The Amber Stone in the Arab Scientific Heritage from the Umayyad Era to the End of the Mamluk Era (41- 923 AH/ 662-1517AD): A Cultural Historical Study

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ABSTRACT
This study sheds light on the history of amber. According to this study a transparent, fossilized plant resin, typically yellow in color, formed millions of years ago through the petrification of secretions from ancient coniferous trees. The primary significance amber lies in its role as a fossil record capable of preserving entire organisms within its matrix. Amber possesses the unique property of attracting light objects such as straw when rubbed; a phenomenon from which the science of electricity originated.
The study devotes considerable attention to the contributions of Arab and Muslim scholars regarding the understanding of amber. Ibn al-Nafīs, for instance, critiqued errors found in translations of Greek texts that conflated amber with the gum of the Roman poplar tree. Furthermore, Ibn Fadl Allah al-Umari drew attention to an error made by earlier translators, who erroneously attributed the origin of amber to the poplar tree rather than to the Roman walnut. Ibn Sahl al-Tabari used amber to treat cardiac weakness and to staunch blood flow; Thābit Ibn Qurra applied it as an astringent for abrasions; and Abu Bakr al-Rāzi prescribed it for gastric ulcers and heart palpitations. Ibn Sīnā and Ibn al-Nafīs emphasized its properties in drying up excess bodily fluids, constricting blood vessels to halt bleeding, and preventing fluid accumulation within the body.
KEYWORDS: Amber, Static Electricity, Fossilized Resin, Electrical Property, Anbar

1. INTRODUCTION

The use of amber dates back to the dawn of human civilization. The discovery of amber beads in royal tombs in Mycenae as well as in various locations throughout Sardinia and the lands of ancient Etruria has proven that an amber trade existed during prehistoric times. Furthermore, the chemical compositional similarities between amber ornaments found in Mycenae and Baltic amber originating from the Tertiary deposits of Prussian Samland, the coasts of southern Sweden, and the northern Russian provinces point to the distant source from which this resin was historically derived. Yet, the one who first transported amber

from the Baltic Sea to the Levant remains unknown, but it is established that the material traveled southward across Europe by land, as well as around the continent by sea.[1]
Amber is a transparent, yellow fossilized resin. It possesses a hardness of 2–2.5 on the Mohs scale, a specific gravity of 1.05–1.10, and a refractive index of 1.54. It originates from the fossilization of secretions from ancient pine and other coniferous trees. Nowadays, amber is extracted from pine trees, and then cut and polished to make various ornamental jewelry pieces. It often contains fossilized inclusions of ancient insects and spiders, a feature that constitutes its primary significance, as it serves as a veritable fossil record of living creatures exactly as they existed millions of years ago. The shores of the Baltic Sea represent the principal source of amber.[2]
In addition to yellow, amber occurs in other colors, such as black, violet, red, and green. It may appear either transparent or translucent, typically taking the form of nodules or small, irregular masses with weathered surfaces resulting from atmospheric erosion. Its appearance may be clouded by tiny water bubbles; however, these dissipate upon heating, leaving the stone crystal clear.[3]
Amber is distinguished by a unique property: when rubbed, it acquires the ability to attract wisps of straw and tiny leaves. It is here that the story of the science of electricity begins. Yet, other stones besides amber possess this attractive quality most notably Tourmaline, which the Dutch introduced to Europe from the island of Ceylon. A gemstone available in a variety of colors, Tourmaline is composed primarily of silicon, boron, and other elements. One of Tourmaline's notable characteristics is that when heated over a bed of glowing coals, it attracts particles of ash; consequently, the Dutch dubbed it the "Ash Magnet." This property was first documented in 1703, and Tourmaline subsequently became known as "Fire Electricity."[4]

1.1. Research Significance

The significance of this study emanates from the fact that it is the first scientific study – as far as the researcher knows – that discusses the knowledge of Arab and Muslim scholars about the Amber stone and the mines from which they used to extract them during the period from the dawn of Islam until the end of the Mamluk era.

1.2. Research Objectives

The main goal of this research is to shed light on the most important scientific achievements of the Arab and Muslim scholars in terms of the manner in which they determined the properties, benefits, and applications of Amber stone.

1.3. Research Questions

The research will answer a major question, which is: What are the novel scientific and practical additions that Arab and Muslim scholars have added to the science of the amber stone during the period from the dawn of Islam until the end of the Mamlūk era? Four questions branch out from this major question, which are:

1. Have there been any previous studies about the Muslims knowledge of amber, and what is particularly important about such knowledge?
2. What is the value of the amber stone and its applications compared to other stones during the Islamic eras subject matter of this study?
3. Where are the locations of amber mines as identified by Muslim authors?
4. When did the amber trade start to flourish in the Muslim world ?

This research adopted the historical, analytical, critical and descriptive research method in which scientific material is collected from the most reliable sources and then arranged,

classified and presented in the form of a descriptive, analytical and critical study, by comparing it with the scientific material contained in the contemporary sources.

1.4. Research Structure

This research is divided into several sections beginning with the introduction which offers a general coverage of amber stone and then narrowing down to discuss how amber stone became of particular importance in human life in general and then in the eyes of Arab and Muslim scholars. This is followed by several questions that describe how the ancient civilizations and the Arab Muslim scientists viewed amber stone and how did they trace its origins and establish various applications for it.

2. Section One: The Nomenclature of Amber

The English word "Amber" is derived from the Arabic word ʻanbar. It is said that ʻAnbar was the name of an Arab individual who was the first to identify and appreciate the value of this stone.[5] Conversely, the Arabic term for "electricity" al-kahraba' originates from the Persian phrase kāh-rubā, meaning "straw-snatcher" or "straw-attractor," a designation inspired by the electrostatic attraction inherent in amber.[6]

Amber possesses a particularly intriguing property: when rubbed against wool, it generates static electricity. This charge enables it to attract light, dry objects such as tiny scraps of tissue paper, feathers, wheat straw, and even human hair. This phenomenon may well explain why Syrian women who traditionally affixed decorative amber weights to the ends of their spindles while spinning wool dubbed the stone "The Clutcher".[7]

In the Persian language, amber is also referred to as Khadrubad meaning "straw-attractor." An ancient Persian romance, Majnūn Layla, recounts the lover describing his beloved thus: "She was like amber, and I merely a piece of straw; if she were to touch me, I would cling to her forever."[8]

The Greek physician Dioscorides (d. 90 CE) described one variety of amber, which he termed Lyncurium (lynx stone), based on the belief that it originated from the urine of the lynx; he described another variety, which he termed Chryselectrum, due to its yellow hue resembling that of gold.[9]

Furthermore, in the Greek language, amber is known as al-Qatrun and Admitus; in Syriac, it is called Daqna and Hayyanufra.[10] It may also be referred to by its secondary Persian name, al-Kahraman. It appears that Western culture was influenced more by the Arabic term than by the Persian one.

