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History Of Distillation For Water Purification, Spirits And Medicine-Making

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Abstract

The accessibility of potable water has been a crucial concern for world health and survival since the inception of humanity. Desalination was employed as a technique for dehumidification and distillation in ancient civilizations. Nevertheless, there is limited documentation regarding the utilization of distillation in ancient civilizations. This research provides a novel examination of archeological discoveries and a comprehensive analysis of allusions in Vedic texts about alcoholic beverages. This text discusses several facets based on archiological and anthropological survays of Indian, Chinese Islamic, Mesoamerican, and other cultures, contributions of science and technology within the world. The study focuses on the current germplasm diversity, conservation, and origin of distillation devices for spirit and medicine making -making across the world.

Introduction

Desalination and Distillation

Distillation is the oldest and, most commonly used method of Desalination. However, Distillation has been used more for Wine, Perfume water, and medicine rather than desalinated water since the dawn of civilization.
Knowledge of Desalination and Distillation lies in observation in which convergence of water to vapor and vapor to water occurs.

In every ancient civilisation and culture, water was a basic necessity to live, next to food, safety, and hygiene. Usually, some gods or goddesses were allied with water. Also, water was very significant for purifying the body and for cleaning Almost in all mythologies divinity is linked with water, various bodies of water,ter or water-based practices, and religious principles that use it for purification of body and soul. Minoans, Babylonians, Greeks, Romans, and the Americans and Indians all had deities for water irrigation of crops as well as water purity. Since the very beginning of humankind on Earth, the adequacy of available water has been of utmost importance for survival and prosperity.(Andreas N Angelakis, 2012)

Water is the basis of all that is good in life. The most beautiful things happen to us because the water provides us with vigour" (Rigveda X-9-1). Water is the beginning of everything (Thales of Miletus (636–546 BC))

Water is like a mother in this world. It is the sovereign of the world. It holds divine wealth, immortality, pious deeds in its possession for the welfare of the living beings" (Rigveda X-30-10 to 12). "The same mantra is repeated in the Atharvaveda (I-5-1) and is repeated in our rituals performed even today. "Water exercises maximum control over the living beings on earth" (Atharvaveda. I-5-4).

On the other hand, Since the time of ancient civilisation, Distillation has been used for making wine and perfumed liquids. In Vedic, Chinese, Greek, Roman, Mesoamerica and other civilisation wine and scented liquids have a significant role in the rituals and social practices.
There are many authors have highlighted the historical aspects of Distillation and Desalination previously.
In the desalination community, there is an interest in knowing the history and cultural roots
of technology development. There are many significant resources available on this. In the 19th century, many authors like (Mitra, 1881),(Gorman, et al., 1899)(Mouchot, 1869)(Zimmer, 1879)and other shave have given numerous references on the historical development aspects of Desalination and Distillation processed (Bourke, 1893)

(Nebbia & Menozzi, 1966) had given a very detailed account of history until the year 1800, the comprehensive bibliography written by Delyannis and Piperoglou(A.A. Delyannis and E . Piperoglou, 1967), and the two-volume of the book titled Quest for Pure Water by Baker and Taras(Baker, 1981)(Tares, 1981). Some very notable accounts based on archaeology were given by Lumholtz, Allchin, Mahdihassan, and Villarreal (Lumholtz, 1902)(Allchin, 1979)(Mahdihassan, 1981) and (Villarreal, et al., 2009). Detail references of the context are given in the Introduction of the History of Science by Sarton and History of Chemistry by Partington (Sarton, 1948)(Partington, 1962). There are essential details provided by the above authors. Somehow most of the authors had not spanned the eastern and Mesoamerican civilizations. In this review study, we tried to cover across cultures.

1 Prehistoric era (Until c. 3300 BCE)

The availability of drinkable water is one of the most critical global health and survival subjects from the very beginning of humanity. People living in the warm, arid zones of the world with the severest water deficiencies are always in quest of a source of drinkable water.
The result of dehumidification of humid air was a practical way to get drinkable water was known in prehistoric times(Kalogirou, 2009). Many caves or artificial caverns are found in the mountains. One of such cave is the city of Petra in Jordan. The cold stone surfaces act as Dehumidifiers which condenses the air humidity, and the water is collected in basins, as shown in Figure 2

