



**Research Paper**

**HOT WATER SPRINGS: ANCIENT AND MODERN ERA**

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India was a cradle of civilization in the ancient world. A vast number of statements and materials presented in the ancient Vedic literatures can be shown to agree with modern scientific findings and they also reveal a highly developed scientific content in these literatures. The great cultural wealth of this knowledge is highly relevant in the modern world.

An interesting feature of all ancient civilization was that its inhabitants realised the tremendous value of water in human life. Each of these civilizations was located on the banks of a river or within a convenient distance from the sea. This was to ensure a perennial supply of water for day to day activities.

It is indeed astonishing to realize that at the dawn of civilisation, the humans understood the significance and importance of water. Apart from cooking, personal cleanliness and hygiene, water was vital for cultivation and irrigation of crops. In that early age, water was a major mode of transport; with further progress and development water again became an invaluable source of food as well as trade and commerce.

According to the RigVeda, all life on this planet is evolved from apah (water). Water is usually acknowledged as the basic need of all living creatures upon the face of this earth. There are copious references in Vedic literature about medicinal properties of water, uses of water, last but not the least the importance of conservation and preservation of water.

Caraka and other sages of ancient India have said that entire water is ultimately of one type which falls from the sky as directed by Indra.

*jalamekaṃ vidhaṃ sarvaṃ patatyaindraṃ nabhastalāt ।  
tatpatatpatitam caiva deśakālavapekṣate ॥*

— Caraka Saṃhitā Sūtrasthānam, 196

It was believed that Lord Indra directs the fall of water from heaven according to the activities performed by the mortals. Modern scientists say that absolutely pure water consisting only of water free from any dissolved optically void is laboratory curiosity and most difficult to prepare. Such a water could be soft, colourless, odourless and would have a pH value of 7.0. but ancients could distinguish this type of water known as *antarikṣham* and this becomes clear from the statement of *susruta* :

*pāṇīyam antarikṣam anirdeśyarasamanṛtam  
jīvanam tarpaṇam dhāraṇam āśvāsajananam  
śramaklama pipāsā madamūrcchātandrānidrādāha  
praśamanam*

- Suśruta Saṃhitā, Sūtrasthānam, 45.3

Even though ancient texts said that entire water is of one type, water was broadly classified into two classes, *divya* and *bhuma*.

*Divya* is that falls from the sky and again it was classified into four types, viz., *dharna*, *kara*, *tusara* and *haima*. *Dhara* is the rain water, *kara* is the hail stones, *tusara* is snow water and *haima* is the water from the dew. Rain water is again *gangam* and *samudram* based on seasonal variations which are responsible for bringing about the various merits and the demerits of water. The *gangam* is that water which is not contaminated whereas *samudram* is contaminated with dust, poison, etc..

Among the *bhauma* there are nine types:

- 1) Nadeya – water of rivers emerging from mountain, having tinge of sapphire
- 2) Nisyanda – slightly warm and clear obtained by making pit
- 3) Sarasa- water collected from streams flowing from rivers
- 4) Bhauma – clear and tasty water from ponds and wells
- 5) Kaunda- water found in midst of rocky reservoirs. Sweet, clear having therapeutic values.
- 6) Tadaka – water collected in large lakes and which is mixed with fresh water every year
- 7) Nairjhara – soft, clear, tasty water of water-falls which flow down by piercing the rocks of mountains
- 8) Varksa –water obtained from trees,which are nourishing and refreshing
- 9) Audbhida – water which gushes out with force from a spring.

It was not long before man discovered importance and beneficial properties of water: its ability to protect from diseases, as well as its healing and preventive properties. Multiple magical virtues were attributed to water, and it was even considered a true gift of the gods. Numerous myths and legends, considering the miraculous healing of the soul and body, were attributed to its mysterious powers. Man has always searched for health and wellness in water, which, throughout history, has often been loaded with symbolic and cultural values. These type of properties were mainly found in '*Kaunda*' type of water.

The description of these type is also mentioned in Bible:

***Hast thou entered into the springs of the sea? Or hast thou walked in the recesses of the deep?***

***[Job 38:16] [Emphasis Added]***

Here it was mentioned that Hydrothermal vents are found in areas of the ocean floor that are spreading, such as at mid-ocean ridges, where tectonic plates are being pulled apart. Molten magma then rises from deep inside the Earth, superheating the cold ocean water around it. The average temperature of deep-ocean water is only 2°C (36°F). The water coming directly from a hydrothermal vent can reach up to 350°C (662°F) and is rich in dissolved chemicals. The hot spring water forms a plume above the vent, somewhat like smoke rising from a chimney into the air.