Al-Kindi (d. 256 AH / 870 CE) stated: "It is al-Kaharba spelled with an alif following the kaf.[11] It is also Karba as cited by Paul and Abu al-Khayr signifying Lyncurium, Adamantus, and al-Qatrun. In Syriac, it is Daqta and Hayathu. Bishr claimed that it is a 'grass-attractor' known variously as al-Kaharba, al-Qaharba, and al-Karba while in Sindhi, it is called Sundah and Bana. It has also been said that al-Karba is a dew that settles upon the mountains of Bulgaria;[12] it subsequently congeals and falls into the sea, drifting to the shoreline, where it is then gathered."[13]

We find several appellations for it among the Arabs; for instance, Hunayn Ibn Ishāq al-Ibādi (d. 260 AH / 873 CE) identifies it with Aghiris specifically, the "Roman poplar."[14] He notes: "Among the Franks, amber is called Amber Agrisa meaning 'golden amber'."[15] We have found that Al-Khazini referred to a piece of amber-like resin as "al-kahraba'."[16] Al-Muzaffar Yusuf Ibn ʻUmar Ibn Rasūl (d. 694 AH / 1249 AD) also employed the term al-kahraba or amber in his comparative description of amber versus sandarac. However, when discussing al-kahraba, he notes that it is, in fact, the "gum of sandarac" (ṣamgh al-sandarūs). He describes it as possessing the property of attracting straw and plant debris,

and states that it is called kāh rūbā meaning "straw-snatcher" in Persian. It is also referred to as qahraba,[17] miṣbāḥ al-Rūm (The Lamp of the Byzantines),[18] and ṣamgh al-jawz al-Rūmī (Byzantine Walnut Gum).[19]

Ibn al-Ḥashshā' (d. 647 AH / c. 1250 AD) clarifies that "Poplar Gum specifically the gum of the Byzantine poplar, the bark of which is called tūz is primarily used to bind bows (though other materials may occasionally be used). Anyone who claims that this gum is actually kahraba is mistaken. Dioscorides noted this misconception as a belief held by the common people of his time, doing so only after having fully described the properties of poplar gum. Ḥunayn subsequently transmitted this notion as if it were established fact, and many people followed suit; however, it later became evident that this was a flawed assumption."[20] It may also be referred to as Sirāj al-Layl (The Night Lamp) said by some to be the "Lamp of the Quṭrub" (a mythical creature) and by others to be the "Amber Tree."[21] Furthermore, Qarn al-Baḥr (Horn of the Sea) is identified as kahraba,[22] as is Qayd al-Baḥr (Fetter of the Sea).[23]

In Neo-Latin, the term Electricus was derived from the name for amber or substances resembling amber. This term, in turn, originates from the ancient Greek word ἤλεκτρον (élektron) which serves as a synonym for amber and refers to its characteristic ability to attract small objects after being rubbed. This association ultimately led to the emergence of the derivative terms "Electric" and "Electricity," which first appeared in the writings of Thomas Browne (d. 1682 AD).[24]

The ancient Greek word for amber is ἤλεκτρον (élektron). Consequently, the name for the negatively charged particle the electron that orbits the atomic nucleus was derived from this word. Indeed, many terms in use to this day trace their origins back to the word for amber (or élektron in Greek), such as electrics, electron, electricity, electret, electronic, electrician, electromagnet, electrode, and so forth.[25]

The term coined by the British scientist William Gilbert (d. 1603) was Electrica translatable as "electrics" which he defined as referring to "those substances that attract in the same manner as amber."[26] The terms conductor and insulator, meanwhile, are attributed to Jean Théophile Desaguliers (d. 1744).[27]

As for the term battery, it was coined by Benjamin Franklin (d. 1790) to describe a series of Leyden jars connected to one another for the purpose of amplifying electrical energy.[28] The Arabicized term baṭṭāriyya (battery) corresponds to one of the following native Arabic words: naḍīda, murakkim, or mudakhira. Currently, these terms denote a device composed of several cells connected together.[29]

Upon reviewing later Arabic scientific literature, we observed that translators working from foreign languages into Arabic during the 19th century formulated various definitions for electrical phenomena. Some posited that: "Electricity is an extremely subtle fluid, diffused throughout all bodies in varying quantities. It possesses specific characteristics which shall be highlighted subsequently and gives rise to wondrous phenomena worthy of attention. This fluid was named 'electricity' (kahrabāʾ) because amber (Kahraman) was the first substance in which its existence was recognized; indeed, this Arabic designation is a direct translation of its name in European languages, wherein it is termed électricité derived from electron, meaning amber."[30] Others asserted: "By 'electricity,' one does not refer to the physical substance [i.e., amber] itself, but rather to a luminous fluid."[31] This clearly demonstrates the influence of Western definitions upon these Arab translators' definitions formulated prior to the discovery that electricity is, in fact, a current of electrons.

2.1. Distinction between Amber (Kahraman) and Ambergris (Anbar)

It is essential to avoid confusing Kahraman the fossilized stone extracted from tree sap that solidified millions of years ago with Anbar. The latter is a lightweight, gray-colored organic substance with a waxy appearance that forms within the intestines of a specific type of whale known as the Sperm Whale (Physeter macrocephalus). It is expelled by the whale through regurgitation, subsequently drifting onto the shores of tropical seas, where it is collected and utilized in the manufacture of incense and perfumes.[32] The English, in particular, transformed Anbar into candles that produced a light far whiter and significantly more intense than traditional tallow candles, and unlike the latter did so without emitting foul-smelling smoke. By the second half of the eighteenth century, Anbar candles had become the most expensive form of artificial lighting available in both America and Europe.[33]

