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## Unlocking the ancient secret of the levitating Shiva-lingam of the Somnath Temple: The forgotten crowning achievement of ancient Indian scientific thought

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### Abstract

Mahmud of Ghazni, an Afgan King, is primarily remembered in history owing to his numerous raids on India. Most prominent of these being the raid on Somnath temple in 1025-1026 A.D. His historians vividly describe the levitating Shiva-lingam of the Somnath Temple which was suspended in air by magnets in roof and walls of the temple. We argue on basis of historical evidence that the Shiva-lingam was made of iron-nickel meteorite fragment. Further as regarding its levitation, a law of modern magnetism known as Earnshaw's theorem prohibits the stable levitation of one magnet by other magnets. However it can be circumvented by use of diamagnetic materials like bismuth. We hypothesise on basis of historical accounts that at the ancient Somnath temple, diamagnetism using bismuth was used to levitate the iron-nickel meteorite Shiva-lingam. Metallurgy in ancient India was well advanced for such advanced experimentation.

**Keywords:** Somnath, ancient, shiva-lingam, levitating, magnet, loadstone, bismuth, lead, iron-nickel meteorite

### Introduction

The Hindu Shiva temple of Shri Somanath located in the Prabhas Kshetra near Veraval in Saurashtra on the western coast of Gujarat, India, is the first among the twelve Jyotirlinga shrines of the God Shiva. The temple is considered very sacred among the Hindus due to the various legends connected to it. Somnath means "Lord of the Soma", an epithet of Shiva<sup>[1]</sup>. The very mention of this ancient, revered Jyotirlinga brings vivid in the memory of every Indian the infamous raid of Mahmud of Ghazni on the famous temple. Mahmud of Ghazni, taking advantage of the bitter, internecine fighting among the Indian Kingdoms at that time, managed to defeat the Indian Kings and storm Somnath, looting the temple and breaking the famous idol in 1025–1026 A.D<sup>[2]</sup>. History chiefly remembers Mahmud of Ghazni for this nefarious deed and even the textbook history of the ancient Somnath temple usually centers around this infamous looting raid.

However, another forgotten aspect of the Somnath temple was the floating Shiva-linga in the temple. About it, the famous Persian geographer Zakariyah Al Kazvini wrote the following interesting account<sup>[3]</sup>.

"Somnath is a celebrated city of India, situated on the shore of the sea and washed by its waves. Among the wonders of the place was the temple in which was placed the idol called Somnath. This idol was in the middle of the temple without anything to support it from below, or to suspend it from above. It was regarded with great veneration by the Hindus, and whoever beheld it floating in the air was struck with amazement, whether he was a Mussulman or an infidel. The Hindus used to go on pilgrimage to it whenever there was an eclipse of the moon, and would then assemble there to the number of more than a hundred thousand. They believed that the souls of men used to meet there after separation from the body, and that the idol used, at its pleasure, to incorporate them in other bodies, in accordance with their doctrine of transmigration. The ebb and flow of the tide was considered to be the worship paid to the idol by the sea. Everything that was most precious was brought there as offerings, and the temple was endowed with the taxes gathered from more than ten thousand villages.

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There is a river, the Ganges, which is held sacred, between which and Somnath the distance is two hundred parasangs. They used to bring the water of this river to Somnath every day, and wash the temple with it. A thousand Brahmans were employed in worshipping the idol and attending on the visitors, and five hundred damsels sang and danced at the door – all these were maintained upon the endowments of the temple. The edifice was built upon fifty-six pillars of teak, covered with lead. The shrine of the idol was dark, but was lighted by jewelled chandeliers of great value. Near it was a chain of gold weighing two hundred mans. When a portion, or watch, of the night closed, this chain used to be shaken like bells to rouse a fresh lot of Brahmans to perform worship. When Sultan Mahmud, the son of Sabuktigin, went to wage religious war against India, he made great efforts to capture and destroy Somnath, in the hope that the Hindus would then become Mohammedans. He arrived there in the middle of Zu-l-ka'da, 416 A. H. (December, 1025 A.D.). The Indians made a desperate resistance. They kept going in to the temple weeping and crying for help; and then they issued forth to battle and kept fighting till all were killed. The number of the slain exceeded fifty thousand. The king looked upon the idol with wonder, and gave orders for

the seizing of the spoil and the appropriation of the treasures. There were many idols of gold and silver, and countless vessels set with jewels, all of which had been sent there by the greatest personages in India. The value of the things found in the temples of the idols exceeded twenty thousand thousand dinars.