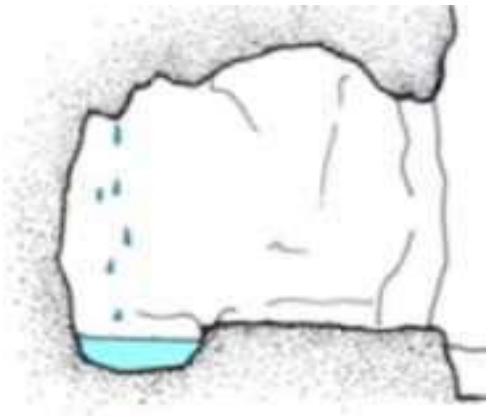

Figure 1 Natural cave Fordehumidificaion

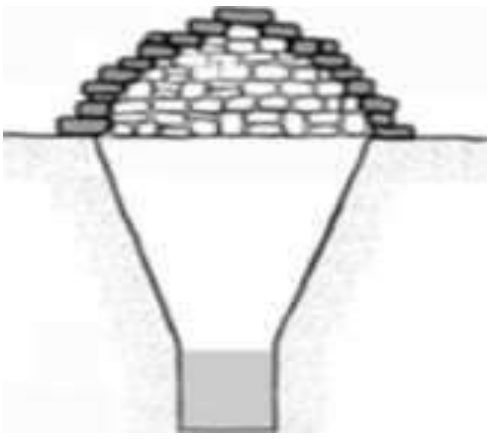

Figure 2Stone Cupola for dehumidification

Laureano describes a conceivable prehistoric system for water dehumidification in which humid air passes through an arrangement of stones as an air-permeable cupola. During the night the rocks are cooled. Moisture from the incoming moist air condenses inside of the cupola, and the condensed water drops down into a cavern. The setup was constructed below ground and retrieved from the side. The area inside the condensation chamber remains cool also during the day. Hence, the water could have been continuously produced(Kalogirou, 2009).
These techniques use the principles of dehumidification of ambient humid air whereby the temperatures of the stonewall are below the dew point of the incoming air, and therefore the water vapour condenses. At

that time, the phenomenon was most probably not understood, and consequently, it was observed and understood and then used as a water source.

2 Bronze Age – first urbanization (c. 3300 – c. 1800 BCE)In the Indian sub-continent, Harappans (c. 3200 - 1500 BC) seem to be aware of the process of alcoholic fermentation and Distillation. Mahdi Hassan has assembled total distillation pots from clay items routinely found in Indus Valley excavations. (Mahdihassan, 1972)had also reported that even before --Aryans entered Inata, which Max Muller dated as 3000 BC, the pre-Aryan hill tribes fermented Mahua-flowers (Bassialatifolia') and distilled the liquor. (Mahdihassan, 1972), Very early elaborate references of the distillation process do exist in Vedas which refers to the identification of certain types of pots as parts of stills. Such earthen vessels were found in many archaeological excavations in northwest Pakistan. Their occurrence, lead to the conclusion that the Distillation was widely used in that region between 150 BC and c. AD 350. This type of still resembles one of the two main types surviving in popular use throughout South Asia into this century.

3 Iron Age (1500-200 BCE)

In arid areas, it is widespread to find an increase in groundwater salinity and infrequent rainfall. The cumulative world population growth together with the growing agricultural and industrial activities globally contributes to the depletion and pollution of drinkable water resources In a developing country. historically it has been seen that the establishment of a distribution system to disseminate potable water has proven critical for public health improvements(Nelson, 2001)

In ancient India, the importance of clean water is well understood. Clean and safe water is distinguished from impure and unsafe water (*Rigveda VI-28-7; IV-57-2*).

There are many methods to extract drinkable water from saline water known to most of ancient society, and these methods are collectively called desalination methods. The accounts of Desalination in ancient civilizations are not well recorded. However, much archaeological evidence suggests that both Desalination and Distillation are known and used in ancient cultures. (Fairley, 1907).

Delyannis, in his very imperative paper referring Old Testament (Vetus, M.Dc. XXVIII Verse: 22- 25), in Exodus (about 1500 BC,) of a situation in which Moyses brought his Son to the red sea and with a wood he turned bitter water to sweet one and indicate that the Knowledge of desalination trace to Old Testament. Delyannis says It is conceivable that the "wood" mentioned above had ion-exchange properties ((Delyannis, 2003) However, no references provided supporting for the suggested ion-exchange processes.

