The Diamond 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 research highlights the importance of diamond in the Arab scientific heritage during the period from the Umayyad era to the end of the Mamlūk era. Diamond occupies a prestigious position among all precious stones, which is why Arab and Muslim scholars called it the "King of Gems" due to its exceptional qualities that earned it such status. It is the most beautiful gemstone and the hardest known substance, possessing the highest refractive index. Arab and Muslim scholars paid close attention to the diamond stone since the very beginning of their documentation of knowledge about precious stones.
The research sheds light on how Arab and Muslim scholars developed a unique classification system for diamond types much better than the previous classifications. Based on diamond's mining location, color, and various other properties, they established a precise system for evaluating and pricing it, which they used in the diamond trade. Muslims used the aforementioned diamond properties for adornment and beautification, and employed their hardness in cutting and processing other hard stones, along with various other applications such as performing certain complex and difficult types of medical surgery. The research also sheds light on the methods and techniques used to extract diamonds from mines, identifying the most prominent countries and regions in which they were mined. The research is made up of an introduction, research significance, questions and objectives, methodology, several subsections, and a conclusion summarizing the most important findings**.**
Keywords: Diamond stone, diamond mines, diamond trade, gemstones, Umayyad era, Mamluk era.

1. INTRODUCTION

The best thing that we can present and offer to the next generations, as an incentive to support them in the field of creativity and excellence, is to publish and explain the greatest creative achievements made by our former brilliant and innovative scientists who have excelled in the various aspects of the human and applied sciences, including those related to the science of gemstones. The most important of these gemstones is diamond during the period from the Umayyad era to the end of the Mamlūk era, and the knowledge offered by the Arabs and Muslims in this valuable field.

Diamonds are among the major and most valued gemstones in human history, surpassing rubies and emeralds. This is because they have very special characteristics relative to other gemstones as they do not change over time, and they are solid, rare, durable, and have a beautiful shine. As for the rest of gemstones, they are less precious because of their low hardness and because they are more common and widespread.

In early times, diamonds have been used as tools for engraving and cutting more often than being used for ornamentation. The history of discovery and interest in diamonds extends over more than five thousand years since they were known as gemstones and used for ornamentation. [1] They have been known to the ancient Indians, Greeks and Romans, and were greatly appreciated by these ancient people and were the subject matter of many legends. However, diamonds were more difficult to cut and polish than other gemstones. In old times, they have been cleaned and polished in primitive ways, where they were polished by rubbing with each other, and then they were used as gems without changing

One of the oldest descriptions of diamonds that we have received from the Greeks is found in "The Stones", a book attributed to Aristotle, which will be taken into account later by many Arabs who were interested in writing about it during the period from the Umayyad era to the end of the Mamlūk era. [2]

We reviewed the English translation of the "The History of Stones", a book attributed by Hassan Kamel Ibrahim to have been written by Theophrastus, the Greek historian, and compared it with what was mentioned about diamonds in the "The Stones", Aristotle's book, and we found a great difference between the two books, and hence Hassan Kamel Ibrahim may have been wrong in attributing "The History of Stones" to Theophrastus, as it may have been written later by an unknown writer.[3]

2. 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 diamond stones 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.

3. 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 diamond stone.

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

5. RESEARCH METHODOLOGY

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.

6. Research Structure

The nature of this research necessitated dividing it into several sections beginning with the introduction which offers a general coverage of the gemstones and then narrowing down to discuss how diamond stone became of particular importance in human life in general and then in the eyes of Arab and Muslim scholars. The introduction then discusses the research problem and its significance and then discusses the research objectives, research questions, research methodology and the previous studies. The research then sets 12 sections that discuss the various topics of the study based on material borrowed from Arab and Muslim writings about the science of diamonds which are as follows:

- Diamond Nomenclature
- The Status of Diamonds among Other Gems
- Formation of Diamond
- Mining and Excavation of diamonds
- Types of diamonds
- Natural and Synthetic Diamond
- Combustion of diamonds
- Diamond Shapes
- Diamond Processing
- Diamond Sorting
- Diamond Cutting
- Diamond colors
- The Market value of diamonds
- Diamond Trade
- Diamond Applications

The research ends up with the conclusion, which contains the most important findings and recommendations, followed by a list of sources and references.

6.1 Diamond Nomenclature.

"Al-Mas", the name of diamond in Arabic is derived from the Greek word "αδαμας" (adamas), which means indestructible, or invincible. [4] The Greeks also gave the name "αδαμας" (adamas) to all minerals that have the characteristics of diamonds in terms of hardness, and other languages borrowed this name from them with more or less variations. The Arabs used to call diamonds before adopting the Greek name "durr" (meaning pearl), perhaps because they look like pearls in terms of luster and color. [5]

The Arabs derived the word "al-Mās" from adamas, the Greek origin, by replacing the letter "dāl" with "lām", meaning that the alif and lām before the "lām" donate the Arabic definite article "al". Al-Fayrūzabādi believes that it is a common mistake to say "Mas", by cutting off the "al" which he believes are original parts of the word, but many Arab authors did not agree with his view and wrote (Mas), considering the alif and lām as donating the Arabic definite article. Therefore, we must not be dismissive of its occurrence in the letter "mīm" entry and not the alif entry in the literature that dealt with gemstones. In every case, both "Mās" and "al-Mās" have been used by many Arab writers and are still doing so.[6]

Al-Birūni did not miss mentioning all the names of diamonds he knew in his time, saying: "The name of diamond in Hindi is "Hera" and in Roman (Masawaida Idmāntu), which was interpreted by al-Kindi as the one that does not break. In Syriac language it is (al-Miās and Kayvād al-Amās), which is akin to "Mās" or diamond stone".[7] Abdul Nabi believes that diamonds were called "al-sāmūr" at some time in Arabic, which he may have quoted from Sirāj al-Dīn Ibn al-Wardi (d. 852 AH/1447 AD) about the stone that cuts all other stones

easily. [8] The same naming of diamond as "al-samūr" was previously mentioned in a narration by Shihāb al-Dīn al-Nuwairi (d. 733 AH/1333 AD) when the workers asked Dhul-Qarnayn how to cut iron and copper, and he recommended the use of "al-samūr", which is the diamond stone. [9]

It is also narrated that diamond stone is "the whitest of what God created, and it was the one with which Solomon, the prophet, used to cut the rocks and jewels of Jerusalem".[10] Diamonds are currently known in modern scientific terms by the chemical formula (C), since their original substance is carbon. [11]

6.2 The Status of Diamonds among Other Gems.

Abu al-Rayhān al-Birūni expresses his views about the place of diamond among the precious stones by saying: "I placed diamond stone abreast of the other precious gems that are of comparable value, namely pearls and emeralds, because it is the gem that is superior to other gems in almost all characteristics. He elaborates by saying that it is not acted upon by other gems while its acts upon all of them (perhaps alluding to its use in cutting, shaping and polishing other gemstones), and that it defeats time and weather, and in this way the status of diamond is akin to the status of a master who is obeyed by the lowly and the rabble. The similarity between diamond and ruby is the closest in terms of endurance and solidity, and in terms subjugation of other gemstones by piercing and cutting, while pearls, unlike terrestrial jewels, are aquatic animal species, a fact that does not make them inferior as they can grow and mature, unlike non-living things." Table 1 shows the specifications of diamond stone. [12]