These Kaunda are referred to as hot water spring which was also mentioned in other literature like *Ramayana* and *Mahabharata*. From these literature it was believed that the hot springs are originated because of the different aspects one of the eg is Manikaram located at Himachal Pradesh. The legend of Manikaran states that while roaming around, Lord Shiva and Goddess Parvati, once chanced upon a place that was surrounded by mountains and was lush green. Enamoured by the beauty of the place, they decided to spend some time there. It is believed that they actually spent eleven hundred years here.

During their stay here, Goddess Parvati lost her mani in the waters of a stream. Upset over the loss, she asked Shiva to retrieve it. Lord Shiva commanded his attendant to find out the mani for Parvati, however, when they failed, he was extremely angry. He opened his third eye, a tremendously inauspicious event which led to disturbances in the universe. An appeal was made before the serpent god, Sheshnag, to pacify Lord Shiva. Sheshnag hissed thereby giving rise to a flow of boiling water. The water spread over the entire area resulting in the emergence of precious stones of the type Goddess Parvati had lost. Lord Shiva and Goddess Parvati were happy at the outcome.

The name Manikaran is derived from this legend. The water is still hot and is considered extremely auspicious. A pilgrimage to this place is thought of as complete. It is also believed that there is no need to pay a visit to Kashi after visiting this place. The water of the spring is also supposed to have curative powers. The water is so hot that rice can be cooked in it.

Because of the various properties which are already mentioned in earlier literature, the study of hot water springs have gain main importance. The geo-tectonic setup of India, the fault map zones and the epicenter of seismicity indicate about the anomalous nature of different types of geothermal distributions i.e. hot water springs. Geological Survey of India had identified 340 Hot-water springs which are characterized by orogenic activity. Geothermal Studies in India taken place by Schiagintweit who documented 99- Hotwater springs in India in 1864 . R. D. Oldham in 19th century published an inventory of three hundred thermal springs India. La Touché published a list of mineral springs in 1918. Subsequently, studies on the hot springs were carried out by Heim and Ganssar (1938), Pranvananda (1949) , Ghosh (1954) , Chatterjee and Guha (1964) .

The Ministry of Power and Irrigation of our country constituted a committee on 'Hot Springs' in 1963 to explore the commercial potential of thermal or Hot-water springs which was comprised of members from the GSI, NGRI (National Geophysical Research Institute) and Jadavpur University (Kolkata).

In this study we have selected hot springs which is one of the major hot springs in India, that are situated at Vajreshwari and Ganeshpur, thane, Mumbai, Maharashtra.

#### **Vajreshwari hot springs:**

*Vajreshwari is at the foot of Mandakini Mountain, which was formed out of a volcanic eruption and it is this proximity that accounts for the many hot springs in this region. There exist several hot springs here. There are even more hot springs further afield. According to scientists, their proximity to the former volcano in the region accounts for their creation. It is reported that there are around twenty-one hot water springs, just within a five-kilometer radius of the temple. The Tansa river flows through here, rich with its hot waters. The hot springs stretch for about 7 km in the bed of this river, the most well known ones being located here and at the nearby villages of Akloli, Ganeshpuri and Satvalli. The temperature of the water in the springs ranges from 43° C to 80° C. A couple of tanks in front of a Shiva temple trap the water of seven of the hot water springs. Because the waters are laden with minerals, the water appears blackish.*

#### **Ganeshpuri hot springs:**

*Ganeshpuri is about 2 km away from Vajreshwari and is also famous for its natural hot springs. Three of the springs are in the bed of the Tansariver, near the temple of Shri Bhimeshvar and they have reservoirs built round them. Two of the hot springs are in natural hollows in the rock. The temperature of hot water is 52°C to 85°C.*

#### **Ancient Era :**

#### **Mythology of the place and Kundas as mentioned in ancient literature :**

#### **Legends :**

The region of Vadvali is mentioned in the Puranas (Hindu scriptures) as visited by Avatars (incarnations) of Vishnu (Hindu god of preservation): Rama and Parshurama. The legend has it Parshurama had performed a yajna (fire offering) at Vadvali and the hills of volcanic ash in the area are its residue.

