Antiquities from the Khokra Kot Mound at Rohtak in the Jumna Valley.

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DURING a flying visit to Rohtak[1] (Long. *76° 35′ E., Lat. 28° 54′ N.)* on March 24, 1936, my attention was drawn by a friend (Dr. V. S. Puri, PH.D.) to certain mounds at Khokra Kot in the immediate outskirts of the city. The mounds cover an extensive area and rise, at a rough guess, 20 to 30 ft. above the surrounding country. In places their structure is exposed in the steep sides of ravines cut by the rains. Here even a casual observer would not fail to notice the great profusion of old bricks, bits of pottery, bones and other relics exposed at different levels in the crumbling sides of the ravines. In one of these ravines, during the two half-hours available to me, a varied collection was made of which a full description will be published elsewhere. Meanwhile a few remarks may be offered on some of the more interesting finds.[2]

(*a*) *A mint of the Yaudheyas* (*ca.* 100 *B.C.*). —In a well-defined dark layer only a few inches thick and a couple of feet in horizontal extent, exposed in the side of a cliff at about three feet below the surface, I collected, *literally in hundreds* during the course of a few minutes, fragments of black terra cotta discs like those shown in the reconstruction in Fig. 1. The discs were perforated in the centre and were marked on both faces with a depressed wheel-like pattern, the eight spokes of the wheel ending in as many circular seal-like impressions (also in negative relief). As Rai Bahadur Pandit Prayag Dayal, Curator of the Central Museum, Lucknow, to whom I showed the relics, at once remarked, these discs are no doubt matrices or moulds in which coins must have been cast in molten metal. Some of these moulds were found sticking together in piles of two or more. The abundance of material in hand, and the excellent state of its preservation enable one to form a very adequate idea of the technique employed. We obviously have here a dump of discarded moulds from an ancient mint. While reserving the details for the full paper the mode of casting may be indicated here in a diagram (see Fig. 2). The metal (shown dotted) was poured in through the vertical canal in the centre, and must have spread radially into the coin sockets at different levels in the matrix. An interesting point is the oblique line seen on the rims of many of the fragments. This must have served as a key to enable the discs to be replaced accurately in position (Fig. 2 *a*).

Since writing the above I have actually found, on splitting some of these fragments apart, virgin coins still embedded in their sockets, from which they first saw the light 2,000 years after they had cooled in the matrix. The metal used for these coins was bronze, not copper. A fragment kindly analysed by my colleague Dr. A. C. Chatterji showed a small proportion of tin and also a little iron. The Latin word *aes* (*Æ*) as generally used by numismatists is perhaps a legacy from the early days when copper, bronze and brass were confused under the one name. These coins contain no zinc.

About the signs and script on the two faces of the discs I dare not at present say much. The obverse shows a humped bull (*Bos indicus*), always facing right and with the head turned obliquely towards the onlooker (Fig. 3); in front of it there is always the conventional sign of a tree within a railing, and round the margin a well-preserved legend in the Brāhmī script. This legend, hitherto incompletely read on similar coins figured by Cunningham,[3] Mr. K. P. Jayaswal has kindly interpreted for me as follows: *Yaudheyānā* (*ṃ*) *Bahudhāñake.* The proper name *Bahudhāñake*, according to him, denotes either the place where the mint was situated or (more probably) a political community included in a federal league of the Yaudheyas, a famous warrior tribe whose sway extended over a large part of the southern and south-eastern Punjab.[4] If the latter interpretation is correct the legend would mean "amongst the Yaudheyas the Bahudhāñakas"

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[1] In response to an invitation from the Punjab University to deliver extension lectures in Botany. Rohtak lies about 40 miles west-north-west of Delhi, about 250 miles in a bee-line from Harappa and 560 from Mohenjo-Daro.

[2] These relics were exhibited at a public lecture in Rohtak (March 24) and again at a lecture delivered before the Philosophical Society, Patna (April 14).

[3] *Coins of Anc. India*, 1891, pl. VI, 2, 3.

[4] Cunningham, *Coins of Anc. India*, 1891, pp. 75 79; Rapson, *Ind Coins*, 1898, pp. 14–15.