Table 1: The specification of diamond stone (Kadhlak, 2018). [13]

Property	**Description**
Color	Colorless, red, blue, grey, green, yellow
Scratch Color	White
Sparkle	Diamond sparkle
Clarity	Transparent
Refractive Index	2.42
Hardness	10
Specific Weight	3.5
Cleavage	Perfect (octahedral)
Break Point	Oyster, breakable
Shape of the Cluster	Octahedral, cube
Crystallization Process	Cubic
Existence	Diamonds are found in basic rocks and in sand
Chemical Composition	C
Original Country of Extraction	South Africa

6.3 Formation of Diamond.

According to modern geological knowledge, diamonds are among the oldest gemstones on Earth, having been formed 300 million years ago. They belong to the group of non-metals and their formation came from melted magma when volcanoes started to erupt and lava poured millions of years ago. They are formed from pure free carbon under very special conditions of high pressure (60-80 thousand atmospheres) and relatively high temperature (1000°C). They are found in kimberlitic pipes (volcanic chimneys) which are created as magma flows through deep fractures in the Earth. Diamonds can come in many colors, such as brown, red, yellow, blue, etc., but the best diamonds are pure, transparent and colorless. The mass of a diamond is measured in carats (0.2 grams), and diamonds weighing

more than 100 carats are very rare in nature. [14] According to ancient knowledge, Theophrastus (a student of Aristotle) may have been the first to suggest that diamonds consist of different lamina (thin layers) closely packed together, but he didn't specify the structure or nature of these compact layers, and he didn't indicate whether they are of volcanic or sedimentary origin. [15]

With the spread of Aristotle's theory of the four states of matter (heat, cold, dryness, and humidity), a new interpretation of the structure of diamond stone was developed. It was stated in "The Book of Stones" attributed to Aristotle that diamond stone "is created by alternation of excessive cold and heat and alternation of excessive humidity and dryness, which are very extreme opposite states that rarely take place in nature".[16] which is the interpretation that was later adopted by a large number of Arab authors.[17]

Arab scientists also developed several hypotheses to try to explain the origin of diamond stone. Among these hypotheses was one put forward by Jābir Ibn Hayyān (d. 200 AH/815 AD) based on Pliny's theory of sulfur and mercury, in which he says that all natural substances are formed from these two elements. [18]

Of course, it should not be understood from this belief that he is referring to the currently known elements of mercury and sulfur which were not known as chemical elements at that time, but he may have been indicating that they are the two essential elements that replaced the four elements of water, earth, air, and fire, that have been established by Aristotle.

Jābir explained his theory of diamond saying: "I can say that diamond was a mineral made up of water only. When it was heated, some of the water started to evaporate causing the rest of water to solidify; and as the heat became too much, the water residue became dry, viscous and thick due to its compactness; and gradually became something similar to mercury, which is the metal that combines moisture and dryness. Thereafter, weather conditions made it salty as well as more and more dry, and being salty rather than sweet deprived it from turning intro gold. Has it been bonded with sweetness instead of saltiness and not excessively dry, it would have turned into gold. As it fell short of becoming gold, it turned into solid stone that consumes all things by its saltiness and extreme dryness".[19]

As we can see from the text above, Jābir pointed out that there is a relationship between the formation of diamonds and gold, due to change in some natural factors, which he referred to as change in the "taste," which was what prevented diamonds from turning into gold.

This is also the relationship that Aristotle had previously referred to when he said: "There is affinity between diamond and gold, and it clings to it wherever it is found". [20] Goldsmiths know this characteristic as they often see particles of diamond in the gold bars that they work on. [21]

The idea of a relationship between diamond and gold also appeared with Apollonius of Tyana (d. 97 AD). It is, as Baylaq al-Qabjāqi mentioned (alive till 681 AH/1282 AD), based on Pliny's theory of mercury and sulfur. In this respect al-Qabjāqi quoted Apollonius as saying: "When we speak about the formation of diamond stone in its mineral, we find that diamond is a golden stone and is similar to melted stones because there is nothing among the stones that crushes it the way stones crush one another. Therefore, it is similar to other objects and none of them can corrupt it except the "abār" (lead). This is what made these authors regard it as a golden stone. Nothing could spoil it except the "abār" (lead) because it is golden, just as the "abār" corrupts and crushes gold. "Abār" crushes gold because of its sulfur, and that is due to the combination of the sulfur in the "abār" with the saltiness of the diamond, and when the salt in diamond senses the smell of sulfur it crumbles and gets crushed. Besides, the color of diamond is white because it contains moisture and when moisture was repelled by the glow of fire, it became white. [22] Due to the existence of a structural relationship between gold and diamond, then what affects gold and breaks it up

will affect diamond and break it up as well. This is why we the vast majority of Arab and Muslim authors adopt the idea of the ability of poor-quality lead.

6.4 Mining and Extraction of Diamond.

India may have been the first country to mine diamond stone around 296 BC. Indians regarded diamond as of high value because of its luster and durability. [23]

Diamond mines were widespread in India before the reign of Alexander, specifically in Daqān, Bengāli, and Gulqand, where the latter was famous for the large size of its diamonds, and the number of diamond miners at that time may have exceeded 30,000 workers. Due to excessive mining, the quantity of diamond in India decreased. The Spanish invaders discovered new mines in Brazil in 1728 AD, and the Dutch also found diamond mines on the Indonesian island of Borneo. The Russians found other mines in the western bend of the Ural Mountains in 1821 AD. [24] It is often related that diamond belongs to the East [25], and since old times diamond mines were located in Transoxiāna. [26] Arab sources have indicated that diamond is found in the valleys of Mount Serendip [27] (the valleys of Mount Rāhūn),[28] which are located on Serendip Island (currently Sri Lanka).[29] Atārid Muhammad al-Hāsib, the Baghdād Astronomer (d. 206 AH/821 AD) mentioned that the name of the valley is "Wādi al-Hayyāt," (serpent valley). [30] and it appears that it is the same valley that was called Wādi Ayn al-Shams [31] as diamond was extracted by eagles from that valley. The Serendipity diamond was used to carve artifacts from all types of stone. [32] Al-Birūni (d. 440 AH/1047 AD) was the best scholar to explain the methods of diamond mining and extraction from their ores, as he said: "Diamond mines are located side by side with the places of ruby minerals on the island of Dhayun. Sand pebbles are removed and washed from diamond in the same way as gold particles are extracted. The sand comes out of the conical washer and diamonds are deposited at its bottom, which was the method used in the Kingdom of Khawar, which is adjacent to Serendip (Sri Lanka). Abu Abbās al-Omāni said that its minerals are in Tangalān Qāmarūn, in an earthen mountain where the soil is washed away from the diamond ore during the year in which there is a lot of lightning. [33]

