, and cannot possibly believe in its vegetal provenience. Pliny has inserted his principal notice of asbestos in his book on textiles, because it was as a textile that the substance was chiefly utilized and known. Certainly this textile deserved the name "linen;" in fact, it could not have been termed anything else. We ourselves still speak of asbestos-cloth, and entertain no thought of a vegetable product in this connection. There are vegetal, animal, and mineral fibres, and any material woven from these may be called cloth. The verb *nascitur* ("it is born, it grows"), used by Pliny, does not allow of inferences, any more than the word *linum*. This term does not necessarily refer to plant-life; on the contrary, Pliny employs it also with reference to minerals. Thus the Indian *adamas* does not "grow" (that is, occur) in a stratum of gold. [2]

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[1] Even so cautious a worker as E. O. VON LIPPMANN (*Abhandlungen*, Vol. I, p. 17) wrongly makes Pliny say that asbestos is an incombustible flax. Pliny does not express himself in this manner.

[2] Indici non in auro nascentis (xxxvii, 15, § 56); or the selenitis is said to grow in

The notion of the vegetal character of asbestos, indeed, did not exist in classical antiquity, but it is Hellenistic and seems to have sprung up somewhere in the anterior Orient. The earliest source to which I can trace it is the Greek Alexander Romance (*Pseudo-Callisthenes*, III, 22) in which is described a dining-room of imperishable wood in the palace of Queen Candace,—not exposed to putrefaction, and inconsumable by fire. Other manuscripts, however, read ἀμιάντων and "stones" instead of "wood;" so that the passage is now rendered, "There was there also a dining-room of incombustible amiantus."[1] A Syriac work on natural history of uncertain date, wrongly ascribed to Aristotle, in which Syriac translations of the Homilies of Basilius the Great and the Physiologus and several other unknown books have been utilized, makes a distinct allusion to an "asbestos tree:" "This tree is styled 'The Constant One.' When a man takes a piece of it and flings it into a very hot bath, the latter becomes tepid, as though it had never experienced fire. Also a fire-stove which is set in flames is extinguished and cools off; likewise a baking oven and chimney is extinguished as soon as a piece of that tree is thrown into them."[2] This notice is followed in the same work by the description of the salamander, which, as will be noticed farther on, plays such a signal part in the mediæval legends of asbestos. The tree-asbestos was adopted also by the Arabic writer Abū Dulaf (below, p. 329). It turns up also in China.

The scarcity of information which the ancients have left to us on the subject of asbestos is to some extent made good by three relics of asbestos tissues still preserved in Italy. One found at Puzzuolo in 1633 belonged to the Gallery Barberini. Another, in

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Arabia (nasci putatur in Arabia [67, § 181]). In a similar manner *croître* was employed in French: R. DE BERQUEN (*Les merveilles des Indes orientales*, p. 15, Paris, 1669), for instance, has, "Cette precieuse pierre croist en plusieurs endroits du monde."

[1] A. AUSFELD, *Der griechische Alexanderroman*, p. 99.

[2] K. AHRENS, *Buch der Naturgegenstände*, p. 80.

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the Library of the Vatican, was discovered in 1702 a mile outside of the Gate of Rome, called Porta Maior; it was a corpse-cloth, five feet wide and six feet and a half long, coarsely spun, but as soft and pliant as silk, enclosing the skull and calcined bones of a human body,—discovered in a marble sarcophagus, thus furnishing a remarkable confirmation of Pliny's statement. The deceased, judging from the sculptured marble, was a man of rank who is supposed to have lived not earlier than the time of Constantine. A third piece of asbestine cloth, of considerable dimensions, is shown in the Museum Borbonico at Naples; it was found at Vasto in the Abruzzi.[1]

The early Chinese notices of asbestos bear the same sober character as those of the classical authors.

Early Importation of Asbestos into China.—The Chinese first became acquainted with asbestos through their trade with the Roman Orient. Indeed, the first authentic notices of a product from this mineral in the Annals refer to the territory of western Asia. The *Wei lio* 魏略, written by Yü Huan between 239 and 265,[2] enumerates asbestos-cloth among the products frequently found in Ta Tsᶜin (the Roman Orient).[3] The same statement is made in the Annals of the Later Han Dynasty;[4] likewise in those of the Tsin and Liu Sung Dynasties.[5] The fact that Ta Tsᶜin produces asbestine cloth is mentioned also in the famous Nestorian inscription of Si-ngan fu. The term used in the Annals is *huo huan pu* 火浣布 (literally, "cloth which can be cleansed by fire"), evidently suggested by the stories of the ancients. After the example of Wylie,[6] I use

[1] J. Yates, *Textrinum Antiquorum*, pp. 359, 360.

[2] See Chavannes, *Tᵉoung Pao*, 1905, pp. 519—520; and Pelliot, *Bull. de l'Ecole française*, Vol. VI, 1906, p. 364.

[3] Hirth, *China and the Roman Orient*, p. 74.

[4] *Hou Han shu*, Ch. 118, p. 4 b.

[5] Hirth, *l. c.*, pp. 40, 45, 46, 61; Chavannes, *Tᵉoung Pao*, 1907, p. 183.

[6] *Chinese Researches*, section III, p. 141.

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the term "fire-proof cloth" as a convenient synonyme, though this meaning is not directly conveyed by the Chinese expression.

The alleged philosopher Lie-tse [1] mentions a tribute of asbestos-cloth to King Mu of the Chou dynasty (1001—946 B.C.) on the part of the Western Jung. Asbestos is characterized there as follows: "The fire-proof cloth, in order to be cleansed, was thrown into the fire. The cloth then assumed the color of fire, and the dirt assumed the color of the cloth. When taken out of the fire and shaken, it was brilliantly white like snow." This text is not authentic, but retrospective, and cannot be older than the Han period. In the same manner as the diamond was a product hailing from the Roman Orient, so also was asbestos. [2]

In like manner the text of the *Chou shu* 周書, [3] alluding to the same event as that of Lie-tse, is of a purely retrospective character, and devoid of chronological value. [4] The matter, indeed, is not connected with King Mu or the Chou dynasty; but the fact is borne out by these two texts that under the Han (206 B.C.—A.D. 220), asbestos-cloth, together with diamond-points, was imported into China over a land-route leading from the Roman Orient by way of Central Asia. [5]

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[1] Ch. 5, *T'ang wên*.

[2] WYLIE (*l. c.*, p. 142) seems to regard Lie-tse's text as historical; and HIRTH (*China and the Roman Orient*, p. 250) even goes so far as to say, that if the philosopher Lie-tse, whose writings are said to date from the fourth century B.C. (A.D. in Hirth's book is a misprint), can be trusted, asbestos-cloth was known in China as early as a thousand years B.C. E. FABER (*Naturalismus bei den alten Chinesen*, p. 132), in his translation of Lie-tse, justly wondered that things like asbestos were already known in times of such hoary antiquity; but certainly they were not. The alleged *kun-wu* 鯤鉡 sword mentioned in Lie-tse is not, as hitherto believed, a sword, but a diamond-point.

[3] See CHAVANNES, *Mémoires historiques de Se-ma Ts'ien*, Vol. V, p. 457.

[4] The text of the *Chou shu* has passed into the *Po wu chi* (Ch. 2, p. 4 b, ed. printed at Wu-ch'ang).

[5] King Mu was the chosen favorite and hero of Taoist legend-makers, to whose name all marvellous objects of distant trade were attached (in the same manner as King Solomon and Alexander in the West). The introduction of the Western Jung is emblematic of the intermediary rôle played by Turkish tribes in the transmission of goods from western Asia to China.

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Wylie was inclined to believe that the earliest allusion to asbestos occurs in the *Shi i ki* 拾遺記, where it is said that the people of Yü-shan 羽山 brought yellow cloth for presentation to the Emperor Shun. This, according to him, is not very distinct; but as we learn from the same authority that the same nation, on two later occasions, brought an offering of fire-proof cloth, it seems not unfair to infer that the former offering was of a similar character. That work, however, as stated by Wylie elsewhere,[1] has little historical value. It was written by Wang Kia 王嘉 of the fourth century; but this work is not preserved, having been afterwards disarranged and partially destroyed. Even if the passage in question were traceable to Wang Kia, our belief in it would not be strengthened; for no authentic work of the pre-Christian era contains any allusion to this matter. Asbestos was found on Chinese soil only in post-Christian times; and Chinese notions regarding asbestos being, as will be seen, to a large extent based on Western folk-lore, it is reasonable to conclude that the Chinese were not acquainted with asbestos before their contact with the Roman Orient. The various accounts of the *Shi i ki* about tributes of asbestos, however, point to the fact that this material came from Western regions.

General Liang-ki 梁冀, who lived under the Emperor Huan 桓 (147—157) of the Han dynasty,[2] had a costume made from asbestos-cloth, which he used to wear on the occasion of great banquets. He would insist on declining the wine-cup till it was spilled on his suit; and then with feigned anger he would take it off, ordering it to be thrown into the fire. It blazed up as if it were reduced to ashes; but the stains being removed, and the fire extinguished, the cloth appeared bright and clean, as if it had been purified with lees.[3]

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[1] *Notes on Chinese Literature*, p. 192.

[2] He died in 159 (Giles, *Biographical Dictionary*, p. 478).

[3] Compare Wylie, *Asbestos*, p. 143. This text is handed down under the name of

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A report of incontestable authenticity concerning asbestos-cloth being sent as tribute to China refers to the second month of the year 239, in the time of the Three Kingdoms, when envoys from an unnamed country of the Western Region (*Si Yü*), introduced at the Court by means of double interpreters, offered fire-proof cloth to Ts'i Wang Fang 齊王芳 (240—253) of the Wei dynasty. The Emperor directed his military staff to test it, and to proclaim the result to the officers.[1] The intention was perhaps implied to make use of this material for army purposes. Under the Wei, also, the tradition was upheld that early under the Han, gifts of such cloth had been presented by Western countries. Two sovereigns of the Wei lent expression to an ill-founded scepticism as to the actual existence of this substance,—a belief which was not shared by the Taoist Ko Hung 葛洪 of the fourth century.[2] Ko Hung inaugurates a new period in the study of this subject on the part of the Chinese. Under the Han and throughout the third century, the Chinese accepted asbestos products as a fact, without inquiring into the nature of the mineral or the causes of its wonderful properties. They were satisfied to state merely the effects of its properties. Ko Hung is the first Chinese author to render an account of the origin of asbestos in the romantic spirit appropriate to the Taoist school. The ideas which he expounded, however, are closely inter-

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Fu-tse 傅子, who lived in the latter part of the fourth century, and appears in P'ei Sung-chi's commentary to *San kuo chi* (*Wei chi*, Ch. 4, p. 1). HIRTH (*China and the Roman Orient*, p. 251) wrongly ascribes it to the text of *Wei chi* itself; he aptly reminds us of the jest practised by the Emperor Charles the Fifth, who astonished his guests after dinner by exposing an asbestos table-cloth to a fire. In the *Encyclopædia Britannica* (Vol. II, p. 714) this anecdote is connected with Charlemagne; R. H. JONES (*Asbestos*, p. 3) allows both Charleses to pass. The one attribution is as true as the other.

[1] *San kuo chi* (*Wei chi*), Ch. 4, p. 1.

[2] These texts have been translated by WYLIE (*l. c.*, pp. 150—151): they are therefore not reproduced here, especially as they bear no immediate relation to our subject, which is to trace the development of Chinese notions of asbestos in their dependence on Western beliefs. Compare also the analogous text in the *Yü kien* 寓簡 (WYLIE, *Notes*, p 165), Ch. 3, p. 2 b (ed. of *Chi pu tsu chai ts'ung shu*).

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twined with those which the further development of the matter at the end of the classical period in the Occident brought to life. The sober and prosaic notices of the Han and Wei periods thoroughly coincide with those of the classical authors, while Ko Hung's thoughts are on the same level as those of the post-classical writers. In their efforts to find a plausible explanation for the origin of asbestos, the Taoist nature-philosophers directed their thoughts toward the animal and vegetable kingdoms, now explaining it as the hair of a beast, now as the fibre of a plant, and also, through the introduction of the activity of a volcano, welding these two theories into one. Nobody as yet has unravelled the mystery of how these strange speculations arose.[1] As regards the supposed animal origin of asbestos, the gist of the Chinese accounts in general is that there is a fiery mountain (volcano) on which lives an animal lustrous with fire, about the size of a rodent, covered with hair of unusual length and as fine as silk. Ordinarily it dwells in the midst of the fire, when its hair is of a deep-red color; but sometimes it comes out, and its hair is then white. On a dark night the forest is visible from the reflection of the animal's lustre. It is put to death by being sprinkled with water, whereupon its hair is spun and woven into cloth, which makes what is called fire-proof cloth. If the cloth becomes soiled, it is purified by fire. The solution of this riddle may be betrayed in advance: the Chinese animal yielding asbestos

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[1] Chavannes (*Bulletin de l'École française*, Vol. III, p. 438) indicates an interesting text in *Pei shi* (Ch. 97, p. 2), according to which the Emperor Yang (605—616) of the Sui dynasty despatched Wei Tsie and Tu Hing-man on a mission to the countries of the west; in the kingdom of Shi (Kesh, at present Shāhr-i-sabz) they took ten dancers, lion-skins, and hair of the rat which enters the fire (*huo shu mao*). Chavannes cites the definition given of this animal in the *Ku kin chu*, "The fire-rat enters the fire without burning; its hairs are over ten feet long; they can be made into a textile known as 'cloth washable in the fire.'" "Ce sont des fibres d'amiante ou asbeste qu'on présentait aux Chinois comme étant les poils d'un animal merveilleux," is the comment added by M. Chavannes.

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is a disguise of the classical salamander, whose hair or wool was believed by the Arabs and mediæval Europe to furnish the material for asbestos textiles. The history of this subject must be studied in detail to arrive at a correct appreciation of the Chinese traditions, which, on their part, are of sufficient extent and importance to throw light back on the development of the matter in the West.

The Salamander in Greek and Roman Lore.—An animal by the name of salamander is first mentioned by Aristotle (384—322 B.C.): "On the Island of Cyprus, where copper-ore is smelted and accumulates for many days, animals are developed in the fire, somewhat larger than the big flies with short wings that go hopping and running through the fire. They die when removed from the fire. The possibility, however, that the bodily substance of some animals is not destroyed by fire, is proved by the salamander; for this creature, as it is said, will extinguish the fire while passing through it." [1]

Aubert and Wimmer, in their edition of Aristotle's work, [2] reject this passage as unauthentic, and presumably with good reason. Aristotle does not mention this animal in any other passage, and it is not clear from his text what kind of animal he understands by *salamandra*; it is also difficult to credit a scholar of the intellectual calibre of Aristotle with the belief in animals crossing fire unhurt, which belong, not to natural history, but to the realm of fable.

Theophrastus (372—287 B.C.), Aristotle's great disciple, mentions the salamander in two of his writings as an animal which he apparently knew from personal experience. He enumerates "the lizard,

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[1] *Ὅτι δ'ἐνδέχεται μὴ κάεσθαι συστάσεις τινὰς ζώων, ἡ σαλαμάνδρα ποιεῖ φανερόν· ἄυτη γάρ, ὡς φασί, διὰ πυρὸς βαδίζουσα κατασβέννυσι τὸ πῦρ* (*Historia animalium*, v, 19, § 106).

[2] *Aristoteles Tierkunde*, Vol. I, pp. 119, 515

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which is called the salamander," together with birds and the green frog, among the animals whose appearance prognosticates rain.[1] In his treatise on fire he discusses means of counteracting the force of conflagrations; for instance, vinegar, and vinegar mixed with the white of an egg. "If the power of cold is added to such a fluid," he continues, "this co-operates toward the extinction of fire, and this property is said to be found in the salamander; for this creature is cold by its nature, and the fluid flowing out of its body is sticky, and at the same time contains such a juice that it penetrates forward. This is shown by water and fruits which, when touched by it, become injurious, and usually have a deadly effect. The animal's slowness of motion is also of assistance; for the longer it tarries in the fire, the more it will contribute toward its extinction. However, it cannot extinguish a fire of any dimensions, but only one commensurate with its nature and physical ability; and a fire in which it did not dwell long enough will soon light up again."[2] Also Theophrastus, in the same manner as his master, reproduced a popular opinion of his time, as seen by his addition "it is said" (*φασί*); but compared with Aelian and Pliny, he is rational and reasonable to a high degree.[3]

Aelian[4] tells the following story of the salamander: "The salamander is not a product of fire, nor does it rise from the latter like the so-called pyrigoni;[5] yet it does not fear fire, but, going against the flame, the animal tries to combat it like an adversary. The witnesses to this fact are the artisans and workmen dealing

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[1] Καὶ ἡ σαύρα φαινομένη ἣν καλοῦσι σαλαμάνδραν, ἔτι δὲ καὶ χλωρὸς βάτραχος ἐπὶ δένδρου ἄδων ὕδωρ σημαίνει (*De signis tempestatum*, 15; opera, ed. Wimmer, p. 391).

[2] *De igne*, 60 (opera, ed. Wimmer, p. 361).

[3] The important text of Antigonus of Carystus will be discussed in another connection (see below).

[4] *De natura animalium*, II, 31.

[5] The insects mentioned in the text of Aristotle quoted above.