In the Indian subcontinent, the ancient text dated back to 1500 BC, the Rig Veda, Sam Veda, and Yajur Veda the idea of infiltration, water movement, storage, and evaporation exists. During the time of Atharva Veda, the concept of water evaporation, condensation, rainfall, river flow, and storage and again repetition of the cycle was explained as in the earlier Vedas. According to the Atharva Veda, the sun rays are the main cause of rain and evaporation, as mentioned

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(AV, I, 5.2 AA.) (Anon., 2018).

In the western world, a similar understanding was shone by Aristotle after more than a thousand years. The necessary Knowledge of the water cycle in nature is the key for all development of Desalination and distillation process.

A fresh look into the archaeological finding and reviewing the references of the Vedic text elaborates beverages, and distilled alcoholic drinks exist. The clear references to the preparation of three categories of beverages and medicinal drinks such as Soma, Sura, and Parisrut exit in Vadic Time. Soma may be produced of ephedra as fresh herbal extract or juice. Sura is a beer-like drink made from millet grain. These two were known to the Aryans before coming to India. And, third would be Parisrut, a distilled spirit believed to be made fromMahuwa flowers, or those of Bassia latifolia. Parisrutand Distillation were probably learned from earlier habitant tribes of India(Mahdihassan, 1981) There are references to the Distillation process also adopted in the making of Sura.(Mitra, 1881)(Allchin, 1979).

Zimmer elaborately mentioned the drinks used by Aryan and referred thatParisrut is first recorded in Rigveda: 9, 1, 6 very vaguely as an epithet of soma and in other places as an adjective. Apparent reference of Parisrut was a beverage mentioned first in the Atharvaveda, distinct from Soma and Sura(Zimmer, 1879).

Since the time of the Rigveda (c. 1200 BC) Sura is widely referred to as an intoxicating drink, used in many Vedic rituals in conjunction with the more prestigious Shomrasa(Allchin, 1979)(Prakash, 1961) whereas Parisrut is an alcoholic beverage prepared by fermentation and Distillation of some flowers possibly Mahuwa which is rich enough in fermentable sugars to produce alcohol.(Gorman, et al., 1899) This quality Mahua has been known since the Vedic period DrMajumdar, mentions "Madhuga, honey-plant (recorded in) Atharvaveda, 1, 34,4; VI 122, 3 and occurs as Madhu-dugha in Rigveda, VI; 70, 1-5.". He also mentioned that, if Soma is distinct from both Sura and parisrut, as these two being intoxicant, hence, Soma was not an alcoholic drink. The mythical Som-rasa where Rasa meansthe juice is still not very clear which ingredients are being used for preparation(Majumdar, 1945)

As it is widely accepted that Rigveda was lastly composed in India whereas part of it had already been accomplished before Aryan reached India. Though there is controversy on the origin Aryan but discussion on this is beyond the scope of this review. Atharvaveda was entirely composed in India. This explains logically how soma and Sura are chronicled in Rigveda while Parisrut almost appears first in Atharva Veda. word soma entered Sanskrit about 4000 BC and the last hymn of Rigveda was composed of about 2000 b.c. in India, whereas Atharvaveda can be dated as 1500 b.c. Then Parisrut was mentioned initially about 1500 b.c. which could also signify the time when Distillation was first practised by the Aryans in India. However, as it was learned from the previousinhabitant natives of this region.(Gorman, et al., 1899)(Mahdihassan, 1981)Therefore, we may say the art of distilling is known in India more before.

Figure 3 *Desalination setup used by Jharkhand Tribes*

Figure 4Distillers *of alcohol used by tribes in Pabna, Bangladesh*

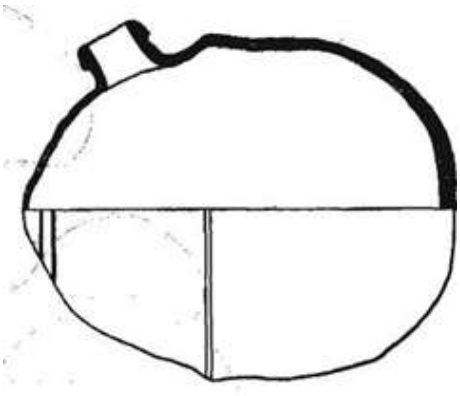

Figure 5 Pot found in excavations at Sirkap, near Taxila.

