MEMOIRS
OF THE
NUMISMATIC SOCIETY OF INDIA
No. 1

THE TECHNIQUE OF CASTING COINS IN ANCIENT INDIA

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With seven half-tone plates, two maps and numerous line-figures in the text.

THE NUMISMATIC SOCIETY OF INDIA
PRINCE OF WALES MUSEUM
BOMBAY
1945

TO THE

MEMORY

OF

Dr. KASHI PRASAD JAYASWAL

1881–1937

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INTRODUCTION.

That a palæobotanist, with no pretensions to a knowledge of archæology, should here venture into the field of numismatics, demands an explanation. My introduction to this field was due initially to a chance discovery at Rohtak, about eight years ago, of what has since turned out to be an important mint site of pre-Christian India.[1] But my pursuit of this line of research would have been impossible had it not been for the help and encouragement I have received from several distinguished men versed in this science of purely human interest. At the same time my own occupation in the study of fossil plants has been of assistance to me in the present work, because the aims and methods of the palæobotanist are not essentially different from those of the archæologist. The aim of both is historical : the interpretation and reconstruction of the past. And the method in each case is to piece together scattered fragments of evidence found buried in the earth—in either case "fossil" evidence in the literal sense of the word.

The material accidentally brought to light in March 1936 was briefly described in the May number of "Current Science" (*loc. cit.*). Among other relics, it included some thousands of terra-cotta coin moulds, a few virgin coins still lying within their moulds, and some other fragments which promised to throw light upon the technique of casting coins in ancient India. This being a subject of which our knowledge is extremely meagre, I was encouraged by the late Dr. K. P. Jayaswal to undertake a detailed study of the apparatus.

In this quest I was led to examine also some coin moulds found elsewhere in India, *e.g.*, at Taxila, Mathura, Nalanda and other ancient sites.

Incidentally I was able to show that some supposed seals described in 1884 by Dr. A. F. R. Hoernle[2] from Sunet near Ludhiana were in reality coin moulds in which some of the later Yaudheya coins must have been cast. While following up this clue I came across a quantity of material which led me to the conclusion that Sunet probably marked the site of a later mint of the Yaudheyas,[3] just as the *Bahudhānyaka* mint at Rohtak had belonged to the earlier members of that famous warrior people.

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[1] Sahni (1936) pp. 796-801, figs. 1-5.

[2] Hoernle (1884).

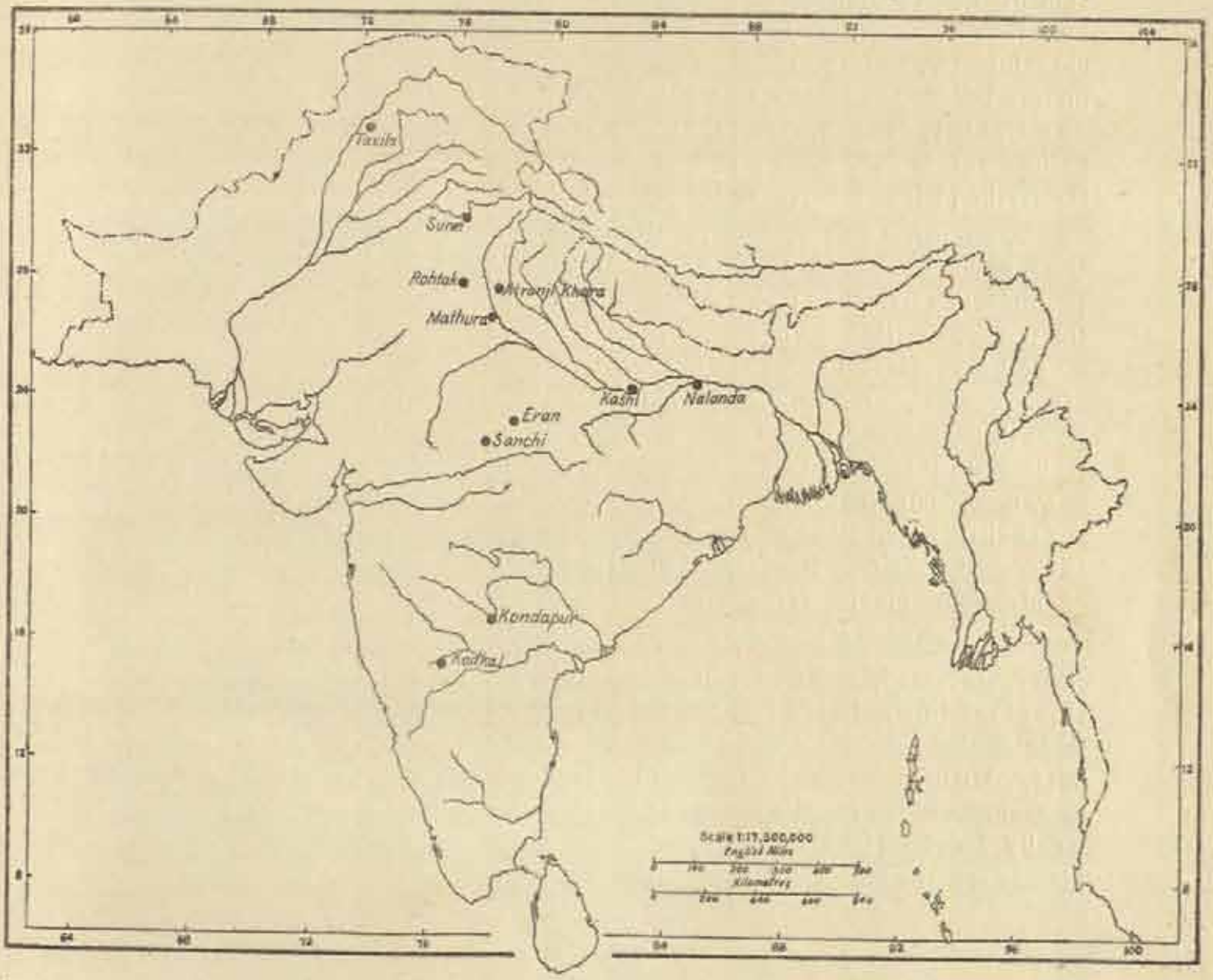
[3] Sahni (1941) pp. 65-67, figs. 1-12.

With the knowledge of ancient Indian methods of casting coins, which an intimate study of these relics had yielded, I was led to compare the techniques followed in other countries, particularly those adopted in China and during the Roman period in Europe and northern Africa.

While I have thus been tempted to carry this work far beyond its original scope I am grateful for the new contacts it has brought me and for the pleasure I have derived from labouring in a fresh field in which, I find, the paths of research are endless, as they are in my own.