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with fire. As long as their fires flame up brightly and further their labor, they pay no attention to this creature; but when the fires go down and become extinguished, and the bellows blow in vain, they become aware of the counteraction of the animal. Then they trace it out and visit their vengeance upon it; thereupon the fire rises again, and assists their work." In another passage of the same work (IX, 28) Aelian asserts that the hog, when swallowing a salamander, is not hurt, while men partaking of its flesh are killed. The same is expressed by Pliny: "Those in Pamphylia and in the mountainous parts of Cilicia who eat a boar after it has devoured a salamander will die, for the danger of poison is by no means indicated in the odor or taste of the meat; water and wine in which a salamander has perished, even if it has only drunk of the beverage, will also have a mortal effect." [1] In the zoölogical portion of his great work, Pliny describes the animal thus: "The salamander is an animal of the shape of a lizard, with a star-like design. It never comes out except during heavy rains, and disappears when the sky becomes serene. Such intense cold inheres in this animal, that by its mere contact, fire will be extinguished, not otherwise than by the action of ice. The milky mucus flowing from its mouth, whatever part of the human body it may touch, causes all hair to fall off; and the spot thus touched assumes the appearance of tetter." [2]

In Book XXIX, where he treats the remedies derived from the animal kingdom, Pliny has devoted another chapter to the salamander.

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[1] Apros in Pamphylia et Ciliciae montuosis salamandra ab iis devorata qui edere, moriuntur: neque enim est intellectus ullus in odore vel sapore; et aqua vinumque interemit salamandra ibi inmortua vel si omnino biberit unde potetur (XI, 53, § 116). In XXIX, 23, he dilates still further on the subject.

[2] Sicut salamandrae, animal lacertae figura, stellatum, numquam nisi magnis imbribus proveniens et serenitate desinens. Huic tantus rigor, ut ignem tactu restinguat non alio modo quam glacies. Eiusdem sanie, quae lactea ore vomitur, quacumque parte corporis humani contacta toti defluunt pili, idque, quod contactum est, colorem in vitiliginem mutat (X, 67, § 188).

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The most interesting point that he makes there is this: "If the assertion of the Magi were true, that the animal is helpful in conflagrations, since it is the only creature able to extinguish fire, this experience would long ago have been made in Rome; Sextius also rejects this statement as incorrect." [1] This passage shows that there were men who disavowed this popular belief; and they are headed by Dioscorides, who affirms that it has been said, and wrongly, that the salamander remained immune on entering fire. [2] Further, Pliny imputes the superstition to the Persian Magi; and it may, indeed, have spread into the antique world with the diffusion of the Mithraic cult into Rome.

O. KELLER [3] also holds that the fables about the salamander betray Oriental origin, but he has not succeeded in tracing their sources. [4] Pliny's and Aelian's stories doubtless go back to the Alexandrian Physiologus, whether they may have drawn upon this work directly, or received them by way of oral tradition flowing from Alexandria. The *Physiologus* (Ch. 31) states that the salamander entering a fire-stove extinguishes the fire; [5] and the same is found

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[1] Ex ipsa quae Magi tradunt contra incendia, quoniam ignes sola animalium extinguat, si forent vera, iam esset experta Roma. Sextius...negatque restingui ignem ab iis.

[2] L. LECLERC, *Traité des simples*, Vol. II, p. 235.

[3] *Antike Tierwelt*, Vol. II, p. 321. Keller neglected the fundamental passage of Theophrastus regarding the salamander.

[4] The evidence produced by Keller in favor of the Oriental origin is rather perplexing. The name "salamander," which cannot be explained from Greek, indubitably comes from Asia. Arabic and Persian offer the name by omitting the syllable *al*, and the word thus abbreviated is said to mean "poison within." It is of course impossible to derive the Greek name from Persian or Arabic; on the contrary, Arabic *samandal* سمندل, *samandar*, *samaidar*, *semendel*, *semendul*, *samand*, *sandal*, and Persian also *sālāmandirā* سالامندرا, are derived from Greek *salamandra*, as admitted by all competent philologists (F. HOMMEL, *Namen der Säugetiere bei den südsemitischen Völkern*, p. 33; the Ethiopic Physiologus still offers the form *salmandar*; STEINGASS, *Persian-English Dictionary*, p. 642; YULE, in his *Marco Polo*, Vol. I, p. 216). The derivation from Persian *sām* سام ("fire", not "poison," which is *samm* سم, an Arabic word) and *andar* ("within") certainly rests on mere playful popular etymology.

[5] F. LAUCHERT, *Geschichte des Physiologus*, pp. 27, 261.

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in the *Hieroglyphica* of the Egyptian priest Horapollon of the fourth century A.D.[1] The tradition, accordingly, must have been current in Egypt as early as the first or second century. Let us note right here that the *Physiologus* (Ch. 7) tells also the legend of the phœnix which cremates itself in the Temple of the Sun at Heliopolis, how on the ensuing day arises from the ashes a worm, which develops on the second day into a young bird, till on the third the phœnix itself comes out therefrom in its previous shape; for this notion has likewise been associated with the attempts to account for the origin of asbestos,—asbestos, salamander, and phœnix, all representing or yielding matters going through fire unscathed. The Physiologus contains no reference to asbestos; and it must be emphasized that the assimilation of the three has not taken place in classical antiquity, during which they were clearly separated. A wondrous and fabulous book of the type of the *Cyranides*, a late Greek work written between 227 and 400, would not have missed this opportunity, had such an assimilation then existed among the Greeks; but it does not mention a fire-proof textile spun from the animal's hair.[2]

The Salamander and Phœnix among the Arabs.—Old d'Herbelot,[3] even, knew that the Arabic word *samandar* designates the animal styled by us "salamander," and that Oriental authors are not in accord as to its species,—the one taking it for a kind of marten,

[1] F. Hommel, *Aethiopische Ueb. d. Physiologus*, p. xxxii.

[2] F. de Mély, *Lapidaires grecs*, p. 91. This work defines the salamander as a quadruped bigger than the green lizard, and Pliny and Dioscorides also take it for a lizard. O. Keller's (*l. c.*, p. 318) identification with *Salamandra maculata* — that is, the animal now called by us salamander (or eft, newt) — seems to me arbitrary. The amplifications of the Cyranides are interesting: the animal's heart renders him who carries it with him fearless of fire, intrepid in a conflagration, and incombustible; and when its heart is worn as an amulet by people burnt with fever, the fever will at once abate, etc.

[3] *Bibliothèque orientale*, Vol. III, p. 192.

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its hair being made into a strong stuff, which can be thrown into fire to be cleansed, when it is soiled, without being in the least damaged; others taking it for a kind of bird generated and consumed in the fire, and found only in places where a perpetual fire is entertained; others, again, describing it as an insect or reptile like a lizard,—but neither D'HERBELOT nor YULE[1] noticed that the salamander as a bird (his product "salamander's plumage" being the equivalent of "asbestos") is no other than the masqueraded phœnix of the ancients.[2] The climax of these curious adjustments is reached by Damīrī (1344—1405), in his *Ḥayāt al-ḥayawān*, who notes the phœnix under the title "salamander," describes it as an animal like a fox or marten, and attributes to it the yielding of asbestos: "*Samandal* سمندل is a certain bird that eats *al-bīš* البيش (aconite), which is a plant found in the land of China, where it is edible. It is green in that country; and when it is dry, it becomes a kind of food for the people of China without any injurious effect on them. But if it be taken away from China, even to a distance of a hundred cubits, and is then eaten, the eater of it dies instantaneously.[3]

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[1] *The Book of Ser Marco Polo*, Vol. I, p. 216.

[2] JULIUS CAESAR SCALIGER (*De subtilitate ad Cardanum*, fol. 305 b, Lutetiae, 1557), however, identified it with the phœnix, "which is not entirely fabulous, but, as we read in the navigators, occurs in the interior of India, and is called by the natives *semenda*."

[3] This story is found in (and is probably copied from) Ibn al-Baiṭār (1197—1248), who quotes Ibn Semdjun as follows: "Some physicians report that the plant *bīš* بيش, grows in China toward the frontier of India, in a country called Halāhil, where alone it occurs. It is eaten as a vegetable in the country of Halāhil, toward the frontier of India. In a dried state it is an article of food for the people of the country, who experience no harm from it. When taken out of that country, if only to a distance of a hundred paces, it acts as a poison, instantly killing him who eats of it" (L. LECLERC, *Traité des simples*, Vol. I, p. 298). This text is important, inasmuch as it shows that the consumption of edible aconite did not take place in China, as Damīrī wrongly asserts, but in a border state of the Himalayan region of northern India. Damīrī's allegation appears embarrassing, as "the Chinese do not seem to have considered any of the aconites as edible" (G. A. STUART, *Chinese Materia Medica*, p. 11); neither does BRETSCHNEIDER (*Bot. Sin.*, pt. 3, pp. 252—257) know anything about such a practice. The statement of the *Pie lu* regarding one variety of aconite, that it is of a sweetish taste, only shows that there is a non-

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A wonderful thing in connection with the phœnix is that it takes pleasure in fire and in remaining in it. When its skin becomes dirty, it cannot be cleansed except by means of fire. It is found largely in India.[1] It is an animal smaller in size than the fox, piebald in color, with red eyes and a long tail. Sashes are woven of its soft hair; and when they become dirty, they are thrown into fire, upon which they become clean without being burnt. Other authorities assert that the phœnix is a bird found in India, that

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poisonous aconite in China. On the other hand, we know that in India only two varieties of *Napellus* are poisonous, — *Napellus* proper and *Aconitum rigidum* — while the two others, *Aconitum multifidum* and *A. rotundifolium*, are harmless and are eaten in Bhūtan (Hooker, *Flora of British India*, Vol. I, p. 29). According to Flückiger and Hanbury (*Pharmacographia*, p. 15), the tubers of *Napellus* are taken in Kunawar as aphrodisiac. Arabic *bīš* is derived from Hindi *bīš*, the latter from Sanskrit *vishā* (*visha*, "poison"), *Aconitum ferox* (*ativishā*, *Aconitum heterophyllum*; Hoernle, *Bower Manuscript*, p. 186). The word appears in al-Bērūnī (Sachau, *Alberuni's India*, Vol. II, p. 159) and in Qazwīnī, who describes how the fabulous poisonous girls of India are reared on it (Silvestre de Sacy, *Chrestomathie arabe*, Vol. III, p. 398). Regarding aconite in India, see Watt, *Dictionary of Economic Products of India*, Vol. I, pp. 84—99 (also published as a separate pamphlet in the series *Agricultural Ledger*, No. 3, 1902); in Tibet, H. Laufer, *Beitr. zur Kenntnis der tib. Med.*, p. 57. Much valuable and interesting material on Western and Eastern beliefs in aconite poison and its effects has been gathered by W. Hertz, *Sage vom Giftmädchen* (*Abh. bayer. Akad.*, Vol. XX, 1893, pp. 48—52). Of course, it is not the phœnix which feeds on aconite, but the salamander as a venomous animal. Its poisonous character, inherited from the classical authors, is explained by the Arabs through this process of nutrition.

[1] Pliny (xix, 4) attributed asbestos to the deserts of India, where, under the scorching rays of the tropical sun and among numerous deadly serpents, it acquires the property of resisting fire. Hierocles, a Greek writer of the sixth century A.D., says of the Brahmans of India that their garments are made of the soft and skin-like fibres of stones, which they weave into a stuff that no fire burns or water cleanses; when their clothes get soiled, they are thrown into a blazing fire, and come out quite white and bright (McCrindle, *Ancient India as descr. in Class. Lit.*, p. 186). G. Watt (*Dictionary of the Economic Products of India*, Vol. I, p. 338) mentions two localities, — the Gokūk Taluka, in the Belgaum district in the southern Maratha country, where asbestos is used as an external application in ulcers, made into a paste, after rubbing it down with water; and the country to the south and west of the Kurum River, Afghanistan, where it is medicinally employed and made into brooms and rough ropes, and padding for saddles. Watt imparts a vernacular name for asbestos, *shankha* [*çaṅkha*]*-palita*, which he translates "wick made of shells." On Ceylon, asbestos is found, but is not mined commercially (J. C. Willis, *Ceylon*, p. 3, Colombo, 1907).

lays its eggs and produces its young in fire. It possesses the property of being unaffected by fire. Sashes are made of its feathers and taken to Syria. If one of them becomes dirty, it is thrown into fire, which consumes the dirt over it, but the sash itself is not burnt. Ibn-Khallikān states, 'I have seen a thick piece of it woven in the shape of a belt for a riding beast throughout its length and breadth. It was put into fire, but the fire had no effect on it whatever. One end of it was then dipped in oil and left over the burning wick of a lamp, upon which it lighted up and remained so for a long time, after which the flame was extinguished; and it was found to be in the same condition as before, unaltered in any way.' He further states, 'I have read in the writing of our shaikh, the very learned Abd-al-Laṭīf, that a piece of *samandal* a cubit in breadth and two cubits in length was presented to the sovereign of Aleppo. They kept on dipping it in oil and lighting it up, until the oil was exhausted, but yet it remained as white as it was.'" Farther on, Damīrī mentions the salamander under the name *samandar* سمندر and *samaidar* سميدر as "a certain animal well known to the people of India and China, according to Ibn-Sīdah." [1]

Damīrī has compiled his information from the writings of his predecessors. The earliest Arabic notice of the *samandal*-phœnix, as far as I know, occurs in the *Adjaib al-Hind* عجايب الهند ("The Wonders of India"), written in the tenth century, where the bird is localized on one of the Islands of Wāqwāq الوقواق: "It can enter fire without burning itself, and remain there long without eating anything but earth." [2] This work, however, while naming the phœnix

[1] A. S. G. Jayakar, *Ad-Damīrī's Zoological Lexicon*, Vol. II, pt. 1, pp. 79—81 (Bombay, 1908). G. Ferrand (*Textes relatifs à l'Extréme-Orient*, Vol. I, p. 248) objects to Jayakar's translation of *samandal* by "phœnix;" but Jayakar is certainly right. The three ideas of asbestos, salamander, and phœnix are assimilated in this notion.

[2] Lith and Devic, *Livre des merveilles de l'Inde*, p. 172. L. M. Devic, in his separate translation of this work (p. 204, Paris, 1878), has this comment: "Semendel ou

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for the salamander, makes no reference to a fire-proof textile obtained from the animal. As shown below (p. 328), the geographer Yāqūt (1179—1229) mentions the popular belief that asbestos is the plumage of a bird. In regard to the Caliph Māmun, it is told that the Indian King Dehim presented him with a skin of the bird *samandal* which no fire was able to consume.[1]

If the Chinese, as will be seen, made the salamander a rodent, this zoölogical feat meets a parallel among the Arabs. Qazwīnī enumerates the *samandalun* or *sandalun* as his fifth kind of rat, and describes it as a species of rat that enters fire, recording the same as Damīrī relates about the phœnix (above, p. 319); adding

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Semendoul est le nom arabe et persan de la salamandre, animal fantastique sur la nature duquel les Orientaux ne s'accordent guère; les uns en font un quadrupède, d'autres un oiseau, d'autres enfin un reptile, tous lui attribuant d'ailleurs la faculté de vivre dans le feu sans se brûler. Marco Polo désigne par ce nom l'amiante." No Arabist as yet seems to have conceived the notion that this tradition becomes intelligible only if we combine the three classical traditions concerning asbestos, salamander, and phœnix associated in post-classical time by the common idea of their incombustibility; hence we meet in Arabic literature accounts of asbestos termed "salamander" which is an animal interpreted as a reptile, phœnix, and finally also as a mammal. — G. FERRAND (*Journal asiatique*, 1904, Mai-Juin, pp. 489—509) has advanced the theory that the one of the two Wāqwāq spoken of by the Arabic writers should be identified with Madagascar (the other is Japan, *Wa-kuok* 倭國; compare also the notice of CHAVANNES, *T'oung Pao*, 1904, pp. 484—487). In an additional notice (*Journal asiatique*, 1910, Mars-Avril, pp. 321—327) FERRAND admits that Wāqwāq may be identified also with Java-Sumatra. In his admirable work *Textes relatifs à l'Extrême-Orient* (Vol. I, p. IV), he adds to these possibilities also East Africa. While not contesting the ingenuity of Ferrand's theory, it is not convincing in all parts (it is chiefly based on the supposed etymology of Wāqwāq being derived from the native names for Madagascar, *Vahuaka*, and for the tree *vakua*). The authority of al-Bērūnī, however, is not to be disparaged, according to whom Wāqwāq belongs to the Qumair Islands; the latter, according to his statement, belong to the Dīva Islands (Maledīva and Laccadiva); further, as assured by the same author, Qumair is not, as believed by the common people, the name of a tree, but of a people whose color is whitish, and who practise the religion of the Hindu (SACHAU, *Alberuni's India*, Vol. I, p. 210). Wāqwāq is here clearly indicated as an island or insular group in the Indian Ocean with a populace of Hindu culture. The phœnix, as shown by the above extract from Damīrī, is naturalized by the Arabs in India; and it is difficult to believe that the Adjaib should place the bird on Madagascar, in Indonesia, or in East Africa.

[1] G. WEIL, *Geschichte der Chalifen*, Vol. II, p. 253.

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at the end, however, that the animal merely looks like a rat, but in reality is none, and that it occurs in the country of Gūr (east of Herāt in Khovaresm).[1] A gloss to the Talmud, which repeatedly alludes to the legends of the salamander, remarks that the animal has the shape of a mouse, and arises when the wood of the myrtle is burnt in a stove during seven consecutive years.[2] It is the same when other Oriental authors make the salamander an animal resembling a marten, except that it differs from it in color; for the salamander is always red, yellow, or green.[3]

THE SALAMANDER AND PHŒNIX IN MEDIÆVAL EUROPE.—In the poetry of the European middle ages the salamander appears first of all in the love-songs of the Provençal Troubadours. Pierre de Cols d'Aorlac regards the erotic fire burning in his heart as so pleasing that it is the more desirable to him, the more it burns him, like the salamander, which is happy in fire and blaze.[4] In the contemporaneous lyrics of Italy we meet the allegories of the salamander and phœnix woven together: the amorous fire (*il foco amoroso*) is likened to that tenanted by the salamander; the poet is consumed by it, but at the same time rejuvenated like the phœnix; or he dies from the effect of the amorous fire like the phœnix, not being endowed with the salamander's property of being able to live in fire; or he rises again to a new life, like the phœnix, and life in fire becomes his second nature, as is the case with the salamander.