Al-Kindi indicated that diamond stone is gathered from the minerals of rubies and in the proximity of places where rubies are found because of their affinity and resemblance. Some scholars classified diamond as one of the minerals of gold, which is possible as both are rare, precious and of high value. They indicated that diamond stone is found among the minerals of "Surn Dib" and "Surn Bahram" which are two Indian phrases meaning the Islands of Gold and the Land of Gold, respectively. These scholars supported their statements by saying that diamond particles are sometimes found in pure fine gold comparable in size to grains of sand, which may spoil the layers of gold compelling the miners to make the foils of gold very thin and then the particles of diamond are forced out of the gold foils. Goldsmiths differentiate in their references between this kind of diamond which they call "Smas" and other kinds of diamond. It was said that there might also be some diamond particles inside amber stones which are very hard and may spoil the scratching machines. [34]

Ibn al-Akfāni (d. 749 AH/1348 AD) mentioned other diamond mines, saying that: "Diamond is mined somewhere near Ghazni, and in Macedonia which was part of the Roman Empire where it took the color of ammonium chloride, while it takes a metallic color in the southern part of the Arab peninsula in Yemen, and is soft and has silvery color in Cyprus". [35]

Arab authors also mentioned other methods for obtaining diamonds, other than extracting them from mines, including the use of eagles. Perhaps the oldest account of this method appears in "The Book of Stones" attributed to Aristotle, who tells us that: "No one has ever reached the valley in which diamond existed except Alexander, who found diamond

stone in the farthest reaches of Khorasan. It was in a valley bottom which cannot be fathomed by the naked eye, and nobody can reach it, nor be able to walk towards it. When Alexander reached it, he found that it has not been marred by mud nor has it been stained by dirt. A variety of snakes and serpents lived in the valley which passes across the border to India. The snakes had the characteristic that no one has ever seen them without dying, as long as they are alive, and when they die they do not harm anybody at all". [36]

In order to solve the problem of these snakes, Alexander wrought mirrors from lustrous metal and took them down into the valley. When the snakes saw their images in the mirrors, they died. Aristotle elaborated about the story of Alexander saying: "Alexander ordered that mirrors be made and let down to the bottom of the valley, and when the snakes saw their images, they died, and only then that the naked eyes managed to perceive them. Alexander was guided by God Almighty upon his arrival to that valley, and he wanted to take some of these stones, so he ordered upon his return to his companions that lean sheep be slaughtered and skinned and thrown into the valley while he returned to the rest of his soldiers. The meat fell and Alexander's companions followed it, and while the snakes were busy eating mutton, they picked up the variety of diamond stones that have been scattered in the valley, and thereafter nobody ever managed to pick up any of these diamonds". [37]

Yahya Ibn Māsawayh (d. 243 AH/857 AD) offered more details about the method of extracting diamonds using eagles, saying: "Diamonds may be in a valley in India the bottom of which nobody can fathom, and in the bottom of that valley there are scattered diamond stones the size of which range between a mustard seed and a barley grain." Soft meat is taken and thrown into that valley, and when the eagles see the pieces of soft meat, they fall behind them and catch them at the bottom of the valley, and the diamonds which are of small size stick to the pieces of soft meat, which then the eagles carry to the surface of the ground allowing the small diamond stones to fall on the ground. When the eagles finish their meals, the diamonds fall to the ground and are picked up. These eagles are trained to behave in this manner".[38] But Jamāl al-Dīn Abū Bakr al-Khwārizmi (d. 383 AH/993 AD) offered another account in which he said that: "This valley housed a giant serpent that made all of Alexander's soldiers recoil and dread its appearance. So he ordered a big mirror be made and used like a shield, then placed it on the tip of a spear and presented to the serpent to see its image in the mirror. When the serpent looked at itself, it was crippled and died immediately. Then he ignited a big fire and made it go down the valley in order to burn the serpent and any other animals down there. Thereafter he ordered ropes and spikes of about five thousand cubits length go down the valley which still did not reach its bottom. Concurrently he ordered eagles be starved for days while roasted sheep were thrown into the valley before their eyes. The eagles started to go down the valley and take the sheep meat out of it along with grains of diamond that stuck to the sheep meat. It took the army a month time to extract all the diamond grains found there, which then made up all the diamond stones found in the whole world. [39)

Ibn Fadl Allah al-Umari (d. 749 AH/1349 AD) mentioned that rare good diamonds were brought from the regions of Kashmir. He described a valley between two mountains in which there are fires that burn day and night, summer and winter. It must have been either a volcanic area or an area with a gas field with diamond stones embedded amid the lava. Only a group of adventurous Indians were capable of extracting these diamonds. In order to get them, they used to slaughter sheep and cut up there meat, then throw piece after piece into that valley using a catapult, due to the presence of flames of fire and snakes. After they throw the meat, they send vultures to race down and take the meat that fell in lava of mild temperature. If they see an eagle taking a piece of meat, they follow it, and some diamonds may fall from the meat, or the eagle may land with a piece of meat somewhere.

They follow the eagle to the place where it landed in order to look for the diamond grains. [40)

"The Book of Stones" gives another account in which the book states that the place where the diamond stones were located was out of the reach of everybody. It is a valley in the land of India with a bottom that cannot be fathomed by the naked eye, and there live various types of snakes. When Alexander reached that place, he wanted to cross it, but his soldiers refused to descend. So he consulted the philosophers, who ordered him to throw pieces of meat into the valley in order to have diamond stones stuck to it, and thereafter send birds to go down and pick it up out of the valley along with the diamond stones that will be stuck to the meat. So Alexander ordered his soldiers to do what the philosophers said and ordered them also to send the birds down and then pick up the diamonds that fell from the meat. Most of what was found was in the form of particles the size of pea grains as only such grains may be stuck to the meat which the vultures may pull out along with the meat. [41]

As for Shihāb al-Dīn al-Abshīhi (d. 852 AH/1448 AD), he was the one who gave new details that seem more logical. He pointed out that snakes escape from their images in mirrors and do not die therefrom. He also indicated that diamonds can also be obtained from the valley when the snakes are absent during their hibernation and estivation periods. The account that he offered is as follows: "There is a valley in India that is said to be infested with snakes. The one who wants to extract diamonds from that valley goes down and places a large mirror in the valley. When the snakes come and look at their images in the mirror, they flee from them and he descends and takes what God destined for him as a means of sustenance. It was also said that people who come to the valley to extract diamonds slaughter sheep and throw their meat in that valley, and diamonds and other precious stones stick to the meat, and then the birds come and snatch the meat and take it to the mountains where they eat the meat and leave the stones behind, which the owner of the meat can take it. It was also said that snakes have a hibernation period of six months in one place and an estivation period of another six months in another place; so when they go to their hibernation or estivation places the treasure hunter may take the stones during their absence, and only God knows the truth of all that".[42]

In any case, it seems that the method of obtaining diamonds from "Wādi al-Hayyāt" (Serpents Valley) has a basis of truth and is not entirely mythical. Marco Polo (d. 1324 AD), who traveled to India in the thirteenth century, described a similar method of diamond extraction, that is by cutting pieces of meat and having them thrown into crevices of rocks (Brewer, 1893, 106).