Among those to whom I am indebted for help and encouragement I have to mention, first of all, the names of three distinguished men who are now no more : Rai Bahadur Daya Ram Sahni, Professor E. J. Rapson, and particularly my late friend Dr. K. P. Jayaswal who introduced me to the Brahmi script and first put me on the correct path in the study of the Rohtak moulds. Apart from the purely technical aspect of the material, on which I have been able to work more or less independently, there is the historical interpretation of the relics. In this aspect of the work I have, of course, had no direct part and I must freely acknowledge my indebtedness to several kind friends who have given me the benefit of their knowledge. In this matter Dr. V. S. Agrawala, Curator of the Museum at Lucknow, has been my constant guide. To him, to Professor Jaya Chandra Vidyalankar and to my esteemed friend Rai Krishnadasa, founder and director of the Bharat Kala Bhawan at Kashi, I am grateful for the pains they took in criticising my manuscript and for many valuable suggestions. Rao Bahadur K. N. Dikshit, Director General of Archæology in India, gave me the privilege of accompanying me (on March 16, 1937) to Rohtak to inspect the Khokra Kot mound and, acting on my suggestion, had the site excavated. The help I have received from the Numismatic Society of India and particularly from its President, Rai Bahadur Prayag Dayal, has been most valuable at a time when hopes of seeing this work published were receding. It was Professor Jaya Chandra Vidyalankar who first identified Rohtak with the ancient *Rohītaka* of the *Mahābhārata*, recognised *Bahudhānyaka* as the name of a territory and fixed its location. Through his kind offices, and the generosity of Rai Krishnadasa, I was enabled to examine some coin moulds obtained by Professor Jaya Chandra at Sunet. For the loan of the coin mould shown in Pl. IV fig. 117 I have to thank Mr. B. M. Vyas, Curator of the Municipal Museum at Allahabad. To Professor H. J. Bhabha, F.R.S., I owe the suggestion that some of my coupled moulds should be X-rayed to ascertain whether they contain any coins (see Pl. IV, figs. 107, 109). In the illustration of this work I have received much help from my research assistants, Mr K. N. Kaul and particularly Dr. R. V. Sitholey, who took great pains on my behalf. My colleague Dr. A. C. Chatterji kindly ascertained the temperatures required in the baking of the moulds, and the composition of some of the coins. Lastly, I am glad to acknowledge the help my wife has given me in drawing up the Index, and in many other ways.

For consulting the reference literature on early coining techniques, which is surprisingly scarce in India, an enforced visit to Vienna in the summer of 1938 served me in good stead. It brought me into contact with that able and kind-hearted gentleman, Professor K. Pink, who was then in charge of the famous Muenzkabinett at the Kunsthistorisches Museum. Professor Pink not only generously placed at my disposal the full facilities of his library and his own fund of knowledge of Roman coins, but also undertook to sponsor the publication of a brief paper, with illustrations, on the technical aspect of my material in a German journal of numismatics, because he thought that it would



Text-fig. 1.—Plants for the manufacture of coins in Ancient India.

be of interest to western students. The article was received in Vienna before the end of the year 1938 and was to appear in the new Zentralzeitschrift which was shortly to be inaugurated in Munich. The subsequent disturbed state of Europe, leading to the outbreak of war, having made communication with Germany impossible, the fate of that article is still unknown to me.

DESCRIPTION.

Unlike the coin made from it, the coin mould or die never passes into circulation. While the coin is peripatetic, the mould is static. The mould therefore has a historical value of its own, supplementing that of the coin: apart from throwing light upon the technique employed it reveals the birth-place of the coin, from where it started on its long peregrinations

In the accompanying map (Text-fig. 1) all the localities from which ancient Indian coin moulds or dies have so far come to my knowlege have been indicated. We would probably be right in regarding all these places as old mint-sites, with the exception, perhaps, of one or two from where the material described can be reasonably suspected to be a forger's apparatus. As might have been expected, the majority of these sites lie in the Indo-Gangetic basin. This is in accord with what we know of the great cultural history of the fertile plains of Northern India.

We must, however, bear in mind that, while we have aimed at making the present work comprehensive and detailed, this can only be regarded as a preliminary attempt to tackle a subject which promises a great development in the future. Within the course of the past few years, while this work has been in progress, several new occurrences of coin moulds have come to light one after another. In particular I would mention the finds at Sunet, Kondapur, Kadkal, Kashi and, quite recently, at Sanchi. There must still be many coin moulds in private collections or in museums which have not yet been made known. I know that in at least two instances (Sunet and Sanchi) objects which are obviously coin moulds have for many years been lying in museums, labelled as "seals." We may therefore confidently look forward to further discoveries of interest in this (for India) almost untrodden field.

The number of cast coins known is vastly greater than that of the moulds so far discovered, and clay moulds, like coins, are well suited to withstand the ravages of time. Hence it would not be at all rash to predict that with further investigation the matrices of at least the majority of cast coins will come to light. We cannot expect *all* of them to turn up, because official mints as well as forgers would probably have taken steps to destroy the apparatus though, luckily for the historian, the past does, sooner or later, yield up its secrets, both as regards the deeds and the misdeeds of man.

a. ROHTAK

We shall begin the descriptive part of this work with Rohtak, where it was my good fortune to make a find of coin moulds richer than any yet recorded from any other part of the world, with the result that it has been possible to make a very detailed study of the technique employed. Before coming to the moulds themselves it may be useful to give a general description of the Khokra Kot mound and of the site of the mint.

General description of the Rohtak mounds.

The modern city of Rohtak (76° 35′ E, 28°54′ N), the chief town of a district of that name in the Punjab, lies about 40 miles west-north-west of Delhi (see Map, Text-fig. 1). The oldest part of the city, with its narrow winding streets and many antique houses, stands on an eminence to the north of the railway station, while the more recently built bungalows and most of the houses belonging to the civil administration lie spread out on low ground to the south-east. A visit to the interior of the city shows that many of the houses stand on foundations which lie in the ruins of old habitations; the city stands, in fact, on a mound, in which cuttings made by the rains have in places exposed these buried ruins (Pl. I, figs. 1, 2).

Rohtak is known to be a city with a long history, about which some information, more or less reliable, may be gathered from the official Gazetteers.[1]

The name Khokra Kot (Khokhrakot or Khokrakote) is applied to a series of mounds covering an extensive area immediately to the north of Rohtak (see Sketch Map, Text-fig. 2). These mounds are separated from the present town only by the Circular Road which roughly marks the limit beyond which the pucca buildings of Rohtak do not extend to the north. It is obvious that these mounds form only an extension of those on which the modern city is built. The history of Rohtak is therefore intimately bound up with that of the ruins of Khokra Kot.

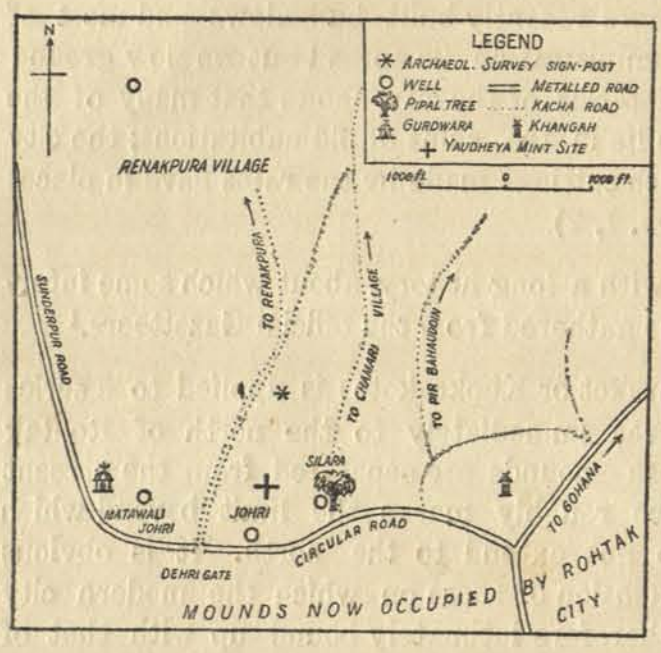
The greater part of Khokra Kot lies between the Circular Road to the south and two diverging roads, one leading north-east to Gohana, the other north-west to Sunderpur. The deserted mounds rise to about 30 feet above the level of the surrounding country, and are traversed by a number of unmetalled roads. Their structure is revealed in a number of ravines cut by the rains, where old bricks, potsherds and other relics such as beads, shell bangles, bits of fused glass and metal can be picked up in abundance. Except for the village of Renakpura, which stands in a slight depression among the mounds in the north-western part of the elevated area, and a few scattered habitations and graves in the southern part, near the Circular Road, Khokra Kot is at present unoccupied.