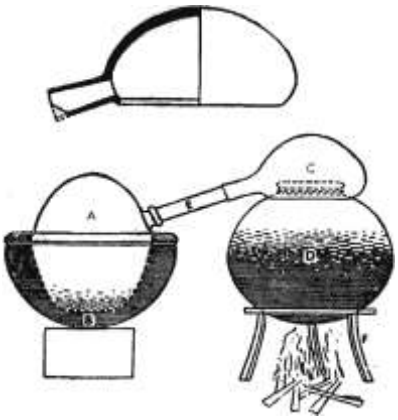

Figure 6*Sir John Marshall reconstructed distillation unit*

Many archaeological findings are also able to throw some light. In his excavations at Taxila, now in Pakistan, Sir John Marshall (1951:420) discovered, a cluster of vessels which he reconstructed as a distillation kit for condensing water. The apparatus comprised a group of terracotta vessels globular pot, covered by an inverted bowl or cowl, having a short spout on one side, and joined by a terracotta tube to a receiver in the form of a distinctive pot and iron tripod entirely enclosed except for a short wide spout on the domed top.

Marshall supposed that the receiver would have been placed in a basin of water to assist condensation. Excavations carried out at Taxila revealed items of pottery that Sir John (Marshall, 1951)has reconstructed into a distillation unit, reproduced here as. Excavations carried out at Taxila revealed items of pottery that Sir John (Marshall, 1951)has reconstructed into a distillation unit, reproduced here as **Error! Reference source not found.**. Wheeler has also found an alike bowl at Brahmagiri, Karnataka. whichdesignated by him as "Brahmagiri Stone Age Culture A". which was Megali culture prevailing from the early first millennium BC to the start of the 2nd Cent. BC(Wheeler, 1947).Gosh found a similar Pot shown in
Figure **5**, in excavations at Sirkap, near Taxila(Ghosh, 1947).In essence, it is very similar to an illicit distillers arrangement assembly used still for alcohol distillation by tribes in Pabna, Bangladesh which is photographed shown in Figure 4Distillers of alcohol used by tribes in Pabna, Bangladesh(Mahdihassan, 1972). The hill tribes in Jharkhand and Bihar continue to use the setup (Figure 3.) which is very similar to the reconstruction (Figure 6) done by Sir John Marshall.If we accept this conclusion it would provide evidence of Distillation in ancient India in the first-century B.C.-A.D. But so long as the Taxila evidence remained unique it could scarcely be sufficient basis for so major a conclusion.
Manusmriti Verse 11.90-93, and many other ancient Sanskrit text have references of consuming distilled (hot) Sura critically such as Mitākṣarā (3.253), Mahābhārata (12.165.48), Gautama (23.1), Baudhāyana (2.1.18, 19, 21), Āpastamba (1.25.3), Yājñavalkya (3.253-256).
Probing into the ancient manuscripts, there are references about their Knowledge of them which probably evolved independently among different civilizations before the dawn of history. Jewish scholars reflect on that the references in the Bible to the customs before the flood show that Noah was not the first to make wine.(Anon., n.d.). The sacred books of India give a alike account of Satyavarman, preparing and becoming intoxicated with mead. He, like Noah, was found in this state by his three sons, Shema Charma, and Jyapoti, (Fairley, 1907) the incidents being parallel to those given in the Bible. In St. Matthew's gospel There is a reference to Distillation when mention is made of the "grass of the field which today is and tomorrow is cast into the oven," explained as the casting into the pot or still of odoriferous grass or herbs to obtain perfumes or medicines. (Fairley, 1907)Another interesting reference is in the Holy Bible, Book of Job, "for He makes small the drops of water: they pour down rain according to the vapor thereof: which the clouds do drop and distill upon man abundantly". (Anon., 1943)
Apart from Indians, the process of wine and spirits making was known to the Chinese and later on Arabs, since ancient times Distillation has been comprehensively studied in China and the Middle East. After examining the available evidence of archaeology and references in documents, Distillation in China was probably first attained during the Eastern Han period (CE25–220). (Huang, 2000)on another account (Shizhen, 1567). suggested the origins of distillation back to the Yuan period(Schottenhammer, 2017). On the other hand, the art of Distillation was already known in China during the seventh century. We also have other references to "burnt wine" (shaojiu) stemming from the Tang and Song periods. The technology to prepare perfumed water by steam distillation was known under the Song, too.(Huang, 2000), Huang Xingzong concludes that the art of Distillation probably existed in Chinese Alchemist the 3rd century" and was well known as a process in the Tang Period (Schottenhammer, 2017).

