

A NOTE ON ANCIENT ZINC-SMELTING IN INDIA AND CHINA

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(Received 9 October 1995, after revision 9 April 1996)

Metallurgy of zinc developed much earlier in India and China than in Europe. Indian literary evidence of zinc-smelting precedes that in China. Ancient mines and workings of zinc-smelting are found at Zawar in Rajasthan where the large-scale production of zinc started from the thirteenth century AD. Excavations at Gui-Zhou region of Yun-han province show that Zinc was produced in China in the sixteenth century AD. Earlier claims of Chinese and western scholars that China smelted zinc earlier than Ming dynasty have been refuted by new research by Chinese scholars. They have come to the conclusion that zinc smelting began in China in the mid-Ming dynasty i.e. the sixteenth century AD. Zinc was exported to Europe in the middle of the seventeenth century AD from China under the name *totamu* or *tutenag*. *Tutenag* possibly has its origin in the word *Tutthanāga* – a name of zinc in South Indian languages. A seventeenth century Chinese author has written that '*Tutenag*' is a word from some foreign language. Thus there is textual and etymological evidence of transmission of ideas regarding zinc between the two countries. These facts together indicate that zinc was smelted some three centuries earlier in India than in China and these ideas were transmitted to China in the sixteenth century AD.

Key Words: *Tutenag*, *Tutthanāga*, *Zinc-smelting*

INTRODUCTION

Study of textual records and systematic investigation of ancient relics together suggest that metallurgy of zinc developed much earlier in India and China than in Europe, where it occurred only in the early eighteenth century. Excavations at Zawar in Rajasthan have pointed to the large scale production of zinc from the thirteenth century AD onwards. Similar excavations at Gui Zhou region of Yun han province show that zinc was produced in China in the sixteenth century AD. Furthermore there is textual evidence of transmission of ideas regarding zinc between the two countries, therefore zinc smelting presents itself as a topic where exchange of scientific and technological ideas between India could be traced.

Totamu, *Tutenag* and *Tutthanāga*.

A clue to the possible transmission of ideas regarding zinc was found in the name '*totamu*' or '*tutenag*' under which zinc was exported to Europe in the middle of the

seventeenth century AD from China.. At that time the Europeans did not know how this metal was smelted. A seventeenth century Chinese author has written,

“.. *Totamu* or *Tutenag* is very similar to lead hence it is called ‘*ya qian*’ meaning ‘poor lead’. But we do not know how it is obtained.”

The same author also informs us that the word ‘*tutenag*’ is a word from some foreign language.¹

‘*Tutenag*’ possibly has its origin in the word ‘*Tutthanaga*’² a name of zinc in south Indian languages. It means ‘a kind of lead obtained from *tuttha*’. *Tuttha* was the name applied to certain ores such as carbonate of zinc or sulphates of copper and iron. Their colours were specified to distinguish between them. Eg.,

Mayuragrivatuttha – A *tuttha* of the colour of peacock’s neck, for copper sulphate.

Haratuttha – A green-coloured *tuttha* for iron sulphate A fourteenth-century AD text *Rasaratnasamuccaya*³ gives *tuttha* as a synonym of *rasaka* and *kharpara*, both being the names of Calamine or Zinc carbonate in Sanskrit.

It appears from the etymology of the word ‘*Tutenag*’ that ideas regarding zinc and its extraction from calamine were transmitted to China from India, and later, zinc and its alloys were exported to Europe from China under the loan-name. A comparison between the History of zinc smelting in India and China substantiates it.

HISTORY OF ZINC-SMELTING IN INDIA

In India, the earliest reference to zinc-smelting is found in *Rasaratnākara* of Nāgārjuna, an early medieval text. Ancient mines and workings of zinc – smelting are found at Zawar in Rajasthan in the eighties by a joint team of scientists from Baroda University and the British Museum. The C¹⁴ datings of the mines go back to about fourth – fifth century BC⁵. A small slag-heap at Zawar is dated as of seventh century AD. Contemporary references are also found in the form of inscriptions found in nearby places. The datings of the other slag-heaps indicate that the large-scale production of zinc at Zawar started from the thirteenth century AD and lasted till the middle of the eighteenth century AD.