When the king asked his companions what they had to say about the marvel of the idol, and of its staying in the air without prop or support, several maintained that it was upheld by some hidden support. The king directed a person to go and feel all around and above and below it with a spear, which he did, but met with no obstacle. One of the attendants then stated his opinion that the canopy was made of loadstone, and the idol of iron, and that the ingenious builder had skillfully contrived that the magnet should not exercise a greater force on any one side – hence the idol was suspended in the middle. Some inclined toward this explanation, others differed from it. Permission was obtained from the Sultan to remove some stones from the top of the canopy to settle the point. When two stones were removed from the summit, the idol swerved on one side; when more were taken away, it inclined still further, until at last it rested on the ground.'



**Fig 1:** Photograph of Somnath Temple in 1869. (Photo by permission of British Library Board – No. 1587)

Thus we see that there the story of floating Shiva-linga of Somnath was true and not merely a writer's imagination as Al Kazvini, himself a Muslim historian, had described it in detail. History is usually dictated by the victors and the achievements of the vanquished are usually skipped or underplayed. That Al-Kazvini described it in such detail is a testimony to the degree to which this achievement of the vanquished Indians was held in admiration even by the victorious army from Ghazni.

So now we are left to the arduous task of guessing how ancient Hindus had devised such a system which could keep a Shiva-Linga floating in air without the aids of modern science or magnetic superconductors. For this, first we have to understand the origin of the Shiva-linga of Somnath.

The ancient text detailing the war between the various Vedic

age Aryan tribes, the Mahabharata, the core kernel of which has been dated by the noted historian Pargiter to around 950 BC, refers to the Prabhasa Kshetra and the legend of the moon worshipping Shiva [2]. Although no temple at Prabhasa is mentioned in the Mahabharata, it is mentioned as a place of pilgrimage. According to a legend narrated in the Shiva Purana (10-11<sup>th</sup> Century AD) [4], once Lord Brahma and Lord Vishnu had an argument in terms of supremacy of creation. To test them, Shiva pierced the three worlds as a huge endless pillar of light, the *jyotirlinga*. The Jyotirlinga shrines are places where Shiva is supposed to have appeared as a fiery column of light. Applying scientific logic, it is clear that the Jyotirlinga shrines are temples where the Shiva-linga is actually a meteorite which appeared as a fiery column of light.

The Skanda Purana (7-10<sup>th</sup> Century AD) <sup>[5]</sup> describes the Sparsa Linga of Somnath as one bright as the sun, the size of an egg, lodged underground. Now this description of size of the Shiva –Linga at Somnath, it being bright as the sun and being lodged underground all tally with it being a meteorite. Meteorites usually appear in a very bright flash as they traverse the atmosphere – hence being compared to the sun in its brightness and since most of the bulk of a meteorite is vaporized in the atmosphere, it's size would have been comparable to an egg, albeit probably slightly bigger as per testimony of other historical accounts about the floating Shiva-linga. When meteorites crash on earth, most of the meteorite disintegrates with force of impact into dust. Rarely fragments from iron-nickel meteorites survive this fiery journey through the earth's atmosphere and can be found intact. These fragments may get embedded in the ground <sup>[6, 7]</sup> probably that is what the Skanda-Purana alludes to when it says that the Sparsa-Linga of Somnath was lodged underground.

Thus a plausible guess would be that the Shiva-Linga of meteorite origin was being worshipped in the Prabhas region by 900 BC and probably it was improvised upon to become the floating Shiva-Linga of Somnath by some ancient genius at a later date.