Figure 7 Assemblage of the still and iron tripod from Bairin(Luo, 2012)

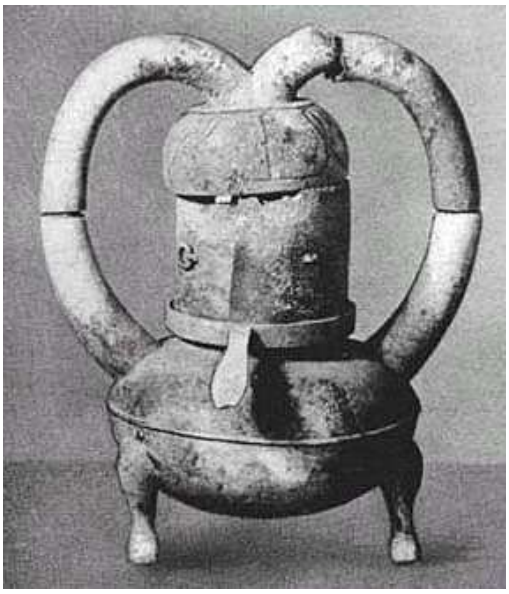

Figure 8 Distillation apparatus from the Han dynasty, dated around the first century AD(Anon., n.d.)

The know-how of Desalination was known in the Middle East and Alexandria in long back to the first and second century BC(Piperoglou, 1967)(Anon., 1982)(Badger, 1926). Distillation was being used by Greek alchemist for Cleopatra, and Alexander of Afrodisia for extracting(A.A. Delyannis and E . Piperoglou, 1967) perfume and scented oil by natural products (Silver, 1962)(Bittel, 1959). The notable works by Jabir Ibn Hayyan who is called sometimes called al-Harrani and al-Sufi(c. 721–815), is considered the father of Arab chemistry, had written an elaborated work on a process similar to Desalination and Distillation (Holmyard, 1928).

Aristotle (BC 384—322) has an understanding of the evaporation and condensation process which reflects in his Meteorology, “Saltwater evaporated forms fresh, and the vapor does not when it condenses condense into seawater again”(A.A. Delyannis and E . Piperoglou, 1967).Aristotle in his work Meteorology says, “seawater can be made drinkable by vaporization; other liquids behave in the same way.” He also speaks of the formation of dew from the moisture in the air(Aristotle, n.d.).Nicander (b.c. 183—135), a Greek poet and physician, spoke of the extraction of perfumes from plants by what we should now call a process of Distillation.

Many references to the desalination process used for ships in the sea. A method of collecting freshwater from seawater is mentioned by Pliny in his book, Natural History (Menozzi, n.d.), in which he had written that over the side of a ship at night just above the water’s surface a fleece or sheep’s wool hanged in the evening and all night, and thus, it will become saturated with the water vapor during the evening and in the night and maybe squeezed out in the morning for getting fresh water. In the middle of the fourth century AD, St. Basil (Menozzi, n.d.), reported on a method used by sailors which comprised of boiling seawater on the shipboard and putting a natural sponge over the mouth of the vessel. The water vapor condenses in a sponge. This vapor could then be squeezed from the sponge and used for drinking purposes.(Howarth, 1984.)

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It is largely thought that earlier the opening of the Christian era the Greeks of Alexandria were aware of the art of Distillation. And well along used by the Arabs for getting essential oils. In 8th and 9th centuries wine distillation and alcohol isolation were known in the Middle East, (Hassan, et al., n.d.)(al-Hassan 2002). but that the Distillation used for obtaining alcohol only developed in Western Europe from the twelfth century AD(Allchin, 1979).

The Alexandrian authors such as ZosimusJ (a.d. 290) and Synesius (about a.d. 350); and two females, Hypatia and Mary the Egyptian. A few of them such as Hypatia who did not accept Christianity, were victimized and killed, and their writings were ruined. after a blameless life devoted to teaching and scientific work. She was said to have invented the hydrometer for taking the specific gravity of liquids and tools for Distillation,

Mary the Egyptian designed the water bath referred to and acknowledged after her in many languages, "bain-marie," "Bagno-maria," etc. Among the limited remnants of the writings known to now is part of those of Zosimus in the Bibliotheque National in Paris. One of his drawings of a distilling apparatus is given in Figure 9, also old forms of distiller from the work of J. Baptiste Porta, written in 1608. The hydrometer and the distiller and are the devices that would find their earliest and most frequent application in the Distillation of alcoholic liquids.(Fairley, 1907)