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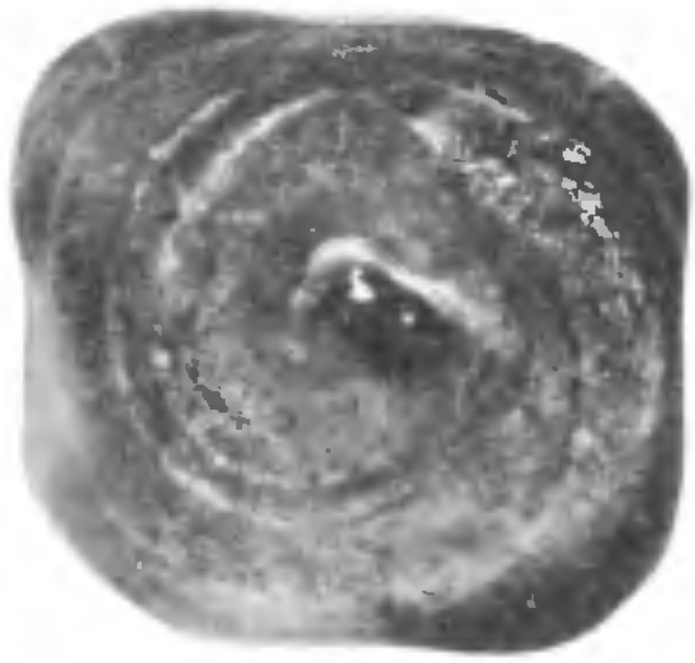

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Figs. 1, 4, 6, 7, 9 are natural size; fig 5, × 2; fig 8, ... × 4½, fig. 10, × 2.

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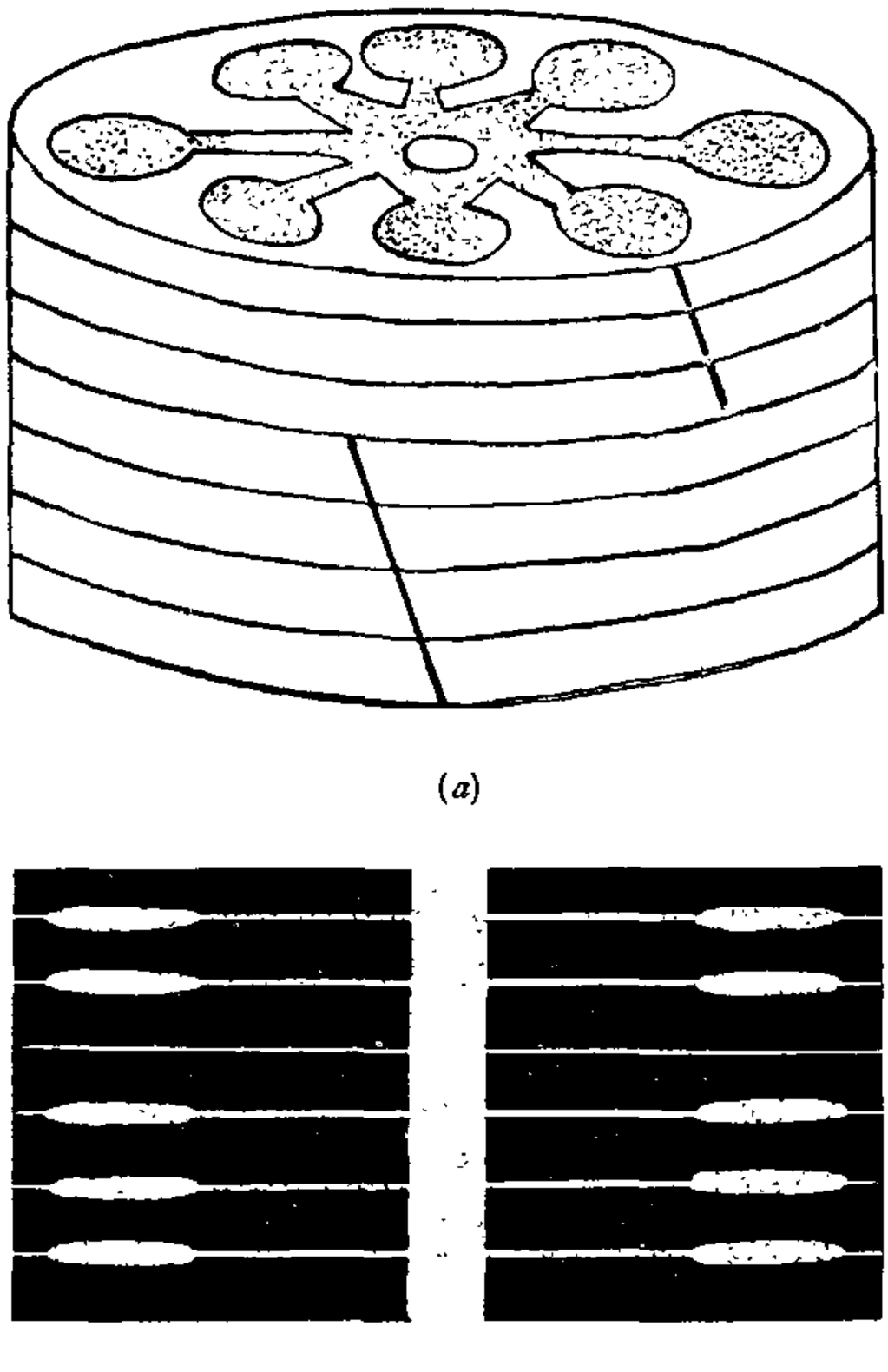