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[1] F. HOMMEL, *Namen der Säugetiere bei den südsemitischen Völkern*, p. 338; JAYAKAR, *Damīrī's Zoological Lexion*, Vol. II, pt. I, p. 80. In another place Qazwīnī mentions also the mineral asbestos (G. JACOB, *Waren beim arabisch-nordischen Verkehr*, p. 18).

[2] L. LEWYSOHN, *Zoologie des Talmuds*, p. 228.

[3] D'HERBELOT, *Bibliothèque orientale*, Vol. III, p. 192.

[4] The idea that the salamander is happiest in fire first occurs in Saint Augustin (*De civitate Dei*, XXI). It is notable how the exaggerations grow. Classical authors stated nothing to that effect, but merely that the salamander coming in contact with fire can extinguish it.

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Also the German poetry of the thirteenth century not infrequently mentions the salamander, and incombustible materials spun from its hair. The latter, for instance, occurs in Wolfram von Eschenbach's Parsifal. The earliest mediæval allusion to this pseudo-salamander asbestos seems to be made in a Provençal treatise on birds and animals ("Naturas d'alcus auzels e d'alcunas bestias"), where it is said, "The salamander subsists on pure fire, and from its skin is made a cloth which fire cannot burn." [1] Again the salamander, through the metamorphosis of the phœnix, appears as a bird. Richard de Fournival, who died about 1260, regards the salamander as a white bird subsisting on fire, and from whose plumage are made cloths that can be purified only by fire. [2] According to the Old-French romance of Bauduin de Sebourc, the salamander lives in the terrestrial paradise as a bird with white woolly down made into tissues; and in Partonopeus de Blois a nuptial coat is lined with salamander's down. [3] Albertus Magnus (*circa* 1193—1280) [4] seems to be the only mediæval author who knew that salamander's plume was asbestos. [5] Konrad von Megenberg (1309—74), who in his *Book of Nature* devoted a chapter to the salamander, [6] tells that Pope Alexander possessed a garment of salamander-wool which was washed in fire instead of water.

[1] Salamandra vieu de pur foc, e de son pel fa hom un drap que foc nol pot cremar. Compare F. Lauchert, *Geschichte des Physiologus*, pp. 186, 188, 189, 202.

[2] Hippeau, *Bestiaire d'amour*, p. 20 (Paris, 1860).

[3] W. Hertz, *Sage vom Giftmädchen*, p. 66 (*Abh. bayer. Akad.*, Vol. XX, 1893). He refers also to the Byzantine poet Manuel Philes (thirteenth century), who, in his didactic poem on the Properties of Animals, classifies the salamander among the birds.

[4] *De secretis mulierum item de virtutibus herbarum lapidum et animalium*, p. 134 (Amstelodami, 1669).

[5] Si vis ignem perpetuum inextinguibilem facere. Accipe lapidem qui Abaston dicitur, et est coloris ferrei et quam plurimum in Arabia reperitur. Si enim lapis ille accendatur nunquam poterit extingui, eo quod habet naturam lanuginis, quae pluma salamandris vocatur, cum modico humidi unctuosi pinguis, inseparabilis est ab ipso, et id fovet ignem accensum in eo.—Albertus' form *abaston* may be compared with the Middle-English forms *asbeston, abeston, abiston, albeston.*

[6] Ed. of F. Pfeiffer, pp. 276—279.

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F. Lauchert [1] has shown that the mediæval notions of salamander and phœnix are traceable to the Greek Physiologus; [2] but he omitted to point out that the conception of the salamander-asbestos is novel, and peculiar to mediæval times. Yule [3] admits that he cannot tell when the fable arose that asbestos was a substance derived from the salamander. Certain it is, that it did not exist among the classical peoples; certain it is, also, that the early mediæval writers, with the exception of Albertus Magnus, were not aware of the fact that the alleged product of the salamander was nothing but asbestos, and that asbestos as a mineral was unknown to them, [4] while it was known to the Arabs. There can be no doubt that the Arabs (say, roughly, in the tenth and eleventh centuries) spread the legend to Europe [5] by way of Byzance and Spain. The lacune indicated by Yule remains, and it will be seen in the further discussion that this gap in our knowledge is aptly filled by the records of the Chinese.

Marco Polo, with his keen power of observation and his large share of common sense, was the first to shatter the European superstition. It is interesting that he uses the word "salamander" in the sense of asbestos.

"In a mountain of the province of Chingintalas there is a vein of the substance from which salamander is made. For the real truth is that the salamander is no beast, as they allege in our part

[1] *Geschichte des Physiologus, l. c.*

[2] Plinian influence is visible in the venomous properties of the "snake salamander, which, when touching even the foot of a tree, poisons all its branches" (Lauchert, p. 194; Pliny, xxix, 23).

[3] In his edition of *Marco Polo,* Vol. I, p. 216.

[4] Megenberg (*l. c.*, p. 434) noted asbestos after Isidorus, but did not see its identity with salamander-wool.

[5] It is interesting to note that our own historians of the middle ages did not always grasp the facts in the case; while our Orientalists, owing to the knowledge of Arabic sources, were able to unravel the mystery. Thus A. Schultz (*Das höfische Leben zur Zeit der Minnesänger,* Vol. I, p. 338) mentions without explanation "the textures produced from salamanders and burnt by no fire;" and G. Jacob (*Waren beim arabisch-nordischen Verkehr im Mittelalter,* p. 18), with reference to Qazwīnī, lays bare the fact.

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of the world, but is a substance found in the earth; and I will tell you about it.

"Everybody must be aware that it can be no animal's nature to live in fire, seeing that every animal is composed of all the four elements. Now I, Marco Polo, had a Turkish acquaintance of the name of Zurficar, and he was a very clever fellow. And this Turk related to Messer Marco Polo how he had lived three years in that region on behalf of the Great Kaan, in order to procure those Salamanders for him. He said that the way they got them was by digging in that mountain till they found a certain vein. The substance of this vein was then taken and crushed, and when so treated it divides as it were into fibres of wool, which they set forth to dry. When dry, these fibres were pounded in a great copper mortar, and then washed, so as to remove all the earth and to leave only the fibres like fibres of wool. These were then spun, and made into napkins. When first made these napkins are not very white, but by putting them into the fire for a while they come out as white as snow. And so again whenever they become dirty they are bleached by being put in the fire.

"Now this, and nought else, is the truth about the Salamander, and the people of the country all say the same. Any other account of the matter is fabulous nonsense. And I may add that they have at Rome a napkin of this stuff, which the Grand Kaan sent to the Pope to make a wrapper for the Holy Sudarium of Jesus Christ." [1]

This sober account based on information received in China has left a lasting impression upon European science, and has taught how to discriminate between asbestos as a mineral and the salamander as an animal. A. Boetius de Boot [2] rejected Polo's designation of

[1] Ed. of Yule and Cordier, Vol. I, p. 213. It will be seen farther on that Marco Polo's account is confirmed by the contemporaneous Annals of the Yüan Dynasty.

[2] *Gemmarum et lapidum historia*, p. 383 (Lugduni Batavorum, 1636).

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the mineral as salamander, restoring the ancient names "amiantus" and "asbestinus," and ridiculed the belief in any animal living in fire. Relying on Marco Polo, A. KIRCHER [1] has fully discussed the subject from a scientific point of view; and his contemporary, the zoölogist JOHN RAY, [2] was able to state, "Quod Salamandra sine ullo incommodo in igne vivere possit a vulgo creditum, verum a doctioribus dudum abunde refutatum est."

ASBESTOS IN THE NEAR EAST.—Asbestos was well known to the Arabs and Persians, and was much employed by them. [3] A number of valuable notes concerning this matter we owe to the erudition of E. WIEDEMANN. [4] Evliya Effenda narrates that the wonderful carpet presented by Khosru I Nūrshirvān to the monastery which he built near Ütch Kilise was made of asbestos, and that asbestos textiles were manufactured on Cyprus. [5] The Arabic soldiers who hurled naphtha at beleaguered towns were equipped with asbestos garments in order to guard them from accidents which might have happened from handling this inflammable substance. [6] Dimashqī, Abul Fēdā (1273—1331), and Yāqūt (1179—1229) point to Badakshān

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[1] *La Chine illustrée*, pp. 278—280 (Amsterdam, 1670). Kircher says that he could receive no information as to the stuff sent by the Great Khan to the Pope (see also CORDIER's note in Yule's *Marco Polo*, Vol. I, p. 216; and compare the above quotation from K. von Megenberg).

[2] JOANNES RAIUS, *Synopsis animalium quadrupedum*, p. 273 (Londini, 1693).

[3] A Syriac allusion occurs in the *Historia Monastica* of the Bishop of Margā (A.D. 840): "Prayer made the martyrs like asbestos before the fire" (E. A. W. BUDGE, *The Book of Governors*, Vol. II, p. 499).

[4] *Zur Mechanik und Technik bei den Arabern* (*SB. P. M. S. Erlg.*, Vol. 38, 1906, pp. 39, 40).

[5] The latter notice goes back to Dioscorides (L. LECLERC, *Traité des simples*; Vol. II, p. 414).

[6] The Italian chevalier Aldini, about 1825, conducted a series of experiments in using asbestos garments for the protection of firemen. His idea was revived in Paris, the firemen there having been furnished with such clothes, and after conclusive proof of their practical utility, was followed in London (R. H. JONES, *Asbestos*, pp. 31, 159).

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as the place where the mineral was found; the former making special mention of lamp-wicks made from it, into which fire penetrates, while they remain unharmed. Yāqūt has the following report: "In the mines near Badakshān is found the stone *fatīla* (that is, 'stone of the wick'), which resembles papyrus (*bardī*). The people believe that it is the plumage of a bird.[1] It is styled also *al-ṭalq*. It is not consumed by fire. It is placed in oil and kindled with fire, in which case it burns like a lamp-wick.[2] When the oil burns, the stone remains as before, and none of its properties changes. This always takes place whenever it is dipped in oil and burns. When thrown into a blazing fire, it is not hurt by it. Coarse table-cloths are woven from it. These, being soiled, are put into fire to be purified, and whatever dirt is on them is consumed by the flames. They are cleansed, and come out as pure as though they had never been affected by dirt." The erroneous designation *al-ṭalq* is traceable to Ibn al-Baiṭār (1197—1248), who groups around Dioscorides' notice of asbestos Arabic accounts of the mineral *ṭalq* corresponding to our mica.[3]

A very interesting description of asbestos is given by Abū Ubaid al-Bekrī (1040—94) of Cordova in Spain, in his *Geography of Northern Africa*, as follows:[4]—

"Among the singular products of the country of the Negroes is noticeable a tree with long and slender stem, called *turzi*. It grows in the sand, and bears a big and swollen fruit containing within it a white wool which is made into stuffs and garments. These stuffs are capable of remaining in a vehement fire forever without

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[1] That is, the phœnix. For explanation see above, pp. 318—323.

[2] Compare the statement of Theophrastus (p. 302).

[3] L. Leclerc, *Traité des simples*, Vol. II, pp. 414, 415. Pseudo-Aristotle (Ruska, *Steinbuch des Aristoteles*, p. 174) also describes mica under the same name.

[4] MacGuckin de Slane, *Description de l'Afrique septentrionale par El-Bekri*, p. 336 (Alger, 1913).

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being damaged. The jurist Abd al-Melek affirms that the inhabitants of Al-Lames, a town of that region, wear only clothing of this kind. Near the river Derā is found a substance similar to it. This is a sort of stone, called, in the language of the Berber, *tamatghost*. When rubbed between the hands, it softens to such a degree that it assumes the consistency of linen. It serves for the making of cordage and halters, which are absolutely incombustible. A costume was made from this substance for one of the Zenatian princes who ruled at Sidjilmessa. A man of proved veracity told me that a trader had sent for a napkin made from this mineral for Ferdilend, King of Galicia, in Spain (Ferdinand I of Leon). He offered it to the prince, explaining that it had belonged to one of the disciples of Jesus, and that fire could produce no impression upon it. He furnished the proof under the eyes of the King, who, struck by such a marvel, expended all his wealth to purchase this relic. He sent it to the sovereign of Constantinople, that it might be deposited in the principal church, and in return received a royal crown with the authorization to wear it. Several persons tell of having seen in the house of Abul Fadl of Bagdad the fringe of a napkin made of this substance, which, when put into fire, became whiter than previously. In order to clean such a napkin, which had the appearance of linen, it was sufficient to place it on a fire."

The employment of asbestos for the purpose of a *pia fraus* is related also by an Arabic traveller. Abū Dulaf who wrote the diary of his journey to China about 941 tells of an incombustible tree, growing in the territory of the tribe Bajā (east of Transoxania), from the wood of which the natives make idols; Christian travellers are in the habit of taking this wood along, asserting that it comes from the cross of Christ. Again he relates about the tribe Kharlok that their houses are of incombustible wood.[1] Both Marquart and

[1] G. FERRAND, *Relations de voyages arabes, persans et turks rel. à l'Extrême-Orient*,

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Ferrand who translated and discussed this text have been unable to cope with this problem. Certainly it is not here the question of a tree, as wrongly supposed by these scholars; still less do we meet here, as suggested by Marquart, the conception that the wood of the cross had miraculously been shooting forth again. What we meet here, in fact is asbestos; and this matter has clearly been expounded as early as 1843 by J. Yates in his classical work *Textrinum Antiquorum: An Account of the Art of Weaving among the Ancients* (pp. 362—365). Yates sets forth that ignorance of the true nature of asbestos caused it to be employed in the dark ages for purposes of superstition and religious fraud, and cites several important documents to this effect. One of these is taken from the *Chronicon Casinense* ("Chronicle of the Abbey of Monte Casino") of Leo Ostiensis who narrates a story that some monks returning from a pilgrimage to Jerusalem brought home a particle of the cloth with which Jesus wiped the feet of his disciples (particulam lintei, cum quo pedes discipulorum Salvator extersit); and when the genuineness of this relic was doubted, they put it in fire from which it came forth in its previous shape. Thus the authenticity of the relic was convincingly established. Tilingius, in 1684, directly says that impostors exhibit to simple women-folks the stone amiantus, and frequently sell it as

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Vol. I, pp. 210, 215. Ferrand has misunderstood Marquart, for he ascribes to the latter the supposition that the question is here of teak-wood. On the contrary, Marquart (*Osteurop. und ostasiat. Streifzüge*, p. 76) has decidedly rejected this idea, and strangely enough proposed to regard the incombustible tree as the birch. Why the birch should be called incombustible I am unable to see. Abū Dulaf is not to be taken too seriously in matters of natural history; and his assigning to certain tribes of certain products, as partially seen also by Marquart, is purely arbitrary or fictitious. The list of his stones presents curious reminiscences of the fabulous stones of the Alexander Romance and the Arabic *lapidaires* based thereon. The most striking of these reminiscences is the stone luminous at night and serving as lamp (*Pseudo-Callisthenes*, II, 42). This stone, according to the Arabic scribe, is found in the country of the Kirgiz! For this reason I am inclined to think that also his incombustible tree is a purely literary invention from the same source. The Chinese have several accounts of unconsumable trees, partly leaning toward asbestos (see Wylie, *l. c.*, p. 148).

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the wood from the cross of the Savior; they easily take faith therein, since it is not consumed by fire and is veined in the manner of wood. It is equally manifest that Abū Dulaf's incombustible tree which supplied Christians with sacred souvenirs of the cross was nothing but asbestos, and the report of al-Bekri previously mentioned affords additional evidence to this effect. The alleged products ascribed by Abū Dulaf to Central-Asiatic regions are fancifully construed from the legends told in the Alexander Romance, and there, as mentioned above (p. 308), we encounter also the asbestine wood.

Under the Sung dynasty asbestine stuffs were imported into China by the Arabs over the maritime route; they were seven inches wide, differing in length. In the period Chêng-ho 政和 (1111—18), under the Emperor Hui-tsung, asbestine stuffs of half this width were sent as tribute by the Arabs, and at a later date were followed by dishes and baskets of the same material, which on the whole looked like the cloth then made from the product of the cotton-tree, but somewhat darker and almost black in color. When flung into the fire, they came forth brilliant white.[1] Mosul produced asbestine cloth during the middle ages.[2]

The Salamander-Asbestos in China.—After this review of the development of the relevant beliefs in the West, we are prepared to understand the asbestos traditions of the Chinese. In these, three stages of development are clearly set off. The first, already described, ranging approximately from the Han to the third century, I am tempted to term the "historical or classical" set of beliefs,

[1] We shall revert once more to this text, not utilized by Wylie and inserted in the *T'ie wei shan ts'ung t'an* 鐵圍山叢談 (Ch. 5, p. 20; edition of *Chi pu tsu chai ts'ung shu*) of Ts'ai T'iao 蔡絛, who lived in the first half of the twelfth century. Wylie (*Notes*, p. 196) states regarding this author that he treats mostly of events which occurred in his own time, and that the work shows a good deal of research, and may be relied upon as an authority in investigations regarding that period.

[2] Hirth and Rockhill, *Chau Ju-kua*, p. 140.

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agreeing, as they do, with Greek and Roman lore; the second, from the beginning of the fourth century down to the end of the Sung, denotes the "romantic" period of beliefs, coinciding with those of mediæval Europe and the Arabs; the third, inaugurated by the Yüan or Mongol dynasty, is the "realistic," or, if the word be allowed, "scientific," period, based on the actual discovery of asbestos on Chinese soil. We have to deal here first with the mediæval romanticism inaugurated by the speculations of the adepts of Taoism.

