STUDIES IN ANCIENT INDIAN MATERIALS AND INDUSTRIES

A Pottery Glaze of Kushana Period from Khokrakot Mound

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Introduction

IN connection with the studies initiated in this laboratory on ancient Indian materials and industries belonging to proto-historic and historic periods, a glazed pot-sherd from Khokrakot mound* in Rohtak District was found to be of much interest as it provided an authentic specimen of glaze of the Kushana period (1st-3rd centuries). As the author is not aware of any published data on Indian glaze samples of comparable age, it was thought desirable to carry out a complete chemical analysis of the sample in order to determine its composition and the technique of colouring.

Incidentally it may be remarked that Khokrakot has yielded a vast collection of ancient coin moulds and other important archælogical material which have thrown a flood of light on coining technique in ancient India.[3]

Experimental

The glazed sherd has a chocolate-brown body and represents part of a coarse thick ware, the concave surface of which carries a layer of dirty brownish green glaze of 0·5 to 1 mm. thickness. The glaze shows crackle but is adhering very firmly to the surface of the sherd. For the preparation of a sample for chemical analysis the glaze was chipped off the body very carefully and traces of the body material adhering to the glaze were removed before powdering the sample for quantitative estimation. It had the following percentage composition: SiO_2, 61·76; Fe_2O_3, 5·07; FeO, 0·82; Al_2O_3, 14·77; MnO, 0·04; CaO, 2·29; MgO, 2·13; Na_2O, 9·73 and K_2O, 4·12. Total, 100·73.

The chemical analysis shows that it is not a phosphate glaze and it is free from lead and barium. Early Egyptian[4] and other Middle Eastern glazes are also free from barium and phosphate, the addition of which is a later development in the technique of glass making and glazing. Ancient Chinese glasses (550 B.C.) have been found to contain both barium oxide and lead oxide.[5] The present specimen, therefore, represents an ordinary soda-lime glaze containing an appreciable amount of potash and a very high proportion of alumina. Addition of alumina prevents devitrification of glass, and produces a harder, durable, and more elastic glass.[6,7] Alumina in excess of 4%, however, is not a desirable constituent of glass of excellent working quality, and the amount of 14·77% found in this sample is, therefore, unusually high. The colour of this glaze is due to iron oxides.

As the manufacture of glass is not far removed from that of glaze, and since chemically there is no difference between the two, it is interesting to compare the chemical composition of this glaze with the composition of earlier glass specimens of 4th-3rd century B.C., *i.e.*, the glass specimens unearthed at Taxila. From published analyses of Taxila glasses,[8] it is seen that no glass from Taxila shows such a high alumina content. In other respects, its composition is similar to that of Taxila glass. The alkalies are present to the extent of 13·85%, but the alkaline earths, lime and magnesia, account for only 5·42% of the sample. If the oxides, R_2O_3 are added to silica, it is seen that 81·60% of acidic oxides are present.

In the absence of chemical data on the composition of glazes of Kushana period from other sites, it is not possible to make a comparative general study of the glaze industry of this age. Recently some glazed pot-sherds have been found by the author from the glass factory site of Kopia, which has been dated tentatively by Nagar[9] to circa 5th century B.C., on stylistic grounds. Although no age value should be attached to such surface finds, it is likely that these glazed sherds might be assignable to Kushana times, *i.e.*, 1st-3rd centuries. The chemical examination of these specimens is likely to throw much light on the technique and composition of glazes of this period, and on the

* There is a series of mounds covering an extensive area in the immediate outskirts of the modern city of Rohtak (Long. 76°35′ E.; Lat. 28°54′ N.) in the East Punjab. One of these mounds, in the immediate neighbourhood of the city, has long been preserved as a protected monument by the Archæological Survey of India,[1] and is known as Khokrakot mound. Rao Bahadur K. N. Dikshit,[2] late Director-General of Archæology in India, has concluded from an examination of the surface finds that Khokrakot was in occupation upto the Kushana period.

question of the development of the glaze industry from 4th-3rd century B.C., to 2nd-3rd century A.D. This work is in progress.