Arab scholars, for their part, recognized the fundamental distinction between Anbar and Kahraman, as evidenced by the descriptions provided by Al-Antāki. According to his account, Anbar originates from "springs at the bottom of the sea that discharges an oily substance; when this substance rises to the water's surface, it solidifies, and the sea subsequently casts it ashore." Other theories suggested it was a form of dew that settled upon the sea and subsequently congealed, or alternatively the excrement of a specific type of fish. Al-Antāki, however, dismisses these latter notions as mere myths: there is no truth regarding the fish that swallow a fatal substance that causes them to die and float to the surface, where the Anbar is subsequently discovered within their internal cavities. The finest quality of Anbar is the fragrant, ash-gray variety (al-ashhab), followed in descending order of quality by the blue, yellow, and pistachio-green varieties. A piece is considered pure (khalis) if, when chewed, it stretches and elongates without breaking; any other consistency indicates inferior quality. It is frequently adulterated using gypsum, labdanum, and wax mixed in specific proportions known only to expert practitioners. Its primary sources are the Sea of Oman, the Bab al-Mandab strait, and the coast of the "Western Gulf" (the Atlantic coast of North Africa); it is most frequently cast ashore during the month of Nisan (April). Individual pieces can weigh as much as one thousand mithqals (a unit of weight). Furthermore, pieces of the purest Anbar are often found in bird claws, as birds land upon the floating substance, which becomes attached to their claws.[34]

Fig. 1. A crude piece of amber (right) and a slightly processed piece (left)
URL: https://share.google/PB1zB6kVSmYvh0ISC

We believe that the reason for the confusion among Arabs regarding the terms "anbar" (ambergris) and "kahraman" (amber) stems from the fact that amber possesses a low density, causing it to float in seawater after seeping from its primary sources along the Baltic shores. This characteristic likely led people to confuse it with ambergris, the

substance expelled by the sperm whale resulting in both substances being collectively referred to as "anbar."

2.2. Newly Discovered Properties of Amber

As previously mentioned, amber is a secretion produced by cypress, cedar, and pine trees as a defense mechanism against insects that feed on their wood. This viscous fluid flows down the tree trunk, sealing the holes created by these insects. Should the fluid encounter a single insect or a cluster of them trapped within such a cavity, it engulfs them. Over time, the substance hardens, preserving the insects within its matrix. If the tree subsequently dies, falls, and becomes buried, the amber mass along with its entombed contents acquires a rigidity that allows it to retain its original form. Furthermore, given its insulating properties, it remains impermeable to both water and air, a factor that enables it to endure for thousands of years.[35]

Fig 2. A piece of amber with insects embedded inside.
URL: http://fossilshk.com/insect.html

Consequently, amber serves as an exceptional natural archive for the preservation of organisms that perished millions of years ago. Fundamentally, amber is fossilized tree resin. Through a process analogous to the chemical reactions utilized in the manufacture of plastics, the resin hardens as its constituent organic molecules bond together to form larger, more complex structures. This solidified resin which we identify as amber is capable of remaining in its pristine state for hundreds of millions of years.[36]

Fig. 3. A golden colored piece of amber in its pristine state
URL: https://share.google/9Ua9tgeS5sLVcq5s5

Amber originated from the resin secreted by the stems of ancient plants specifically conifers dating back to the Miocene or Cretaceous periods approximately 40 to 60 million

years ago. It is, in essence, a carbon-based organic substance resulting from plant secretions. It is distinguished by its transparency and its yellow hue, which often tends toward brown. Its color may be clear, or it may be tinged with other shades such as red or orange and marked by sinuous streaks. The latter variety specifically that which encapsulates the remains of living organisms is highly sought after by both amateurs and professionals for its scientific value and rarity; indeed, this material can offer insights into the environments that existed during prehistoric eras. Furthermore, it is combustible when exposed to fire, potentially emitting dense smoke with a fragrant aroma.[37]

2.3. Amber Mines

Amber mines are situated in close proximity to the Baltic Sea; the stone is also found in smaller quantities near the shores of Burma, Romania, Australia, the Adriatic Sea, and the coast of Sicily.[38] Furthermore, Carthaginian merchants obtained amber from regions in Spain and France as well as from the shores of Germany and the Baltic Sea.[39]

In the Baltic region, amber is known as succinite.[40] It was particularly abundant in the Samland Peninsula also referred to as Sambia or the Kaliningrad Peninsula, a landmass located within the Kaliningrad Oblast of Russia, situated on the southeastern coast of the Baltic Sea.[41]

Fig. 4. A yellow colored polished oval amber stone with shades of brown
URL: https://share.google/Bhvx3hiecWrp6sEiD

The Arabs, too, were aware of several amber mines. Abu Rayhān al-Birūni (d. 440 AH / 1048 CE) enumerated the amber mines known in his era, noting that the stone was found in Tinklān Qamrūn, as well as in the islands of al-Zābaj (a region known as the "Land of Gold" or, in Hindi, Suran Dib, meaning "Islands of Gold," and Suran Bahram, meaning "Land of Gold").[42] Additionally, Muhammad Ibn Abi Bakr al-Zuhri al-Gharnāti (d. after 541 AH / 1154 CE) recorded that amber was procured from the island of Saidas, located to the east of Crete in the Mediterranean Sea.[43]

2.4. Medical Applications of Amber

Amber has garnered significant attention regarding its potential for medical applications; an interest evident across every civilization that has utilized the stone.

The great Greek physician Asclepiades of Bithynia (d. 40 BC) recommended amber tablets for the treatment of bleeding; this appears to be the earliest recorded medical use of amber.[44]

The earliest medical applications of amber among the Arabs date back to the 9th century AD, specifically to Ibn Sahl al-Tabari (d. 247 AH / 861 AD). He utilized amber powder to

treat cardiac weakness[45], melancholy, and fainting spells,[46] as well as to staunch bleeding;[47] he also noted that its smoke was beneficial for treating colds and for drying out fistulas.[48]
Thābit Ibn Qurra al-Harrāni (d. 288 AH / 901 AD) also employed it, in therapeutic enemas to treat abrasions.[49] Furthermore, Abu Bakr al-Rāzi (d. 313 AH / 925 AD), who is considered the scholar who most extensively discussed the subject, used it to treat gastric ulcers[50] and stomach disorders.[51] The practice of treating ailments with amber based on the methods of Abu Bakr al-Rāzi was subsequently adopted by Abu Yahya Zakariya al-Qazwīni (d. 682 AH / 1283 AD),[52] Ibn Sīnā (d. 428 AH / 1037 AD),[53] and Salih Ibn Nasr Allah Ibn Sallūm al-Halabi (d. 1081 AH / 1670 AD).[54]