In India, brass artefacts containing appreciable amounts of zinc are found from the 2nd, 3rd millennia BC, whereas those with more than 34 percent of zinc are found from the fifth century BC, which corresponds to the earliest date of minings at Zawar. These facts together indicate that, although earlier low-zinc brasses were possibly made by the cementation of zinc bearing copper ore, the later high zinc brasses could

have been made after the process for the separation of zinc metal was discovered. A possibility of a process similar to the 'si huo' process of the Chinese (which is discussed in the following pages of the article), also cannot be ruled out. In this regard medieval alchemical texts need a careful scrutiny, since they give details of innumerable such alloy-making processes.

HISTORY OF ZINC SMELTING IN CHINA

Brass was used for metal work since very early times in China. However it was only in the mid-Ming dynasty that it was used in coinage. Brass artefacts in substantial amounts are found in China only after the Sui (581 – 618 AD) and Tang (619 – 917 AD) dynasties⁶. i.e. after the introduction of Buddhism into China from India.

Earliest Chinese and western scholars claimed that China began to smelt zinc earlier than Ming dynasty and that 'lian' in earlier literature eg. Han dynasty's Wan Meng period (6 – 22 AD) or in early Ming literature "*Wo yuan bai shui quian*", which is a name of a kind of metal (1428 AD) and Shui Xi in mid-Ming literature (1522-1566 AD) which is a name of metal or ore, was zinc. These claims have been refuted on the basis of new research by Chinese scholars⁷. They have come to the conclusion that "Zinc-smelting began in China in the mid-Ming dynasty (sixteenth century AD). The Jiaging period (1522 -1566) was its initial stage, and by the Wanli period (1573 – 1619) zinc was fully produced. There is no evidence to prove that China had used metallic zinc before 1621".

Their conclusions are based on the study of historical literature and analysis of the coins and other materials of the respective periods.

Certain coins of Tianqi period (1621 – 1627 AD) contained large percentage of zinc (over 30%) which led the scholars to believe that they were made not by the cementation process but by the direct addition of zinc metal. This again has been refuted by new research which shows that additional smelting of brass with calamine (called the 'Si-huo' brass) gave rise to brass with more than 28 per cent of zinc (theoretically claimed highest percentage of zinc in brass by the cementation process)⁸.

A comparison of the traditional methods of smelting of zinc in India and China has been made by some scholars⁹. It enlightens certain facts like:

1. The principle of the technique of traditional zinc smelting of both India and China is the same viz. earthenware distillation of zinc and heating from outside; the temperatures are also comparable.

2. Methods for the condensation of zinc vapour were different, China employed

the upward condensation method whereas India, that of downward condensation. Thorough investigations of the traditional zinc smelting process have been made in the Gui Zhou region of Yun han province, which show that condensation of zinc was achieved in an inverted hat-like compartment in the upper part of the furnace¹⁰.

Zinc-smelting methods underwent a number of development stages in both countries¹¹. It is possible that the earliest models of the crucible and furnace, which consisted of mud-vessel which is tightly closed and heating is from outside, was the same in both the countries, and possibly there was a transmission of ideas regarding zinc-smelting from India to China at that time. This conclusion is also supported by the following facts, eg. the Indian literary evidence of this kind of Zinc smelting precedes that in China. In China the earliest record concerning zinc-smelting technology is seen in a Ming – dynasty text *Tian Kong Kai Wu* written by Song Ying xing (1937 AD)¹². Secondly, the name of Zinc, *Tutenag* was always suspected to have come from a foreign language. Again there are remarkable similarities between the large scale, later techniques of zinc-smelting, e.g. the perforated platform for resting the crucibles, the smelting furnace being separated into high and low temperature zones, further the purity of the product is also comparable i.e. about 98-99 per cent of zinc. it is interesting to not that in the Tang dynasty the Chinese did use one upper-fire lower – condensation method for smelting mercury from Cinnabar¹³.