There is more evidence contained in the historical accounts itself about the Somnath Shiva-linga clearly pointing it to being a Iron-nickel meteorite remnant. The Arab Historian Abulfeda, who wrote at the commencement of the thirteenth

century, in his description of the raid of Mahmud Ghazni on the Somnath temple writes that Mahmud lighted a fire around the Somnath Shiva-linga to split it on account of hardness of stone <sup>[1]</sup>. Iron-Nickel meteorites are very hard, harder than common rocks found on earth's surface and strongly magnetic. Farrington in his article on the constituents of meteorites in the Journal of Geology writes that Nickel-iron meteorites are strongly magnetic, have a specific gravity between 7.6 and 7.9 and are harder than steel <sup>[8]</sup>. Thus during his raid on Somnath, Mahmud must have tried to smash the Shiva-linga using hammers or stones but being very hard, it resisted those efforts. Being in hostile enemy territory with time running short <sup>[1]</sup>, Mahmud would have then turned to the age-old technique of rock splitting using fire and water which worked.

Also the Arab historian Farrukhi Sistani, contemporary of Mahmud Ghazni, wrote that the idol at Somnath was not of an Hindu deity but of a pre-Islamic Arabic Goddess Manat <sup>[9]</sup>. According to other historical descriptions of the idol of Manat, it was aniconic block of black stone. Historians have found no evidence for this and this claim of Farrukhi Sistani is now seen as an effort to enhance Mahmud's prestige in the Islamic world. However one can glean from this that the Shiva-Lingam at Somanath was also made of black stone, hence the effort of Farrukhi Sistani to refer to it as the idol of Manat. Nickel – iron meteorites with high metallic content are black and strongly magnetic as shown in the picture below.



**Fig 2:** Fragment of the nickel-iron meteorite that landed in Sikhote-Alin in Russia in 1947. Note the Black colour. (Photo courtesy H. Raab)

Iron-Nickel meteorites were worshipped in other parts of world too in earlier times. Partly this was because of the fact that the meteorite crashes to the earth in a very spectacular fashion, a bright flash of light streaking across the sky followed by loud noise and a small cloud of dust and vaporized meteor material. The Willamette meteorite In USA has for long been venerated and worshipped by the Clackamas tribe of native American Indians <sup>[10]</sup>.

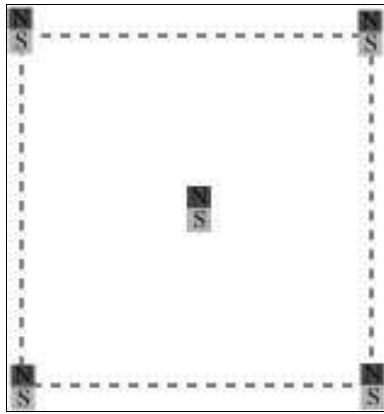
As to how the ancient Hindu craftsmen had managed to devise a system through which they could keep the Shiva-linga afloat in air without support, one has to understand the following things-

The mechanism used for making the Shiva-linga float was a magnetic levitation mechanism. However magnetic levitation is not an easy task and was probably never

achieved in pre-modern world except at Somnath. A glance at a few basics of magnetism can make us realize the obstacles faced by the architects of the levitating Shiva-linga at Somnath. Earnshaw's theorem prohibits the stable levitation of one magnet by other(s) <sup>[11]</sup>. So if one tries to make one magnet 'hover' using the magnetic attraction of another, the 'hover' magnet will either sits limply on the tabletop or snap quickly to the other one. It is not possible to make a bar magnet levitate in a stable position only through the use of other bar magnets as stipulated in Earnshaw's theorem.

If we pretend we have a collection of bar magnets arranged in a square, another bar magnet placed in the center of the square will not be in a stable position, and will be pulled (and twisted around) out of the center, and likely towards

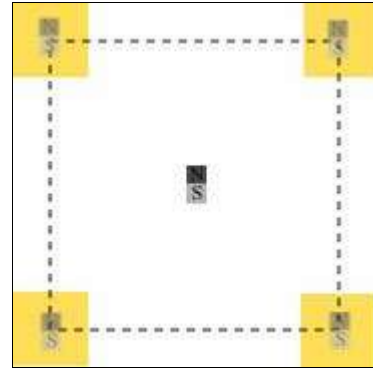
one of the other magnets:



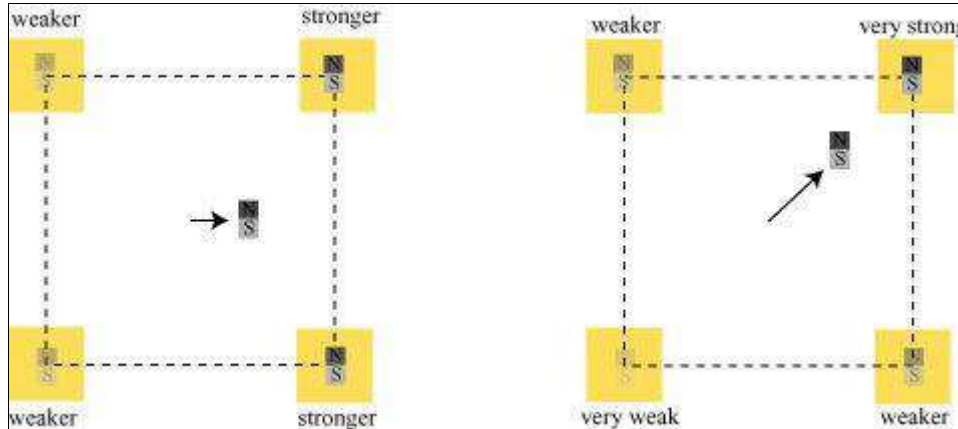
(It would be best to imagine the bar magnets standing up, i.e. the north pole of the magnet pointing out of the paper/monitor). Using vector calculus, one can show that a levitation device composed of any set of point charges/fixed magnets will have a 'leak' and the magnetic levitation will be unstable.

Because of this instability when using static fields, one can only create magnetic levitation with permanent magnets if the magnetic fields are time-varying or the levitating magnet is spinning. This latter possibility is used in the modern toy called the Levitron [12]. Magnetic levitation trains which rely on permanent magnets use dynamic feedback to keep the train stable and running. However none of this was probably available at the time when Somnath was built, then how the Shiva-linga at Somnath was kept levitating?

The answer to this lies in their clever use of bismuth as diamagnets. Diamagnets can be levitated in stable equilibrium in a magnetic field, with no power consumption. As to how use of diamagnets allowed the artisans of Somnath to violate the Earnshaw's theorem, the following points are illustrative. Returning to our square arrangement of magnets, let us now replace the bar magnets in the corners with diamagnets. When the permanent magnet is right in the center of the square, the diamagnets all have 'effective bar magnets' of equal strength induced by it:



(Remember: Our bar magnets are still pointing out of the paper/monitor). When we move the bar magnet from the center, its magnetic field will be weaker in the diamagnets it moves away from and stronger in the diamagnets it moves towards. For instance:

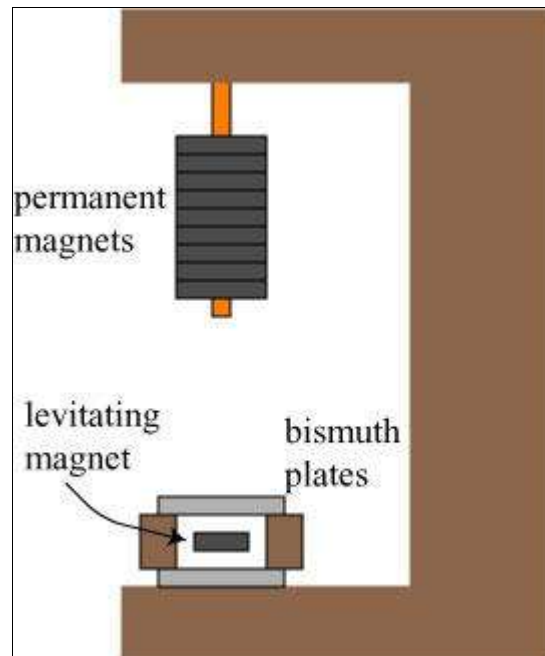


The net result is that the diamagnets closest to the bar magnet push it away very strongly, while the diamagnets far away push it very weakly. This increasing and slackening of force keeps the magnet stably near the center of the system. The 'leak' that we had found earlier in our four point charge/bar magnet system has been 'sealed' by the varying strength of the diamagnetic response.