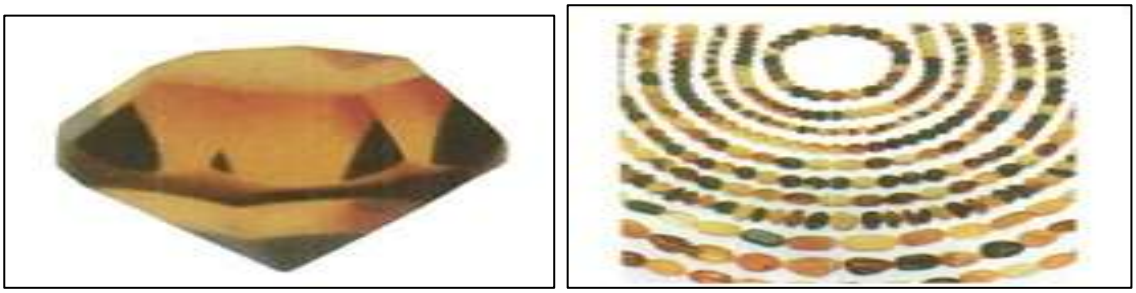

Fig. 5. Two amber pieces, one to be inserted in a ring, and the other a necklace
URL: Aqīl, Muhsin, *The Illustrated Encyclopedia of Gemstones*

Additionally, Abu Abdullah Muhammad Ibn Ahmad al-Tamīmi (d. 390 AH / 1000 AD) utilized it in the treatment of certain psychological conditions.[55] Hunayn Ibn Ishāq al-Ibādi (d. 260 AH / 874 AD) stated the following regarding amber: "If its leaves are applied as a poultice mixed with vinegar, it provides relief from the throbbing pain associated with gout. Furthermore, its resin is sometimes incorporated into the mixtures used for ointments. When its fruit is ingested mixed with vinegar it benefits those suffering from epilepsy. Moreover, it is recounted that the resin which flows into the river; known as the Eridanus, solidifies within its waters; this substance is termed Ilecton though some people refer to it as Chrysoforon and it is, in fact, amber. When rubbed, it emits a pleasant fragrance; its color resembles that of gold; and if ingested, it prevents the excessive flow of humors within the stomach and intestines."[56] Ibn Sīnā subsequently adopted these concepts from al-Ibādi.[57]
Al-Birūni justified his discussion regarding the use of amber in treating the effects of the "evil eye" by stating: "I have chosen to mention amber specifically because the women of the Eastern Turks covet specimens of large size and beautiful coloration, hoarding them as one would hoard precious treasures. They show a distinct preference for the Byzantine variety due to its clarity and the radiance of its golden hue, while they pay no heed to the Chinese variety even when it is available to them as it falls short of the Byzantine type in the aforementioned qualities. Furthermore, they cite no other reason for their desire to possess it than its efficacy in warding off the harmful influence of the envious eye."[58]
According to Ibn al-Nafīs (d. 687 AH / 1288 AD), amber possesses therapeutic properties due to the scarcity of the aqueous element and the abundance of the earthy element within it; consequently, it is characterized by a dry temperament. This is attributed to the fact that the earthy element within amber is intensely dry, thereby imparting this quality to the substance as a whole. It is this dry temperament that endows it with an effective therapeutic influence upon the human body.

As for the overall composition of amber, it may be predisposed toward dryness or inclined toward moisture, owing to the prevalence of aerial elements within it. Furthermore in addition to its dryness amber must possess an inclination toward warmth, as the density of the aerial element within it exceeds that of the aqueous element. Nevertheless, its earthy component is not cold; thus, it must deviate from a state of perfect equilibrium toward warmth. This warmth, however, must be mild in nature being aerial in origin and is tempered by the coolness of the water element. He asserted that the warmth of amber is more akin to the nature of air than to that of fire; the rationale for this lies in the fact that its fundamental composition lacks dense, fiery elements.

Had its warmth been truly fiery in nature, it would have possessed a pungent and burning taste, a characteristic that is evidently absent. We may therefore conclude that its warmth must be aerial in origin and, consequently, mild rather than intense. Given that amber is warm, it acts to dissolve and disperse substances. When this warmth is coupled with dryness, it results in the desiccation of such substances; thus, it is certain that amber functions as a desiccant.

Furthermore, by virtue of its capacity to dissolve and disperse, it also serves as a soothing agent. However, given the mildness of its warmth, its efficacy in dissolving and dispersing, remains limited. Since amber possesses only a mild degree of warmth, it is incapable of completely dissolving and eliminating bodily humors; instead, it acts to soften them. This capacity for softening is the predominant characteristic of amber, a trait attributed primarily to its mild thermal nature. Furthermore, given that amber is characterized by a translucent, yellowish-white hue a color akin to light itself the admixture of the vital spirit with any portion of this substance imparts to it a distinct luster and luminosity. It is this quality that positions amber among those remedies known to inspire joy and cheerfulness. As a substance that is both desiccant and astringent, aids in staunching the flow of blood and other bodily fluids. This efficacy stems from the following mechanisms:

- Its desiccant power eliminates the moisture that drives the movement and agitation of fluids.
- Its astringent property constricts the walls of blood vessels, thereby reducing blood flow.

Amber is considered an effective agent for arresting hemorrhage in any part of the body; moreover, its internal administration aids in the treatment of epistaxis (nosebleeds). Additionally, amber prevents the accumulation of fluids in the head and their subsequent descent into the lungs, chest, and stomach, rendering it beneficial in the treatment of colds and associated ailments. By virtue of its ability to inhibit the downward migration of humors into the chest, amber contributes to the prevention of coughs, hoarseness, and similar symptoms. Likewise, it impedes the descent of substances into the stomach, thereby averting the onset of diarrhea and other digestive disturbances.