There is no doubt that a great quantity of old bricks robbed from Khokra Kot have gone into the building of houses in Rohtak. The Dehri Gate, situated on the Circular Road near the south-west corner of Khokra Kot, is an interesting example of a structure built of bricks belonging to various periods (Pl. I, fig. 3). Some of the *pucca* houses at Renakpura are partly built of large slab-like bricks, 2½ inches thick, 9 or 10 inches broad and about 16 inches long, which

[1] The Punjab District Gazetteer (1910) Vol. III A. Rohtak District (C. M. G. Press, Lahore; The Gazetteer of the Rohtak District (1883-84) p. 16, Punjab Government Publication; The Imperial Gazetteer of India (1908) Vol. XXI pp. 310-322.

indicate that they are derived from the Gupta period. Extensive brick-robbing is also indicated by the confused state of the strata in excavations recently carried out near the mint site.

Patches of cultivation and scattered graveyards and cremation grounds cover a considerable part of the mounds. There is not much natural vegetation. The most conspicuous plants are babul (*Acacia arabica*), karir (*Capparis aphylla*), ber (*Zizyphus* sp.) and ak or madar (*Calotropis procera*), all species characteristic of the southern Punjab desert flora. There is evidence, however, that in former times the region was by no means such an arid tract as it is now. Near Renakpura, for instance, there are a number of old *dhenklis*, a lever arrangement (rather like a see-saw) with which water is drawn in many parts of India where it is near the surface. These *dhenklis* are now out of use because the water-level has fallen.



Text-Fig. 2.

Rough plan of the Khokra Kot mound at Rohtak. Approximately to scale.

Previous work on the history of Rohtak.

In a note on "Rohtak" an Archæological Survey report states[1] "The town of Rohtak is surrounded by several extensive mounds, containing remains of the ancient city of Rohtak. One of these, in the immediate neighbourhood of the town, has been declared a protected monument". The note then proceeds to describe some sculptures of comparatively late date found in some of the unprotected mounds but says nothing about the protected mounds which are together known as Khokra Kot. In the Proceedings of the Asiatic Society of Bengal for the year 1881, however, there is a lengthy report in which A. F. R. Hoernle[2] quotes a statement by Durga Pershad, a former Tehsildar of Rohtak, describing certain excavations carried out at Khokra Kot during the year 1880. The digging was carried down, it appears, to a depth of 60 to 80 feet and three distinct strata of habitations were discovered. Among a variety of relics collected the only datable ones appear to have been some small coins found in the third stratum, and of these Hoernle gives a detailed

[1] D. R. Sahni (1920) Annual Progress Report of the Superintendent; Hindu and Buddhist Monuments, Northern Circle, for the year ending 31st March, 1919, para. 18, p. 13.

[2] Hoernle (1881), p. 69 ff.

description with figures. The other relics, being presumably of no great interest, are briefly disposed of and are not figured. The coins were assigned by Hoernle to the late *Saka* period.

As suggested in my preliminary note,[1] it is by no means impossible that a systematic excavation will show the site to be as old as the so-called Indus civilisation. Mr Dikshit wrote to me (16th February, 1937) that an examination of some surface finds indicated that Khokra Kot was in occupation up to the *Kushāṇa* period when it was partially abandoned, only the southern part, where Rohtak now stands, remaining populated. The recent excavations carried out by the Archæological Department have not so far revealed any prehistoric antiquities but, as stated, there has been a good deal of churning of the strata through brick-robbing, and the digging operations were therefore not extended beyond a limited area.

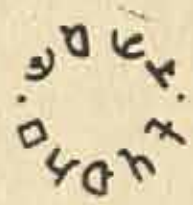
Discovery of a mint-site of the Yaudheyas: the ancient Rohītaka.

The coin moulds here described were all found at one very localised spot, which is marked on the accompanying sketch map (Text-fig. 2; see also Pl. I, fig. 2). No building of any kind was found at the place and the preservation of the dump of coin-moulds must be due to a lucky chance, because it was embedded in a narrow ridge only two or three feet wide which had escaped demolition.

The discovery of this ancient mint site was first announced in May 1936 when a brief illustrated account of the coin moulds was given. The find was made accidentally on March 24, 1936. While looking for a memento of a casual visit to the mound, I chanced upon a fragment of a disc of baked clay which bore on both faces certain designs and a script in sunken letters, both of which were at first a complete puzzle to me. This solitary fragment was found in a dust heap at the bottom of a sort of cliff cut through the mound. The relic was soon traced to its home in a dark horizontal layer, exposed to view higher up in the cut face of the cliff, at a level about three feet below the surface (Pl. I, fig. 2), from where it had no doubt been washed down. The layer was only a few inches thick and two or three feet in horizontal extent. But it was a pleasant surprise to find that it was almost entirely made up of similar fragments of clay discs. This layer was obviously a dump of discarded coin moulds, and it was equally clear that here was the site of an ancient mint where coins must have been made by the process of casting. Within a few minutes several hundreds of the fragments were pulled out, and these formed the basis of the note referred to. Soon afterwards, on May 10, 1936, a second visit was paid to the mound; a small digging was made and I was able to add to the collection several thousand fragments of moulds, as well as other relics which threw light upon the details of the technique employed at the mint.

[1] Sahni, B. (1936), pp. 796-801, figs. 1-5.

Meanwhile Dr. K. P. Jayaswal, who had examined my material on April 30, 1936, and to whom I am most deeply indebted for his encouraging guidance, had read the legend (it was in the Brahmi script) and fixed the date of the moulds as *ca.* 100 B. C. The large number of well preserved fragments of the negatives, from which I had made positives in plasticine, enabled him to complete the reading on the obverse as follows:—



Yaudheyānā (*m*)

Bahudhāñake

Both lines read from left to right.

This legend, and the familiar signs of the bull and elephant, at once identified the moulds as belonging to the Yaudheya coins already well known from the works of Prinsep[1], Cunningham[2], Rapson[3], and others. In fact, this reading of the legend had already been conjectured from coins examined by Professor Rapson[4], although the second line was not quite clear: Dr. Jayaswal had now confirmed Rapson's reading. But the main point is that although the coins of the Yaudheyas were known ever since Cautley's find at Behat, now over a century old, we had no data concerning either the technique of their coining or the location of their mints[5]. These gaps in our knowledge were now at least partially filled. It was now certain that at least one of the Yaudheya mints was situated at Rohtak. Shortly after the publication, in May 1936, of my first note Dr. Jayaswal[6] wrote a brief account explaining the significance of the discovery, in the Journal of the Behar and Orissa Research Society, where he quoted the following verses from the Mahabharata:

ततो बहुधनं रम्यं गवाढ्यं धनधान्यवत्। कार्त्तिकेयस्य दयितं रोहीतकमुपाद्रवत् ॥४॥
तत्र युद्धं महच्चासीच्छूरैर्मत्तमयूरकैः। मरुभूमिं स कार्त्स्न्येन तथैव बहुधान्यकम् ॥५॥

Sabhāparvan, Ch. 32.