In the diagram below, a strong collection of permanent magnets are supported by a wooden frame above the 'levitation' area, and provide the 'lift' for the levitating magnet. The levitating magnet itself is supported between a pair of plates made of bismuth which — and this is in fact the key point — is a strongly diamagnetic material [13]. (Data

from [www.scitoys.com](http://www.scitoys.com), [www.sparkbangbuzz.com](http://www.sparkbangbuzz.com)).

We can now understand the configuration of the magnets and the diamagnetic material in the ancient Somnath temple in the diagram below. The stack of permanent magnets [the loadstone canopy as described by Al Kazvini] provided the lifting anti-gravity force to the levitating magnet [the levitating iron-nickel meteorite Shiva-linga], while the diamagnetic plates [ Bismuth ] maintained the position of the levitating magnet and provide its stability. The diamagnetic plates act very much like a pair of fellows escorting a drunk friend home: whenever their friend 'wobbles' in their direction, they apply some gentle pressure to direct him back upright!



**Fig 3:** Diagrammatic representation of how bismuth and magnets were used to levitate the Shiva-linga at Somnath temple (Courtesy [www.scitoys.com](http://www.scitoys.com), [www.sparkbangbuzz.com](http://www.sparkbangbuzz.com)).

Al-Kazvini specifically mentions in his description of the Somnath temple – “The edifice was built upon fifty-six pillars of teak, covered with lead”. That Al Kazvini’s account of Somnath was accurate is also verified by other sources. Al Kazvini described that the original temple stood on teak pillars covered with lead. This is also corroborated by Jaina Texts which mention Hemachandra, the trusted minister of Chaulukyan (Solanki) King Kumarapala (1143-1172 AD) advising Kumarapala to replace the dilapidated wooden temple at Somanath with a stone made one to attain salvation <sup>[14]</sup>.

In no other ancient or modern Hindu temple has the usage of lead been described except Somnath. Al-Kazvini specifically stated that the temple stood on pillars coated with lead. Now one may say that probably lead was used to protect the wood from pests, termites etc but Somnath does not have a tropical climate where such measures would be required and even if a protective metal encasing for the teak pillars was required, lead would hardly be the metal of choice. Brass, silver etc would have been the preferred choices. Then why lead was used in the Temple of Somnath. The answer to this is that what Al-Kazvini described was not lead but bismuth. Bismuth is physically similar to lead and is as heavy as lead – hence the confusion between the two in ancient times was very common <sup>[15, 16, 17, 18, 19]</sup>.

Now as to why Bismuth was used in the Somnath temple, one has to realize that Bismuth is the most strongly diamagnetic metal – a property that was essential for making the Shiva-linga levitate. Although Bismuth and lead may physically be alike, they differ greatly in their diamagnetic properties. Bismuth has a magnetic susceptibility value of  $-16.6 \times 10^{-5}$  and lead has a magnetic susceptibility value of  $-1.8 \times 10^{-5}$ . Magnetic susceptibility value is a measure of the diamagnetic strength of a material, hence bismuth is almost 10 times more strong a diamagnet than lead <sup>[20, 21]</sup>.

One also has to keep in mind that since bismuth is a bit brittle, hence the use of teak pillars in the ancient Somnath temple as an internal support for the bismuth and also the

fact that bismuth was not as plentiful as other metals and hence not readily available in ancient times. Using teak pillars as internal struts along with bismuth would have cut down the amount of bismuth required for making the Shiva-linga levitate. Another interesting point is that even Ibn Zafir as quoted in M Nazim’s “The life and times of Sultan Mahmud of Ghazna” <sup>[9]</sup> says that the floor of the Somnath temple was also made of planks of teak, the interstices being filled with lead. Again this was not lead but bismuth.

Unlike other metals like silver, it would have been impossible to make the floor of the shrine itself from Bismuth as bismuth is very brittle. Hence the clever builders of the Somnath temples used teak planks for making the floor of the shrine but since they needed more diamagnetic force for levitating the Shiva-Linga, they filled the gaps deliberately left between the teak planks with pieces of bismuth.