Zinc was smelted in Europe from 1730 AD onwards by one William Champion, his method was the same as the Indian one, hence it is more than likely that this process was based on traditional Indian method of Zinc smelting; than on the Chinese.

A high-zinc alloy with 95 per cent zinc and 5 percent copper was made at Bidar near Hyderabad in the southern part of India. Traditionally it is supposed to have begun in the fifteenth century AD, but pieces found so far go back only to the seventeenth century AD¹⁴. It was used to make exquisite utensils where on lustrous black body of the vessel, intricate design is made with silver. The radio-isotope study of this article show that they contained small amount of lead which led some scholars to think that possibly this zinc came from China. Further research in this direction is necessary to establish the fact though. In fact large amount of archaeological as well as literary exploration needs to be done in order to have a clear picture about the transmission of ideas regarding zinc-smelting between India and China.

CONCLUSION

Metallurgy of zinc developed much earlier in India and China than in Europe where it occurred only in the early eighteenth century. There is textual and etymological evidence of transmission of ideas regarding zinc between the two countries. Indian literary evidence of zinc smelting precedes that in China. Furthermore large scale

production of zinc at Zawar in India definitely started by the thirteenth century AD. According to the new research by the Chinese scholars there is a clear indication that zinc smelting began in China in the Jiajing period (1552 – 1566 AD) of the Ming dynasty.

These facts together indicate that zinc was smelted some three centuries earlier in India than in China and these ideas were transmitted to China by the sixteenth century AD.

REFERENCES

1. Needham, Joseph. *Science and Civilization in China* Vol. 5, Pt 2 p. 212 Cambridge University Press, 1976.
2. Deshpande, Vijaya *Early exchange of scientific ideas between India and China*, A paper read at the Seventh Annual Conference of the Indian History and Culture Society at Chandigarh, March 1984.
3. Apte, Vinayak (ed.). *Rasaratnasamuccaya*, Anandāsrama Sanskrit Series, No. 19, Poona, 1890.
4. 'Rasaratnākara' of Nāgārjuna – See in Ray, P. (ed.) *History of Chemistry in Ancient and Medieval India*, incorporating the history of Hindu Chemistry, Indian Chemical Society, Calcutta, 1956, p. 129.
5. Biswas, Arun Kumar 'The Primacy of India in Ancient Brass and Zinc Metallurgy' *Indian Journal of History of Science*, 28(4), 1993.
6. Zhou, Weirong and Fan Xiangxi. 'Application of Zinc and Cadmium for the Dating and Authenticating of Metal relics in Ancient China'. *Bulletin of the Metals Museum*, Vol. 22, (1994-II), pp. 16-21.
7. Zhao, Weirong. 'A New Study on the History of the Use of Zinc in China. *Bulletin of the Metals Museum*, Vol. 19 (1993), pp. 49 to 53.
8. Zhou, Weirong and Fan Xiangxi. 'A Study on the Development of Brass for Coinage in China. *Bulletin of the Metals Museum*, Vol. 20 (1993 – II) pp. 35-45.
9. Mei, Jianjun. 'A comparison between the ancient Zinc smelting techniques of India and China' *Studies in the History of Natural Sciences*, Vol. 12, No. 4 (1993), pp. 360-67.
10. Hu Wenlong and Han Rubin. 'The technique of Zinc smelting in Ancient China from the traditional method' *History of Chinese Metallurgy*, October, 1986, p. 36.
11. Yang Weizeng. 'An Investigation into History of Zinc smelting by Distillation' in *Researches into the History of Ancient Chinese Chemistry*, Beijing University Publication, 1985.
12. Song, Yingxing. Section on the Five Metals of 'Tian-kong Kai Wu' (1637 AD).
13. Zhao, Kuang hua – A lecture on Ancient Chinese Sand extraction smelting of mercury and its chemical achievements. 'Researches into the History of Ancient Chinese Chemistry' Beijing University Publication, 1985, p. 128.
14. Craddock, P.T. 'Zinc in India' in '2000 Years of Zinc and Brass' British Museum Occasional paper No. 50, British Museum Research Laboratory, 1990, p. 52.
15. Biswas, A.K. 'op. cit.', p. 322.