It was thus clear that Rohtak must be identified with the ancient Rohitaka of that epic[7]. However, as I came to know later, Professor Jaya

[1] Prinsep (1834), p. 229 and Pl. XVIII, figs. 11, 12; (1835) pp. 624-626 and Pl. XXXIV, figs. 5, 6, 9, 10; (1858) pl. IV, figs. 11-12, pp. 84-85; pl. XIX, figs. 5, 6, 9, 10, pp. 201-202; see also Cautley (1834), pp. 43-44; (1834*a*) pp. 221-227.

[2] Cunningham (1891), pl. VI, fig. 2, pp. 75-79; (1882) pl. XIV, pp. 139-145.

[3] Rapson (1898), pl. III, fig. 13, pp. 14-15; (1900) p. 107, note 1.

[4] Rapson (1900), p. 107, note 1.

[5] Rapson (1922), p. 528.

[6] Jayaswal, K. P. (1936), vol. XXII, pp. 59-62, pl. II.

[7] The name Rohitaka, it has been suggested, was given to this place owing to the abundance here of the plant known in Sanskrit as *Rohitaka* (Latin *Amoora Rohituka* W. & A.; synonym: *Andersonia Rohituka* R.). A reference to the published floras, however, shows that this plant does not occur anywhere in the Punjab, in fact nowhere in N. India west of Oudh. It may be that it has become extinct in the Punjab during historic times. *Amoora*

Chandra Vidyalankar[1] had already established this identity two years previously, and what is more important, he had recognised Bahudhanyaka as the name of a territory and fixed its location. Writing in 1934, he described Nakula's conquest of the Western Quarter in the following words[2]:

नकुल खाण्डवप्रस्थ से बड़ी भारी सेना के साथ पच्छिम दिशा को निकलता है और पहिले पहल "गवाढ्य धन धान्य वाले कार्त्तिकेय के प्रिय" रोहीतक पर जा टूटता है वहां उसका शूर मत्तमयूरकों से भारी युद्ध होता है; वह समूची मरुभूमि को और बहुधान्यक को शैरीषक और महेत्थ को वश में कर लेता है, तथा राजा आक्रोष को भी, जिसके साथ कि बड़ा भारी युद्ध होता है।

रोहीतक और शैरीषक स्पष्ट ही आधुनिक रोहतक और सिरसा हैं। दिल्ली से जो रास्ता आज दक्खिन पंजाब की तरफ़ सीधा बढ़ता है, वह रोहतक, महेम, हांसी, सिरसा फ़ाज़िलका होते हुए सतलज पार करता, और फिर गुगेरा के सामने रावी का घाट उतर कर गोजरा होते हुए झंग पहुंचता है।.....रोहतक-सिरसा के समूचे प्रदेश में कुछ अंश मरुभूमि थे और कुछ बहुधान्यक।

The wealthy State of *Rohītaka* comprised two provinces, *Maru* and *Bahudhānyaka* (*Prākrit, Bahudhāñaka*), and the city of *Rohītaka* must have been the capital of the Yaudheyas. It is interesting to know that Captain Cautley's coins from Behat (near Saharanpur), which were the first of the Yaudheya coins to be discovered, belonged to a Bahudhanyaka mint. We shall have more to say at a later stage concerning the coins of the Yaudheyas and the history and conquests of these warriors. Professor Jaya Chandra Vidyalankar[3], in discussing the date of King Kanishka, gives a critical review of the relative power and geographical extent of the territory of the Yaudheyas.

Description of the coin.

Before describing the moulds and their technique it is perhaps well to give a brief description of the coins to which they evidently belong.

My moulds are all of one general type of coin although, as we shall see, there are a great many variations. It is a small bronze coin of the Yaudheya series which has been well known since Prinsep[4] first figured it over a hundred

Rohituka is a member of the family Meliaceae. It is a middle sized evergreen tree with a heavy crown of foliage and with a bark which is used as an astringent. It is stated to occur over a wide area including Oudh and N. E. India, the Western Ghats, Ceylon and Malaya.

[1] Jaya Chandra Vidyalankar (1934), pp. 3-4.

[2] Nakula starts from Khāṇḍavaprastha towards the west with a very big army and first of all attacks Rohitaka, (which was dear to Kārttikeya and rich with cows and grain) and there a big battle was fought with the brave Matta-Mayūrakas. He conquers the whole of the province of Maru and also Bahudhānyaka, Sairishaka and Mahettha; he also subjugates Raja Ākrosha with whom there is a great battle.

Rohitaka and Sairishaka are clearly the modern Rohtak and Sirsa. The route which today leads from Delhi direct to the southern Punjab, passes through Rohtak, Mahem, Hansi, Sirsa and Fazilka; after crossing the Sutlej it descends to the banks of the Ravi opposite Gugera, and reaches Jhang *via* Gojra. . . . . The Rohtak-Sirsa country comprised of the divisions of Marubhūmi and Bahudhānyaka.

[3] Jaya Chandra Vidyalankar (1929), pp. 60-63.

[4] Prinsep (1834), (1835); and subsequently again in (1858) pl. IV, figs. 11-12, pp. 84-85; pl. XIX, figs. 5, 6, 9, 10, pp. 201-202.

years ago on the basis of Captain Cautley's find at Behat. Since then this coin has been figured, described or mentioned by many authors, including Cunningham[1], Vincent Smith[2], Rapson[3], Chakrabortty[4], Sahni[5], Jayaswal[6] and Allan[7]. According to Smith this coin is among the earliest of the Yaudheya series.

The main features of the coin, *as revealed by a study of the moulds,* are given below. I have not had access to the coin itself except in three specimens thickly encrusted with verdigris, which I discovered *in situ* on splitting some of the moulds. They had been overlooked by the operator while breaking up the moulds. I have of course, refrained from cleaning these rare specimens[8]. The following description is therefore confined to features deduced from the structure of the moulds, from some of which positives have been made in plasticine, sealing wax, and lead.

AES. OBVERSE.—Humped bull always facing right, with the head turned obliquely towards the observer; left foreleg raised, ears always omitted; in front of the bull a *yūpa* or sacrificial post within a railing. Along the margin a *Brāhmī* legend in two curved lines which are sometimes clearly separated by stops.

Line 1. *Yaudheyānā (ṁ)*

Line 2. *Bahudhāñake*

Both lines are to be read from left to right[9] *and without turning the coin round.*

REVERSE.—Elephant *nearly* always facing right, but in a variety of postures, standing or moving; trunk always upraised. Below his feet a long curved line (not serpentine). Above the back a flowing pennon or flag and the *triratna* or *nandipada* symbol.

That the ∧ shaped object over the back of the elephant is not the letter *ga* but definitely a flag or a pennon was suggested to me by Rai Krishnadasa. His view is fully corroborated by the appearance of this object in the moulds shown in Pl. II, figs. 27, 28, 38. In figs. 27, 28 the form is ⚑ (more like a flag) and in fig. 38 it is more like a flowing pennon.

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[1] Cunningham (1891), pl. VI, fig. 2, pp. 75-79; (1882) pl. XIV, pp. 139-145.

[2] Smith (1897), p. 888.

[3] Rapson (1898), pl. III, fig. 13, pp. 14-15; (1900) p. 107, note 1.