Among the other therapeutic benefits of amber are the following:

- Alleviation of Inflammatory Swellings: Amber can mitigate the severity of inflamed tumors and swellings.
- Treatment of Jaundice: The efficacy of amber in the treatment of jaundice has been well-established.
- Preservation of Pregnancy: Amber may contribute to safeguarding the fetus against miscarriage. Muhammad Ibn Ahmad Abu al-Qāsim al-Irāqi (d. 700 AH / 1301 AD) also noted its applications in psychotherapy, stating: "Whoever wears the 'amber stone' as a token of love and affection shall be loved by all who behold him, and they shall attest to his goodness and righteousness."[59]

3. Section Two: Ancient Civilizations' Knowledge of Amber

Amber has been recognized and utilized for ornamental purposes by the peoples of prehistoric Europe since the Middle Stone Age. However, other peoples of the world also became acquainted with it and sought to discover its useful applications.[60]

3.1. The Phoenicians

Researcher Muhammad Yahya al-Hāshimi posits that the Phoenicians were the first people to discover amber. They likely procured it from the Baltic Sea and subsequently transported it to every region their travels took them.[61] The Phoenicians were merchants specializing in the amber trade; the material later became known to the Greeks, appearing in the writings of Herodotus (d. 425 BC) and Plato (d. 347 BC).[62]

The Phoenicians expanded their voyages beyond the Eastern Mediterranean specifically from the coastal plains of Lebanon, Syria, and Palestine venturing into the uncharted ocean in search of amber in the North Sea. Amber also reached them via the Rhine and Rhône rivers to Marseille, and across the Alps to Etruria particularly the Po Valley as well as to other locations via various overland routes. Indeed, caches of amber have been discovered along these routes as it had been hidden for centuries after caravans were attacked or fell victim to the natural hazards of the journey. While it is well established that these routes existed and that the amber trade along them was flourishing prior to the founding of Rome or Carthage, it is conceivable that Phoenician voyages to the Baltic Sea date back even further, given that Mycenaean amber beads have been dated to at least two millennia before the modern era.[63]

It appears that the Roman historian Pliny the Elder (d. 76 AD) also had observations to offer regarding the use of amber within Phoenician society. It is evident that Syrian women engaged in spinning during the Phoenician era utilized amber by affixing it to the tip of their spindles, a device to which they gave the name "the Gripper." It is probable that the amber became electrified as it spun and rubbed against their clothing, thereby attracting bits of straw and similar objects.[64]

Pliny goes on to note that Syrian women referred to amber as "Harpaga" meaning "the Gripper", a designation clearly rooted in a specific property entirely distinct from the one that led people to liken it to an embodied sunbeam. This name, in turn, derived from its application in spinning the most ancient manual craft known to humanity and from the specific method of spinning in which it had been employed since the dawn of civilization.[65]

We may therefore surmise that the name originated with the ancient Phoenicians, and that the amber from which they fashioned beads and ornaments found its way into the hands of every woman who spun with a spindle, provided she could afford a spindle crafted from such a precious material. As the spindle was used spinning rapidly in the process it rubbed against the women's loose-fitting garments; consequently, it became electrically charged as amber invariably does when subjected to friction. Thus, when the spindle neared the ground, it would attract dust, scraps of paper, or bits of straw lying there, or occasionally even draw in the hem of light fabrics. This phenomenon was readily apparent to the spinner: the straw would leap toward the excited resin, or the threads of a hem would reach out toward it. Moreover, unless she exercised caution, the dust and other particles attracted in this manner would become entangled in her yarn. Hence, she dubbed the amber spindle "the Seizer," for it appeared to grasp these light objects as if endowed with invisible claws that not only caught them but held them fast. This may well have constituted the very first astute observation of the electrical effect. It is remarkable that this fact became evident

through the very first practical application of amber in contrast to its use for ornamentation and it further attests to the keen intellect and powers of observation of Syrian women.[66]

3.2. The Ancient Egyptians

Amber has been known to the Egyptians since the Mycenaean Bronze Age,[67] meaning that the Ancient Egyptians utilized amber as early as the period preceding the emergence of the dynastic ruling families, around 4000 BC.[68] However, its use by the Egyptians does not, by any means, imply that amber mines were located within their territory. The Roman historian Pliny the Elder, citing Nicias (d. 413 BC), reported that amber was produced in Egypt; yet, this assertion lacks any factual basis.[69] Furthermore, it remains doubtful whether the Ancient Egyptians utilized amber on a widespread scale at any point prior to the late stages of their history. Indeed, only a small number of amber beads have been discovered in their tombs, with the most recent of these specimens dating back to the second and third centuries AD.[70]

3.3. The Greek

Amber often in the form of necklaces has been discovered in the tombs of certain Ancient Greeks, dating back to 900 BC.[71] As previously noted, Plato drew a parallel between the attractive properties of amber and those of the "Stone of Heracles" (magnetite). Epicurus (d. 270 BC) attributed the phenomena exhibited by both substances to a single underlying cause: atoms and invisible particles that emanate outward from the attracting object, bond with the attracted object, and draw it back toward their source. This explanation appears to have satisfied the Greeks and Romans of that era as well as the rest of the world for the subsequent two millennia leading them to believe that amber and the lodestone were intrinsically linked; or, at the very least, that they exerted attraction for precisely the same reason, thereby rendering any deeper investigation into the subject a futile endeavor.[72]

The color and luster of amber reminded the imaginative Greeks of the gold dust that shimmered in the sands of the Pactolus just as the gleaming metal itself reminded them of the yellow rays of the sun. Consequently, they bestowed upon it the very same name they applied to those metallic compounds that acquired a golden sheen when polished. All were, in their eyes, the progeny of the solar "Elector". Thus, alongside natural gold and alloys of gold and silver, amber came to be known in the Greek tongue as "electron." In Greek literature dating back to the eras of Homer (8th century BC) and Hesiod (died c. 700 BC) references to it appear frequently. It is found inlaid in the ceiling of the royal palace of Menelaus, adorning the bracelets of Penelope, the necklaces of Eumaeus, and the shield of Heracles an artifact around which legends have long gathered. Indeed, through the lost tragedy of Aeschylus (died 456/455 BC), the Hippolytus of Euripides (died 406 BC), and the Metamorphoses of Ovid (died 17/18 AD), the myth of Phaëthon was born a tale recounting his death by a thunderbolt, his plunge into the River Eridanus, and the transformation the Heliades weeping sisters into poplar trees that sigh ceaselessly, shedding their amber tears along the riverbanks.[73]

Sailors spoke of other Electrid Islands situated in the German Ocean and off the coast of Calabria, where the "Electrida" tree was said to grow, and of stones in distant Britain that "purified thick amber." It often happens that historical facts become as it were embedded within the very names of things; thus preserved, their knowledge is transmitted across the centuries. Just as we today find the bodies of insects that lived in the distant past entombed deep within yellow amber, so too woven into a name coined by the ancients lies the story of how electricity first became known to the civilized world.[74]