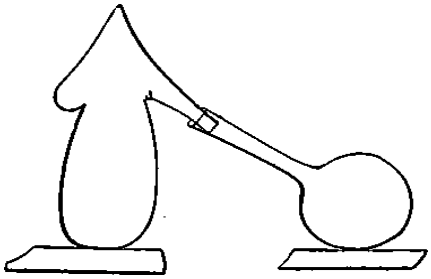

Figure 9Alembic and reservoir figured by Zosimus the Panopolitnin, of Alexnndria,said to have been copied from the ancient Temple of Memphis, in Egypt(Fairley, 1907)

Knowledge of the Distillation like other ancient science reached Europe by Arabs. Arabs acquired it from different civilizations. Therefore, Gibbon and other historians have attributed the invention of Distillation and other chemical arts to the Arabians. Arabs outclassed others in trade and commerce and traded across many countries, by land and sea, including India, China, and the East Indies. The art of distillation dates known in these regions, from a period before the Christian era, and possibly independent of Egypt in its discovery. The contribution of Arabs in spreading Knowledge across civilization is unparalleled(Fairley, 1907).
However, Distillation is known to humans very early also in other civilizations. (Fairley, 1907) given an interesting detail That the acquaintance of Distillation and distilled liquors In many of the South Sea Islands has existed before it was introduced by Europeans. when Captain Cook first visited the Society Islands, he found them already in possession of these distillation skills, using still (

Figure 10 Primitive Still used in Tahiti, the Society Islands) which, from its most primitive form and materials, may have been known for many centuries. The body of the still is a large stone hollowed to form a pot, placed on stones with a gap between, for the fire. Above of this pot is placed ahead molded of the hollowed-out trunk of a tree. In this is inserted a long bamboo cane, which passes through a trough or gutter filled with cold water to serve as a condenser. (Fairley, 1907)

Figure 10 Primitive Still used in Tahiti, the Society Islands(Fairley, 1907)

Figure 11 Original trifid and gourd-shaped pot from the Captcha cultural phase (1500- 1000 BC) of Colima, Mexico, replicated for the experiments. National Museum oí Anthropology and History (Villarreal, et al., 2009)

The existence and use of distilled drinks in Mesoamerica before European contact in 1521 is debatable. However, In the late 19th century, (Bourke, 1893) and Lumholtz suggested that Distillation had developed

before contact based on their findings that several cultures in western Mexico (Lumholtz, 1902)(Villarreal & Colunga-GarcíaMarín, 2007). (al, n.d.)(Needham & Lu, 1985) also supported the theory that Distillation in Mesoamerica may have been invented earlier than European contact. Mesoamericans was producing distilled beverages using a very primitive but efficient still, clearly dissimilar from the Arab-type, introduced by the Spanish in the 16th century. Burman disagreed and proposed that these simple stills were derivatives of those introduced by Filipinos to the Colima region in the late 16th century for making coconut spirits(Bruman, 1940). He emphasized their resemblance to East Asian stills described by Feliciano (Feliciano, 1926)and regional use of the Tagalog-origin word tuba (the Filipino term for fermented coconut beverage) to refer to the fermented beverage. Zizumbo-Villarreal and Colunga-GarcíaMarínprovided additional evidence supporting Burman's proposal.(Villarreal, et al., 2009).

Medieval Period

Some historical events had a great impact on the flow of Knowledge across the great cultures, among of them is the Moorish occupation of the Iberian Peninsula and then later on the establishment of great learning centers like the University at Toledo. Such a learning center became a gateway to Knowledge and the work of early Greek, Persian, Egyptian, and Arabs to Europe.

Applications of Desalination by solar energy were not referred to in medieval times. However, Knowledge of Soler energy and its application was used to fire alembics used for concentrate dilute alcoholic solutions or herbal extracts for medical and cosmetic applications and used to produce wine and numerous perfume oils(Delyannis, 2003)According to (Malik, et al., 1985) the earliest reference is that of an Arab alchemist in the 15th century reported by (Mouchot, 1869). Mouchot described that the Arab alchemist had used polished Damascus mirrors for solar Distillation to focus solar radiation onto glass vessels comprising saltwater for producing freshwater.