Al-Qabjāqi mentioned the possibility of extracting diamonds through other means, such as search and excavation, or taking advantage of the instances of floods and winds, that is in the cases where erosion and attrition take place, without going into the technical details of the process. [43] Figure 1 shows the current diamond stone mining locations.

6.5 Types of Diamond.

Diamonds were not commonly used by people in ancient times. Pliny the Elder (d. 79 AD) says that: "Diamond was for a long time known only to kings, and to a few of them only".[44] Theophrastus mentioned that the colorless Eastern topaz stone was sometimes sold as diamond, but in fact it was fake diamond. [45] Pliny mentioned six types of diamonds, not including quartz crystals, which were also called diamonds during his time.[46]

Confusion between diamonds and other stones also occurred among the Arabs. According to al-Birūni who died during the Umayyad era in the year ….. : "Some people think that "dharān" is the same as diamond, but it is not, rather, it is a name derived from the word "dhar", which is the process of precious stones cutting and shaping, and was originally the process of quenching hard iron with water, as well as the process of making steel that is

mentioned in the beginning of the book of Joshua, which pointed out that "dharān" is a sword made through this same process, indicating that "dharān" has nothing to do with diamond. [47]

As for the rest of these types, they include the Indian diamond, which was sometimes the size of a hazelnut, and the Arabian diamond, which was clearly a real diamond, as evidenced by its strange shape, which Pliny described as consisting of two shells united at the wide ends of the stone. It has also been noted for its silvery or steely luster, an amazing property of the stone in its natural state. Macedonian diamonds found in the gold mines of Philippi were no larger than a cucumber seed. As for the Cypriot diamonds, which had a blue hue, and the Siderite diamonds, which were dense in color, they were much heavier than blue sapphires and could only be pierced by other diamonds. [48]

We will find in the Arabic literature on precious stones that the Arabs classified the types of diamonds in two ways: either according to the country of origin, which they derived from their forerunners, or according to their colors, which they created by themselves. Figure (2) shows the recent world diamond stone mining locations and figure (3) shows recent world white diamond stone mining locations.

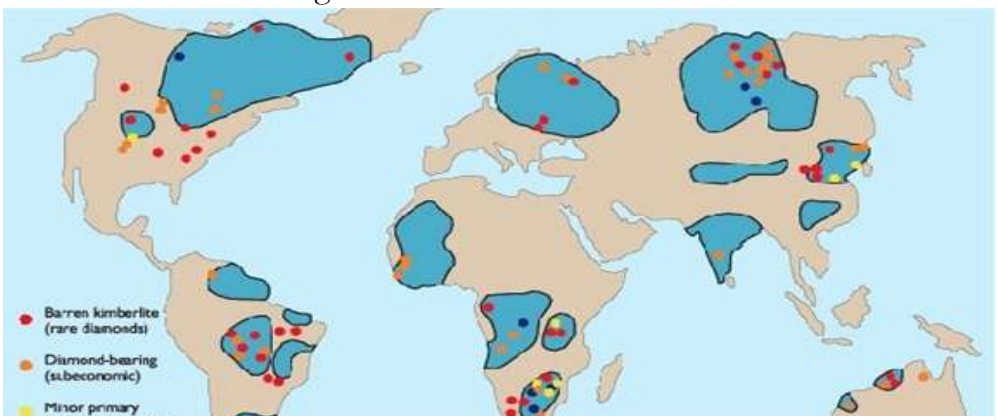

Figure 1: Diamond Mining Locations.
(http://www.diamants-infos.com/br…/images/carte_des_mines.gif)

According to the country of origin, they classified diamond as follows (Ibn Rasūl, 2000, 341):

1. The Indian diamond: The color of the Indian diamond tends to be white, and its size ranges from the size of a sesame seed to that of a walnut. But it is rare and its color is close to the color of good pure ammonium chloride.
2. The Macedonian diamond: This one resembles the Indian diamond, but is larger in size.
3. The Iron type diamond: This type of diamond is soft, and its color resembles the color of iron, but it is heavier. It is found in Suqa in the country of Yemen, and it resembles a saw.
4. The Cypriot diamond: This one is silver white in color, and is affected by fire. Some experts do not consider it as a diamond because it is combustible.

The Arabs were the only ones to classify diamonds according to their colors as follows[49]

The Crystalline type: This diamond is very white resembling the color of crystal.

1. The Olive type: This one is more attractive than the crystalline one, and its whiteness is mixed with an oily color like that of the Pharaonic glass.
2. There are also yellow, green, red, grey, and black types, and Ibn al-Akfāni added the blue, silver and iron types thereto. [50]

Al-Birūni indicated a method by which to distinguish between real diamonds and fake ones, saying: "The method of testing diamond embodies placing one of the edges of the stone in a candle flame for a few minutes, and then hold it in front of sun rays. If a red color like that of a rainbow shine therefrom, it is most probably a good kind of diamond, and such a

color never shines except from the white and yellow types; and therefore it is the one preferred by the Indians and regarded as the best of all the Indian types, which they cherish as some experts say. If that is the case, it must be because it is superior and dominates other kinds of diamond. An Indian book mentions that it must be flavored by exhaling on it till it becomes hot, then it is thrown into brine in which silver has been washed; if it turns white, then it will be the preferable one that is suitable for ornamenting swords and necklaces with diamond studs, and for all the adornments that adorn the upper parts of the body; the one that turns red in the brine in which silver has been washed will be suitable for ornamenting the middle parts of the body; the one that turns yellow in that brine will be suitable for ring lobes and bracelet studs; and the one that turns black in that same brine will be suitable for anklets and feet chains. They say that any change in this arrangement and adornment in colors other than the ones mentioned for these positions of the body will make thunder crack and its sound will split the diamond; if this is true, it will then be amazing".[51]

Al-Tifāshi said: "Some of the Persian jewelry merchants who used to frequent the countries of India and China to acquire precious stones told me that there is a type of diamond that has a great ray. When its ray is cast on whatever is near it, such as a wall, a garment, or a human face, with a different color, it will emit something like a rainbow. This type of diamond is used by the nobles of India as jewelry which they wear to beautify themselves, and they never allow others to handle it; and except for the ray that it emits, it is oily in color, and is used to cut rubies and gifted to the merchants".[52]

6.6 Natural and Synthetic Diamond.

Natural diamonds are the most valuable ever known commodity and none of the other gemstones have ever been compared to them, and hence it is very important to devise methods by which to distinguish between natural diamonds on the one hand and synthetically grown or treated diamonds on the other hand (Kirkley et al., 1991).

Natural diamonds are formed in the Earth's upper mantle at depths greater than 150 km over a period of millions of years. The high temperature and pressure forms diamond which is the most stable form of carbon under these conditions. The environment slowly crystalizes carbonaceous deposits into single crystal diamonds which are eventually brought to the surface in volcanic eruptions. Contrary to the media, high quality synthetic diamonds can be realized, and because of their commercial value as gemstones attempts to grow diamonds started in the 1800s. Currently there are two main procedures that are used; high pressure and high temperature (HPHT) synthesis and chemical vapor deposition (CVD).