The earliest attempts to explain the origin and composition of asbestos were made by the celebrated alchemist Ko Hung 葛洪 (249—330), in his work *Pao-pʿu-tse.*[1] This author reports on three kinds of asbestos (*huo huan pu* 火浣布) as follows: "As regards the first kind of fire-proof cloth, it is said that there is in the ocean a majestic mound[2] harboring a fire that burns of itself.[3] This fire rises in the spring, and becomes extinguished in the autumn. On this island grows a tree, the wood of which is able to resist the action of fire, and is but slightly scorched by it, assuming a yellow color. The inhabitants make fuel of it in the usual way, but this fuel is not transformed into ashes. When their food has been cooked, they extinguish the firewood by means of water. In the same manner it is put to use again and again, and indeed represents an inexhaustible supply. The barbarians gather the flowers

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[1] My rendering is based on the text as quoted in the *Wei lio* 緯略 (Ch. 4, p. 3; ed. of *Shou shan ko tsʿung shu*, Vol. 74). This fundamental source on the subject has been overlooked by Wylie.

[2] *Su kʿiu* 肅邱. I should be inclined to regard this as the proper name of Volcano Island, if this term were traceable in the Liang Annals, which, as will be seen below, contain the source for this account of Ko Hung; but it does not occur there. Again, the notice of the Annals goes back to the lost reports of Kʿang Tʿai 康泰, on his mission to Fu-nan in the first part of the third century. If Kʿang Tʿai's report had contained the name *Su kʿiu*, we might reasonably conclude that it would have found its way into the Annals; for this reason it may be solely an invention of Ko Hung.

[3] That is, an active volcano.

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of these trees, and weave cloth from them. This is the first kind of fire-proof cloth. Further, they also peel the bark of these trees, boil it by means of lime, and work it into cloth, which is coarse and does not come up to the quality of the material prepared from the flowers. This is the second kind of fire-proof cloth. Moreover, there are white rodents (*pai shu* 白鼠) covered with hair, each three inches long, and living in hollow trees. They may enter fire without being burnt, and their hair can be woven into cloth, which is the third kind of fire-proof cloth." [1]

The first two sorts of asbestos established by Ko Hung, and alleged to be of vegetal origin, are certainly imaginary; and how this matter came about will be fully discussed hereafter. Here the fact that concerns us is that Ko Hung is the first Chinese writer in whom the idea of the animal origin of asbestos has crystallized. Certainly, his "white rodent" is nothing but the salamander of the Western legend, whose wool furnishes asbestos. At first sight it is striking, of course, that Ko Hung's notice far precedes in time any Western version of the legend; yet this can rationally be explained. Two conjectures which might be made to get easily over this state of affairs would not prove before the facts. We cannot assume that the legend is spontaneously Chinese in origin and migrated from China to Western Asia: in China it has no basic facts, whereas

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[1] 抱朴子曰。火浣布有三種。其一曰海中肅邱有自生火。春起秋滅。洲上生木。木爲火焚不糜但小(gloss: 一無小字)焦黃。人或得薪俱如常。薪但不成灰。炊熟則以水滅之。使復更用如此不窮。夷人取此木華績以爲布一也。又其木皮赤剝之。以灰煮治以爲布毳不及華俱可火浣二也。又有白鼠毛長三寸居空木中。入火不灼。其毛可績爲布三也 (*Wei lio*, Ch. 4, p. 3).

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we have traced its logical development in the West from the combination of salamander and asbestos. Nor would it be possible to regard the account of Ko Hung as unauthentic or as an anachronism, as we have a number of texts, ranging from the fourth to the sixth century, all relating to the same legend. The *Wu lu* 吳錄[1] is credited with the statement that in Ji-nan (Tonking) is captured a fire-rodent whose hair is made into cloth, being styled "fire-proof cloth."[2] According to BRETSCHNEIDER,[3] this book was written in the third century, during the period of the Three Kingdoms (221—280); but it is hard to believe that at that early date the legend of the salamander-asbestos was known in China. The localization in Ji-nan, foreign to Ko Hung, also seems somewhat suspicious. We have noticed above (p. 312) that asbestos was known in the China of that period, and that in the coeval Annals a tribute gift of it from the Western Regions (*Si Yü*) is on record for the year 239, no reference, however, being made to the salamander story. The earliest date that we may assume for the coming into existence of the latter on Chinese soil is the end of the third or the beginning of the fourth century.

It is more interesting that Kuo P'o 郭璞 (276—324), a contemporary of Ko Hung, likewise alludes to the salamander-asbestos; for Kuo P'o, in his commentary to the *Shan hai king*, is made to say the following, as translated by WYLIE:[4] "Ten thousand *li* to the east of Fu-nan is the kingdom of Ké-po. More than five thousand *li* farther east is the burning mountain kingdom, where, although there may be long-continued rain on the mountain, the

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[1] Records of the Kingdom of Wu, by Chang Pu 張勃 of the third century.

[2] *Wei lio*, Ch. 4, p. 3. WYLIE (*l. c.*, p. 149) quotes this passage from *T'ai p'ing yü lan* (Ch. 820, p. 8), where the locality is defined as Pei-king 北景 in Ji-nan.

[3] *Bot. Sin.*, pt. 1, p. 209, No. 1043.

[4] *L. c.*, p. 146.

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fire constantly burns. There is a white rat in the fire, which sometimes comes out to the side of the mountain, in order to seek food, when the people catch it and make cloth from the hair, which is what is now called fire-proof cloth." What Wylie transcribes Ké-po is properly Ch'i-po 耆薄; and this is nothing but a variant for the well-known Shê-p'o 闍婆, the old Chinese designation for the island of Java. The fact that in this connection the question really is of Java becomes evident from other parallel texts alluding to the same matter.[1] The name "Shê-p'o" for Java, however, does not appear in Chinese records earlier than the first half of the fifth century, the first embassy coming from there being listed in the year 433: consequently Kuo P'o of the Tsin dynasty cannot have possessed any knowledge of Shê-p'o, which name must be a later interpolation in his text. Aside from this point, however, the story is entirely creditable to him, because the geographical portion of it, as will be seen, is based on the narrative of K'ang T'ai of the third century, and is even more exactly reproduced by him than by Ko Hung. Kuo P'o, however, shuns the account of vegetable asbestos, as related by K'ang T'ai and repeated after him by Ko Hung, and focusses the notion of asbestos exclusively on the white rodent (that is, the salamander) inhabiting an active volcano. K'ang T'ai knew nothing at all about this animal. Ko Hung does not naturalize it anywhere. It is Kuo P'o who took up this legend and placed its home on the Volcano Island first reported by K'ang T'ai: consequently Kuo P'o's story is a compromise reached between the salamander story coming from the West and the tree-asbestos story of Fu-nan, but it is valueless for tracing the region from which the salamander legend hailed. It did not hail from Volcano

[1] Compare Pelliot, *Bull. de l'Ecole française*, Vol. III, p. 264; Vol. IV, p. 270; these texts will be discussed farther on.

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Island in the Malay Archipelago, as K'ang T'ai located there only the alleged tree-asbestos, which in fact is bark-cloth, that has nothing to do with mineral asbestos. K'uo P'o, further, shows his familiarity with the salamander in his edition of the dictionary *Erh ya*.[1] This enumerates ten kinds of tortoise, the tenth of which is termed "fire tortoise" (*huo kuei* 火龜); and K'uo P'o annotates that it is like the "fire rodent" (*huo shu*).[2] The latter animal is not included among those enumerated in the text of the *Erh ya*; that is to say, it is entirely foreign to the ideas of ancient national Chinese culture, but is a borrowed type, which first dawned upon the horizon of the Chinese in the very age of K'uo P'o himself.

Another contemporaneous allusion to the same matter is found in the *Ku kin chu* 古今注, written toward the middle of the fourth century by Ts'uei Pao 崔豹, who says that the fire-rodent remains immune when going into fire, and that what is termed "fire-proof cloth" is made from the animal's hair, which is ten feet long.[3] Ts'uei Pao, in his succinct and sober statement, thoroughly agrees with Ko Hung, differing from him only in somewhat exaggerating the length of the hair. Yet the same author, in the same work, presents a more fantastic account of the matter, which he traces to the *Book of Marvels*[4] ascribed to the Taoist adept Tung-fang So (born in 160 B.C.). This attribution, as is well known, certainly is fictitious; and the following text bears out this fact again, because it is based on the account of K'ang T'ai, and must therefore be later than the third century. Tung-fang So, according

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[1] Ch. B, p. 10 b.

[2] This name has been adopted by the Polyglot Dictionary of K'ien-lung (Ch. 31, p. 24) with the literal renderings into Manchu *tuwai singgeri*, Tibetan *me byi*, and Mongol *galχi khulugana*. The explanations given in the Manchu dictionaries show that the salamander-asbestos is understood (see SACHAROV, *Manchu-Russian Dictionary*, p. 765).

[3] *P'ei wên yün fu*, Ch. 36, p. 59.

[4] Entitled by him *Shen i chuan* 神異傳, otherwise *Shen i king* 神異經.

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to Ts^{c}uei Pao, is made to say,[1] "In the southern regions there is a volcano forty *li* in length, and from four to five *li* in width. In the midst of this volcanic fire grow trees unconsumable by fire, and day and night exposed to a scorching heat, over which neither wind nor rain has any power. In the fire lives also a rodent, a hundred catties in weight, and covered with hair over two feet in length, as fine as silk, and white in color.[2] Sometimes it comes out; and by sprinkling water over it, it is put to death. Its hair is then removed and woven into cloth, which is known under the name 'fire-proof cloth.'" Another text, likewise wrongly connected with the name of Tung-fang So, expatiates on the animal with still greater vagaries of fancy, and will be discussed below. We notice that in this Taoist narrative the salamander is made a denizen of Volcano Island, in the same manner as by Kuo P^{c}o. We accordingly have two versions of the legend current during the fourth century,—a simple and sober one, accounting for the origin of asbestos from an animal identical with the Western salamander; and an elaborate and fantastic one, aggrandized by Taoist lore under the influence of K^{c}ang T^{c}ai's report of a Volcano Island in the Malay Archipelago.

The salamander turns up again in that interesting book *Liang se kung tse ki*, relating to the beginning of the sixth century, and written by Chang Yüe (667—730),[3] "Merchants from the Southern

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[1] *Pien tse lei pien*, Ch. 21, p. 6. The text is quoted also in the commentary to *San kuo chi*, *Wei chi* (Ch. 4, p. 1 b), in the *Wei lio* (Ch. 4, p. 3), and in the *Ts^{c}i tung ye yü* by Chou Mi.

[2] It must certainly be white, because asbestos coming out of a fire has this color. Wylie (*l. c.*, p. 145), who translates from a modern edition of *Shen i king*, has the addition, "It ordinarily lives in the fire, and is of a deep-red color; but sometimes it comes out, and its hair is then white."

[3] See this volume, p. 198. The text in question is preserved in the *Wei lio* 緯畧, Ch. 4, p. 3 b; and in the *Ko chi king yüan*, Ch. 27, p. 13. Wylie (*l. c.*, p. 143) seems to have translated from another book. His addition, "which the emperor had deposited among the miscellaneous cloths," is not in the text before me.

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Sea brought as presents three pieces (*tuan*) [1] of fire-proof cloth. [2] Duke Kie, recognizing it from afar, exclaimed, 'This is fire-proof cloth, indeed: Two pieces are made from twisted bark, [3] and one is made from the hair of a rodent.' On making inquiry of the merchants, their statement exactly agreed with that of the duke. [4] On asking him the difference between the cloth of vegetal and that of animal origin, the duke replied, 'That manufactured from trees is stiff, that from rodents' hair is pliable; this is the point by which to discriminate between them. Take a burning-mirror and ignite the *tsê* trees [5] on the northern side of a hill, and the bark of the trees will soon become changed.' The experiment was made, and it turned out in accordance with his affirmation." [6] The witty duke, accordingly, exploded the old tale of K'ang T'ai, that bark cloth was incombustible and a sort of asbestos. He himself, on former occasions, had doubtless applied the experiment which he recommended in the course of the story, and was possessed of that truly scientific

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[1] A cloth measure of 18 feet.

[2] According to the text of the *Wei lio*, "Duke Kie, passing a market, noticed traders offering three *tuan* of fire-proof cloth" (杰公至市見商人齎火浣三端).

[3] It is notable that he speaks of twisted, not of woven bark, as K'ang T'ai and his followers did (see p. 347).

[4] This sentence is omitted in the text of the *Wei lio*.

[5] 柘木 *Cudrania tribola*, Hance. Wylie takes this for 斫, or he may have found this reading in his text; for he translates, "Take some wood cut down on the north side of the hill and set a light to it by means of a solar speculum." Duke Kie, of course, did not mean to say this. He wanted to prove by experiment that tree-bark is not incombustible, like asbestos; and with this end in view, it was not necessary to chop the trees.

[6] 南海商人齎火浣布三端。杰公遙識曰。此火浣布也。二是緝木皮所作。一是績鼠皮所作。以詰商人具如杰公之說。因問木鼠之異公曰。木堅毛柔是可別也。以陽燧火山陰柘木熱之木皮改。常試之果驗 (*Ko chi king yüan*, Ch. 27, p. 13).

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spirit which does not halt at received traditions, but tries by experiment to get at the root of things. To him true asbestos was only the kind attributed to the salamander,[1] and the duke's wisdom demonstrates that the rodents' hair of the Chinese was really mineral asbestos.

The texts thus arrayed bear out sufficiently the fact that the legend of the salamander-asbestos was popularly current in China from the fourth to the sixth century; and the records of the Chinese very aptly fill the gap which, as we noticed (p. 325), exists in the West between the close of classical antiquity and the traditions of the Arabs and mediæval Europe. The Chinese texts are all prior to those of the Arabs, and it is therefore necessary to conclude that the Chinese and the Arabs must have borrowed the legend from a common source extant in Western Asia at least during the third century. This source is as yet unknown to us, but the conviction of its existence is a postulate without which we cannot intelligently understand the case. There are also indications in Western sources which allow the inference that this prototype resulting in the Chinese and Arabic notions must have lingered in the anterior Orient in the beginning of our era. We have referred to the probable Oriental origin of the salamander legend, and to Pliny's association of it with the Persian Magi; we have pointed out also that it was current in Egypt during the first century A.D., and that Pliny's and Aelian's stories are dependent on the Alexandrian Physiologus. There is accordingly good reason to believe that the

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[1] This is confirmed by another passage in the same work *Liang se kung tse ki*, in which Volcano Island (火洲) is mentioned. Here it is said that from the bark of the fiery tree growing there only cloth is made, while fire-proof cloth is produced from the hair of the fire-rodent living on a blazing mound. This text will be found in *T'u shu tsi ch'éng, Pien i tien* 41, Woman Kingdom (*Nü kuo*), *hui k'ao*, p. 2. It is said to have been translated in its entirety by D'Hervey-St.-Denys in his *Mémoire sur le Fou-sang*, which unfortunately is not accessible to me.

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salamander legend was known in the Orient on a line stretching from Egypt to Persia, and that the numerous translations of the Physiologus, if nothing else, supported its wide diffusion. At the same time, however, as we know from the Chinese records, asbestos-cloth was in evidence in western Asia, and was traded from there over the routes of Central Asia to China. Salamander and asbestos being familiar to the nations of the Roman Orient, they were in possession of the elements with which to form that legend which proceeded from them to China and at a later date loomed up among the Arabs. It may be supposed that this primeval version, as yet unknown, will turn up some day in an early Syriac source (or possibly in a Greek papyrus): and if a Syriac work should tell us of an asbestos-tree, and immediately join to this a notice of the salamander,[1] we may imagine that the temptation was strong to link those two accounts together.

The germ of this lost Oriental version possibly is traceable to a Greek text, from which it can be shown how the identification of asbestos with the salamander may have been effected. Antigonus of Carystus, who was born between 295 B.C. and 290 B.C., and lived at Athens and Pergamum,[2] has left a small collection of "Wonderful Stories," among which is the following:[3] "There are worm-shaped hairy creatures living in the snow. In Cyprus, where copper-ore is smelted, an animal is engendered a little larger than a fly. The same occurs also in the smelting-furnaces of Carystus. Part of them die when separated from the snow; others, when separated from the fire. The salamander, however, quenches the fire." This text is based on that of Aristotle, given above (p. 314), where

[1] See above, p. 308.

[2] Compare U. von Wilamowitz-Möllendorff, *Ueber Antigonos von Karystos.*

[3] *Historiae mirabiles*, 90, 91 (*Rerum naturalium scriptores Graeci minores*, ed. Keller, Vol. I, p. 22).

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are also mentioned worms found in long-lying snow.[1] Antigonus, however, has here an essential addition, not met with in Aristotle or any other author; and this is that this fire animal occurs also in the furnaces of Carystus.[2] Now, we have seen that, according to Apollonius and Strabo, Carystus on Euboea was one of the principal asbestos-producing regions, and that from this locality the mineral was even named Carystius. Antigonus hailed from Carystus, and this fact may entitle us to the opinion that he was acquainted with the asbestos mined near his home town. True it is, he does not mention asbestos in the few fragments of his writings which are preserved; and there is nothing to indicate that in the above passage he means to include asbestos in the "smelting-furnaces of Carystus." The point which I wish to make, however, is that it was easy to read this interpretation into his text. An Oriental Greek, Syrian, or Arab, for instance, who knew that "Carystius" was a synonyme for "asbestos," could well have been reminded thereof while reading this passage, and the immediate mention of the salamander might then have led him to link the two notions together.[3] In this manner we gain a satisfactory clew as to the probable origin of the salamander-asbestos assimilation, which certainly must have been brought about on the soil of Hellenism,

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[1] Aristotle does not name the animal living in fire, but, judging from his description, it appears to be an insect. PLINY (XI, 36, § 119), who speaks of the same creature after Aristotle, calls it *pyrallis* or *pyrotocon* (others read *pyrausta*), and describes it as a winged quadruped (*pinnatum quadrupes*) of the size of a larger fly. AELIAN (*Hist. anim.*, II, 2) styles it *pyrigonos* ("fire-born").