(*a*)

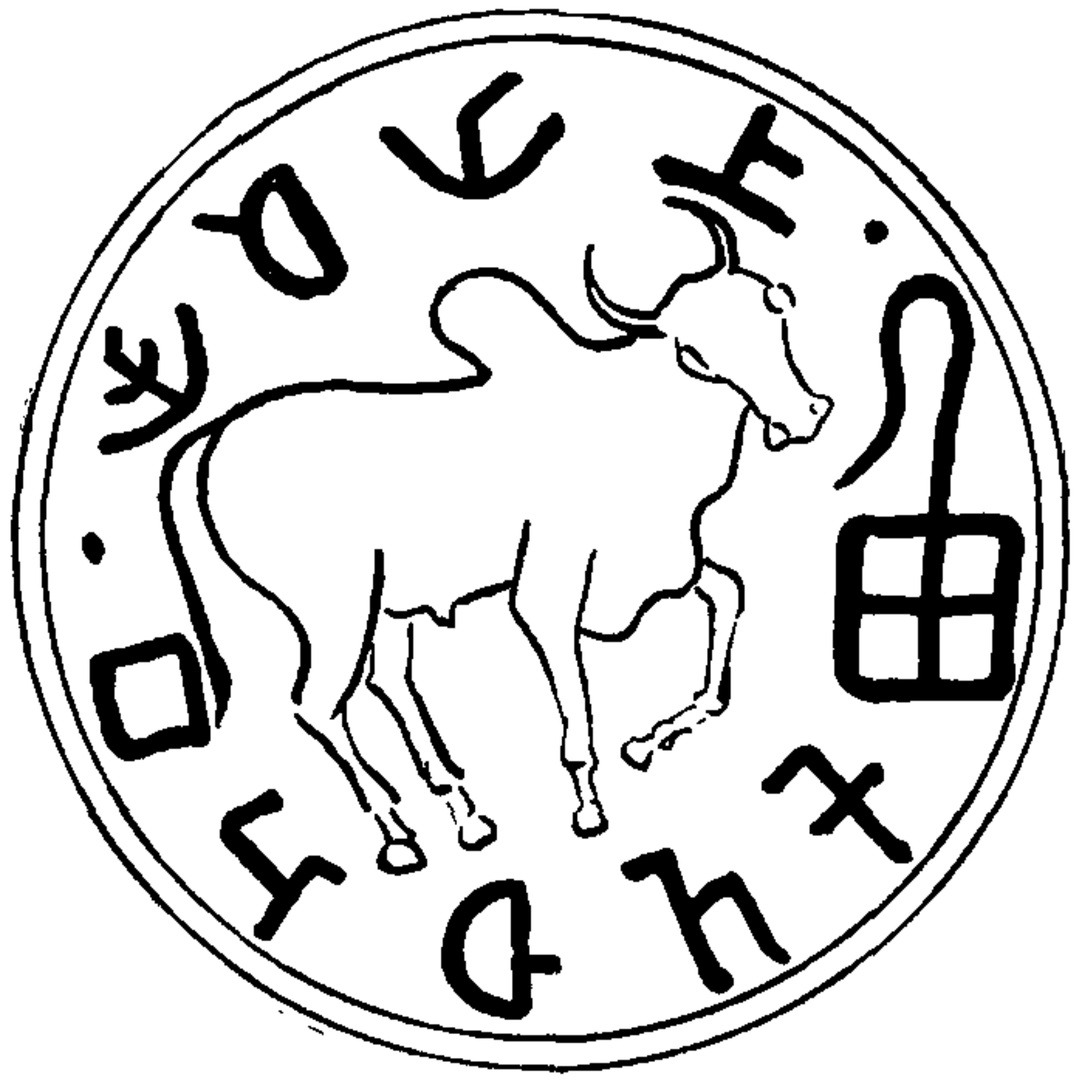
(*b*)