Figure 2: White Diamond Mining Locations.
(http://www.diamants-infos.com/br…/images/carte_des_mines.gif.)

6.

Theophrastus stated that diamond is the closest of all gems to the characteristic of maintaining an incombustible character (Theophrastus, 1774). However, a method of

melting diamonds has spread among Muslim authors, which consists of placing the diamond stone in the blood of a goat and then exposing it to fire in order to melt. This process turns it into a deadly poison. [53)

Until the late 17th century AD, there was a belief that diamonds are not affected by fire, but this belief changed in 1694 AD when some Florentine scientists placed a small piece of diamond stone in the focus of a burning mirror, which made the diamond vanish without a trace. Later, Lavoisier noticed in the late eighteenth century that if a diamond stone is burned, a gas emerges therefrom, which when he dissolved in water and examined, he found that it was carbonic acid. He concluded that if a piece of diamond is heated in a container from which air is removed, it does not burn nor does it vanish because it will not find oxygen to combine with and turn into carbonic acid. [54)

6.8 Diamond Shapes.

In general, all crystalline shapes of diamond grains belong to the cubic system, but diamond crystals sometimes take other shapes that belong to the triangular, dodecahedral, octahedral, or hexagonal kinds, and sometimes a composite shape results from such shapes. Diamond crystals may exist in the form of twins, which are called simple twins when they are composed of two joined crystals or multiple twins when more than two identical crystals combine. [55]

Arab scientists have been aware of the crystalline forms of diamond since the ninth century AD. Atārid Muhammad al-Hāsib, the Baghdad astronomer, asserted that: "In whatever manner diamond is broken, it will still be shattered into particles with sharp edges resembling obelisks, with which you can pierce whatever gems you wish". [56] Ibn Māsawayh also indicated that: "When diamond is struck with a lead sledge hammer and it was shattered into a thousand of pieces, the pieces will only be triangular in shape. A piece as such may be placed at the end of a drill to drill solid stones and gems with. [57]

Abū al-Fadl Ja'far Ibn Ali al-Dimashqi (6th century AH/12th century AD) believed that the shapes of diamonds are always the same and they don't differ; this is because, all of them are horned and have five or three angles. They are usually white in color, resembling crystals with a slight reddish tinge, and their transparency resembles that of ruby, but they are lighter than rubies and heavier than glass and crystal (Al-Dimashqi, 1999, 26). However, al-Dimashqi did not mention the method or means by which he was able to discover all this, and it is most likely that he was making these statements while natural diamonds with faces like these ones have been in his hands.

Al-Tifāshi for his part indicated that: "Among the properties of diamonds is that all of them have more or less six or eight right angles, and they have right angled triangular surfaces. "When diamond stone is broken, it will be shattered into triangular pieces whatever small sizes they have." These statements were quoted from him by Baylaq al-Qabjāqi, [58] Zakariyya Ibn Muhammad al-Qazwīni (d. 682 AH/1283 AD), [59] and al-Qalqashandi (d. 821 AH/1418 AD).

Ibn al-Akfāni was the only one among Arab scholars to say that "all diamond shapes are naturally serrated, conical, and triangular." By saying serrated he meant to say that they resembled gears or cogs, which are toothed wheels intertwined with chains, such as those we find on bicycles. Perhaps he has seen diamond crystals that have had such a shape.[60]

6.9 Diamond Processing.

Rough pieces of diamond, when seen for the first time by a person, they may look very much like broken pieces of glass or other transparent crystals. But when cut into well-crafted gemstone with multiple faces, they take on a unique, dazzling, and brilliant appearance. However, many procedures involved in that processing of diamond that transform raw material of diamond into fantastic jewels are hardly known to the majority of those working with gem diamonds, including gemologists, jewelers, and the general

jewelry-buying people. (Figure (3) shows a raw piece of diamond at the beginning of processing and a similar processed white diamond) (Caspi, 1997).

Figure 3, Left: A white transparent diamond before cutting; Right: A white transparent diamond after processing (Caspi, 1997).

Much of the diamond manufacturing business has undergone a silent revolution over the last 20 years. Employing lasers, computer imaging techniques, precise measurement tools, and other equipment of modern technology, numerous producers have enhanced their capacity to cut gem diamonds in ways that were unthinkable just a few years ago. An important outcome of this transformation is that the diamond business can now function more profitably. Furthermore, rough diamonds that would have been challenging to cut using conventional manufacturing methods, if not impossible, may now be handled by means of modern technology (Caspi, 1997).

6.10 Diamond Sorting.

There are various methods for sorting rough gem-quality diamonds. Sorting may depend on size, color, shape, or clarity, which are the primary sorting criteria. According to Stewart (1991), rough diamonds are grouped into over 5,000 categories using both manual and automated sorting. The majority of diamond manufacturers usually employ one or several sorting procedures and categorize them in a fewer categories depending on the quantity they can handle and the typical sizes that they are using.

Regardless of quality, raw diamonds are usually sold by weight. To sort big amounts of diamond stone, sieving procedures are typically used, especially if most of the package is made up of small diamonds (Bruton, 1981). For this purpose, sequences of sieve plates with holes of specific graded width are used to let diamonds pass through. The larger diamonds stay trapped in the sieve, while the smaller ones fall through the perforations in the plate.

With decreasing holes' widths at each level downward, a large number of sieve plate layers are piled on top of one another. This allows the sorter to arrange diamonds into roughly equal-sized packets before weighing. Although by now there is much advanced technology for this purpose, still the rough diamonds are typically weighed on a scale.

6.11 Diamond Cutting.

Indian jewelers, who were perhaps the first to realize that diamonds could be ground into powder, have discovered the wonderful difference that removing the shell makes in the appearance of the diamond stone. However, they made no attempt to shape the stone, but they only polished the natural edges, and added only several small facets when they wished

to hide some imperfections. The famous French traveler Jean-Baptiste Tavernier (d. 1689), from whom we got most of our knowledge of early mining in India, found that diamond stone was always covered with severely defective crust on many sides. The full glowing beauty of a diamond stone is only revealed when it is professionally cut to reveal its brilliant glow.[61]

It has been spread in Greek and Arabic literature that "asrab" which is a type of bad lead with a black color, can crush and break diamond stone. The source of this idea comes from the "Book of Stones" attributed to Aristotle, where he says: "The peculiarity of this type of lead is that it does not stick to any of the incarnated bodies without shattering it, and when it presses on that body, it breaks and splits it, and takes away its light. This characteristic is inherent in "asrab", which is made advantage of to break and shatter other bodies as well as remove any engraving made on them. When a body of stones is brought near to "asrab", which is characterized by looseness, creaking, stench, and loneliness, such a stone will be destroyed, and nothing will remain on it. It is the worst type of lead".[62]