[2] Pliny, in harmony with Aristotle, places it only on Cyprus (*in Cypri aerariis fornacibus*), while Aelian gives no locality.

[3] It is possible also that the *μυιῶν* of the Greek text (from *μυῖα*, "fly") led to a confusion with *μῦς* ("mouse"), and gave rise to the conception of the salamander as a rat (Qazwīnī), mouse (Talmud), or rodent (Chinese). On the other hand, it must be admitted that this metamorphosis is capable also of a logical explanation: the salamander-lizard is smooth and hairless; when the salamander was made to yield asbestos, it naturally had to be transformed into an animal with hair-growth.

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during the second or in the beginning of the third century A.D.

Besides the salamander of the character of a rodent, we receive another intimation as to the nature of this animal, which answers the classical notions. A work *Sung chi* 宋志 ("Memoirs of the Sung Period"), by Shên Yo 沈約,[1] contains the following notice: "Blazing Island (Yen chou 炎洲) is situated in the southern ocean, and harbors the animal *ki* (or *kie*)-*ku* 猞猲. When it is caught by people, it cannot be wounded by chopping or piercing. They gather fuel, build a fire, bind the animal and throw it into the fire, and yet it will remain unscorched."[2]

The name for this animal, which is clearly differentiated from the rodent that follows, seems to be connected with some Malayan form underlying our word "gecko," described thus by YULE and BURNELL:[3] "A kind of house-lizard. The word is not now in Anglo-Indian use; it is a naturalist's word; and also is French. It was no doubt originally an onomatopœia from the creature's reiterated utterance. Marcel Devic says the word is adopted from Malay *gekok* [*gēkoq*]. This we do not find in Crawfurd, who has *tăké*, *tăkék*, and *goké*, all evidently attempts to represent the utterance. In Burma, the same, or a kindred lizard, is called *tokté*, in like imitation."[4]

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[1] Quoted in *Ye k'o ts'ung shu* 野客叢書 by Wang Mou 王懋 of the Sung period (*Ko chi king yüan*, Ch. 27, p. 13). Regarding this work see WYLIE, *Notes on Chinese Literature*, p. 161. It was published in 1201.

[2] Then follows the story of the rodent-salamander mingled with the alleged bark-cloth asbestos: "There is, further, the Volcanic Country, constantly enveloped by fire which is not quenched by rain. In this fire there is a white rodent. When the trees in the forests on this burning island have been wetted by rain, their bark becomes scorched; and when exposed to fire, it becomes white. The islanders gather this bark during several months, and weave it into cloth, which makes fire-proof cloth. Either the bark of the trees or the hair of the rodents may yield it."

[3] *Hobson-Jobson*, p. 367.

[4] "Some of the Borneo reptiles produce singular sounds. The commonest among them is a gecko, the *chichak*, which name imitates perfectly the cry which it produces. A much louder and more characteristic cry is that of *Goniocephalus borneensis*, a large

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The characters *ki-ku*, in this case, are chosen by the Chinese author only to imitate the sounds of a word like "gecko." As a rule, the animal *ki-ku* is regarded as a mammal. The word first appears under the T'ang in the *Yu yang tsa tsu*, and is synonymous with *fêng li* 風狸, *fêng mu* 風母 ("wind mother"), or *fêng shêng shou* 風生獸 ("wind-born beast").[1] On the other hand, the Chinese know a saurian, *ko-kiai* 蛤蚧, being a word-formation analogous to the Malayan names of the lizard, and, according to Chinese authors, imitative of the call of the animal.[2]

It thus appears that the rodent-salamander of the Chinese, after all, was a lizard like the salamander of the ancients; and the lizard character of the animal leaks out in the earliest account of the subject by Ko Hung, when he says that the animal lives in hollow trees; for it is the lizard who has acquired this habit. A. R. Wallace,[3] in describing the lizards of the Aru Islands, observed, "Every shrub and herbaceous plant was alive with them; every rotten trunk or dead branch served as a station for some of these active little insect-hunters."

The fact that it was not the Arabs from whom the Chinese received the salamander-asbestos tale is illustrated, from a negative

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lizard which lives on trees and has a high and serrated crest down its back. The Malays call this lizard *kog-go*, an imitation of its call-note, which is frequently repeated" (O. Beccari, *Wanderings in the Great Forests of Borneo*, p. 35). In the *Encyclopædie van Nederlandsch-Indië* (Vol. IV, p. 400) the word is given as *toke*, which is peculiar to Sundanese; it passed also into the language of the Batak on Sumatra; in Malayan it is *tekek* and *tokek*; in Javanese, *tekek*. Compare Moro *tagatak* or *tukatuk*, "lizard" (R. S. Porter, *Primer of the Moro Dialect*, p. 45). In the same encyclopædia (Vol. I, p. 551) will be found a description of the genus and of the beliefs in its venomous property, which are very similar to those entertained by the ancients in regard to the salamander.

[1] See the texts of *Pên ts'ao kang mu*, Ch. 51 A, p. 20 b; and *Wu li siao shi*, Ch. 10, p. 12.

[2] *Pên ts'ao kang mu*, Ch. 43, p. 6. The oldest text referring to it is the *Ling piao lu i* of the T'ang (compare Pfizmaier, *Denkwürdigkeiten aus dem Tierreiche Chinas*, *SBAk. Wien*, Vol. 80, 1875, p. 14).

[3] *The Malay Archipelago*, p. 331.

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viewpoint, by the absence in China of any specific reference to the phœnix, of which the Arabs make a great case (p. 319). Some Chinese works have a general reference to birds, but the coincidence is not perfect. Thus the apocryphal *Sou shên ki* 搜神記[1] has a volcano in the region of the K'un-lun, inhabited by herbs, trees, birds, and mammals, all existing in blazing fire and yielding fire-proof cloth.[2]

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[1] WYLIE, *Notes*, p. 192. The passage is in Ch. 13, p. 3 (of the Wu-ch'ang print).

[2] A case of a different character may be mentioned in this place, as it reveals a very curious coincidence between a Chinese and an Arabic text. The interesting work *Tu yang tsa pien* 杜陽雜編, written by Su Ngo 蘇鶚 in the latter part of the ninth century, contains the following story (Ch. B, p. 1; edition of *Pai hai*): "During the year of the reign of the Emperor Shun-tsung 順宗 (A.D. 805) the country Kiü-mi 拘弭 [otherwise 拘彌, the territory of Keria; see CHAVANNES, *Documents sur les Tou-kiue occidentaux*, p. 128] sent as tribute a pair of birds insensible of fire (却火雀一雄一雌). These birds were uniformly black and of the size of a swallow. Their voice was clear, but did not quite resemble that of ordinary birds. When placed on a fire, the fire was spontaneously extinguished. The Emperor, admiring this wonder, had the birds put in a cage of rock-crystal [rock-crystal being believed to be a transformation of ice and to have a cooling effect], which was hung in the sleeping-apartments of the palace. At night the inmates of the palace tried to set fire to the birds by means of burning wax candles, but entirely failed in damaging their plumage." Abū Ubaid al-Bekrī (1040—94) of Cordova (MAC GUCKIN DE SLANE, *Description de l'Afrique septentrionale par El-Bekri*, p. 43) has the following account: "Nous donnons le récit suivant sur l'autorité d'Abou-'l-Fadl Djâfer ibn Yousof, Arabe de la tribu de Kelb, qui avait rempli les fonctions de secrétaire auprès de Mounis, seigneur de l'Ifrîkiya: 'Nous assistions à un repas donné par Ibn-Ouanemmou le Sanhadjien, seigneur de la ville de Cabes, quand plusieurs campagnards vinrent lui présenter un oiseau de la taille d'un pigeon, mais d'une couleur et d'une forme très singulières. Ils déclarèrent n'avoir jamais vu un oiseau semblable. Le plumage de cet animal offrait les couleurs les plus belles; son bec était long et rouge. Ibn-Ouanemmou demanda aux Arabes, aux Berbers et aux autres personnes présentes s'ils avaient jamais vu un oiseau de cette espèce, et sur leur réponse qu'ils ne le connaissaient pas même de nom, il donna l'ordre de lui couper les ailes et de le lâcher dans le palais. A l'entrée de la nuit, on plaça dans la salle un brasier-fanal allumé, et voilà que l'oiseau se dirigea vers ce meuble et tâcha d'y monter. Les domestiques eurent beau le repousser, il ne cessa d'y revenir. Ibn-Ouanemmou, en ayant été averti, se leva, ainsi que toute la compagnie, afin d'aller voir ce phénomène. Moi-même, dit Djâfer, j'étais un de ceux qui s'y rendirent. Alors, sur l'ordre d'Ibn-Ouanemmou, on laissa agir l'oiseau, qui monta jusqu'au brasier ardent, et se mit à becqueter ses plumes, ainsi que font tous les oiseaux quand ils se chauffent au soleil. On jeta alors dans le brasier des chiffons imprégnés de goudron et une quantité d'autres

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While the Chinese, in a somewhat masqueraded form, received the legend of the salamander, they never adopted this word, as did the Arabs and Persians. It was reserved for the Jesuit Father Ferdinand Verbiest (1623—88) to introduce the Chinese, in his *Kun yü tᶜu shuo*, to an illustration of a European salamander under the title *sa-la-man-ta-la* 撒辣漫大辣, which he says occurs in the country Germania (*Je-êrh-ma-ni-ya*) in Europe: "Its habitat is in cold and moist places, its temper is very cold, its skin is thick, and its strength is such as to extinguish fire; its hair is of mixed color, black and yellow; a black and spotted crest runs along its back down to its tail." The figure by which his note is illustrated shows a cat or fox-like mammal. [1]

Theory of the Vegetal Origin of Asbestos.—In order to arrive at a correct appreciation of the complex notions developed by Ko Hung and Kuo Pᶜo regarding asbestos, we shall now turn our attention to another matter. In the first half of the third century A.D., Kᶜang Tᶜai 康泰 and Chu Ying 朱應 were engaged in a mission to Fu-nan 扶南 (Cambodja), and on their return to China published two works in which were laid down their experiences during this memorable journey. Their record furnished to the compilers of the Chinese Annals a great deal of information on the ancient history

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objets inflammables, afin d'augmenter l'intensité du feu, mais l'animal n'y fit aucune attention et ne se dérangea même pas. Enfin il sauta hors du brasier et se mit à marcher, ne paraissant avoir éprouvé aucun mal.' Quelques habitants de l'Ifrīkiya assurent que, dans la ville de Cabes, ils avaient entendu raconter l'histoire de cet oiseau. Dieu seul sait si elle est vraie." In examining each for itself, we should certainly take both the Chinese and the Arabic story for an abstruse fable. Such a fire-proof bird most assuredly does not exist. On either side we are treated to the report of eye-witnesses. The two stories apparently are independent, although the subject is identical. After all, might this mysterious bird be an offshoot of the salamander-phœnix, restored to life by an overstrained imagination?

[1] *Tᶜu shu tsi chᶜéng*, XIX, chapter "Strange Animals," *hui kᶜao* 3, p. 9.

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of that country.[1] In the article on Fu-nan, inserted in the Annals of the Liang Dynasty (502—556),[2] we meet a curious notice on asbestos with reference to a Malayan region, as follows: "It is reported that Fu-nan is bounded on the east by the ocean known as Ta-chang 大漲 ('Great Expanse').[3] In this ocean is a great island on which the kingdom of Chu-po 諸薄 (Java) is situated. East from this kingdom is the island of Ma-wu 馬五洲.[4] Going again over a thousand *li* in an easterly direction across the Ta-chang Ocean, one reaches Volcano Island.[5] On this island there

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[1] PELLIOT, *Bull. de l'Ecole française*, Vol. III, p. 275.

[2] *Liang shu*, Ch. 54, p. 3; likewise in *Nan shi*, Ch. 78, p. 3.

[3] Corresponding to our Chinese Sea, extending from Hai-nan to the Straits of Malacca.

[4] PELLIOT (*Bull.*, Vol. IV, p. 270) is inclined to identify this island with Bali by assuming a clerical error ("Ma-li" for "Ma-wu").

[5] *Tse jan huo chou* 自然火洲 (literally, "the island of fire which burns of itself"). PELLIOT (*Bull.*, Vol. III, p. 265) has justly recognized that the reading "great island" 大洲 in *Liang shu* and *Nan shi* is an error for "fire island." Indeed, the text of *Nan shi* is quoted with the correct reading in the *Wei lio* (Ch. 4, p. 3) of the Sung period, in an essay entitled "Asbestos." WYLIE, in his study *Asbestos in China* (p. 149), not consulted by Pelliot, translated the name by "spontaneous combustion great island." He accordingly accepted the wrong reading, and took the word *jan* in the sense of "to burn." The latter point of view is justified, as, for instance, the *Hüan lan* 玄覽 (*Ko chi king yüan*, Ch. 27, p. 13) writes 燃火之洲. Which of the numerous volcanic islands of the Archipelago, one of the chief volcanic belts on the globe, should be understood by K'ang T'ai's "Volcano Island," certainly is difficult to guess. In my opinion, Timor stands a fair chance of claiming this honor. A. R. WALLACE (*The Malay Archipelago*, p. 5) observes, "To the eastward, the long string of islands from Java, passing by the north of Timor and away to Banda, are probably all due to volcanic action. Timor itself consists of ancient stratified rocks, but is said to have one volcano near its centre." Again on p. 7, "In Timor the most common trees are Eucalypti of several species, so characteristic of Australia, with sandal-wood, acacia, and other sorts in less abundance. These are scattered over the country more or less thickly, but never so as to deserve the name of a forest. Coarse and scanty grasses grow beneath them on the more barren hills, and a luxuriant herbage in the moister localities. In the islands between Timor and Java there is often a more thickly wooded country, abounding in thorny nnd prickly trees. These seldom reach any great height, and during the force of the dry season they almost completely lose their leaves, allowing the ground beneath them to be parched up, and contrasting strongly with the damp gloomy, ever-verdant forests of the other islands. This peculiar character, which extends in a less degree to the southern peninsula of Celebes and the east end of Java, is most probably owing to the proximity of Australia. The

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are trees which grow in the fire. The people in the vicinity of the island peel off the bark, and spin and weave it into cloth hardly a few feet in length. This they work into kerchiefs, which do not differ in appearance from textiles made of palm and hemp fibres,[1] and are of a slightly bluish-black color. When these are in the least soiled, they are thrown into fire and thoroughly purified. This substance is made also into lamp-wicks which never become

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south-east monsoon, which lasts for about two-thirds of the year (from March to November), blowing over the northern parts of that country, produces a degree of heat and dryness which assimilates the vegetation and physical aspect of the adjacent islands to its own. A little further eastward in Timor-laut and the Ké Islands, a moister climate prevails, the south-east winds blowing from the Pacific through Torres Straits and over the damp forests of New Guinea, and as a consequence every rocky islet is clothed with verdure, to its very summit. Further west again, as the same dry winds blow over a wider and wider extent of ocean, they have time to absorb fresh moisture, and we accordingly find the island of Java possessing a less and less arid climate, till in the extreme west near Batavia rain occurs more or less all the year round, and the mountains are everywhere clothed with forests of unexampled luxuriance." "The land mammals of Timor are only six in number, one of which is a shrew mouse (*Sorex tenuis*), supposed to be peculiar to the island" (*ibid.*, p. 160).

[1] *Tsiao ma* 蕉麻. Pelliot renders this by "scorched hemp" (*du chanvre roussi*), as if the reading were 焦. Wylie translates the term "raw hemp;" but the word *tsiao* denotes a particular group of plants, the fibre-furnishing palms, and is co-ordinated with the word *ma* ("hemp"). Clothing of palm-fibres was particularly made by the aboriginal tribes of southern China, and known as *hung tsiao pu* 紅蕉布 (*hung tsiao* being a variety of the genus *Musa*; see the *Ch'i ya* 赤雅 by Kuang Lu, Ch. A, p. 5, ed. of *Chi pu tsu chai ts'ung shu*). The so-called Manila hemp of commerce is obtained from the Abaca (*Musa textilis*), the staple material for Filipino weavings (see C. R. Dodge, *Descriptive Catalogue of Useful Fibre Plants of the World*, pp. 248—249, Washington, 1897; and the recent interesting article of C. Elata, *Philippine Fiber Plants*, in the *Philippine Craftsman*, Manila, 1914, pp. 442—456). Marco Polo (ed. of Yule and Cordier, Vol. II, p. 124) mentions that the people of the province of Kuei-chou manufacture stuffs of the bark of certain trees which form very fine summer clothing. I do not believe with Yule (p. 127) that Polo here refers to the so-called grass-cloth, but he indeed means literally cloth woven from the bark-fibres of trees. The Miao in the prefecture of Li-p'ing, province of Kuei-chou, indeed make textiles from tree-bark, called bark-cloth (*p'i pu* 皮布; see *Ta Ts'ing i t'ung chi*, Ch. 400, p. 4). According to Megasthenes (Strabo, XV, 60) the Sarmanes (Sanskrit *çramaṇa*, "ascetic") of India used to wear garments made from the bark of trees. The various kinds of hemp grown in China are briefly enumerated in *Chinese Jute, published by Order of the Inspector General of Customs* (Shanghai, 1891).