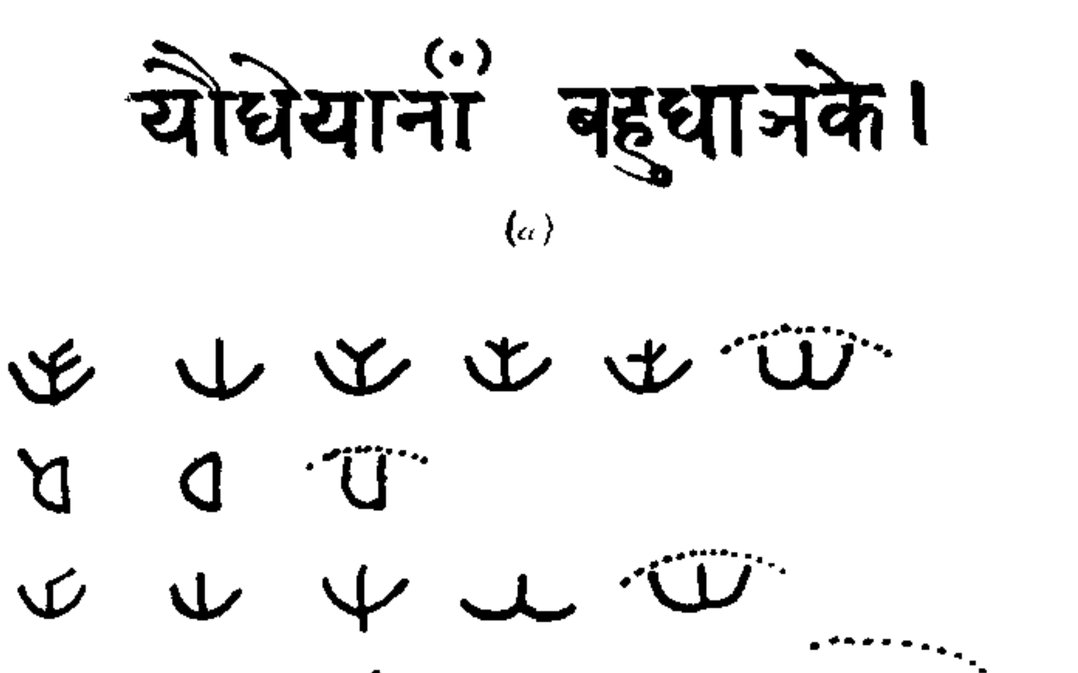
Fig. 2.

The reverse bears the Indian elephant (*Elephas maximus*), also (almost) invariably facing right, in various standing or running postures, but always with the trunk upraised. Above the elephant's back there is constantly the Brāhmī letter *ga* (like an inverted V or Y), accompanied by the *triratna* or *nandipada* symbol (Fig. 5).