It seems that in the period between the ninth and sixteenth centuries AD, no one dared to try or test the validity of this idea, with the exception of al-Birūni, who was astonished by such information. Rather, we find all Arab and Muslim authors and scholars transmitting it and proving it in their works, including Jābir ibn Hayyān, who says: "I admit that diamond is a golden stone, a stone most similar to the dissolved bodies because none of the stones crushes it in the manner that other stones crush each other. So I likened it to the dissolved bodies, and nothing of the bodies can corrupt it except "abār" (a type of lead), this is why I believe that it is a golden stone.[63]

But Jābir Ibn Hayyān was the only one, and perhaps the first, to provide an explanation based on the theory of sulfur and mercury, as he said: "But now diamonds cannot be corrupted by anything except "abār" because it is a golden metal, just as "abār" corrupts gold and crushes it. "Abār" crushes diamonds by means of its sulfur, when the sulfur of the "abār" combines with the salinity of diamond." Because the salt found in diamond stone has a sulfurous smell, it is fragmented and crushed by "abār".[64]

The method of cutting diamonds was sometimes done by adding wax, as was reported by Atārid Muhammad al-Hāsib, the Bagdad astronomer (d. 206 AH/821 AD), who said: "when diamond is placed in wax or bitumen and struck with lead, it crumbles.[65]

If we take the hardness of diamond as equal to 10, based on the Mohs scale, the hardness of the best type of lead does not exceed 1.5, that is, only half a degree higher than talc, which is considered the most brittle material in nature, and is given a hardness of only 1, based on the Mohs scale, which means that the idea is unfounded.

What is blamed on the Arab scholars is that they did not test the validity of this common idea since the days of the Greeks, although they knew that polishing and cutting of diamond could only be accomplished using the powder of diamond itself.

As for the diamond polishing process, it is known that diamond stone is the hardest material in nature. Therefore, diamonds are only broken by diamonds. This is evidenced by the fact that the Romans were able to smooth and polish diamond stone using the powder of cheaper diamonds to polish other precious stones.[66)

The idea of polishing diamond with its own powder is attributed to the German Lodewyk van Bercken (late fifteenth century AD) (Bertrand, 1903, 867), who came up with this idea by chance in 1472 AD when he rubbed one diamond with another one, causing both of them to crumble and become like soft filings.[67] But this attribution is not correct, as we know that the Indians knew this process thousands of years earlier.

6.12 Modern Diamond Processing Technology.

The manufacture of a diamond into a faceted gemstone (figure 2) presents some very special challenges, including:

1. As diamond is the hardest stone (10 on Mohs scale of stone hardness) ever known on earth, its processing represents a very daunting work.
2. Despite the fact that diamond has a single refractive index regardless of type, its crystal orientation is the one that decides its hardness, and hence can be cut and polished in only one direction which is referred to as the grain (Vleeschdrager, 1986).
3. In order to maximize light return through the crown facets, the cutting procedure must be on the key angle of total light reflection within the faceted diamond. Diamond has a very high refractive index (2.42), and early in the century, Tolkowsky (1919) developed a mathematical foundation for the round brilliant cut's shape and facet arrangement. Nowadays, a wide range of fancy cuts and various cutting styles are also employed (Tolkowsky, 1919).
4. For faceted diamonds, the distinctions between the different color and clarity grades can be rather minor, and even small changes in weight retention and cutting technique can have a big impact on the diamond value.

During the cutting process, each of the following issues needs to be resolved. As it was in the case of past decades, the production of gem diamonds now entails taking the following fundamental steps:

1. Choosing the rough diamond. This entails evaluating each diamond for different possible cutting style, color grade, and clarity grade.
2. Marking the rough parts that will be processed.
3. Taking decision about how the rough crystal will be cleaved.
4. Taking decision on how the girdle will be dealt with.
5. Polishing the facets.

6.13 Diamond Colors.

According to Theophrastus, when diamonds are pure, as they generally are, their color is completely pure, but it is sometimes found tinged with mineral particles that remained therein at the time of its original formation, as is the case with other gemstones, and is therefore yellow, reddish, or bluish in color, and sometimes, but rarely, greenish. The color of diamond is sometimes the same as that of other gemstones, but it is much superior in terms of hardness. So the common crystal has sometimes the same incidental qualities, although much softer and of little value. [68]

Jābir Ibn Hayyān tried to explain scientifically the reason why diamonds acquired their bright white color, where he said: "The color of diamonds was white because they were bonded with moisture and the moisture removed and repelled the glow of fire from them, so they became white, which is the secret of diamonds. [69] Al-Kindi said that the best color of diamond that he saw was the color of the rainbow of clouds. [70]

Atārid Muhammad al-Hāsib, the Baghdad astronomer, indicated that the color of diamond is like "the color of good, pure ammonium chloride". [71] Both he and Ibn al-Wardi [72] took this information from the "Book of Stones" attributed to Aristotle. [73] Yahya Ibn Māsawayh described the method of detecting good diamonds, saying: "Some of the diamonds may cast rays that resemble the rays of the rainbow that is produced by light passed through a glass cup and cast on a wall. If it proves to have such a characteristic, Indians will use it for ornamentation; otherwise, they will keep it with other precious stones such as rubies. [74]

Ibn Fadlallah al-Umari offered a method by which diamonds are repaired when their color weakens or when they lose color, saying: "When diamonds are spoiled and their color weakens, they are thrown into hot human blood to remain therein for days, after which they regain their color and other characteristics. [75] Figure (3) shows diamond stones of various colors.

Figure 4: Diamond stones of various colors (Zumrud.com)

6.13.1 Various Colors of Diamonds.

Pure diamonds are colorless, but most natural diamonds exhibit a variety of colors. These colors typically arise from trace amounts of atomic or molecular impurities, which create what are known as color centers, and hence are responsible for the diamond's overall hue. Additionally, the size of the diamond influences color intensity, a larger stone generally appears more vividly colored than a smaller one with the same type of color center (Shigley, 2013).

6.13.2 Yellow Diamonds.

Yellow diamonds are among the most common and sought after fancy colored diamonds. Their vibrant color is primarily caused by the presence of nitrogen atoms within the crystal lattice. Nitrogen absorbs blue light, allowing yellow wavelengths to dominate, which gives the diamond its distinct hue (Cantigny, 2010; Nassau, 1994). The intensity of yellow can range from faint to deep, with vivid and intense yellow stones often marketed as "canary diamonds", being the most valuable (Moses et al., 1997). Yellow diamonds are graded based on the richness and saturation of their color (Hofer, 1998).

Yellow diamonds are mined in several countries including South Africa, Australia, and Russia. The Kimberley Mine in South Africa is particularly well-known for producing high-quality yellow stones.

Yellow diamonds are popular in both engagement rings and high-end jewelry due to their warm, sunny appearance and relative affordability compared to rarer colored diamonds. In recent years, yellow diamonds have grown in popularity, often favored by celebrities and designers (Moses et al., 1997). Figure 5 shows some yellow diamonds.

Figure 5 - Yellow diamonds.