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exhausted." This text presents a somewhat amazing effort at associating heterogeneous ideas. The real affair described is the well-known bast-cloth, common to the Malayan and Polynesian tribes, and peculiar to many other culture-areas, which assuredly is not incombustible; and this product is passed off as asbestos. The reference to the purification in fire and to the making of wicks doubtless proves that asbestos is intended. On the other hand, the resemblance of asbestos-fibres to hemp or flax is well-known.[1]

The term "bark-cloth" is equivocal: it denotes principally two types,—one known under the Polynesian name *tapa*, in which the bast is flayed and pounded or macerated in water till it becomes soft and pliable;[2] and another, in which the bast-fibre shreds into filaments that may be spun and woven. As K^{c}ang T^{c}ai refers to the latter process, he must have had textiles of bast-fibre in mind. Ko Hung, as already stated, based his account of asbestos on K^{c}ang T^{c}ai's report, and was familiar with both beaten and woven bark-cloth; for he has established two vegetable varieties of asbestos,—one woven from the flowers of trees, the other prepared from bark.

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[1] Hence our name "earth-flax" (Dutch *steenvlas*, that is, "stone flax;" German *Flachsstein*).

[2] This method is practised not only by the Malayo-Polynesian stock, but also by the negroes of Africa and the aboriginal tribes of America. Only a few instances from literature may be given, whose number might certainly be augmented by many others. W. Marsden (*History of Sumatra*, p. 49, London, 1811) says on this subject, "The original clothing of the Sumatrans is the same with that found by navigators among the inhabitants of the South Sea Islands, and now generally called by the name of Otaheitean cloth. It is still used among the Rejangs for their working dress, and I have one in my possession, procured from these people, consisting of a jacket, short drawers, and a cap for the head. This is the inner bark of a certain species of tree, beaten out to the degree of fineness required; approaching the more to perfection, as it resembles the softer kind of leather, some being nearly equal to the most delicate kid skin; in which character it somewhat differs from the South Sea cloth, as that bears a resemblance rather to paper, or to the manufacture of the loom." In central Celebes the art of weaving is still unknown, and the tribes use only beaten bark cloth derived from a large variety of trees (P. and F. Sarasin, *Reisen auf Celebes*, Vol. I, p. 259, where the process is described). See also Dodge, *l. c.*, pp. 98—101.

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Is K^{c}ang T^{c}ai himself responsible for this fanciful combination, or did he merely reproduce a tradition overheard by him in Fu-nan? We know that K^{c}ang T^{c}ai, during his residence in that country in the first part of the third century, encountered a Hindu named Ch^{c}ên-sung 陳宋, who had been despatched there by the King of Central India in response to the mission intrusted to Su-wu 蘇物 by Fan Chan 范旃, King of Fu-nan. Thus K^{c}ang T^{c}ai availed himself of the opportunity of interviewing Ch^{c}ên-sung on all matters concerning India, and on his return to China published a work on the hundred and odd kingdoms of which he had heard. This valuable source of information has unfortunately perished.[1] India and Fu-nan entertained close commercial relations: diamonds, sandal-wood, and saffron being expressly mentioned in the T^{c}ang Annals as products that were exchanged by India with Ta Ts^{c}in, Fu-nan, and Kiao-chi (Tonking).[2] True it is, asbestos is not specified in the list of these products; but K^{c}ang T^{c}ai's story allows us a peep behind the scenes, for it incontrovertibly shows that asbestos was known in Fu-nan during the time of his sojourn. Certainly it could not have come from any Malayan region, where asbestos, as far as I know, is not found or utilized by the native population: it evidently arrived in Fu-nan from India. In A.D. 380 India presented to the Court of China an offering of fire-proof cloth;[3] and this same event is alluded to in the Annals of the Tsin Dynasty, in the life of Fu Kien 苻健 (337—384),[4] in the statement that India offered fire-proof cloth.[5] We remember that Pliny naturalizes asbestos in India, that Hierocles equips the Indian Brahmans with

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[1] PELLIOT, *Bull.*, Vol. III, p. 276.

[2] *T^{c}ang shu*, Ch. 221 A, p. 10.

[3] *Shi leu kuo ch^{c}un ts^{c}iu*, Ch. 37, p. 11 (compare WYLIE, *l. c.*, p. 143).

[4] GILES, *Biographical Dictionary*, p. 230.

[5] *Tsin shu*, Ch. 112 (compare *Pien tse lei pien*, Ch. 21, p. 6).

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asbestos garments, and that the Arabs derived the mineral from Badakshān (pp. 320, 327): hence we are entitled to presume that asbestos was sometimes shipped also from India to Fu-nan in the beginning of the third century. This postulate is necessary to account for the fact that K^{c}ang T^{c}ai struck correct notions in Fu-nan regarding asbestos,—notions which agree with those of the classical authors. Asbestos products, however, were rare in Fu-nan, as in Hellas and Rome (PLINY, rarum inventu) and everywhere else, and the supply presumably could not keep pace with the demand; therefore the "malign and astute" people of Fu-nan [1] conceived the ruse to trade off Malayan bast-cloth under the name of "asbestos." This at least seems to me the best possible theory explaining K^{c}ang T^{c}ai's account, as far as the theory of vegetal origin is concerned. A specific example of what the Fu-nan asbestos was is offered by the interesting story of Duke Kie, discussed above, from which it appears that bast-cloth was really shipped to China under the label "asbestos." The merchants who offered this ware hailed from the Southern Sea, and this product must have been identical with what was shown K^{c}ang T^{c}ai on his visit in Fu-nan. Duke Kie's clever experiment also demonstrates that K^{c}ang T^{c}ai had merely fallen victim to a mystification.

The influence of the asbestos text in the Liang Annals is apparent not only in the Taoist school of the fourth century, as shown above, but also in several later works. Thus the *Hüan lan* or *Yüan lan* 玄(元)覽, a work of the T^{c}ang period (618—906), [2] says, "In P^{c}i-k^{c}ien 毘騫 there is the Island of Blazing Fire, producing a tree the substance of which can be woven, and which furnishes what is called fire-proof cloth." The geographical term "P^{c}i-k^{c}ien"

[1] Thus they are characterized in the Annals of the Southern Ts^{c}i (PELLIOT, *Bull.*, Vol. III, p. 261).

[2] Cited in *Ko chi king yüan*, Ch. 27, p. 13.

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occurs in the Fu-nan account of the Liang Annals as the name of a great island of the ocean, situated 8000 *li* from Fu-nan, and, according to Pelliot,[1] seems to have been along the Irrawaddy and the Indian Ocean. The information of the *Hüan lan,* of course, is deficient, as in the Liang Annals Volcano Island has nothing to do with P^{c}i-k^{c}ien, but is located far eastward, in the Malay Archipelago.

In the above translation of the passage of the Liang Annals, the kingdom of Chu-po has been identified with Java, the name being a variant of Shê-p^{c}o, by which Java became known from the first half of the fifth century. This conclusion is confirmed by a text ascribed to the *I wu chi* 異物志 and contained in the *T^{c}ai p^{c}ing yü lan*,[2] in which the Island of Blazing Fire is located in the kingdom of Se-tiao 斯調, which is doubtless a misprint for Ye-tiao 葉調. Now, we owe to the ingenuity of Pelliot the identification of this name with the old Sanskrit designation Yavadvīpa,[3] and this solution of the problem seems to me a well-assured result. Since the *I wu chi,* in its account of Volcano Island, depends upon the text of the Liang Annals, it seems equally certain that the Chu-po country mentioned in the latter is the island of Java. The passage of the *I wu chi* is worded as follows: "In the kingdom of Ye-tiao (Java) there is the Island of Blazing Fire, covered with a fiery plain, which lights up spontaneously in the spring and summer, and dies away during the autumn and winter. Trees grow there which do not waste, the branches and bark renewing their fresh appearance; in the autumn and winter, however, when the fire dies out, they all wither and droop. It is customary to gather the bark

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[1] *Bull.*, Vol. III, p. 264.

[2] Ch. 820, p. 9 (edition of Juan Yüan, 1812). The text is quoted also in the commentary to *San kuo chi, Wei chi,* Ch. 4, p. 1.

[3] *Bull.*, Vol. IV, p. 268; and *T^{c}oung Pao,* 1912, p. 457.

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in the winter for the purpose of making cloth. It is of a slightly bluish-black color. When it is soiled, it is thrown into fire again, and comes out fresh and bright." [1] The interesting point here is that the trees alleged to yield asbestos are set in causal relation with the fire of the volcano, which transmits to the bark its fire-proof quality.

Two other texts may likewise be traced to the Fu-nan account in the Liang Annals. The *Hüan chung ki* 玄中記, written by Kuo 郭 [2] of the fifth century, observes that "there is a volcano in the south, producing a tree which is used for fuel without being consumed; the bark, when woven, makes fire-proof cloth, of which there are two kinds." [3] The *Shu i ki* 述異記 ("Record of Wonderful Matters"), by Jên Fang 任昉, who lived in the beginning of the sixth century, annotates that "the fire of this active volcano in the south is extinguished in the twelfth month whereupon all trees push forth branches; while, when the fire rises again, the leaves drop, the same as in winter in China, When the wood is used for fuel, it is not consumed by the fire; and the bark, when woven, makes fire-proof cloth." This version must be connected with one handed down in the *Wên hien tᶜung kᶜao* of Ma Tuan-lin, who erroneously says that the Volcano country (*Huo shan*) became known only at the time of the Sui (589—618), and then quotes the following from the "Customs of Fu-nan" (*Fu-nan tᶜu su* 扶南土俗), by Kᶜang Tᶜai: [4] "Volcano Island is situated somewhat over a thousand *li* east of Ma-wu Island. In the spring the rains set in; and when the rainy season is over, the fire of the volcano

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[1] Compare Wylie, *l. c.*, p. 146.

[2] His personal name is unknown.

[3] In agreement with *Pao-pᶜu-tse* (p. 332).

[4] Compare Pelliot, *Bull.*, Vol. III, pp. 275 and 276, note 2. My rendering is based on the text in *Yüan kien lei han*, Ch. 233, p. 19.

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breaks forth. The trees in the forests of the island, when wetted by the rain, have a black bark, but, when affected by the fire, the bark assumes a white color.[1] The inhabitants of the adjoining isles gather this tree-bark during the spring, and weave it into cloth; they make it also into lamp-wicks. When but a bit soiled, they fling the cloth into fire, and this means purify it. There is, further, a mountain, north of the country Ko-ying (written Kia-ying 加營)[2] and west of Chu-po (Java), 300 *li* in circumference. The active eruption of fire opens from the fourth month, and ceases in the first month. During the period of volcanic activity the trees drop their leaves, as in China during the cold season. In the third month the people betake themselves to this mountain to peel the tree-bark, which is then woven into fire-proof cloth."

The *Lo-yang kia lan ki* 洛陽伽藍記[3] states that the country Kü-se 車斯 produces fire-proof cloth which is made from the bark of trees, and that these trees are not consumed by fire.[4] The number of texts insisting on the vegetal origin of asbestos could doubtless be much increased; but those here assembled are sufficient to show that this doctrine, first traceable to K^{c}ang T^{c}ai, had obtained a permanent hold on the Chinese mind, despite the contradictory explanation based on the salamander. While the Chinese salamander versions unquestionably go back to Western traditions, I am not convinced that this is the case also with the vegetal theory. As set forth above (p. 306), I do not share the opinion of those who impute to Pliny a belief in a plant origin of asbestos.

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[1] This observation, of course, relates in reality to asbestos.

[2] See PELLIOT, *Bull.*, Vol. IV, p. 278, note.

[3] Records of the Buddhist Establishments in the Capital Lo-yang, written by Yang Hüan-chi 楊衒之 in 547 or shortly afterwards (BRETSCHNEIDER, *Bot. Sin.*, pt. 1, No. 483; and CHAVANNES, *Bull.*, Vol. III, p. 383).

[4] *T^{c}u shu tsi ch^{c}éng*, chapter on fire (*tsa lu*), p. 11 b. Kü-se is perhaps identical with Kü-shi 車師, designating "Turfan-Dsimsa."

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The tree-asbestos of the Alexander Romance and a Syriac work (p. 308) represents rather isolated instances which show lack of cohesion, and cannot be unduly emphasized. Asbestos filaments bear such a striking resemblance to hemp or flax fibres, that it becomes intelligible that the theory of their identity could have spontaneously been advanced in various parts of the world. Our own nomenclature of asbestos varieties is witness thereof.[1] In the following section I shall try to explain how this theory originated in Fu-nan.[2]

The Arabs and mediæval Europe, as already observed, were too much absorbed by the identification of asbestos with the salamander and phœnix to pay much attention to the idea of vegetal provenience. This view, curiously enough, loomed up in Europe in MARTINI's *Atlas Sinensis*. It is told there that there is a kingdom

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[1] The mountain-tree asbestos of the Chinese meets its parallel in our "mountain wood" or ligniform asbestos (*xylotil*),—a variety of asbestos which is hard and close grained, generally of a brownish color, and often bearing an exact resemblance to petrified wood. At first sight it might easily be mistaken for the latter, especially when sufficient iron is present to give it the ruddy tinge of decayed wood or bark. Under the microscope, however, the crystal fibre is easily detected, as is also the absence of the vegetable cells which are always to be found in petrified wood (R. H. JONES, *Asbestos*, p. 14). Also the Chinese seem to have taken petrified wood for asbestos (see WYLIE, *l. c.*, p. 152; and the writer's *Notes on Turquois*, p. 24).

[2] An analogous example in which the ancients were deluded in regard to a Chinese product, is presented by Chinese silk taken by several classical authors for thin fleeces obtained from trees (YATES, *Textrinum Antiquorum*, p. 182). VIRGIL (*Georgica*, II, 121) has the verse, "And Seres comb their fleece from silken leaves" (Velleraque ut foliis depectant tenuia Seres). STRABO (XV, 20) supposed the raw silk material to be a sort of byssos fibres scraped from the bark of trees. According to DIONYSIUS PERIEGETES, the Seres comb the variously colored flowers of the desert land to make precious figured garments, resembling in color the flowers of the meadow (*ibid.*, p. 181). PLINY (VI, 20) speaks of the Seres famed for the wool found in their forests; they comb off a white down adhering to the leaves, and steep it in water. The use of water to detach silk from the trees is insisted on also by Solinus and Ammianus Marcellinus, both of whom propound the vegetal theory of the origin of silk. Pausanias of the second century denied that the threads from which the Seres make webs are the produce of bark, and described the silkworm with fair correctness.

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in Tartary styled Taniu, which produces stones; and above these, an herb which fire can never consume. When it is surrounded by flames, it reddens as though it would be entirely burned up; but as soon as the fire is out, it re-assumes its former gray or ash color. It is never very large or high; but it grows like human hair, and has almost the shape of the latter. Its consistency is very feeble and delicate; and when placed in water, it is noted that it turns into mud and is entirely dissolved. [1]

The Volcanic Theory.—After having discussed the opinions of the animal and vegetal origin of asbestos, another question remains to be answered,—How did the idea of a volcano acting upon the formation of asbestos spring into existence and develop? Besides the volcanic theory propounded by K'ang T'ai, there are a few others that call for attention. The *Shi i ki* [2] records an embassy from the country of the Yü-shan bringing a tribute of fire-proof cloth to the Emperor Wu of the Tsin dynasty in the year 280. On this occasion the envoys of Yü-shan stated that "in their country there is a mountain containing veined stones (*wen shi* 文石) sending forth fire, the appearance of smoke being visible at the horizon throughout the four seasons. This fire was known as the 'cleansing fire.' When unclean clothes were thrown on these blazing stones, however big the accumulation of filth, they were purified in this manner, and came out as new." These clothes, of course, must have been of asbestos-fibres. This story is strange, [3] and is hardly reproduced correctly in the Chinese text, as it is now before us. No reason can be discovered why asbestos-cloth should be cleaned in a volcanic

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[1] A. Kircher, *La Chine illustrée*, p. 278 (Amsterdam, 1670). Kircher refutes this error; Martini's story is doubtless derived from the Chinese.

[2] Ch. 9, p. 4 (ed. of *Han Wei ts'ung shu*); compare Wylie, *l. c.*, p. 143.

[3] In all probability it is a mere echo and bad digestion of K'ang T'ai's narrative.

fire, as any other ordinary fire would answer the same purpose. The true story must have been so worded that asbestos itself was produced by the volcano in question, and that the agency of the volcanic fire to which it was exposed was instrumental in rendering it impervious to fire.[1] We have here, then, a reference to an asbestos-producing volcano situated in the west of China. A burning mountain beyond the K^{c}un-lun, upon which any object that is thrown is immediately burnt, is mentioned in the *Shan hai king*;[2] and we have seen that the *Sou shên ki* derives asbestos from this volcano in the K^{c}un-lun.[3] Chinese tradition, accordingly, is acquainted with two volcanoes producing asbestos,—one on an island in the eastern part of the Malay Archipelago, first reported by K^{c}ang T^{c}ai; and another placed in Central Asia. From none of these territories, however, has asbestos ever become known to us: hence we are compelled to conclude that the volcanic theories of the Chinese records have not been prompted by immediate observation, but are the result of a series of speculative thoughts. These thoughts themselves, on the other hand, have a certain foundation in correct observation: it is in the manner of their concatenation that the speculative element comes in.

It may first be noted that from our scientific viewpoint even the direct association of asbestos with volcanoes is quite correct. In the widest sense of the word, we include under "asbestos" both pyroxene and hornblende; the latter most frequently, the former

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[1] In a manner similar to that in which Pliny invokes the scorching heat of the tropical sun in the deserts of India as the cause of the fire-proof quality of the mineral.

[2] Wylie, *l. c.*, p. 146.