After Mr. Jayaswal's independent reading of the legend on the matrices I was able to confirm it with the help of Bühler's palæographic charts.[5] In Fig. 3*b* I have recorded all the variations in the characters that I was able to find amongst the several hundred fragments collected. In Fig. 3*a* is given the full version of Mr. Jayaswal which, it must be stated, was made up from a number of fragments not belonging to the same impression.

There can be no doubt, as Mr. Jayaswal suggests, that the coins made from these moulds belonged to the Yaudheyas; the identical coin has been figured by Cunningham who gives the age as *ca.* 100 B.C. Cunningham mentions on the reverse a combined *triratna* and *dharma-chakra* symbol but his figures do not show a *chakra*, nor do I find a sign of it on any of my numerous well-preserved moulds.





(*a*)

(*b*)

Fig. 3.

[5] *Grundriss*, 1896, Taf. II, IIa.

Apart from making it possible to decipher the complete legend and providing a large number of variations in the alphabet, as well as in the details on the reverse, the discovery of the actual apparatus in which these coins were cast affords valuable data concerning the technique of coining in India in pre-Christian times.

There is one more point to which I may be allowed to draw attention. Before I knew anything of the age of these coin-moulds — indeed before I realised that they were coin-moulds at all — I was struck by the resemblance of certain features with the seals from Harappa and Mohenjo-Daro. The humped bull and the elephant were common to the two; they also almost invariably faced right; then there was the enigmatical square divided into four, also commonly found in the Indus script. Later I learned that this was the conventional sign of a railing round a tree: and a tree before a bull was also to be found among the Indus seals. Lastly, there was the curious fact that my elephants frequently had a clearly bifurcated tail (see Fig. 4): this feature was looked for amongst the Indus seals and there it was again.[6]

I mention these facts because several others have independently noticed resemblances between Indian punch-marks and certain signs on the Indus seals which they have (probably rightly) regarded as their prototypes. Dr. Pran Nath drew attention to these resemblances in 1932,[7] Mr. Durga Prasad in 1933,[8] and Dr. Fábri in 1934.[9] The present instance shows that some of the ancient features were carried on to the *cast* coins as well, at least down to the 1st century B.C.

I must also confess that in my complete ignorance of Brāhmī it was to the Indus script that I naturally turned for possible clues to affinity, and I imagined that I saw several points of resemblance, even of identity. I was thus led to suspect that the two scripts were probably related. Subsequently I learned that more than one noted palæographer holds the view that Brāhmī was derived from the Indus script; so I took the first opportunity (April 10) of discussing my material at Benares with Dr. Pran Nath, to whom I am much indebted. To a complete novice in palæography the possibilities of reading an unknown script in various directions, and at all sorts of angles, could only be a source of bewilderment. However, I came away convinced that my script had *some* relation with the Indus writing, although I must say I was not really satisfied till Mr. Jayaswal, happening to visit Lucknow on April 30, led me by the hand through the wonderful labyrinths of Brāhmī, and fixed the age of the coins beyond doubt.

The dark band exposed in the cliff at Khokra Kot thus certainly represents the site of an ancient mint of the Yaudheyas; and Rohtak not only lay within the area of circulation but was actually one of the distributing centres of their coinage. I have no doubt that further discoveries of importance may be expected from a systematic excavation of the site.

(*b*) *Paddy husk and charred grains of wheat or barley.*—It seems that either the matrices just described were baked over a slow fire of paddy and wheat or barley, or that they were packed in these cereals while the molten metal was poured into them. Well-preserved impressions of paddy husk, as well as entire though charred grains of a cereal (which can only be wheat or barley) have been found sticking to the rims of some discs and to the bottoms of the basal discs of a pile, in the form of a more or less thick carbonised crust. Recognizable impressions of paddy, clearly showing the cell structure of the paleæ, have also been found in the substance or on the surface of many pieces of brown pottery. Husk appears sometimes to have been rather freely mixed with the potter's clay.

(*c*) *The black terra cotta model of a humped bull* (Fig. 6) was found loose, below the cliff in which the clay matrices were found, and was probably derived from the same layer.