Post Medieval

Though fire-based desalination was used in pre-medieval times, however, solar heating devices are known even though no significant appliance of Desalination by solar energy existed until medieval times. During this period, alembics or stills were used to increase the concentration of a dilute alcoholic solution as well as an herbal extract for perfume oils and medicines. Solar energy was used to fire alembics. The stills or alembics were discovered in Alexandria, Egypt, during the Hellenistic period. Cleopatra the Wise, a Greek alchemist, developed many distillers of this type. One of them is shown inFigure 12 Folio of Cleopatra Chrysopoeia from Codex Marcianusgraecus.Figure 13

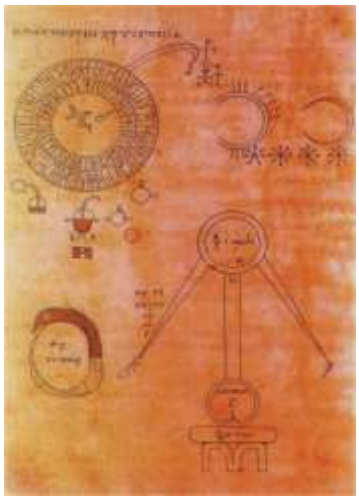

Figure 12 Folio of Cleopatra Chrysopoeia from Codex Marcianusgraecus.(Millesima, n.d.)

Figure 13 The Furnace of the Great Mother with the Codex's folio with Cleopatra's invention of alembic, engraving.Frontispiece from Urban Hjarne, ActorumChemicorumHolmensium, 1712(Fabricius, 1994).(Cheney, 2018)

The head of the pot was called the ambix, which in Greek means the 'head of the still', but this word was

applied very often to the whole still. The Arabs who overtook science and especially alchemy in the seventh century named the distillers Al-Ambiq, from which came the name alembic(Nebbia & Menozzi, 1966).
There are many references available that during the 7th century, Arab scientists developed solar distillation apparatuses that concentrated solar power (Mouchot, 1987)(Delyannis, 2003) .
Mouchotthe well-known French scientist who Also experimented with solar energy, mentions in one of his numerous books that in the 15th century Arab alchemists used polished Damascus concave mirrors (Mouchot, 1987)
Later on, during the Renaissance, Giovani Batista Della Porta (1535-1615), one of the most important scientists of his time, wrote many books that were translated into French, Italian, and German. In one of them, Magiae Naturalis, which appeared in 1558, in the 20th volume several distillation methods, among which one of them was the solar-powered Distillation produced essences from green leaves condensed at the inner surface of the glass vessel Figure 14. Della Porta explains principle is the basis of Solar Stills, that the condensation of humid air on cold surfaces, here it is glass. Whereby water is heated using solar energy, freshwater evaporates and condenses on a cool glass surface as distilled water. (the phenomenon that he experienced in winter in Venice(Mouchot, 1987)(Delyannis, 2003)He mentions three desalination systems(Nebbia & Menozzi, 1966).In 1589 he issued the second edition, wherein the volume on Distillation
Sir Richard Hawkins (c. 1562 -1622) was a 17th-century English seaman, explorer, pirate, and privateer., who traveled the south sea had claimed using shipboard Distillation for the supply of freshwater for seaman.(Nebbia & Menozzi, 1966)(Baker, 1981)Francis Bacon was reviewing earlier published work on water distillation (Baker, 1981), and at the same time, Robert Boyle had published his several works on chemistry and natural philosophy, which included studies of the behavior of gases under vacuum Figure 15 Boyle's Apparatus for Distillation under Reduced Pressure. (Figure 15) and pressure (Sarton, 1948). In the early 1600's Sir Walter Raleigh when he was imprisoned in the Tower of London, he experimented with seawater distillation (Nebbia & Menozzi, 1966). During the reign of Charles II, many such reports (Cleveland, 1754) were published in England.