[4] Chakrabortty (1931), pp. 220-222.

[5] Sahni, B. (1936), pp. 797-798, figs. 1, 3, 4, 5.

[6] Jayaswal (1936), (1936*a*).

[7] Allan (1936).

[8] After the description of the Rohtak material had been completed one of these coins was cleaned (see Pl. II, fig. 26) but did not show up the design very well: it had lain encrusted in the mould for 2000 years.

[9] But see below where the legend is discussed in some detail.

The coin is *ca.* 19 mm. in diameter; in the absence of any clean specimens I cannot give the weight, even approximately. The metal, as analysed by my colleague Dr. A. C. Chatterji, is bronze (copper *plus* tin), but no quantitative analysis has been possible.

To judge from the moulds the obverse face of the coin should be flat or slightly concave, and the reverse slightly convex, because in the moulds the sockets for the bull side are nearly always deep, very slightly convex in the middle, and have a rather prominent edge, while those of the elephant side are like a very shallow saucer, with the edge passing gradually into the general surface of the disc. The surface features of the coins are well brought out in some of the excellent photographs reproduced in Allan's Catalogue of the Coins of Ancient India (Pl. 39, figs. 12, 14-16) and it is easy to correlate these with the photographs of moulds reproduced below. Smith[1] also describes this coin as slightly concave on the obverse. The correspondence between the coins and the moulds is so close that no doubt can be entertained of the coins having been cast in moulds of the same type, if not at the very same mint. If possible, I hope to compare in detail some of the Behat coins with my moulds, with a view to see if any of them correspond so exactly with them that they may be regarded as having originated from the same models. Unfortunately, the whole of the Cautley collection seems to have been sent away from this country: it may be in the British Museum.

Mr. Jai Krishna Agrawal of Lucknow has a small coin, (Pl. III, figs. 77, 78) bearing the same legend and designs as the Rohtak moulds. It is no doubt a cast coin: on one side (fig. 78, top) the margin shows a concave fracture where the coin was broken off from the end of the lug. An interesting point is that this coin, originally cast in bronze, was later plated with a white metal which at first I had taken to be a silver alloy. On analysis Dr. A. C. Chatterji found that it contained no silver, but lead and zinc, with possibly a small admixture of tin. The plating is a clever piece of work, being a thin firmly adhering layer which follows all the relief of the bronze core and which I found it impossible to pull off with a scalpel. In places the plating has now worn away and the bronze is exposed. It would be interesting to know how the plating was executed.

The legend.

As stated above, there has been considerable doubt concerning the reading of the legend on the obverse. In Prinsep's time the division of the legend into the two lines was unknown and he read a part of the legend as "*bayadhaya*"[2] which includes portions of both lines and, of course, makes no sense. In 1858 Prinsep[3] remarked that "the three most conspicuous letters on all of

[1] Smith (1906), p. 181.
[2] Prinsep (1858), p. 85.
[3] Prinsep (1858), p. 202.

these coins are *y dh y*, and it does not seem any great stretch of imagination to see in them a part of the word Ayodhya."

It was Rapson who first clearly showed that the legend is in two lines, and this has been corroborated by the discovery, in some of my moulds, of the stops at the ends of the two lines; but neither of these stops is constantly present, and usually there are no stops at all.

The chief uncertainty about the legend lay, however, in the second line, which was not quite clear in any of the coins examined by Cunningham, Rapson and others. We have seen how the discovery of our numerous well preserved moulds has helped in removing all doubt in the matter. Professor Rapson's conjectured reading of over forty years ago, "*Bahudhāñake*," was fully confirmed by Dr. Jayaswal and an important clue to the provenance and history of these long known coins was established.

It is desirable to state these facts because, as late as 1936, and even after the publication of Dr. Jayaswal's reading, a numismatist of the rank of Mr. Allan[1] was led to suggest that the most likely reading was 𑀢𑀼𑀧𑀥𑀦 [2] (*Kupradhañaba*), which has no meaning; and he placed this word *before* the word *Yaudheyānāṁ* so as to read *Kupradhañaba Yaudheyānāṁ*. This he translated to mean "of the Yaudheyas of *Kupradhañaba*," the latter being a conjectured geographical term[3]. This reading, never suggested before, *was obtained by turning the coin round so as to read the two lines in continuity.* The second line was thus read in the reverse direction, not in the boustrophedonic manner but with the letters upside down and with slight distortions here and there.

Thus it was that

𑀦𑀧𑀥𑀜𑀢

became 𑀢𑀼𑀧𑀥𑀦

(The *ā mātrā* after the 𑀧 is usually absent, but sometimes clearly present in the moulds).

It is interesting to see how such a reading could pass muster. It so happened that in their inverted position the letters 𑀢 and 𑀦 would still be plausible enough *Brāhmī* characters; only, with the altered position of the *mātrā* the

[1] Allan (1936), pp. 267-270 and cxlviii. This reading was essentially the one given by Rodgers (1895, footnote p. 136), who writes "I make it *Kripadhanaba* or *Kripadhanapa Yaudheyana.*"

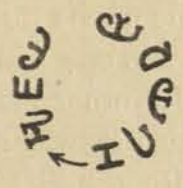
[2] The forms 𑀢 and 𑀥 never actually occur on the coin.

[3] In a subsequent corrigendum (p. clxv) the correct reading was given but apparently it was then too late to revise the discussion in the text, which had already been printed. Jayaswal's reading was first published in my preliminary note (Sahni 1936, p. 796) which appeared in May and, very shortly afterwards, in Dr. Jayaswal's own paper (1936, p. 60).

(*ke*) would become either *kr* or *ku*, although even then the form is unintelligible (see footnote 2 on p. 12). By a strange coincidence, two other letters, the and are *almost* exact inverts of each other, so that if we again follow Mr. Allan in taking a little liberty with the short end stroke, the *ña* would become *pra* and the *hu* would become *ña*. The only serious difficulty was that this reading "required two different forms of *dha* in the same inscription, in Yaudheya and in the other word." "This," writes Mr. Allan, "suggests that the mysterious word should be read the other way." Here he is evidently hot on the scent, and further on gives a full justification of the correct reading conjectured by Rapson, but none the less he prefers Rodgers's version after all.

But even with all this liberty with the *mātrās* and other details the form of the (with the bulge on the left) as given in Mr. Allan's reading still remains unexplained: by turning the coin round the bulge would come to the right.

In fairness to Mr. Allan it must be added that he had some ground for attempting a continuous reading of the two lines by turning the coin round. In another well-known Yaudheya coin, which bears the figure of *Kārttikeya* on the obverse, the legend, in two lines, can only make sense if read continuously in the direction indicated by the arrow in the diagram.



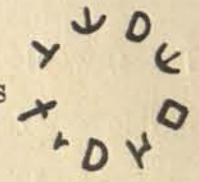
It is perhaps futile to discuss all the unsuccessful attempts in this intriguing quest. Suffice it to say that Vincent Smith's *Bhūpadhanusha*[1] and Cunningham's *Bhūmidhanusha*[2] arrived nearer the mark than the version we have just been discussing.

Before leaving this subject I think attention ought to be drawn to two figures by Prinsep[3] which depict coins of undoubtedly the same type as ours *but with the legend either partly or wholly reversed, so as to read from right to left.* These coins are so interesting that I have thought it fit to reproduce the original figures (see our Pl. III, figs. 69-71). In Prinsep's fig. 6 (our fig. 71) the first line is incomplete but the line is clearly reversed because it reads the *Yau* coming at the right end instead of the left. The second line reads

[1]Smith (1906), i, p. 181, note 1.