Apart from the above I have a few relics of rather uncertain age, some of which were found *in situ*, not far from the cliff containing the coin matrices, but from a level distinctly lower than the latter. I am inclined to regard these as much older, possibly representing the prehistoric (Chalcolithic) civilisation which was first recognised in India by the late Mr. R. D. Banerji at Mohenjo-Daro and by Rai Bahadur Daya Ram Sahni at Harappa. Further enquiry is needed to prove their antiquity, but

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[6] Marshall, *Mohenjo-Daro*, 1931, pl. CXII, 364, 366; pl. CXV, 534.

[7] *Ind. Hist. Quart.*, 1932, VII, 11 ff.

[8] *Journ. Proc. As. Soc. Beng.*, 1933, XXX, *Numismatic Suppl.* for 1934.

[9] *Journ. Roy. As. Soc.* for 1935, 307-318; see Jayaswal, *Ibid.*, 720-721.

they certainly justify the suggestion that the site should be explored in its deeper strata.

(*d*) *The glazed pot of white paste*, bearing on its inside a very clear impression of finely woven cloth (Figs. 7, 8) at once recalls Mackay's account of similar relics found at Mohenjo-Daro.[10] This interesting specimen was pulled out of the exposed side of the same ravine as the one that yielded the coin moulds, but from a level several feet lower and at some distance to one side. The texture of the cloth (enlarged about 4½ diameters in Fig. 8) is finer than in the fragment figured by Mackay. But the workmanship of the pot is crude, the glaze having failed to cover the lower margin of the pot. Here small patches of the naked surface of the paste have a pale pink colour. The thick, uneven bottom is deeply pitted with the marks of finger-tips, evidently made while the paste was being shaped and provided with its cloth lining before the pot was put into the kiln. The freshly broken surface is opaque, white and finely granular; it shows no blow-holes due to gas.

The resemblance with some of the glazed pots from Mohenjo-Daro appeared so striking that I sent a few fragments to Mr. Sana Ullah with a request that he should compare the materials with those from Sind, which he had previously analysed. He reports that the Rohtak fragments are composed of a substance quite different from the faience of Mohenjo-Daro. But he has kindly promised to submit my fragments to a detailed analysis for comparison with the vitreous paste of which some of the Mohenjo-Daro articles were made.

(*e*) *Ink* (*?*).—In the bottom of this pot a minute quantity of a black ink-like substance was discovered (see Fig. 7) which after reading Sana Ullah's account[11] I had suspected to be *śilājit*, a natural exudation from the rocks still used as a drug in Indian medicine. The amount available was hardly enough for a quantitative test, but I am deeply indebted to my colleague Dr. A. C. Chatterji for a qualitative analysis of 0·02 *gm.* of the substance. He reports that while he found in it most of the constituents of *śilājit*, it contained no water, nor magnesium; and he says that a similar result might be given by lamp-black mixed with earth. Mr. Sana Ullah who very kindly examined another sample confirms this view by saying that it is certainly not *śilājit*, but "carbon (probably lamp-black) mixed with mineral impurities". He adds that an exactly similar material has been found in copper inkstands at Taxila. If the black substance is ink (and this small pot might certainly do well for an inkstand), it might indicate that the pot is only slightly older than the coin moulds, because the oldest evidence of the actual use of ink in India dates at most to the 2nd or 3rd century B.C.[12] At the same time, there is nothing strained in the idea that the use of charcoal or soot was known to the Chalcolithic people, who knew the use of the paint brush for drawing lines on pottery.[13] It is the evidence from the structure and composition of the pot itself that must supply the main clue to the age and for this we must await the analysis which Mr. Sana Ullah has kindly promised.

(*f*) *Shell bead.*—Finally, I ought to mention (although I did not collect it myself) a shell bead, carved in the shape of a date (Figs. 9, 10). It was given me by a villager at Khokra Kot, who said it was picked up on the mound, and there seems no reason to disbelieve him. The enlarged end view (Fig. 10) shows the spirally placed laminæ: the bead was evidently carved out of the columella of a massive (marine) gasteropod shell; the minute structure is identical with that of beads (*e.g.*, No. R. 3884) and other shell articles from Harappa which through the courtesy of the curator, Dr. Sita Ram, I was able to compare in the Central Museum, Lahore.