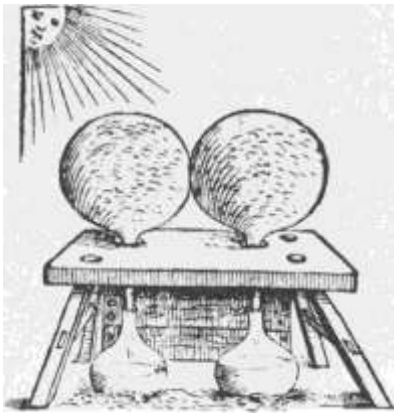

Figure 14 *Solar distillation device by Della Porta(Nebbia & Menozzi, 1966)*

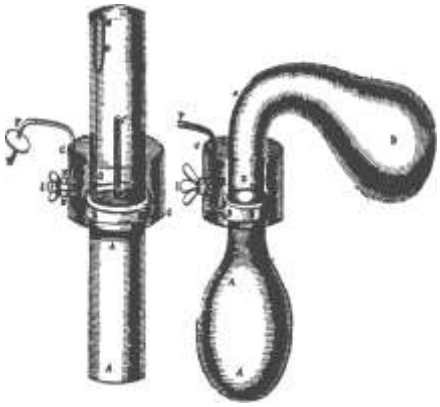

Figure 15 *Boyle's Apparatus for Distillation under Reduced Pressure.(Sarton, 1948)*

Figure 16 *Medals celebrating Fitzgerald still(Nebbia & Menozzi, 1966)*

Mouchot (1825 – 1912) was a very visionary scientist and engineer, who may be credited for his advocacy for renewable solar energy as the energy source of the future believing that the coal which fueled the Industrial Revolution would eventually run out. His solar energy experiment devices and construction of solar Desalination, the Distillation of alcohol, Solar power steam engine are notable. He developed devices using a metal mirror with a linear focus in which a boiler was positioned along its focal line (Figure 17)

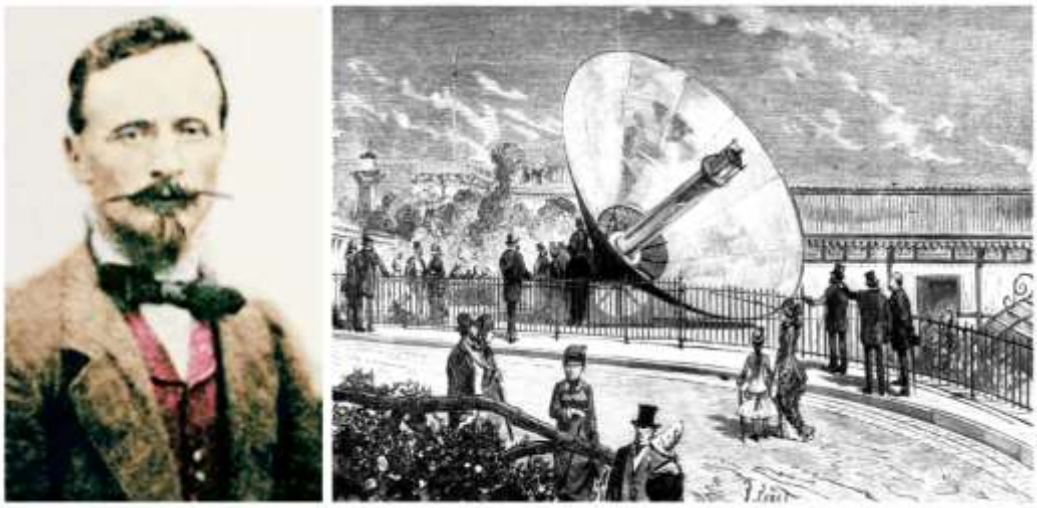

Figure 17Mouchot *and his devices, Storie Di Scienza E Non Solo..1886, http://storiediscienza.altervista.org /blog/primi-motori-energia-solare-1886/*

Conclusion

The roots of the developmentof Distillation and desalination process is traced back to the very early phases of human civilisation. It was existing in one or other way in all ancient civilisation of Indian,china's,Mesoamerican and others. Though they have different origin they are very similar in technical approach as well as in their purpose. Like another achievement of mankind,it also indicates that civilisation finds the solution and develops technology independently in very similar ways.The interaction of civilisationsdown the centuries also propagated the knowledgeacross other civilisation. No technologyremainsabsolutelyunique to anycivilisation. Down the time every civilisation adopt and contribute its growth and adopted it as per its local need, This also holds good for Distillation and Desalination.Historic developments help current generations to appreciate and comprehend the continuity of scientific achievements and to adopt and use old ideas to new existing methodologies

Looking back to history allows a new generation to see development in a new perspective and also help them to acknowledge all civilisation for there contribution and give a broader global outlook and leads to create an environment of global scientific society which act cohesively for knowledge sharing for tackling global scientific challenges.

is not an event that goes back only to very ancient times. Taking into consideration the very rapid rate of new developments, what is for our generation a new sophisticated development and application, is for a new generation already a historical event.

List of Figures

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