The primary deity of the temple, Vajreshwari (vajre?vari), also spelled Vajreshvari, also known as Vajrābāi and Vajrayogini, is considered as incarnation of goddess Parvati or Aadi-Maya on earth. Her name literally means "the lady of the Vajra (thunderbolt)". There are two legends about the goddess' origins, both associated with the Vajra.

Thousands of years ago, a Rakshasa (demon) named Kalikala or Kalikut troubled the rishis (sages) and humans in the region of Vadvali and waged a war against the devas (gods). Distressed the gods and sages headed by Vashishta performed the TriChandi yagna, a fire offering to the Goddess, to please Her. An aahuti (offering of ghee in yajna) was not granted to Indra (king of devas). Enraged, Indra hurled his Vajra - one of most powerful weapons in Hindu mythology- at the yajna. The terrified gods and sages prayed to the Goddess to save them. The

Goddess appeared in all her glory at the site and not only swallowed the Vajra and humbled Indra but also killed the demons. Rama requested the Goddess that she should stay in the region of Vadvali and be known as Vajreshwari. Thus, the Vajreshwari temple was established in this region.

Another legend says that Indra and other devas went to goddess Parvati and requested her to help slay demon Kalikala. Goddess Parvati assured that she will come to their aid at the right time and ordered them to fight with the demon. In the battle, Kalikala swallowed or broken all weapons thrown at him. Finally, Indra threw the Vajra at the demon, which Kalikala broke into pieces and from the Vajra, emerged the Goddess, who destroyed the demon. The devas extolled her as Vajreshwari and built her temple.

The 7th canto of Navanath Kathasar states that Machindranath served goddess Vajrabhagawati (Vajreshwari) for a month by giving her a bath of the water of hot springs.

There are around 21 kunds (Surya, Chandra, Agni, Vayu, Sita, Lakshmi, Lakshmana etc.), which are hot water springs, nearby this place, which are believed to be the blood of the *rākṣhasa* killed by the Devi.

### **Modern Era :**

The Scientific Revolution established science as a source for the growth of knowledge. During the 19th century, the practice of science became professionalized and institutionalized in ways that continued through the 20th century. As the role of scientific knowledge grew in society, it became incorporated with many aspects of the functioning of nation-states.

The history of science is marked by a chain of advances in technology and knowledge that have always complemented each other. Technological innovations bring about new discoveries and are bred by other discoveries, which inspire new possibilities and approaches to longstanding science issues.

During the last decades some extensive research efforts have been made to prove various uses which are already mentioned in the ancient literature and to explore new insights from these hot water springs which are associated with their potential applications in clinical, microbiological and biotechnological fields. Some of these findings done by us are as follows :

1. Various metals and minerals are present like sulphur, ferrous, iron, chloride, fluoride, phosphate etc. Which are already mentioned in literature.
2. These water have anti bacterial and anti healing properties which are in similar line with ancient literature.
3. The first life evolves from water is proved scientifically by in silico method using phylogenetic relationship drawn by Bioinformatics tools.
4. A new insight is found out which shows that these water have special type of species that have properties to reduce heavy metals thus these water can be used to control pollution.

*Some other findings are as follows :*

1. *Scientists of the National Chemical Laboratory have isolated a molecule that inhibits the AIDS causing HIV-1 protease, from a microbe that thrives in the high temperature and alkaline conditions of the hot waters at Vajreshwari.*
2. *In 2011, Pallavi Pednekar et. al. have studied on anti-infective potential of bacteria isolated from Akoli, Vajreshwari, Ganeshpuri, and Satvalli hot water springs.*
3. *In 2014, Vijay Kumar, have explored diversity of thermophilic actinomycetes in different terrestrial hot spring sites like vajreshwari and Ganeshpuri hot Springs and isolated amylase enzyme for biotechnological applications.*
4. *Somen Acharya in 2012 studied the effect of some nutritional and environmental factors on the production of cellulases, in particular endoglucanase (CMCase) and exoglucanases (FPase) from *Bacillus licheniformis* MVS1 and *Bacillus* sp. MVS3 isolated from Vajreshwari hot spring*

5. In 2008, George, J., et. al. have worked on isolation and characterization of sulphate reducing bacteria *Desulfovibrio vulgaris* from Vajreshwari thermal springs.

From the above discussions we can conclude that our ancients literature acts as a precursor for modern technology or science. All the facts described in the literature are theoretic proof of what are discovered by science and technique.