6.13.2 Red Diamonds.

Red diamonds are the rarest of all natural colored diamonds and are highly prized for their extraordinary scarcity. Unlike most colored diamonds, which owe their color to chemical impurities, red diamonds get their color from a rare deformation in the crystal structure known as plastic deformation (Cartigny, 2010; King et al., 2002). This distortion affects how light passes through the stone, resulting in the deep red coloration. Red diamonds are graded as fancy red without intensity modifiers such as "light" or "vivid" because they are so scarce that standard intensity grading is impractical (Hofer, 1998).

The Argyle Mine in Australia, which closed in 2020, was the most significant source of red diamonds, producing nearly all of the world's known supply of red diamond (Smit et al., 2019). These diamonds are typically small, most weigh less than a Carat and command extremely high prices per carat due to their rarity.

Figure 6 - A red diamond.

6.13.3 Pink Diamonds.

Pink diamonds are among the most captivating and valuable fancy-colored diamonds, admired for their romantic color and rarity. Their color is believed to arise from structural deformation during formation, rather than from trace elements like nitrogen or boron (Cartigny, 2010; King et al., 2002). This intense pressure distorts the crystal lattice, altering how light is absorbed and scattered.

The most famous source of pink diamonds was the Argyle Mine in Western Australia, which produced over 90% of the world's pink diamonds until its closure (Smit et al., 2019). These diamonds often show a range of shades from blush to deep rose, with the most valuable displaying vivid or intense saturation with minimal brown or orange modifiers (Hofer, 1998).

Graded is based on color intensity from faint to fancy vivid pink diamonds (see fig.7) with strong, pure color being the most prized. They have consistently broken auction records and are in high demand among collectors and luxury buyers (Moses et al., 1997). Their beauty, rarity, and symbolism have made pink diamonds not only a luxury item but a valuable long-term investment (Rondeau et al., 2004). Figure 7 shows a pink diamond.

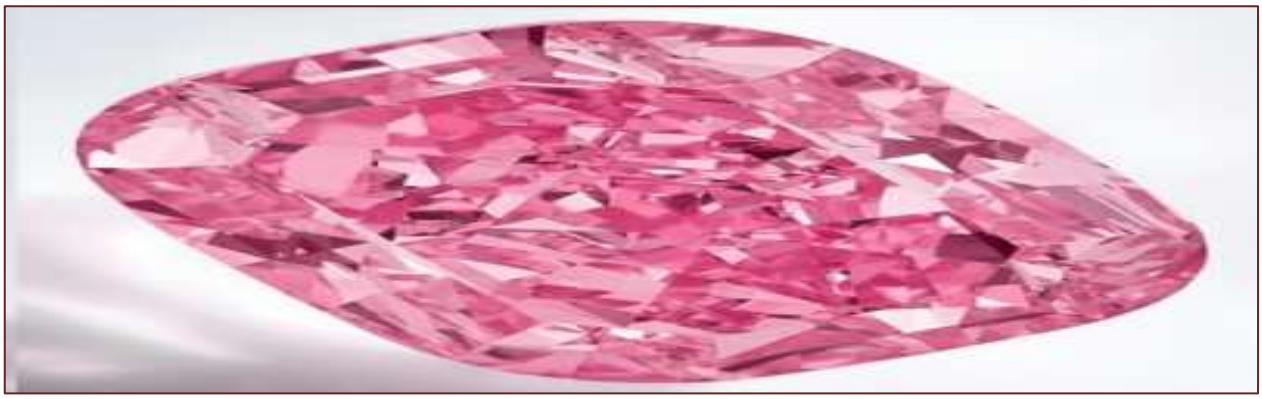

Figure 7 - A pink diamond.

6.13.4 Blue Diamonds.

Blue diamonds are among the most mesmerizing and valuable of all colored diamonds. Their color is caused by the presence of boron impurities within the crystal structure, which absorb red, yellow, and green light, resulting in a blue appearance (Cartigny, 2010; Gaillou et al., 2009). The concentration of boron directly influences the intensity of the blue color making diamonds with more boron take a deeper blue.

These diamonds are predominantly found in a few select locations, including the Cullinan Mine in South Africa. Historically, the Golconda mines in India were also renowned for producing exceptional blue diamonds (Hofer, 1998). The presence of boron not only imparts color on blue diamonds but also gives them semiconducting properties unusual among diamonds (Guillou et al., 2009).

Famous examples include the Hope Diamond, known for its deep blue color and legendary history. Like other fancy-colored diamonds, blue diamonds are graded based on color intensity, with "fancy vivid blue" being the highest and most valuable category (Moses et al., 1997).

Blue diamonds are symbols of strength and elegance. Their rarity, scientific interest, and breathtaking beauty make them highly coveted in the gem world, both as jewels and investment assets (GIA, 2021). Figure (8) shows a blue diamond.

Figure 8 - A blue diamond.

7. The M

Crude diamonds obtained from rivers, often have a strange greasy appearance, and are not attractive to the eye, for this reason Persians ranked, in the thirteenth century, pearls, rubies, emeralds, and topaz before diamonds. Besides, diamonds in the middle ages were often considered less valuable than emeralds and rubies. [76] Abū al-Fadl Ja'far Ibn Ali al-Dimashqi (6th century AH/12th century AD) indicated that kings wanted large diamonds because of their rarity and they preferred them because they separate them from the general public. Al-Dimashqi figures that the value of one diamond during his time was just equivalent to the value of a fine amber sapphire. [77] Diamonds are known to have been the first mineral currency known to the world, as they were used in bartering and other trade operations. They were used as a currency in eastern and western India, which was what the Arabs also used to do when they became in touch with Europe and India. [78]

The value of diamonds as viewed by the Arabs according to the place and time. Its weight was measured in dirhams and the value of a dirham weight of diamond particles amounted to one hundred dinars, and when this weight belongs to a single piece of diamond, then its price will be one thousand dinars. [79] Baylaq al-Qabjāqi estimated that "the common average value of a one-carat of diamond is two dinars." Yaqūb Ibn Ishāq al-Kindi mentioned in the book he wrote about gemstones that the largest sizes of diamond stones that he saw ranged between the size of mustard seed and that of a walnut. The most expensive diamond he saw in Baghdad was the weight of a mithqal and was valued at eighty dinars. He found that a large diamond suitable for a ring lobe will be estimated at half a mithqal, and its price will be multiplied by three, four, or five times the price of the piece of diamond whose size is equal to a mustard seed, or a pepper seed. The cheapest diamond he saw in Baghdad was a mithqal weight and was priced at fifteen dinars.[80]

Al-Qabjāqi remembers, saying: "I have been shown by the jeweler Abu Saīd al-Sāmiri, in Cairo in the year 660 AH, a diamond stone whose weight was approximately the same as that of a dirham".[81] In the past, the value of a mithqal was 200 dinars, and when the diamond piece is the size of a hazelnut or close to it, its value ranged between 300 and 500 dinars.[82] "When the weight of a piece of diamond is one carat, its price will be two dinars, and if its weight is doubled, its price will also be doubled." [83] The price of half a mithqal

weight of a single diamond may reach one hundred dinars, but if the diamond is in the form of a small grain of the same weight, then its price will be lowered to eighty dinars. Al-Kindi remembers that he has never seen a piece of diamond bigger than a walnut, and the price of a walnut weight of diamond can be three to five times that of several small grains of diamond. The "Brothers Jewelers" remember that they have never seen any diamond stone greater than the weight of three dirhams. In general, the weight of diamond has been measured at that time in dirhams rather than in mithqal, and its weight was measured in the same way as the weights of emeralds and gold. The "Brothers Jewelers" used the same logic to indicate that during their time the price of several pieces of diamond was one hundred dinars, while that of a single piece of the same weight may reach a thousand dinars. Nasr narrated on the authority of Mu'iz al-Dawla Ahmad Ibn Buwayh that he sent a gift to his brother al-Hassan Rukn al-Dawla in the form of a diamond weighing three mithqals, which had never been heard of before. [84) If we count the dinar as equivalent to 5 dollars nowadays, the most expensive piece of diamond would have been sold in the 11th century AD for the equivalent of 5000 dollars.