3.3.1. Aristotle (4th Century BC)

Aristotle (d. 322 BC) meticulously examined the structure of amber according to the account provided by Ibn Rushd and appears to have ascertained its origin. He observed that "these substances thicken when exposed to heat and solidify when exposed to cold. Amber is found in association with a specific type of organism; indeed, if such an organism approaches the trees, it becomes entrapped within the substance. The agent responsible for the thickening of amber is heat emanating from the river itself. Amber forms along the riverbanks from the trees growing there; furthermore, if a piece of amber is cast into water, it emits smoke."[75]

Aristotle presented in his "Meteorology" work evidence suggesting that amber originally exists in a liquid state before subsequently solidifying. He notes that "the water bodies that solidify as a result of cold include ice, snow, hail, and frost. Other solid bodies are those from which all moisture has been expelled by the Earth itself such as pottery and amber. In connection with amber, there also exist substances known as 'tears', which are bodies formed through the action of cold such as myrrh, gum, and frankincense. Amber, too, appears to belong to this category of substances; indeed, the animals found embedded within it, serve as an indication that it was formed through a process of solidification. Heat is expelled from the substance by the cooling influence of the river, causing its moisture to evaporate much in the same way that moisture evaporates when honey is heated and diluted with water."[76]

3.3.2. Theophrastus (3rd Century BC)

Theophrastus (d. 287 BC) succeeded Aristotle as the head of the Lyceum, where he taught for thirty-five years. In his historical treatise, he described and distinguished between what he termed "stones" and "earths," in contrast to "metals." The former, as he hypothesized, is derived from the earth itself, and the latter from water. "He refers not only to indigenous stones found in Greece, but also to other stones of foreign origin such as alabaster from Egypt, pumice from Sicily, carbuncles from Carthage, Massylia, the Nile cataracts, and Aswan; emeralds from Tyre, Cyprus, and Bactria; pearls from the Indies and the shores of the Red Sea; gypsum from Syria; cinnabar from Spain; and so forth covering a vast category that encompasses minerals from many diverse and distant lands. Consequently, there remains little doubt that he composed this work with Aristotle's own collections laid out directly before him."[77]

Theophrastus has provided us with specific information regarding the attractive properties of amber. He states: "Amber is a stone. It is excavated from the earth in Liguria and possesses an attractive force. It is said to attract not only straw and small splinters of wood, but even copper and iron, provided these have been cut into thin pieces." Significantly, we find no indication that a "spirit" is the agency responsible for moving these stones a notion entirely absent from Theophrastus's concise and pragmatic description of their properties.[78] He then places both amber and the magnetic stone into the category of attracting substances: "However, the greatest and most pronounced attraction qualities are those found in the stone that attracts iron. Yet this stone is rare and is to be found in only a few locations. Nevertheless, it must be classified alongside these stones, for it possesses a similar property."

We find him stating that the formation of amber is brought about by either heat or cold as Aristotle had previously stated. They differ, moreover, in the material and the manner in which the terrestrial particles comprising them flowed together. Furthermore, their masses possess tangible "powers" distinct from their physical attributes of hardness, color, density, and the like which encompass their capacity to exert influence upon other bodies, or to be susceptible or impervious to such influence themselves. Thus, Theophrastus notes that

some are fusible, others infusible; some can tint water, while others can induce petrification. Foremost among these powers is the property of attraction.

This dispassionate and concise enumeration of physical properties and the theories and classifications derived therefrom stands in stark contrast to the fundamentally spiritual worldview of the Greek philosopher Thales of Miletus (d. 546 BC). Indeed, it is not difficult to imagine that Theophrastus himself may have regarded Thales's doctrine with something of the same disdain with which a modern astronomer views the planetary speculations of astrologers, or a modern chemist views the theories that once kindled the hope of transmuting base metals into precious ones.[79]

In addition to noting the attraction properties of lodestone and amber, Theophrastus was the first to announce the existence of a third substance possessing the same characteristics as amber a material he termed "lynx-stone." He described it as a material utilized by engravers in much the same way they used emeralds, noting that it possessed a remarkably hard texture. To substantiate this claim and to demonstrate its attraction qualities in comparison to those of amber he cited Diocles of Carystus (d. c. 295 BC), a prominent physician from Carystus who was reputedly second only to Hippocrates, though only fragmentary remnants of his works survive today. Theophrastus describes amber as a transparent substance of a fiery hue, typically recovered through excavation. He then proceeds to assert in some detail that the lynx-stone is derived from the urine of the lynx, a supposed origin from which it derives its very name.

Theophrastus notes that amber originates in Liguria, a region bounded in part by the Eridanus (or Po) River on whose banks the Greeks, since the time of Herodotus, had erroneously believed that resin is to be found. Long before the era of Theophrastus, the "Ligurian stone" was already well known. It is plausible that the confusion stemmed from the similar nomenclature applied to two distinct substances: the Ligurian stone, which was, in fact, amber, and the "lynx-stone" a material that Pliny later dismissed as mythical and entirely non-existent.[80]

However, the consensus among ancient writers tends toward the view that the lynx-stone and amber are one and the same. Consequently, the lynx-stone may well be situated somewhere within that cloud of illusions which has always obscured the path of science and perhaps will continue to do so forever.

3.3.3. Posidonius (1st Century BC)

The Greek Posidonius (d. 51 BC) proceeded from the concept of "cosmic sympathy" to offer us perhaps the very first explanation for the movement of the tides by linking them to the phases of the moon.[81] The concept of "cosmic sympathy" was destined to resurface among certain natural philosophers of the Renaissance, who believed that bodies could exert influence upon one another from a distance through magical forces of sympathy, attraction, or repulsion forces akin to those observed in amber or magnets. The humanist philosopher Marsilio Ficino (d. 1499) states in his commentary on Plato's Symposium: "The entire power of magic is encompassed within love; for the work of magic is the attraction of one thing to another by virtue of their natural affinity. The parts of the world resemble the organs of an animal, united amongst themselves within a single nature. From their shared relationships is born a shared love, and from this love is born a mutual attraction and this is true magic. Thus, the lodestone attracts iron, amber attracts straw, sulfur attracts fire, the sun draws leaves and flowers toward itself, and the moon draws the seas."[82]

3.4. The Romans

During the era of the Roman Empire, the city of Aquileia located near Italy served as a hub for the production of carved amber jewelry. As noted above, Pliny the Elder had indeed devoted his attention to amber, though he offered no new insights regarding it.[83]