Ordinarily one should not attach an age value to a relic of which the source and stratigraphical position is unknown. For this reason no definite opinion can be expressed as to the age of this solitary specimen. If I draw attention to it here it is not as proof of a prehistoric age but as a further ground for my suspicion that well-directed excavation of the deeper strata, which would probably be more accessible at Khokra Kot than they were on the banks of the Indus, will yield relics as old as those at Harappa or Mohenjo-Daro.

The resemblance with some of the beads from these localities is so close that our specimen might equally well have come from

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[10] See Marshall, p. 570, pl. CLVII, 14.

[11] Marshall, pp. 689–690.

[12] See Bühler, *Indian Palæography*, 1904, pp. 5, 6, 97.

[13] Marshall, pp. 319–320.

either of these places. But of course the illiterate villager could hardly have brought or obtained it from these far off places which, as already stated, are about 250 and 560 miles away as the crow flies. Sir John Marshall and others have already suggested that in all probability the "Indus" culture extended to other parts of India. And there would seem to have been no more likely direction for its spread than into the fertile plains of the Jumna and the Ganges.

In my full paper I shall acknowledge all the help so generously given me by a number of kind friends, but apart from those already named above I would like to record my special thanks to my assistant Mr. K. N. Kaul, M.Sc., for the excellent photographs here reproduced.

May 8, 1936.

Postscript.—During a second visit to Khokra Kot to-day a further collection of *several thousand* fragments of coin-moulds similar to those described above, was made.

Rohtak, 10*th May*, 1936. B. S.

Fluorescence in Ultra-Violet Light as an Aid to Chemical Analysis.

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THE more spectacular applications of this method are now well known. Ultra-violet light now ranks as one of the "mystery rays" concerning which the man in the street is duly informed when a forgery or similar crime is "in the news", and numerous workers interested in the various ramifications of science applied to industry have put on record their belief as to the value of the method.

One aspect of the subject, however, does not appear to have received quite the attention it deserves, and this is the application of the method to what we may term ordinary chemical analyses, in order to distinguish them from the more or less specialised or empirical methods used in connexion with industrial work. In many cases these provide very sensitive and specific tests, some of which may be used quantitatively, and it is felt that once the possibilities are better known they will give the analyst yet another string to his bow.

The principle of the method of fluorescence analysis is now so well known that the shortest introductory description will suffice. In brief, substances which appear identical in ordinary daylight or artificial light may emit a characteristic fluorescence in ultra-violet light which not only enables them to be identified, but also supplies information regarding their nature and origin; hence the value of one of the applications of this method in industrial work, *e.g.*, the checking of samples against deliveries. This fluorescence may be so vivid as to be apparent even when minute quantities of material are present, and hence again its uses in criminological work, *e.g.*, for the detection of forgeries and erasures, etc. In chemical analysis, however, the underlying principles are rather different and they may be summarised as follows:—

(1) Production or disappearance of fluorescence.

(*a*) Thus, two non-fluorescent substances (one a reagent and one the unknown) are caused to react so as to produce an end-product which fluoresces visibly even if the quantities involved are very small.

(*b*) Conversely the fluorescence of a substance or a reagent may be destroyed by the reaction. The obvious disadvantages of this method are that it is less sensitive and less specific than (*a*).

(*c*) Allied with (*b*) is the method based on the property of certain ions of inhibiting in a specific way the fluorescence of a substance without reacting with it chemically. Such inhibition may therefore be used as a test for the inhibiting substance, and if, as is usually the case, the minimum amounts necessary for the purpose are known, the method enables one to say whether the quantity present is over or above that amount.

(2) The change in the colour or intensity of the fluorescence of a substance may be used to indicate the end-point of a quantitative reaction in which it does not of necessity participate. In other words, the substance plays a part similar to that of the ordinary indicator used in volumetric analysis.

(*a*) The substance to be determined may be its own indicator (just as the disappearance of the colour of potassium permanganate indicates that an oxidation-reduction reaction is complete).