1. Sahni, D. R., *Annual Progress Report of the Superintendent, Hindu and Buddhist Monuments, Northern Circle*, 1919, para 18, p. 13, 1920. 2. Dikshit, K. N., Private communication to B. Sahni, dated 16th February 1937. 3. Sahni, B., *The Technique of Casting Coins in Ancient India* (Numismatic Society of India, 1945). 4. Lucas, A., *Ancient Egyptian Materials and Industries*, 1934, p. 418. 5. Beck, H. C., and Seligman, C. G., *Nature*, 1934, **133**, 982. 6. Morey, C. W., *The Properties of Glass*, 1938, p. 64. 7. Hodkin, F W., and Cousen, A., *A Text-book of Glass Technology*, 1925, p. 106. 8. *Annual Report of the Archæological Survey of India*, 1922-23, p. 158; 1925, p. 43. 9. Nagar, M. M., *Amrita Bazar Patrika*, Allahabad, 14th Aug. 1949.

RAPTAKOS MEDICAL FELLOWSHIP AWARDS

THE Raptakos Medical Research Board Fellowships for the year 1953 have been awarded to the following candidates for research work in subjects mentioned against their respective names:—Mr. D. V. Rege, University Department of Chemical Technology, Bombay—Role of Folic acid and vitamin B_{12} in nucleic acid metabolism; Mr. M. Bhimasena Rao, Indian Dairy Research Institute, Bangalore—*Milk diets in relation to* Infantile Cirrhosis; Mrs. Shanta Savur Srinivas Rao, Haffkine Institute, Parel, Bombay 12—Isolation and the study of biological properties of the therapeutically important constituents of the Cobra and Russell's Viper venom; Dr. Shyam Kumar Vaish, Indian Veterinary Research Institute, Izatnagar—Diet and its relation to blood and tissues electrolytes.

CENTRAL LEATHER RESEARCH INSTITUTE, MADRAS

THE Central Leather Research Institute, which was inaugurated by Shri T. T. Krishnamachari, Central Minister for Commerce and Industry, on 15th January 1952, is the result of co-operation by many interests. The Government of Madras made a gift of nearly 84 acres of land in the Guindy area and also bore the cost of procuring and reclaiming it. The leather industry has made so far contributions amounting to nearly Rs. 1·21 lakhs and further support is expected. Rs. 35·5 lakhs has been sanctioned for buildings and equipments and the annual recurring cost is expected to be Rs. 3·5 lakhs.

Research, training and dissemination of technical knowledge to the leather industry are the three-fold function of the Institute. Research in the Institute can be classified into three broad categories. The first is fundamental work comprising research on the histology of hides and skins, physical structure and properties of hide and skin fibres, chemical constitution of hide and skin proteins. Next comes applied work including research on the application of chemistry, physics, bacteriology, microscopy and other branches of science in tanning and production of leather, control processes including study of the mechanism of vegetable tannins, mineral tanning agents, discovery of new tanning agents, tanning auxiliaries and tanning processes. Lastly, there is development research implying investigations on processes of tanning and manufacture of leather auxiliaries practised in western countries to adapt them to Indian raw materials and conditions, pilot plant and extra-mural demonstrations of processes to industrial concerns, trials of new tanning auxiliaries and testing their performance in actual industrial manufacture.

The model tannery of the Institute has been equipped with a complete set of tanning machinery so that researches on leather manufacture may be carried up to a semi-commercial scale and trainees can get the advantages of working with intimate knowledge of demand conditions, production problems and consumer acceptance.

The Institute will form the nucleus for the dissemination of technical education to Indian leather industry including the issue of technical bulletins, contributions of articles to scientific and leather trade journals and answering of technical enquiries, etc. This work has already been started and a technical bulletin is being issued monthly. Technical enquiries received from different parts of India are also being replied to.