[3] The Sung History, according to Bretschneider (*Mediæval Researches*, Vol. II, p. 190), describes a volcano north of Urumtsi, which contains sal ammoniac: "Inside there is a perpetual fire, and the smoke sent out from it never ceases; clouds or fogs are never seen around this mountain; in the evening the flames issuing from it resemble torch-light; the bats, from this phenomenon, appear also in a red color." Compare W. Ouseley, *Oriental Geography of Ebn Haukal*, p. 264.

more rarely, assuming an asbestiform character. Pyroxene, a very common mineral, is a constituent in almost all basic eruptive rocks, and is principally confined to crystalline and volcanic rocks. In different localities it is associated with granite, granular limestone, serpentine, greenstone, basalt, or lavas. Likewise hornblende is an essential constituent of igneous rocks.[1] Nevertheless we cannot grant the Chinese the merit of having made such an observation, which is due solely to our modern geological research. There is, moreover, no volcano in Asia which to our knowledge has ever yielded asbestos, nor do the Chinese pretend to have actually imported the material from a volcanic region. To them the volcano is a romantic place of refuge to explain the perplexing properties of asbestos. The introduction of the volcano must not be explained by reading into it the latest achievements of our geology, but from the thoughts evolved by the nature philosophy of the Chinese, nourished by the glowing accounts accruing from foreign countries. The question will be difficult to settle, whether K^{c}ang T^{c}ai owes his theory to himself and his Chinese environment, psychological and educational, or whether he borrowed it outright from the people of Fu-nan. I feel positive of the one fact, that the volcanic point in it was conceived in Fu-nan; for China has no volcanoes, and all Chinese accounts of such relate to countries abroad.[2]

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[1] R. H. Jones, *Asbestos*, p. 21. Asbestos occurs in high altitudes. In Italy, for instance, it is rarely found at a lower level than five thousand feet, ranging from this upwards to twelve thousand; in fact, up to the line of perpetual snow. Hence the addition "mountain" is so prominent in our names for the varieties; as, "mountain wood," "mountain leather," "mountain paper," "mountain cork," "mountain flax."

[2] There is a negative criterion which illustrates that the Fu-nan tradition of the volcanic asbestos is not due to an impetus from outside. The Arabic authors make frequent allusions to the volcanoes of Java and neighboring islands, but never mention asbestos in this connection. Ibn Khordādbeh, in his *Book of the Routes and Kingdoms* (844—848), tells of a small volcano in Jāba (Java), a hundred cubits square, and only of the height of a lance, on the summit of which flames are visible during the night, while it throws up smoke during the day. The merchant Soleiman, who wrote in 851, speaks of a

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To K^{c}ang T^{c}ai, asbestos-fibres were of vegetal origin, the product of the bark of a tree, somewhat on the order of palm or hemp fibre. The ready-made textile was impervious to fire, and the mind eager to account for this wonder of nature settled on the theory that this property should have been brought about through the action of a natural fire. The material in its crude state had already habituated itself to fire, which had hardened it in such a manner that it could successfully resist all attacks of the element,—an idea also alive in Pliny's mind. People of Fu-nan who had occasion to visit certain Malayan islands with their belt of volcanic mountains observed the great luxury of vegetation which there prevailed, and its endurance despite volcanic eruptions. Pliny tells us of an ash-tree overshadowing the fiery spring of a volcano and always remaining green. [1] Chao Ju-kua, describing the action of Mount Etna, observes, "Once in five years fire and stones break out and flow down as far as the shore, and then go back again. The trees in the woods through which this stream flows are not burned, but the stones it meets in its course are turned to ashes." [2] If there were plants to outlive the ravages of volcanic destruction, the primitive mind argued that the absorption of subterranean fire had made them fire-proof. The fibres of asbestos, being fire-proof, were consequently derived from plants growing on volcanic isles, this association being facili-

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Mountain of Fire near Jāwaga (Java) which it is impossible to approach; at its foot there is a spring of cold and sweet water; the same is reiterated by Ibn al-Faqih (902). Masūdī (943) reports a tradition regarding the Malayan volcanoes, according to which, during the thunder-like eruptions, a strange and terrifying voice resounded announcing the death of the king or chief, the sounds being louder or lower in accordance with the importance of the person (see G. Ferrand, *Relations de voyages arabes, persans et turks rel. à l'Extréme-Orient*, Vol. I, pp. 28, 41, 59, 99, 110, 145; and Carra de Vaux, *Maçoudi, Livre de l'avertissement*, pp. 90—92). Not one of these or any later Arabic writers mentions asbestos among the products of either Java or any other Malayan region.

[1] Viret aeterno hunc fontem igneum contegens fraxinus (II, 107, § 240).

[2] Translation of Hirth and Rockhill, p. 154.

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tated by the fact that their inhabitants manufactured fabrics of bark-fibres. That this hypothesis was formulated in Fu-nan appears plausible to a high degree; for, aside from the inward probability of this supposition, there is no such account in classical antiquity, Western Asia, or India. Pliny neither correlates asbestos with volcanoes, nor does he speak of asbestos in his discourse on the latter.

The report of K'ang T'ai, duly adopted by his countrymen, was then crossed by the salamander story inflowing from the Roman Orient, and the imaginative Taoists at once set to work to reach a compromise between the salamander-asbestos and the volcanic tree-bark asbestos. If the vegetable kingdom in certain places could survive a volcanic fire, and if, as stated by Western traditions, the salamander could exist in fire, there was in all the world no reason why the hardy creature could not stand a *volcanic* fire as well. This was the act of Kuo P'o, who ejected the trees and replaced them by the salamander, that now made its home in the blazes of Volcano Island in the Malay Archipelago (p. 335). To the author of the *Sou shên ki*[1] this compromise seemed too radical, and he arbitrated by restoring K'ang T'ai and bringing Kuo P'o to honor. The vegetable as well as the animal kingdom, in his way of reasoning, can live in volcanic fires; and asbestos is either the product of the bark of these plants, or of the plumage of birds or the hair of beasts. Wang Mou of the Sung period accepted this verdict, and acquiesced in the belief that there is foundation for both these statements.[2]

Discovery of Asbestos on Chinese Soil.—The Annals of the Later Han Dynasty, in the interesting chapter dealing with the

[1] Ch. 13, p. 3 (of the Wu-ch'ang print).

[2] Wylie, *l. c.*, p. 147.

southern Man (*Nan Man*) and the barbarous tribes in the south-west of China (*Si-nan I* 西南夷), have the following report: "Their contributions of tribute-cloth, fire-down (*huo tsʿui* 火毳), parrots, and elephants, were all conveyed to the Treasury."[1] Wylie[2] refers this account to the tribe called Jan-mang 冉駹),[3] mentioned in this chapter of the Annals a couple of pages before; but it would seem that it relates in fact to the Pai-ma-ti 白馬氐,[4] a tribe settled in Sze-chʿuan Province (north-east of Mao chou).[5]

The term "fire-down," employed in the text of the Annals, is explained by the commentary as being identical with the term "fire-proof cloth" (*huo huan pu*); that is to say, it is understood by the Chinese in the sense of asbestos. The word *tsʿui* is very ancient, and appears as early as the time of the *Shi king*[6] with the significance of clothing woven from the down of birds or the fine undergrowth of hair of mammals.[7] Such textiles woven from bird's down are ascribed by the Chinese also to the aboriginal tribes inhabiting southern China. E. H. Parker[8] has extracted from the *Ling nan i wu chi* the information that the chiefs of southern China select the finest down of the geese and mix it with the

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[1] *Hou Han shu*, Ch. 116, p. 11 b.

[2] *L. c.*, p. 150.

[3] He wrongly transcribes the first character *Tan* (compare Hirth, *China and the Roman Orient*, p. 36). The tribal name *Mang* is doubtless identical with the Mang 莽 studied by G. Devéria (*Frontière sino-annamite*, p. 159); see also Chavannes, *Tʿoung Pao*, 1906, p. 689.

[4] *Ibid.*, p. 11 a.

[5] Compare the interesting study of J. H. Plath, *Fremde barbarische Stämme im alten China*, p. 515 (*SB. bayer. Akad.*, 1874). The Pai-ma-ti seem to have extended from Sze-chʿuan as far as into Kan-su (Chavannes, *Tʿoung Pao*, 1905, p. 528).

[6] Legge, *Chinese Classics*, Vol. IV, p. 121.

[7] It is only the soft down of wild birds and wild beasts. The translation "habillement fait en laine," given by Biot (*Le Tcheou-li*, Vol. II, p. 6), is erroneous, as already pointed out by J. H. Plath (*Nahrung, Kleidung und Wohnung der alten Chinesen*, p. 37); also Couvreur has the wrong rendering, "vêtement de laine."

[8] *China Review*, Vol. XIX, p. 191.

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threads of white cloth to make coverlets, the warmth and softness of which are not inferior to those of soft floss cushions. In other words, Mr. Parker adds, eider-down quilts were known in China very long ago. D. I. Macgowan, in his highly interesting essay *Chinese and Aztec Plumagery*,[1] makes this contribution to the subject: "A work styled 'New Conversations on things seen and heard at Canton,' was written by a native of Su-chou who spent many years in that city in a mercantile capacity in the latter part of the last century. In a short section devoted to bird clothes, he says, 'There are several kinds of birds, the feathers of which are woven into a peculiar cloth by the Southern Barbarians. Among them is the celestial goose velvet,[2] the foundation of the fabric being of silk, into which the feathers were ingeniously and skilfully interwoven, on a common loom, those of a crimson hue being the most expensive. Of these wild goose feathers, two kinds of cloth were made, one for winter, the other for summer wear. Rain could not moisten them; they were called 'rain satin,' and 'rain gauze,' respectively. Canton men imitated the manufacture, employing feathers of the common goose, blending them with cloth. This fabric, though inferior in quality, was much cheaper.'" The tribe Nung 儂 in Kuang-si made a special industry of fabricating a tissue of cotton and goose-down.[3] Kuang Lu 鄺露, who spent several years among the Miao tribes in the service of one of the female chiefs,[4]

[1] *American Journal of Science and Arch.*, 2d ser., Vol. XVIII, 1854, p. 59. This important study has been unduly forgotten by the present, and I apprehend also by the preceding, generation. Neither Bretschneider nor Hirth, in their references to *so-fu*, has ever appealed to it, and acquaintance with this treatise would doubtless have led them to better results.

[2] Apparently a literal translation of *t'ien ngo jung* 天鵝絨 ("silk-floss of the wild swan"). I find this term mentioned in the *T'ien kung k'ai wu* (Ch. 2, p. 46) as the name of a fur garment woven from down and feathers of hawks and wild geese.

[3] G. Devéria, *Frontière sino-annamite*, p. 112.

[4] Wylie, *Notes on Chinese Literature*, p. 59.

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and wrote an interesting account of them in his book *Ch'i yá* 赤雅,[1] mentions the bird-feather textiles under the name *niao chang* 鳥章 and discriminates between fine feather weavings styled *so-fu* 鎖袱[2] and coarse feather textiles termed "goose fishing-nets" (*ngo ki* 鵝罳).

This evidence permits us to infer that the term *huo ts'ui*, as applied to asbestos coming from the South-western Barbarians,[3] signifies "bird-down able to resist fire," and accordingly echoes a tradition current among these barbarians themselves. If nothing else, the peculiar choice of this term, which occurs in no other text, would amply support this opinion. The conclusion that the barbarians themselves worked this fibrous asbestos into a textile would of course not be forcible; at least, it is not imperative, and it is sufficient to assume that they had gotten hold of the raw material. When we further consider that parrots[4] and elephants named in the Annals are local products, the conclusion may be hazarded that also asbestos was found in the same region. This impression is confirmed by a statement of Yang Shên 楊愼 (1488—1559) to the effect that "fire-proof cloth is produced in Kien-ch'ang 建昌 in Shu (Sze-ch'uan). This substance is as white as snow, and is obtained from crevices in the stones, being identical with what the Annals of the Yüan Dynasty term 'stone silk-floss' (*shi jung* 石絨)."[5] An asbestos-producing locality in

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[1] The preface is dated 1635. The passage is in Ch. A, p. 5 b of the reprint, in *Chi pu tsu chai ts'ung shu.*

[2] The Arabic word *ṣūf* صوف (T. WATTERS, *Essays on the Chinese Language*, p. 355).

[3] The occurrence of the term in the Han Annals is an isolated instance.

[4] In the text "trained birds," interpreted as parrots. Parrots are first mentioned in *Ts'ien Han shu* (Ch. 6, p. 6) under the name "birds able to speak" (*néng yen niao* 能言鳥). They are frequently referred to in the Annals as tribute gifts (for instance, *Kiu T'ang shu*, Ch. 198, p. 9 b; *T'oung Pao*, 1904, p. 40).

[5] *Ko chi king yüan*, Ch. 27, p. 13 (compare WYLIE, *l. c.*, p. 153). Regarding the asbestos of the Yüan see below.

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Sze-ch'uan is here clearly pointed out; and this agrees with the statement of F. P. SMITH [1] that asbestos is met with in Mao chou, Sze-ch'uan; and, as the Pai-ma-ti were settled near this region, they were very well within reach of asbestos.

It is not surprising that these "barbarians" had come into possession of asbestos; for this mineral is found on the surface in numerous places of this globe, and there are instances on record that it has accidentally been discovered even by primitive tribes. In 1770 P. S. PALLAS [2] reported that the Bashkir, a Turkish tribe in the region of Yekaterinburg, had discovered on a mountain a coarse kind of asbestos of yellowish-gray hue, being exposed to the air in large pieces split lengthwise, with brittle fibres which could be pulverized into a hard white wool. In the same area he visited also the Asbestos or Silken Mountain, [3] giving a circumstantial account of the occurrence and mining there of the mineral, and mentioning also that an old woman had possessed the knowledge of weaving it into incombustible linen and gloves and making it into paper. [4]

The most remarkable utilization of asbestos on the part of a primitive tribe is made by the Eskimo. D. CRANTZ [5] has the

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[1] *Contributions toward the Mat. Med. of China*, p. 26.

[2] *Reise durch verschiedene Provinzen des russischen Reichs*, Vol. II, p. 134.

[3] In Russian *Sholkovaya Gora* (*ibid.*, p. 184).

[4] R. H. JONES (*Asbestos*, p. 37), not familiar with the interesting account of Pallas, represents the matter as though this site had been discovered only shortly before 1890, and even asserts that the Silken Mountain is said to be entirely composed of asbestos. It seems well out of the question that the Technical Society of Moscow, on whose report Jones falls back, could have made such an absurd statement, for Pallas had already said that the mountain consists principally of slate. His investigation is apt to refute also Jones's preposterous allegation that up to the present time little use has been made of asbestos in Russia and Siberia, "on account of the prevailing ignorance respecting its peculiar properties." As early as 1729 news was spread in Russia of an incombustible linen from Siberia. This referred to an asbestos-quarry discovered there about 1720 (P. J. VON STRAHLENBERG, *Nord- und östliche Teil von Europa und Asia*, p. 311, Stockholm, 1730).

[5] *The History of Greenland*, Vol. I, p. 56, London, 1767.

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following observation on the occurrence and utilization of asbestos in Greenland: "The amiantus and asbestos or stone-flax are found in plenty in many hills of this country. Even in the Weichstein are found some coarse, soft, ash-gray veins, with greenish, crystalline, transparent *radii* shooting across them. The proper asbestos or stone-flax looks like rotten wood, either of a white-gray, a green, or a red cast. It has in its grain long filaments or threads, and about every finger's length a sort of joint, and the broken end is hard and fine like a hone. But if it is pounded or rubbed, it develops itself to fine white flaxen threads. When this stone is beaten, mollified and washed several times in warm water from its limy part that cemented the threads into a stone, then dried upon a sieve, and afterwards combed with thick combs which the clothiers use, like wool or flax, you may spin yarn out of it and weave it like linen. It has this quality, that it will not burn, but the fire cleanses it instead of lye or suds. The ancients shrouded their dead, and burnt or buried them, in such incombustible linen. They still make purses or such kind of things of it for a curiosity in Tartary and the Pyrenean mountains. Paper might be made of this linen. The purified filaments may also be used as we use cotton in a lamp. But we must not imagine that the Greenlanders have so much invention: They use it dipped in train (for as long as the stone is oily, it burns without consuming) only instead of a match or chip, to light their lamps and keep them in order." In the *Encyclopædia Britannica*[1] it is stated that "by the Eskimo of Labrador asbestos has been used as a lamp-wick." I do not know from what source or authority this statement comes; but, in view of the data of Crantz, it does not sound very probable.

Marco Polo's account has shown us that in the time of the

[1] Vol. II, p. 714.

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Mongols asbestos was dug, that its preparation and weaving were perfectly understood, and that asbestos products were utilized in China. From this time onward we no longer hear of imported "fire-proof cloth," while the accounts of native asbestos increase. As early as the Sung period an attempt had been made in the Imperial Atelier to spin and weave asbestine fibres imported by the Arabs into cloth, but not with brilliant success. [1]

A positive allusion to a locality where asbestos was found during the Mongol period is made in the biography of the treacherous Uigur minister Ahmed (A-ho-ma), [2] who, in a memorial to the Emperor Kubilai, stated that "Mount Pu-ko-ts'i 布格齊 produces asbestos, which is woven into cloth unconsumable by fire; an officer should be despatched to gather it." In the main section of the Annals [3] the date of this memorial is fixed in the year 1267, and it is added that the Emperor indorsed it and issued an order in compliance with the request. The term for "asbestos" used in this text is *shi jung* 石絨 (literally, "stone silk floss"). We have already seen that Yang Shên (1488—1559) pronounced this term identical with what is generally known as "fire-proof cloth," that is, asbestos; and this identification is certain beyond doubt. [4]

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[1] *T'ie wei shan ts'ung t'an* (already quoted above, Ch. 5, p. 20 b).

[2] *Yüan shi*, Ch. 205, p. 2 a. He figures among the "Villainous Ministers." Marco Polo has told his story (ed. of YULE and CORDIER, Vol. I, p. 415).

[3] *Yüan shi*, Ch. 6, p. 12.