3.5. The Chinese

In the Chinese language, amber is referred to as Hu-po, a term meaning "tiger soul." Tracing the origin of this meaning through folklore, we find tales asserting that a glance from the eye of a dying tiger gives rise to the resinous substance of amber. This concept calls to mind the ancient Greek myth which posits that amber is the petrified form of lynx urine; however, the Chinese writer Duan Chengshi who lived during the Tang Dynasty offers a different perspective: "Some hold that dragon's blood transforms into amber when it spills onto the earth." Others maintain "that the sands of Ningzhou harbor a species of small wasp; when the sandy banks collapse these insects are exposed, whereupon people gather and burn them and from this process, amber is formed."[84]

Not everything recounted by the Chinese regarding the origin of amber falls under the rubric of myth; indeed, the true source of amber has been known since at least the third century AD. A Tang Dynasty pharmacological text specifically, The Essential Herbs of Shu describes the origin of amber as "originally the sap that flows from certain types of trees, falls to the ground, and subsequently transforms into amber after a thousand years."[85]

4. Section Three: Amber According to Arab and Muslim Scholars

Arabs and Muslims were well-acquainted with amber, utilizing it in a wide array of applications ranging from ornamentation to medicine. However, the most noteworthy observation is their refusal to allow inquiries into the origins of amber to become entangled in or dominated by the fabric of Arab mythology. Instead, they pursued the truth of its nature through rigorous examination, scrutiny, and rational inquiry; persisting until they achieved their objective and conclusively established that its true origin lies in trees.

4.1. Abu al-Rayhān al-Birūni (5th Century AH / 11th Century AD)

Al-Birūni refuted those who claimed that amber consists merely of beads floating upon the Sea of the Maghreb and the Sea of Tabaristan, as if they had failed to observe the insects embedded within it, and its ability to float which is attributable to its low density. It appears that Al-Birūni concurred with Al-Kindi regarding the origin of amber from a resinous substance secreted by a tree in the Land of the Saqaliba (the people known as the Slavs), which subsequently falls into a river that carries it out to the sea.[86]

4.2. Abu Ja'far al-Ghāfiqi (6th Century AH / 12th Century AD)

Abu Ja'far Ibn Muhammad al-Ghāfiqi (lived in the 6th century AH / 12th century AD) classified amber into two types: "One variety is imported from the lands of the Romans (the Byzantine/European lands) and the East; the other is found in al-Andalus (Spain and Portugal) specifically in its western regions along the sea coasts, beneath the earth. It is most frequently discovered at the base of Doum palm trees.[87] Ignorant people claim that these sites were once ancient burial ground; and that the kings of Romans would melt down amber and pour it over their deceased ones, believing that it would preserve the corpse. This claim, however, is false! In fact it is found in the form of droplets resembling gum, which is a superior variety, yellower, and harder than the amber from the East, and possesses more potent medicinal properties. An expert informed me that, it is in fact moisture that drips from the leaves of the Doum palm, specifically in this particular region; as the plant emerges from the earth; it exudes a moisture resembling honey, from which

this medicinal substance is formed. Occasionally, flies, figs, nails, stones, and ants may be found embedded within it".[88]

4.3. Abu Yahya al-Qazwīni (7th Century AH / 13th Century AD)

Abu Yahya Zakariya al-Qazwīni described amber, though without adding anything new to the observations of the scholars who preceded him. He stated: "The Kahraba stone is a yellow stone, tending toward whiteness and occasionally toward redness. Its name signifies 'straw-attractor,' for it draws straw and light debris toward itself. It is, in fact, the resin of the Roman walnut tree. Amber bears a resemblance to sandarac resin, except that it is yellow in color and leans more toward whiteness".[89]

Ibn al-Nafīs (7th Century AH / 13th Century AD)

The prominent physician Ibn al-Nafīs may well be the scholar who most thoroughly studied and expounded upon the natural and medicinal properties of amber. In his monumental work, *Al-Shāmil fi al-Sīnā'ah al-Tibbiyyah* (The Comprehensive Book on the Art of Medicine), he devoted three consecutive chapters exclusively to this subject, endeavoring therein to delve deeply into every aspect related to this remarkable stone.

To interpret the properties of amber, Ibn al-Nafīs had to rely on the Theory of the Four Elements, an ancient concept originating in Greek philosophy that spread across various ancient cultures as a foundational framework for explaining the composition of the universe and natural phenomena. This theory is attributed to the philosopher Empedocles (5th century BC) and was subsequently refined by Aristotle (4th century BC). Aristotle posited that the four elements Earth, Water, Air, and Fire arise from the interaction of pairs of primary qualities: Hot, Cold, Wet, and Dry. The specific properties associated with each element are as follows:

−Earth: Solid, Cold, Dry (e.g., rocks).

−Water: Liquid, Cold, Wet (e.g., seas).

−Air: Gaseous, Wet, Hot (e.g., winds).

−Fire: Fiery, Dry, Hot (e.g. flame).

In the first chapter, Ibn al-Nafīs discusses the nature of amber in terms of its structure. He notes that there is a consensus that amber is, in essence, fossilized resin, which is a substance that has transformed over time into a state of extreme hardness. However, scholars have disagreed regarding the specific source of this resin. The prevailing view adopted by the majority is that it is a resin derived from the walnut tree. Conversely, another group maintains that the resin originates from the Doum palm tree. They arrived at this conclusion based on the visual resemblance between the two substances, as both are characterized by a transparent golden hue, or one that tends toward reddishness. Furthermore, this type of material is frequently found in a liquid state, resembling resin. When broken open, specimens may be found to contain flies, straw, or metallic fragments embedded within them. The presence of such inclusions indicates that the material was originally in a liquid state before solidifying around these objects; otherwise, they would not be found encased within it.

Ibn al-Nafīs argues that the assertion that amber is the resin of the walnut tree rests upon a misinterpretation of the writings of Dioscorides. For Dioscorides did not explicitly refer to amber by this specific name; rather, it was the translators who employed this term when translating his works; a phenomenon that frequently occurs during the translation of Greek, Syriac, and similar terminology. Some scholars, however, believe that amber is the resin of the Doum palm; they base this conclusion on the discovery of substantial quantities of amber near the roots of these trees. These scholars argued that Dioscorides did not

assert that this substance was the gum of the Persian walnut. Their reasoning was that every variety of Persian walnut mentioned by Dioscorides emits a pleasant fragrance when rubbed, whereas amber stone as they noted does not give off a pleasant scent.
Based on the foregoing, the essence of amber must be composed of aqueous and earthy elements, in addition to a significant proportion of aerial elements. Otherwise, it could not have attained such a high degree of transparency, particularly if it originated as solidified gum. As is known, the essence of gum consists of aqueous, earthy, and aerial elements; however, the proportion of aqueous elements within it must be relatively low compared to the earthy elements.
If, then, we wish to formulate a medicinal remedy from amber, we are faced with two possibilities:

- The First Possibility: If the remedy is derived from gum, it is evident that it must contain a high proportion of water, as this is a characteristic common to all varieties of gum.
- The Second Possibility: If it is not derived from gum, then its extreme hardness and friability indicate that it consists primarily of earthy (solid) substances. This implies that it contains a relatively low proportion of water.