[2]Cunningham (1882), p. 141.

[3]Prinsep (1858), Pl. XIX, figs. 6, 9.

normally. In his fig. 9 (our fig. 69) both the lines are reversed, thus 

These inconsistencies must no doubt have contributed to the difficulties of numismatists in deciphering the legend, and it is possible that both Rodgers and Allan were influenced by Prinsep's fig. 9 when they accepted *Kupradhañaba*. Indeed Allan himself figures one coin[1] in the which, as he says, the legend is completely reversed, though, curiously enough, he nevertheless adds that it *"begins with Yaudh-"*. But now that the correct reading is established beyond all doubt, it is possible for us to say that the coins shown in Prinsep's figs. 6 and 9 and in Allan's fig. 12 were very exceptional. The differences cannot have been due to mistakes in copying. Prinsep was too careful a worker and engraved his plates with his own hand. It is a pity his originals are not preserved in the Indian Museum; if found elsewhere they should be carefully examined and compared.

These are the only instances of the kind that have so far come to my notice, but I confess I have not had the time to scrutinise every one of my several thousand mould fragments to ~~use~~ see if any of them bear a reversed legend.

The significance of the legend on these coins has already been discussed by Jayaswal[2]. Rohtak, as shown by Professor Jaya Chandra, was the ancient *Rohītaka*, and it must have been one of the mint-places of the Yaudheyas in the province of *Bahudhānyaka*, which was one of the two provinces into which the State of *Rohītaka* was divided, the other being Maru. Maru means desert; Professor Jaya Chandra suggests that it was the desert of *Bāgar*, that is, the portion of Hariana west of the Rohtak-Sirsa line and adjoining the Bikaner territory.

A historical survey of the Yaudheyas is beyond the scope of the present work; but at the suggestion of Professor Jaya Chandra I give below a brief chronology of them based upon notes kindly supplied by him.

The earliest known reference to the Yaudheyas is, I am informed, in the Puranic tradition. In about the 5th century B.C. we find them mentioned in a *sūtra* of *Pāṇini*[3]. Jayaswal[4] suggests that it was this sturdy race of warriors whose presence in force beyond the Beas was the immediate cause of alarm in Alexander's army and its consequent retreat from that river. Jayaswal's suggestion now receives confirmation from the Rohtak finds which prove that

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[1]Allan (1936), Pl. XXXIX, fig. 12 (No. 21 in his Catalogue, p. 267).

[2]Jayaswal (1936) and Presid. Address to the Numismatic Society of India, November 1936, Udaipur meeting.

[3]*Pāṇini's sūtras*, IV. 1. 178 and V. 3. 117. For this reference I have to thank Dr. V. S. Agrawala.

[4]Jayaswal (1924), Hindu Polity, Vol. I, pp. 66-67; (1936), p. 61.

the Yaudheya rule extended to the Rohtak country. The Yaudheyas must at one time have been included in the Mauryan empire, but on the break up of that empire became a sovereign state, issuing their own coinage. The extent of their sway is indicated by the finds of Yaudheya coins, and now of their moulds. Their territory *Bahudhānyaka* is referred to in the Digvijaya-parvan (a portion of the *Sabhā-parvan*) of the Mahabharata, where the people inhabiting that region are called *Mattamayūrakas* (*lit.* those having enraptured peacocks). As evidenced by their later coins, the Yaudheyas worshipped *Kārttikeya* who rides a peacock: it is interesting that the peacock is still considered sacred in the Rohtak country. Thus it would appear that *Mattamayūraka* is only another name of the Yaudheyas. Professor Jaya Chandra Vidyalankar[1], who made a special study of the northern and western portions of the Digvijaya-parva geography, concluded that it contained a picture of the second century B.C. This is now confirmed by the mention of *Bahudhānyaka* on the Rohtak coin moulds of the second or first century B.C. In about 150 A.C. the Yaudheyas were subjected by *Rudradāman*[2], who says that they had gained the reputation of being the best heroes amongst all *Kṣatriyas*; this implies that they had maintained their independence during the Greek and *Saka* invasions. Soon after Rudra's time they regain their independence and extend their territory to Bijayagadh; they are mentioned in the Bijayagadh stone inscription in Bharatpur. Subsequently they form a part of Samudra-Gupta's empire[3] as evidenced in the Allahabad pillar inscription. They are mentioned by Cunningham[4] as surviving in Bahawalpur under the name of Johiyas in the territory called *Johiyābār*. The Imperial Gazetteer[5] speaks of the Johiyas of the Montgomery and Hissar districts in the Punjab, the latter being a district adjoining Rohtak. It appears that they also survive in Sindh and Rajputana[6].

Variations.

A remarkable feature of the moulds is the many variations they show in the designs and script. These variations affect particularly the form of the letters composing the legend on the obverse, and the design of the elephant on the reverse. This must have resulted in a bewildering variety of coins cast in these moulds, even though the coins belonged to the same denomination.

The moulds were studied both in the original and in casts made from them in plasticine. In order to show up the design or script in the photographs the depressions were sometimes filled with a white powder before making the cast (see, *e.g.*, the casts figured in Pl. III). For making many of the casts

[1]Jaya Chandra Vidyalankar (1934).
[2]Kielhorn (1905-6), Vol. VIII, inscription p. 44.
[3]Fleet (1888), Vol. III, No. 1, pl. 1, p. 14; see also No. 58, pl. 36B, p. 251.
[4]Cunningham (1871); Cunningham and Majumdar (1924), p. 281 ff., 689-690.
[5]Imperial Gazetteer of India.
[6]Ann. Rep. Arch. Surv. W. Ind. 1920, p. 79.

figured in this work plasticine made in the laboratory was found quite workable. It may be useful to give the recipe:

Fine (precipitated) clay	½ lb.
Bees wax	¼ lb.
Linseed oil	¼ lb.

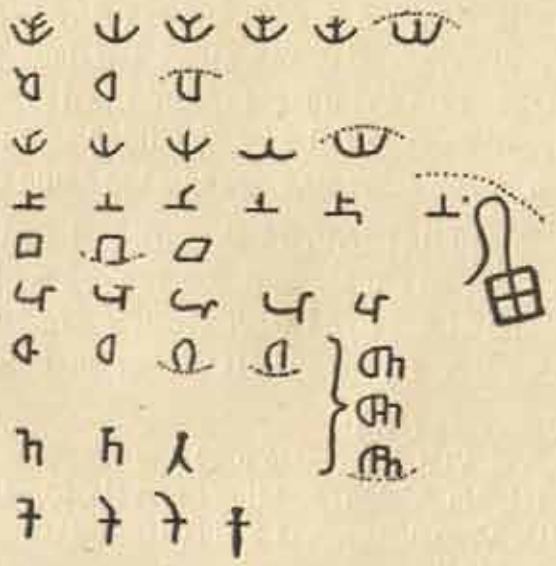
The wax and oil are first heated together, then thoroughly mixed with the clay by kneading and later by beating with a hammer.

Obverse.—The form and posture of the bull is on the whole fairly constant. It is always a rather lanky bull with long legs and a very prominent hump, the head thrown up and turned obliquely towards the onlooker. The head is always to the right (in the coin); the eyes are prominent but the ears are never to be seen. The chief variation is seen in the legs. The left foreleg is always more or less raised, and the foot usually curved inwards (*a*). Sometimes the foot is straight but lifted high (*b*). The hind legs generally stand almost

Text-fig. 3.

parallel to the right foreleg (as in *a* and *b*), but sometimes the characteristic angular bends are more apparent (*c*).