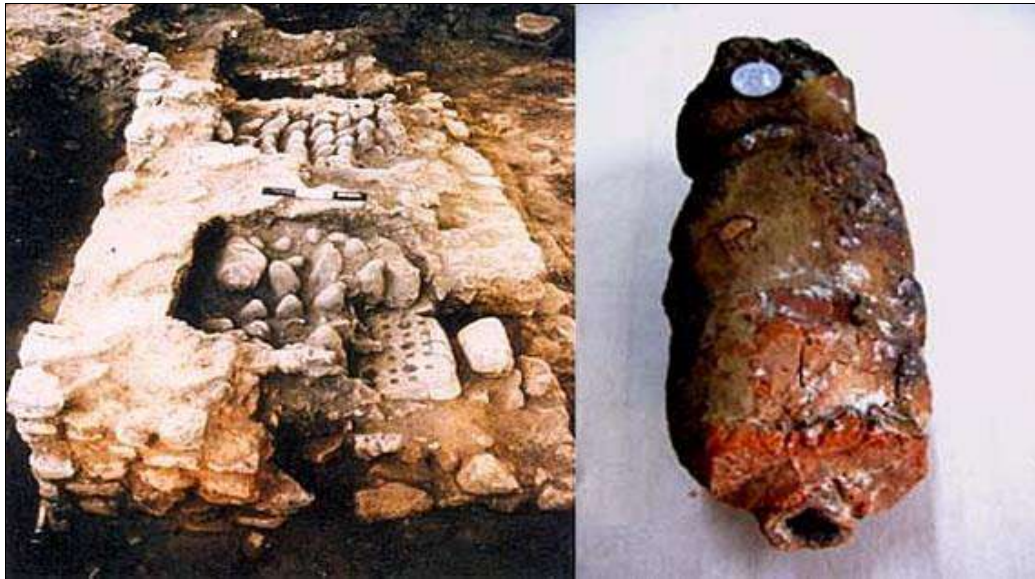
Also for making the Shiva-linga levitate, as illustrated in the simplified diagram above, bismuth would be required above as well as below the Shiva-linga. No account is given by Al-Kazvini of the use of lead [ bismuth actually] above the Shiva-linga but one can surmise that either the parasol [ Chattr – a type of ornamental umbrella constructed above the idols of chief deities in Indian temples ] of the Shiva-linga was of bismuth or a perforated low roof made of bismuth [ or more likely of teak covered with bismuth] was employed for providing the diamagnetic force above the Shiva-linga. The Arab historians probably thought it insignificant as they were dazzled with the floating Shiva-Linga and hence it is not mentioned.

Having understood how the builders of the ancient Somnath temple had used the magnetic properties of the iron-nickel meteorite Shiva –linga and the diamagnetic properties of bismuth in making the ancient wonder of the levitating Shiva-linga at Somnath, one now turns to answer the question as to how the Builders of Somnath acquired bismuth – a metal which was known since ancient times but not used very frequently on a large scale in the ancient world. For this we have to understand the high skills of the

ancient Indians in the field of metallurgy.

Ancient Indian Metallurgists were way ahead of their time. The process of making Zinc was known to them since 2<sup>nd</sup> century AD. Nagarjuna [ 166-203 AD] in his book Rasratnakar describes in detail the method of Zinc extraction from its ore. Zawar, Udaipur district, Rajasthan, is now considered to be the oldest site of industrial zinc

production in the world. Radiocarbon age determinations of launder wood from the old lead-zinc mines of Zawar Mala yielded an age of 2180 $\pm$  35 years. The method of zinc smelting independently developed and patented by William Champion in 1738 was almost identical to the one used by ancient Indian Zinc smelters [22, 23].



**Fig 4:** Ancient zinc smelting furnace and a spent retort from Zawar. (Photo courtesy of Geological Survey of India).

Another testimony of the metallurgical skills of ancient Indians was the “wootz “ steel used in making the fabled Damascus swords [24, 25]. This riddle has still not been cracked yet with modern scientists just knowing that the ancient Indians used a technique which involved incorporating a high carbon content in the steel and forging and hammering it at a relatively low temperature but the exact process employed by the master ancient steel makers still eludes us.

Thus we see that ancient Indians had attained a very high level of proficiency in their metallurgical skills. Now as to how and where the bismuth used in the ancient Somnath temple was procured, it is pertinent to know the following facts.