4.4. Sheikh al-Rabwa (8th Century AH / 14th Century AD)

Abu Abdullah Muhammad Ibn Abi Talib al-Ansāri al-Dimashqi known as Sheikh al-Rabwa (d. 727 AH / 1327 AD) stated that the source of amber is the heather tree. However, this information is incorrect, as heather shrubs produce no gum-like or resinous secretions whatsoever. Sheikh al-Rabwa remarked: "The stone of al-kahruba [amber] attracts straw and chaff. Amber is, in fact, the gum of the heather tree; it may also form on the surface of the earth, resembling pebbles. The finest variety is wax-like because it is streaked with an opaque white coloration, and its scent resembles that of lemons. It is also referred to as the 'Lamp of the Byzantines' (Misbah al-Rūm). It is found in Al-Andalus (Spain), along coastal shores where it lies beneath the earth and within oases, where it is discovered in distinct lumps gathered by plowmen. It has also been said that it is a viscous secretion of the Doum palm resembling honey that subsequently solidifies. Furthermore, flies and other objects are often found embedded within it, having been trapped as it solidified. Yet another theory posits that it is the gum of the 'Byzantine Walnut' tree though God knows best."

4.5. Ibn Fadl Allah al-Umari (8th Century AH / 14th Century AD)

Ibn Fadl Allah al-Umari (d. 749 AH / 1349 AD) revisited and shed light upon an error previously committed by the translators of the works of Dioscorides and Galen. This error lay in their conflation of the "Byzantine Poplar" with the "Byzantine Walnut" specifically regarding which of these two trees actually secretes amber. The truth is that it is the Byzantine Walnut tree that secretes a gum-like substance. This substance is a natural resin known as sandarac, though it possesses no distinct fragrance. As for the Roman Poplar also known as the Balsam Poplar it secretes an aromatic resinous substance. This resin is renowned for its distinctive fragrance and is utilized in a wide variety of applications.[90]
Ibn Fadl Allah al-Umari stated: "Know that the translators of the texts of Dioscorides and Galen have asserted that, in the view of these two authorities, amber is, in fact, the resin of the Roman Poplar. However, this is not as they claimed; indeed, they erred in their attribution to these two scholars. While discussing the Roman Poplar, Galen made the following statement: 'The flower of this tree possesses a heating potency of the third degree; its resin, too, possesses potency similar to that of its flower.' As for Dioscorides, he stated: 'The resin of the Roman Poplar, when rubbed, emits a pleasant fragrance.' Yet,

amber possesses none of the characteristics we have just described neither in its aqueous nature, nor in its potency, nor in its pleasant fragrance, nor even in its heating property."

5. CONCLUSION

- The historical sources reviewed in this study confirm that Arab and Muslim scholars were correct in rejecting the superstitions and myths surrounding the origin of amber. Instead, they recognized it as a fossilized resin secreted by ancient coniferous trees a conclusion substantiated by the presence of preserved insects embedded within it.
- The property of attracting straw and light objects when rubbed, a phenomenon observed by Syrian women during their spinning activities, who consequently dubbed the substance "the Gripper" constitutes the first recorded astute observation of the electrical effect. It is from this observation that the terms "electron" and "electricity" subsequently entered the lexicon of modern science.
- The research demonstrates that the terminological confusion surrounding the European word "Amber" stems from its linguistic derivation from the Arabic term ‘anbar. However, Arab scholars such as Dawūd al-Antāki and Al-Birūni clearly distinguished between ‘anbar of animal origin (derived from whales) and fossilized amber of plant origin.
- One of the study’s most significant findings is the identification of a translational error in the texts of Dioscorides and Galen. This error arose from conflating the resin of the "Roman Poplar" (which is aromatic and possesses warming properties) with that of the "Roman Walnut," which secretes sandarac, a substance closely resembling amber. This specific error was subsequently detected and corrected by the Ibn al-Nafīs and Ibn Fadl Allah al-Umari.
- Drawing upon the theory of the Four Elements, Ibn al-Nafīs analyzed the composition of amber, concluding that it consists of a specific blend of earthy, airy, and watery elements. This elemental analysis successfully explained both the substance's transparency and its various medicinal properties such as desiccation, astringency, and hemostasis thereby representing a pinnacle of scientific inquiry into the nature of matter within the Arab civilization.
- The conclusion that can be drawn from a review of medical texts is that amber was incorporated into a wide range of treatments, extending from addressing cardiac weakness and palpitations (Ibn Sahl al-Tabari, al-Rāzi, Ibn Sīnā) as well as staunching bleeding and treating diarrhea (Thābit Ibn Qurra, al-Rāzi) to curing jaundice and supporting pregnancy (Ibn al-Nafīs). It was even utilized in psychological remedies, such as warding off envy and fostering affection (al-Tamīmi, al-Birūni, al-Irāqi).
- The research established that the Phoenicians were the first to commercially transport amber from the Baltic Sea to the ancient world, and that the Arabic designation “The Gripper” reflects an empirical observation of a physical phenomenon associated with the craft of spinning practiced by women.
- In contrast to Greek myths, such as the "tears of trees" or "lynx urine", and Chinese legends, such as the "tiger's soul" or "dragon's blood", Arab scholars including al-Ghāfiqi, al-Birūni, and Ibn al-Nafīs relied on field observation and rational analysis to accurately identify the botanical origin of amber.
- The study highlights the se scientific significance of amber in preserving microorganisms and insects exactly as they existed 40 to 60 million years ago, thereby serving as a unique window into life during deep geological epochs

•The research concludes that the all terms of "Electricity," "Electric," and "Electron" ultimately derive from the ancient Greek word for amber; this linguistic lineage illustrates how a mere ornamental stone evolved to become a foundational cornerstone in the edifice of modern physics.

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