The variations in the script were figured in my first paper (*loc. cit.* fig. 3*b*, p. 798). I cannot say what value they may have in a study of the morphology of the *Brāhmī* characters, but I reproduce them again below.



Text-fig. 4.

In the first column are given what may be regarded as the normal forms of the letters, the other columns give the modifications.

It is interesting to observe how the exigencies of space have affected some of the letters, leading to a number of exergual forms. Thus the letter  in the first ~~first~~ line, when occurring close to the rim of the coin, loses its outer portion and becomes  , while the  and  in the second line become  and  respectively. Still more interesting is the formation of a sort of compound letter by the approximation of the *dhā* and *nā*, thus  ,  ,  . In Prinsep's fig. 5[1] there is an interesting exergual form in the second line where the has overlapped the  and has been cleverly incorporated into it, thus  (see Pl. III fig. 72).

Of the several variations of the letter *na* in the first line, it is still rather uncertain which was the intended version. The *mātrās* are not always present, and their position also varies. The significance of the dot at the end is doubtful; when present it is usually placed so far off that it may be more probably a stop than an *anusvāra*.

The form and position of the *yūpa* symbol is very constant.

Reverse.—Unlike the bull, the elephant shows a very considerable variety of pose, standing, walking or running (see Pl. I, fig. 5). While usually facing right[2] like the bull, in two specimens (derived from different models) it was seen to face left (see Pl. II, fig. 39). One of the coins described by Cunningham[3] from Behat also has the elephant facing left. The whole body of the elephant is not always included, but the head and trunk are nearly always shown. The trunk is always upraised and one of the front feet is slightly lifted. When the main part of the body is omitted the head with the uplifted trunk is usually placed near the margin, as if the elephant has just entered the circle of the coin; more rarely it is placed near the opposite margin, as if the animal is leaving the circle (Pl. III, fig. 80). The bristles of the tail are sometimes greatly exaggerated giving the tail an unnatural forked or branched appearance (Pl. I, fig. 5; Pl. II, figs. 27-28; Pl. III, figs. 65, 67).

Some slight variations are seen in the details of the *triratna* symbol

[1]Prinsep (1858), pl. xix.

[2]These directions are given as they would be seen in the coin (positive), not as they are seen in the mould (negative).

[3]Cunningham (1882), p. 141.

(see Pl. III, figs. 66, 68) The ⅄ like object over the back of the elephant is of somewhat doubtful nature. It sometimes takes this form ⅄ which suggests that it may be a flowing pennon, as stated by Allan[1]; more commonly it is like a symmetrically placed inverted letter Y; sometimes an inverted V. The late Dr. Jayaswal suggested that it may be the *Brāhmī* letter *ga*, representing *gaṇa* (republic). This is made plausible by the fact that some other Yaudheya coins bear the word *gaṇa* (see above). But Rai Krishnadasa, who has carefully examined many of my moulds, feels convinced that the sign represents a flag or standard. As stated above (p. 10) his view is supported by the moulds shown in Pl. II, figs. 27, 28.

The existence of these variations in the moulds shows that a number of different models must have been used in preparing the negatives; and I have found that several of the varieties, some of the obverse, others of the reverse, occur again and again among the thousands of fragments in my possession. It appears that some of the models were used more frequently than others (Compare, *e.g.*, Pl. II, figs. 27-28; Pl. II, figs. 29-30 and Pl. II, figs. 31-32; Pl. III figs. 83-84; Pl. II, fig. 33 with Pl. III, fig. 81). No actual models have yet been discovered, nor is their discovery in the future at all likely because, most probably, after the original models had once been used for making the first series of coins, the coins themselves were freely used as models, as was the common practice with cast coins in Roman times and as is the practice among forgers even to-day.

While pressing the models into the soft clay no care was taken to place them in any particular orientation, nor could the coupling of obverse and reverse have been done in any fixed orientation. The only concern was to see that the same design did not appear on both faces of a coin. As the number of models used was evidently very large, an endless variety of coins must have resulted from the many permutations and combinations that were possible. The chances are that among the many thousands of coins that were cast in this mint no two coins were exactly alike.

Technique.

The moulds—their form and structure.

A good idea of the form and mode of construction of the moulds may be obtained from a study of the fragments shown in the photographs. In Pl. VII, fig. 146 is given a conjectured reconstruction of the complete mould. As explained briefly in my preliminary paper[2], the mould was made up of a series of discs placed in a vertical column, like a pile of coins. The whole pile was plastered over with clay, only a funnel-like crater being left at the top for receiving the molten metal. The crater led vertically down into a central canal, like the shaft of a mine. From this canal, again as in a mine, horizontal

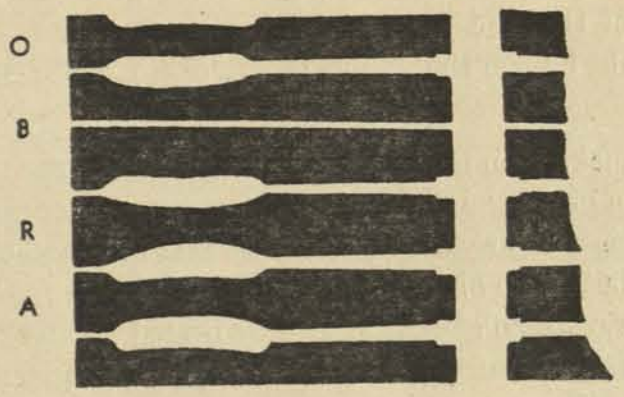
[1] Allan (1936), p. cxlvii.

[2] Sahni (1936), pp. 796-798, fig. 2.

channels led out at different levels, and these opened into the coin sockets. At each level eight such channels radiated from the central shaft, and opened into as many coin sockets arranged in a ring (see Pl. I, figs. 4, 5). The coupled faces of contiguous discs bore the negative impressions of the obverse and reverse, respectively, and were so placed as to make the opposing sockets coincide exactly (Text fig. 5).

After the metal had been poured in and the mould was cool enough it was broken up and the coins, attached in whorls at the ends of the spokes, were broken off, the remaining metal being again put into the melting pot. Occasionally a coin hurriedly broken off would carry away with it the end of the spoke. On the other hand, a portion of the coin margin may be left behind on the spoke and the coin shows a concave scar.

These flaws, incidental to the technique of cast coins, have been discussed in some detail by Bahrfeldt[1]. Such coins were also liable to go into circulation and have been figured by numismatists, *e.g.*, Cunningham[2], Majumdar[3] and others. Cunningham[4] figures an unusually interesting specimen of what we might call a twin coin—a pair of coins still joined together like dumb-bells, having never been broken apart since they were cast in the mould.



TEXT-FIG. 5.—Diagram to show the different possible ways of coupling the discs in the Rohtak coin moulds. The sockets on the two faces of a disc generally do not coincide (see text); the arrangement in a superposed series as shown in this figure is only due to diagrammatic exigency. (Approximately actual size.)

O is a disc with the obverse design on both faces (cf. Pl. II, fig. 17; Pl. III, fig. 86.)