8. Diamond Trade.

Archaeologists proved that the Phoenicians and the people of Carthage traded in diamonds. [85] The Carthaginians, who used to bring diamonds from Africa, traded in diamonds with the Etruscans of northern Italy.[86] The diamond trade also flourished in India since 800 BC. [87] Ptolemy (d. about 170 AD) mentioned a "river of diamonds" in India, and many ancient Sanskrit manuscripts also talked about diamonds in great detail. A confirmed part of the history of ancient India narrates that the diamond stone, now known as Koh-i-noor, meaning the Mountain of Light, belonged to Kama, the King of Anga, who ruled in India 5,000 years ago. [88] The first source from which diamonds were purchased was India. Traditions of this country tell us that gems were known and valued as early as 3000 BC, and indeed, if we are to believe tradition, the Koh-i-Noor, one of the greatest diamonds in the world (now resting in the British Crown), has been worn, nearly 5,000 years ago, by one of the heroes of the Indian mythology. In general the gems obtained from India were of remarkably high quality, and those coming from the famous Golconda mines were second to none. However, India's diamond supply has been practically exhausted, and most of the gemstones obtained in recent years have come from relatively new sources. [89]

9. Diamond Applications.

80% of diamonds are currently used in the scientific and industrial fields due to their distinctive properties. [90] but in the past, they have been used in other fields, such as medicine, industry, and even astrology.

9.1 Perforation and Cutting of Other Gems.

Many Arab scholars have referred to the use of diamonds in the process of perforating other precious stones such as rubies, pearls, emeralds, wood, [91] and even diamonds themselves, which, as is known, are not affected by iron. The method of perforation involves installing a piece of diamond in the head of an iron drill to drill a hole in the gem in question, provided that such a piece of diamond is as large as the desired size of the hole. [92]

Al-Birūni stated that the people of Iraq and Khorasan did not distinguish between types of diamonds and did not use them for anything other than piercing and poisoning. [93]

Al-Birūni also cited the scientific explanation that was common in his time for the reason behind the ability of diamonds to cut other gems, saying: "There are diamond pieces in the form and shape of an antenna or a capillary because of the sharpness of the two ends of the piece and the fullness of its middle. This type is thought to have been capable of cutting and piercing other gems by changing into fiery shapes, because the power of fire and its

sharpness enables it to penetrate everything. On the other hand, diamond is also used to cut and shape white sapphire. [94]

9.2 Medical Applications

One of the medical applications of diamond stone mentioned in the "Book of Stones" attributed to Aristotle, is its use to break up urinary stones. "The method involves taking a tiny diamond stone and installing it at the head of an iron magnet, and then used to pierce the bladder or the urethra.[95] This application has been transmitted by the Arabs, and it seems that the doctor Ahmed Ibn Abi Khālid, who was also known as Ibn al-Jazzār (d. 369 AH/980 AD), actually used this technique to perform an operation, as mentioned by al-Tifāshi, who said that Ibn al-Jazzār applied it to his servant by attaching a small diamond bead tightly to the head of a piece of metal that took the shape of a catheter, which was made of copper or silver, then he inserted it in the servant's pelvis and broke the large stone into smaller pieces, which then came out with urine.[96] However, Ibn al-Bitār denounced this therapeutic practice as dangerous and unadvisable.[97] Arab scholars agreed upon the advantages and disadvantages of using diamond to improve dental health, and according to them diamond "cleanses, purifies, and whitens teeth, and when placed in the mouth it helps in the growth of teeth. [98] However, if a diamond stone is held in the mouth for some time, it will break up the teeth. [99] Baylaq al-Qabjāqi expressed his view on this matter, saying "Some people say that they often put a small piece of diamond in their mouths and it does not harm them at all. But, the difference between what is swallowed and what is put in the mouth is great. [100] In terms of toxicity, Atārid Muhammad al-Hāsib believes that the toxicity of diamonds comes from the snakes that have been living with them before they were extracted, and some of their saliva may have fallen on them. [101] Such a poison has the ability to pierce the intestines and the liverand therefore has a fatal property if ingested.[102]

Among the benefits of diamond is that it relieves stomach pain and severe colic if it is applied to the abdomen from the outside. Another benefit is that when it is applied to an infant immediately after birth, it protects it from epilepsy. [103]

Al-Tifāshi mentioned a strange property of diamonds, saying: "Flies crave them, and when a small piece of diamond is left and the flies fall on it, [104] they swallow it or fly away with it." Al-Tifāshi took this information from al-Birūni, but he did not tell us from where al-Birūni obtained it. This was also quoted from him later by al-Qabjāqi, [105] al-Surūji [106] and al-Qalqashandi [107] (and it seems that nobody has verified it experimentally).

10. CONCLUSION

This research focuses on the extent to which diamond stone was valued and cherished by the Muslims from the dawn of Islam till the Mumlūk era, and the prominent place it occupied among the precious stones. Among the characteristics of diamond stone is the brilliant glow that it emits which makes it far superior than other gems including ruby and emerald. Moreover, diamonds are so tough that they can cut any other material, and can only be cut and shaped by less precious varieties of diamonds, and hence are used in cutting and shaping precious stones including diamond itself. Muslims used diamonds in other purposes beside ornamentation such as performing some types of surgery.

The research further describes the manner in which Muslims used to mine and extract diamond stone and the famous places from which they have been mined and extracted. In this connection they often wrote about a very bizarre method by which diamond was extracted from a deep valley in India infested by snakes and serpents. The method involves throwing sheep meat in the valley after which eagles are sent down to collect the meat with which diamond grains are stuck and come up with it to the surface of the ground where

treasure hunters are waiting to pick up the diamond grains that fall on the ground after the eagles have finished their meals. This method of diamond extraction was first mentioned in the "Book of Stones" attributed to Aristotle and then picked and quoted by many Arab and Muslim authors, the matter which may give it some credence.

Furthermore, the research discusses how Arab and Muslim authors developed a special classification of the types of diamonds based on the places from where they were extracted and their colors and other characteristics, which were superior to the former classifications that were known before them. The research singles the Indian diamonds as being remarkably high quality, but India's diamond supply has been practically exhausted, and most of the diamond obtained in recent years comes from relatively new sources, including from some African countries.

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