Bismuth as a metal is rarely mined and extracted from bismuth ore. The only mines which use bismuth ore as a source of bismuth are the Tasna mines in Bolivia and a few mines in China. Bismuth has always been produced as a by-product of lead smelting from its ore. Crude lead can contain up to 10% of bismuth. Lead has been smelted and used by Indian metallurgists since times immemorial. The open cast lead mine at Rampura-Agucha in Bhilwara district in Rajasthan which are geographically near to Somnath provide evidence of being worked in Mauryan times [3<sup>rd</sup> century BC]. Bismuth too was known in ancient India, It is mentioned as Capala in the Sanskrit alchemical text Rasa-Ratna-Samuccaya [ 12<sup>th</sup>-13<sup>th</sup> century AD] [26], although it is likely that was known much before this date. Concentrated Bismuth-lead deposits are also found at Narda, Neem-ka-Thana tehsil, Sikar district which is not very far from Somnath. It is likely that the builders of Somnath procured the bismuth used in the temple from either of these two ancient mines. Bismuth was probably produced as a by-product of lead smelting by ancient Indian metallurgists. Bar magnets were common in ancient India, being used as toys

and in games as well as for other purposes. Susruta – the famous ancient Indian Surgeon who lived around 4<sup>th</sup> century AD used magnets for removing metallic splinters from wounds. Probably some miners or someone living in the vicinity of lead-bismuth mines made the serendipitous discovery that a bar magnet could be stably levitated using the diamagnetic properties of bismuth. Then they transmitted this information to the priests of Somnath either during a pilgrimage to Somnath or when someone living near the mines and knowing this principle of diamagnetic levitation sought employment at Somnath. Ancient temples in India served as centers of spiritual, administrative and commercial activity providing employment to thousands. The priests at Somnath who must have become aware of the magnetic properties of the iron-nickel meteorite Shiva-linga while handling it during the daily pooja and other ceremonies recognized that using the diamagnetic properties of bismuth, they could make their revered Shiva-linga levitate like a magnet bar. They must have thought it to be a method to honor their chief deity by making his main Shiva-linga idol float in the air.

Having enormous financial and other resources at their disposal, they procured the bismuth from the sources mentioned above and thus was made one of the greatest wonders of pre-modern history which had no parallel at that time.

Even its conquerors and the ones who destroyed it stood in awe of this man-made marvel and their historians too transmitted this legend down the generations. History has not given this ancient marvel it’s just due. The ancient architects of Somnath and the justifiably wonder struck Shiva Devotees who had witnessed and worshipped the amazing spectacle of the Somnath Shiva-linga floating in air are a lot to be envious of.

### Reconstructing the ancient wonder –“The levitating Shiva-Linga of Shri Somnath”

I, being a Neurologist working in the Government sector, have always felt that developing countries like India should not spend money on constructing grandiose religious monuments and should instead focus on spending public money on Hospitals and other public utilities. But ancient innovations can be reconstructed if they are inexpensive and teach our glorious history to our future generations.

The cost of making the small, wooden shrine along with bismuth would be around 2-3 million Indian rupees and this too instead of coming from the public exchequer can be borne by the Somnath temple trust.

The main limitation would be getting a iron-nickel meteorite to serve as the main Shiva-Linga as they are exceedingly rare and not available commercially.

However in 2019 and 2020, there have been two instances of iron-nickel meteorites landing in India.

In 2019, a strongly magnetic iron-nickel meteorite weighing around 15 kg landed in Mahadeva village, Madhubani district, Bihar <sup>[27]</sup> and in 2020, an iron-nickel meteorite weighing 2.8 kg landed in Rajasthan’s Sanchore town <sup>[28]</sup>. Falling of two iron-nickel meteorites in India in such a short span is an auspicious co-incidence.

Since the main limitation of building the shrine has now been removed, the author ardently wishes the Gujarat or the Central Govt. or the Somnath temple trust to rebuild this small shrine in the Somnath temple complex so that our

future generations can see what our illustrious ancestors had built which unfortunately was destroyed by Mahmud Ghazni.



**Fig 5:** The Madhubani meteorite, currently housed in the Patna museum. The strongly magnetic nature of the meteorite is shown by the iron ring sticking to it.



**Fig 6:** Iron-Nickel meteorite fragment from Sanchore-Rajasthan.

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