[4] Giles, Schlegel, and the English and Chinese Standard Dictionary, have adopted it in this sense. The term with the same meaning is used in Japan (GEERTS, *Produits*, p. 450). Also Chang Ning 張寧 of the Ming, author of the *Fang chou tsa yen* 方洲雜言, combines the "stone silk floss" of the Mongols with the ancient tributes of fire-proof cloth (*Pien tse lei pien*, Ch. 21, p. 6; WYLIE, *l. c.*, p. 153). An analogous expression occurs in the form *shi ma* 石麻 ("stone hemp") in the *Tung ming ki* (*P'ei wên yün fu*, Ch. 21, p. 4 b). This text would possess a veritable value if any dependence could be placed on this spurious work (see CHAVANNES and PELLIOT, *Traité manichéen*, p. 145), which may reach back to the middle of the sixth century. The passage in question, however, cannot be exactly dated, nor can the mysterious country Pu-tung be identified

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In regard to the location of Monnt Pu-ko-ts^{c}i, Wylie, who has already called attention to this passage,[1] observed that it is difficult to identify it; but, "as asbestos is said to be found in Tartary, it is not unreasonable to suppose a coincidence in this also." G. Schlegel[2] writes the name of the mountain 別怯赤山,[3] translating this by "red mountains of Pie-kieh," which he places in Sze-ch^{c}uan at 27° 12′ latitude and 102° 53′ longitude.[4]

A. Williamson[5] seems to be the first European author to record the occurrence of the mineral in Shan-tung. Under the title "asbestos" he has the following: "This strange fossil mineral is found at King-kwo-shan, and also at Law-sze-shan. The natives use it for making fire-stoves, crucibles, and other fire-proof purposes. The fibre is good and very feathery, and by the admixture of cotton or hemp could be woven into articles of clothing. Such articles being exposed to fire and having all the alloy consumed, would

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(it appears only in this passage, as shown by *Pien i tien*, Ch. 42, where Pu-tung is ranked among the unidentified countries of the East, solely with reference to this text). The allusion to asbestos is obvious. The text runs thus: "In the lake Ying-ngo 影娥池 there are ships fastened by means of 'stone veins' (*shi mo* 石脈) worked into ropes. These 'stone veins' come from the country Pu-tung 晡東, and are as fine as silk floss. They are extracted from the stone, and reeled like hempen cordage. The material is styled 'mineral hemp,' and is also made into cloth." The passage, at any rate, demonstrates that the mineral character of asbestos was known to the Chinese prior to the age of the Yüan, and possibly during the sixth century. The following text from the Persian geography of Ahmed Rāzī of the sixteenth century and relating to Egypt might eventually be enlisted for the explanation of the Chinese story. It is thus translated by C. Huart (*Publ. de l'Ecole des Langues Orientales*, 5th ser., Vol. V, 1905, p. 121): "Dans certaines localités croît une herbe dont on fait les cordages des gros navires; elle donne une lumière à la façon d'une chandelle; quand elle s'éteint, on la fait tourner plusieurs fois et elle redevient lumineuse."

[1] *L. c*, p. 152.

[2] *Nederlandsch-chineesch Woordenboek*, Vol. III, p. 1066.

[3] This is the reading of the *Fang chou tsa yen*.

[4] It would be interesting to settle this question. Thus far, I have failed to find any indications in the *Yüan shi* regarding the site of this mountain.

[5] *Notes on the Productions of Shan-tung* (*Journal China Branch R. As. Soc.*, Vol IV, 1868, p. 70).

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afterwards form fire-proof garments, such as ancient history speaks of, and such as are used in legerdemain. But the mineral would make most excellent fire-brick, which would be cheaper and more durable than any others. This is worthy of the consideration of the masters of the steamers on the coast." Unfortunately Williamson did not supply the technical name by which the substance is known to the Chinese. This defect was made good by F. P. Smith,[1] who furnished the name *pu huei mu* 不灰木 (literally, "wood without ashes;" incombustible wood), and pointed out three localities where it is obtained,—Lu-ngan fu in Shan-si, district of Yü-tʿien in Tsun-hua chou in Chi-li, and Mao chou in Sze-chʿuan. The occurrence in Shan-tung was confirmed by A. Fauvel,[2] who stated that "asbestos is common in Shan-tung; pounded and mixed with soapstone it is made into crucibles, and very pretty white Chinese furnaces; they are as light as cardboard, and stand any heat; these articles are extensively made in the capital of the provinces." In this account I have full confidence, because Fauvel was a good naturalist and observer, and because I saw and collected such stoves myself. These specimens, six in number,[3] were obtained at Peking in 1903; and from the description given me by Chinese, there could be no doubt that they were really made of asbestos. This impression is corroborated by Professor L. P. Gratacap, Curator of the Department of Mineralogy in the American Museum of Natural History of New York, who states that these stoves "consist of a very finely triturated asbestos, with which (purposely or adventitiously I cannot say) there is an admixture of particles of

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[1] *Contributions toward the Mat. Med. of China*, p. 26.

[2] *China Review*, Vol. III, 1875, p. 376.

[3] In the American Museum, New York (Cat. Nos. 12427, 12652—12656). A specimen is figured in the *Catalogue of the Chinese Collection for the International Health Exhibition, London, 1884*, p. 82, and is defined there as "lime stove."

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limestone; there is evidently also a smearing of clay, which to a slight extent pervades also the asbestiferous mass." As this substance is designated by the Chinese in Peking *pu huei mu*, it is conclusively proved that at present this term relates to a variety of asbestos, though this does not imply that it might not refer also to other lime-like minerals which in our opinion do not come under that category. These asbestos stoves, white in color, enclosed in frames of wood or brass and heated with coal-briquettes, are much utilized in Peking and manufactured about 80 *li* in the hills toward the west of the metropolis. I could not learn the name of the village or locality. [1]

GEERTS [2] pointed out that *pu huei mu* denotes in Japan incrustations of carbonate of lime, which settle around branches of trees immersed in a current of mineral water. This may be; in China this term refers also to petrified wood.

In reading the notes of Li Shi-chên [3] on the subject of *pu huei mu*, we are struck by the fact that he does not make any allusion

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[1] The *Port Catalogues of the Chinese Customs' Collection at the Austro-Hungarian Universal Exhibition, Vienna, 1873* (p. 56) contain the following entry in the Chefu collection (repeated also in later Exhibition Catalogues of the Customs): "Asbestos, *lung-ku-ni* 龍骨泥; place of production, Shan-tung; used for making fire-stoves, crucibles, etc.; the fibre woven with cotton or hemp is made into fire-proof materials." This information is spurious, and based on a misunderstanding of Williamson, who said that the fibre is good and very feathery, and by the admixture of cotton or hemp *could* be woven into articles of clothing; in fact, of course, it is not so woven by the Chinese, nor is it woven by them at all; at least, there is not the slightest evidence of this. Moreover, the term *lung-ku-ni* has nothing to do with asbestos, but denotes a medical preparation made from powdered dragon-bones, that is, bones of fossil animals.—How badly China is treated by our mineralogists, and even in otherwise complete monographs, is illustrated by the book of R. H. JONES on Asbestos. All that is said there in regard to China amounts to the one sentence (p. 39), "In China also asbestos occurs; but, apart from the manufacture of a coarse kind of cloth, we know little of any purpose to which it is there applied." I have never seen or heard of any asbestos-cloth now manufactured in China.

[2] *Produits*, p. 450 (see also p. 344).

[3] *Pên ts'ao kang mu*, Ch. 9, p. 14 b. The translation given by F. DE MÉLY (*Lapidaires chinois*, p. 85) is an incomplete abstract from the *Pên ts'ao*.

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to the "fire-proof cloth;" he does not tell us that it is identical with what anciently was called *huo huan pu*. In fact, the traditions regarding the two products are entirely distinct. Certainly *pu huei mu* refers to the mineral, and *huo huan pu* to the finished textile product.

There is another term, *yang kʿi shi* 陽起石, which likewise refers to a variety of asbestos. It is difficult to see why SMITH [1] and GEERTS [2] were so much exercised about this identification, the one saying that "this variety of hornblende, or greenstone, is scarcely to be called an asbestos, as it is by some writers;" the other even going so far as to impeach some foreign authors on a charge of confusion. Both Smith and Geerts were insufficiently informed on the subject; for what they describe is certainly styled by us "asbestos," whether the Chinese specimens commercially be of good or bad quality. D. HANBURY [3] identified *yang kʿi shi* with "asbestos tremolite, [4] silicate of lime and magnesia;" and this is what we still include under "asbestos." It appears that this stone is used only medicinally. [5] The *English and Chinese Standard Dictionary* [6] lists both *pu huei mu* and *yang kʿi shi* under "asbestos." [7]

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[1] *L. c.*, p. 27.

[2] *L. c.*, p. 448.

[3] *Notes on Chin. Mat. Med.*, p. 111 (*Pharmaceutical Journal*, 1861); or in his *Science Papers*, p. 218.

[4] This word is derived from Tremola, Mount St. Gotthard, where this variety was first found.

[5] F. DE MÉLY, *Lapidaires chinois*, p. 105; BIOT in Bazin, *Chine moderne*, p. 556.

[6] Vol. I, p. 112.

[7] It should be pointed out, however, that this meaning of *yang kʿi shi* is of comparatively recent origin, the exact date of which remains to be ascertained. In the older texts cited by Li Shi-chên on the subject, nothing can be found to remind us of asbestos; and the early sources are so brief and obscure that they hardly allow of any positive conclusions. Thus the *Pie lu* merely refers to Shan-tung as the place of provenience by saying that *yang kʿi shi* occurs in the hills and valleys of Mount Tsʿi and in Lang-ye, adding that it is the root of mica (*yün mu*, "cloud mother") in the Cloud Mountains (*Yün shan*). Tʿao Hung-king states that this mineral, which is dug together with mica,

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Marco Polo proved that he was possessed of a scientific mind when he exploded the salamander legend at the very moment that his Turkish acquaintance told him of how asbestos was dug and spun. The same case might be applied as a test for the scientific ability of the Chinese. True it is, the scholars of the Ming period clearly recognized the identity of the asbestos discovered under the Yüan with the imported fire-proof cloth of old. In vain, however, do we look in the literature of the Chinese for an awakening on their part, and a critical attitude toward the ancient legends, when the mining and working of the material within their boundaries has offered the opportunity ever since the days of the Mongols. The minds of Chinese scholars, at least those of the last centuries, were not trained to observation, and still less to logical conclusions based thereon, especially when these were apt radically to antagonize venerable traditions. The discovery of asbestos in China did not lead to studies by her scholars and to an overthrow of popular errors. On the contrary, the old book-knowledge persisted and triumphed. Wylie quotes the following from Chou Liang-kung 周亮工, an author who lived under the Manchu dynasty and had occasion to see a strip of asbestos cloth: "The ancients said that it was woven from the bark of a tree that grew on a burning mountain; while some say that it is from the hair of a rodent. The statement that it is from the bark of a tree, is the most

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is very similar to mica, only of greater density; and that *yang k'i shi*, dug in Yi-chou together with alum (*fan shi*), is a bit yellow and black in color, but that it is only the root of alum or mica, and that the true state of affairs is not yet assured. T'ao Hung-king, accordingly, was not positive about the true nature of the substance; it may originally have been a variety of mica or alum. At any rate, it has no practical importance for the historian of asbestos, as the Chinese never made any use of it in the manner of asbestos, but only took it internally as a medicine. It should be remembered that Apollonius has allusions to mica in his account of asbestos (p. 304), and that Dioscorides and Pliny liken asbestos to alum (pp. 303, 308).

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probable, as its color is more like hempen than woollen fabrics." To the credit of the Chinese, however, it must be said that Ts^{c}ai T^{c}iao 蔡絛 of the Sung period plainly rejected the legend of the animal origin of asbestos, though he failed to grasp the real nature of the substance. It will be remembered that this author, in his work *T^{c}ie wei shan ts^{c}ung t^{c}an*, reports the importation on the part of the Arabs of asbestine cloth and asbestos raw material, and that the latter was woven into textiles in the Imperial Atelier of the house of Sung. These facts impressed the Sung scholars and set them to thinking. Ts^{c}ai T^{c}iao makes the positive statement that asbestos is not the hair of a rodent (非鼠毛也), and that the Chinese manufactures of his time testify to the fact that the old stories are wrong.

Addenda.—In the letter purported to have been addressed by Prester John to the Byzantine Emperor Manuel, and written about 1165, we read the following about the salamander yielding the material for asbestine garments (F. Zarncke, *Der Priester Johannes* I, p. 89): "In alia quadam provincia [of India, the territory of the alleged Royal Presbyter] iuxta torridam zonam sunt vermes, qui lingua nostra dicuntur salamandrae. Isti vermes non possunt vivere nisi in igne, et faciunt pelliculam quandam circa se, sicut alii vermes, qui faciunt sericum. Haec pellicula a dominabus palatii nostri studiose operatur, et inde habemus vestes et pannos ad omnem usum excellentiae nostrae. Isti panni non nisi in igne fortiter accenso lavantur." In this description the salamander is associated with the silkworm working itself an envelope that is reeled off and spun like silk, the material being incombustible and washed in fire. In view of the popularity of the stories about Prester John in the thirteenth century, the "salamander-silk," so frequently mentioned in the texts of that period, may well be traceable to the passage in question. In one of the mediæval manuscripts edited by Zarncke (pp. 167, 170), twelve men appear before King Manuel as ambassadors of the Presbyter, and impress him by cleaning their robes of salamander-silk in flaming fire. The Presbyter's letter is instructive for another reason; for it shows, as pointed out on p. 325, that the identity of the salamander's product with asbestos was not recognized in the early middle ages. The bread, it is told there, is baked in a vessel made from asbestos; the pavement is of green topaz, which by nature is cold, to moderate the heat of asbestos (A pistoribus panis efficitur et in clibano facto

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ex asbesto ponitur et coquitur. Pavimentum clibani est de topazio viridi, qui naturaliter est frigidus, ut caliditas asbesti temperetur. Alioquin panis non coqueretur sed conbureretur. Tantus est calor asbesti). The walls of a furnace in the bakery (pistrinum) were likewise of asbestos (Est enim furnus factus exterius de lapidibus preciosis et auro, interius caelum et parietes sunt de albesto lapide, cuius natura talis est, quod, semel calefactus sit, deinde inremissibiliter sine igne semper erit calidus). These passages concerning asbestos are wanting in the original text of the letter, and are interpolations occurring in manuscripts of the thirteenth century.

Falstaff, after many uncomplimentary remarks on Bardolph's personal appearance, exclaims, "I have maintained that salamander of yours with fire any time this two and thirty years; God reward me for it!" (SHAKESPEARE, 1 *Henry IV*, III 3, 52). A lizard in the midst of flames was adopted by Francis I as his badge, with the legend, *Nutrisco et extinguo*, "I nourish and extinguish" (E. PHIPSON, *Animal Lore of Shakespeare's Time*, p. 320).

P. 339, note 1. The French translation of the text in question by d'Hervey-St.-Denys has been rendered into English by S. W. WILLIAMS in his article *Notices of Fu-sang* (*J. A. O. S.*, Vol. XI, 1882, p. 98). It appears from this translation as though in the opinion of Duke Kie Volcano Island were situated in the land of the Amazons, about ten thousand *li* north-west of Fu-sang; nor is the cloth from the bark of the fiery tree mentioned in it. In the translation of Williams it runs thus: "In the middle of the kingdom is an island of fire with a burning mountain, whose inhabitants eat hairy snakes to preserve themselves from the heat; rats live on the mountain, from whose fur an incombustible tissue is woven, which is cleaned by putting it into the fire instead of washing it." In fact, the text, as reprinted in *T'u shu tsi ch'êng*, is worded as follows: "Southward [from the country of Women or Amazons], arriving at the southern shore of Volcano Island, the inhabitants on Mount Yen-kun there subsist on .... crabs and bearded snakes in order to ward off the poisonous vapors of the volcanic heat. In this island there are fiery trees, the bark of which can be wrought into cloth. In the blazing mound live fiery rodents, whose hair can be made into stuffs. These are incombustible, and when soiled, are cleaned by means of fire" (南至火洲之南炎崐山之上其土人食蝑蟹髯蛇以辟熱毒洲中有火木其皮可以爲布炎丘有火鼠其毛可以爲褐皆焚之不灼汚以火浣). Yen-kun is an artificially coined term, which does not appear in other texts; it is apparently intended for "blazing (*yen*) Kun-lun." The exact meaning of *sü* 蝑 is not known to me; according to K'ang-hi it is identical with 蚣蝑. The interesting feature of the above text is that the asbestos and salamander story is linked together with fabulous accounts of Fu-sang and the Amazons, and it will be remembered

that the report of a specular lens coming from Fu-sang is embodied in the same text (this volume, p. 198). If I expressed the view that this lens appears to have been of Western origin, and that Chang Yüe was familiar with traditions relating to Fu-nan, India, and Fu-lin (p. 204), this opinion is confirmed by the present case in which Chang Yüe adapts to his purpose the Fu-nan version of asbestos in combination with the salamander story.

P. 351. The country Se-tiao appears in another text of the *I wu chi*, cited in the *Chêng lei pên ts'ao* (Ch. 23, fol. 49). There, a plant is briefly described under the name *mo-ch'u* 摩廚 (according to G. A. STUART, *Chinese Materia Medica*, p. 499, unidentified), which grows in Se-tiao; the latter, it is added, is the name of a country. If it could be proved that *mo-ch'u* is the transcription of a Javanese name (and this is probable), the case would make an interesting contribution to the identification of Se-tiao with Ye-tiao.

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Mr. Charles L. Freer
with kindest remembrance
B. Laufer

ASBESTOS AND SALAMANDER,

AN ESSAY IN CHINESE AND HELLENISTIC FOLK-LORE.

BY

BERTHOLD LAUFER.

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