B shows the plane of contact between two contiguous sets of discs in the compound mould, where two blank faces are coupled with a layer of dusting powder between them to prevent adhesion (cf. Pl. II, figs, 40-41; Pl. IV, figs. 108-109).

R is a disc with the reverse impression on both faces.

A is a disc with the reverse impression on one face, the obverse on the other; *by far the great majority of the discs collected are of this type.*

[1] Bahrfeldt (1904), pp. 433-448.
[2] Cunningham (1891), Pl. VI, fig. 2, also Pl. I, fig. 29.
[3] Majumdar (1936), p. 256, Pl. CXXVI (f).
[4] Cunningham (1891), Pl. I, figs. 24-25; see also Brown (1922), Pl. I, fig. 3.

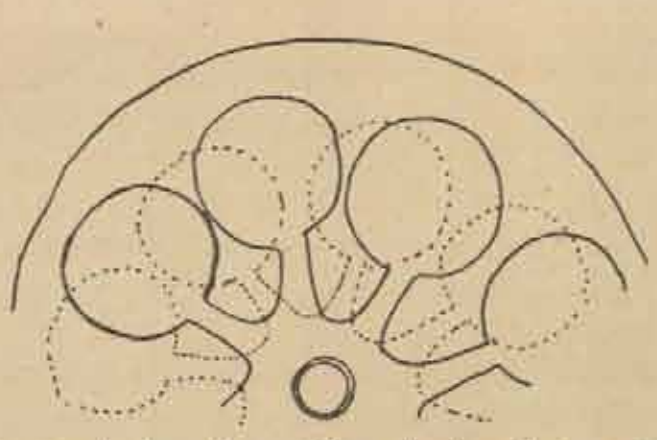
In breaking up the mould the workman would be liable to overlook an occasional coin or two, hidden in a portion of the mould that has been left unsplit. Among the heap of discarded moulds found at Rohtak there were quite a number still sticking together in their original couplings, and on splitting some of them apart I was lucky enough to find three coins lying *in situ* (see Pl. II, figs. 20, 23, 25). One of them has a short piece of the lug still attached.

No complete disc was discovered. I have spent hours trying to piece together the fragments into complete discs, but it was hardly to be expected that this would be an easy matter with the thousands of fragments all jumbled up in a heap. Actually I did not even find two fragments that exactly fitted each other along their fractured edges. However, it is quite easy to make a rough reconstruction of a disc, such as those shown in Pl. I, figs. 4, 5. The curvature of the outer edge shows that the discs were about 87 mm. in diameter, with a central hole 7 mm. across, from which the eight canals radiated so as to open into eight circular coin sockets each about 19 to 21 mm. in diameter. The radial canals are shallow; they gradually narrow from the centre outwards, their broader inner ends being united into a shallow trough round the central aperture.

Along the outer curved edge the discs are slightly thicker (average *ca.* 5 mm.) than they are round the central aperture, where the trough takes away from the thickness of the disc. Occasionally a disc is somewhat thicker or thinner than the normal, but on the whole the workmanship is uniform and very neat.

As a rule the sockets on the two faces of a disc belong to different faces of the coin. If one side bears the obverse impressions, the other bears the reverse The exceptions to this rule are very few. The fragments shown in Pl. II, fig. 17 and Pl. III, fig. 86 bear the obverse impression on both faces; I have not yet found any with the reverse on both sides. At first I thought these rare exceptions were errors of workmanship but, as the diagram in Text-fig. 5 will show at once, it makes no difference whether we have the two faces similar or different, so long as the coupled faces bear the opposite designs.

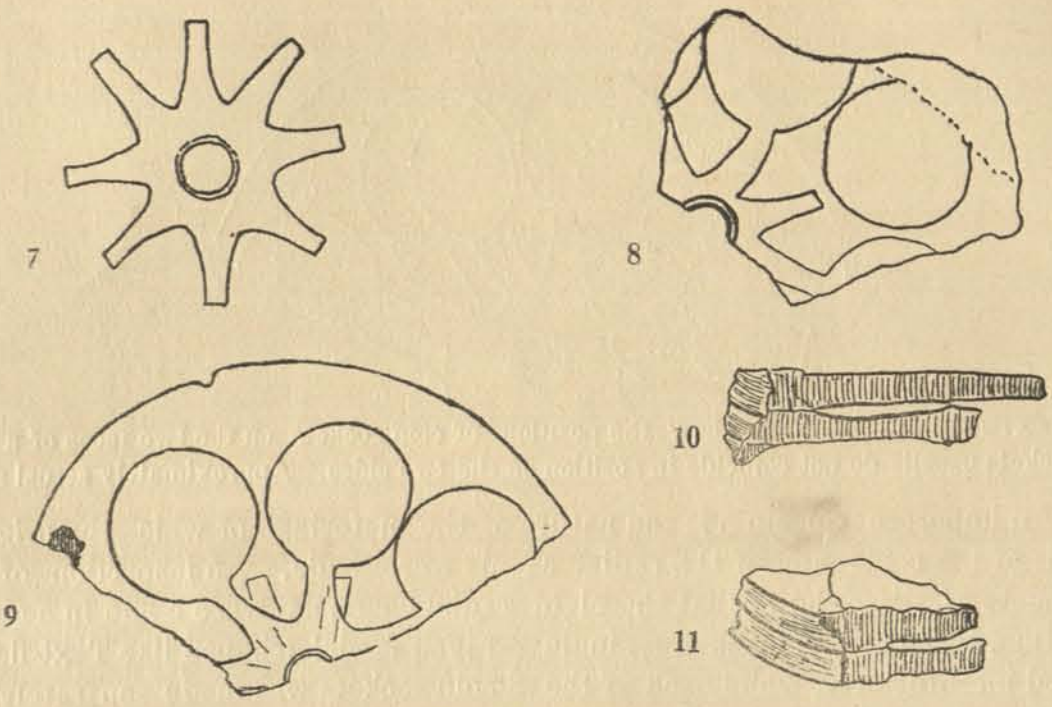
Thus the two faces of the disc are quite independent of each other in the design which they carry. For the same reason it will be clear that neither the radial canals nor the coin sockets need necessarily coincide in their positions on the two faces of a disc. In fact, on practical grounds it is better that they should not, because, if all the coin-whorls in a column of discs were superposed instead of being irregularly disposed as they actually are (see Text-fig. 6) the discs would be more liable to crack owing to uneven heating by the metal



TEXT-FIG 6.—Diagram to show the positions of coin sockets on the two faces of a disc. The sockets usually do not coincide in position on the two sides. Approximately actual size.

An important question is the nature of the materials of which the original models of the coins and of the radial canals were made. An inspection of the fragments of discs shows that the eight radial channels were made in a single operation, that is, by means of a single 8-rayed model (shaped like Text-fig. 7) pressed into the clay, while each of the 8-coin sockets was made separately : a different coin model was pressed in at the end of each ray. This is clear from the fact that no two coin sockets on any one of the fragments examined are identical either in their designs or in their angular orientation round the central canal, and from the fact that the ends of the radial channels do not always meet the circumference of the coin sockets (see Text-fig. 8; Pl. II, fig. 19). It is also proved by an examination of an interesting fragment shown in Pl. II, fig. 42 and Text-fig. 9, which bears two distinct impressions of the 8-rayed model. The fainter impression (with the rays ending blindly) was evidently made in error and it is seen partly superimposed by the correct one.

The model for the eight radial canals was pressed down into the clay to half its own thickness. This model was no doubt a flat piece of metal cut into the shape of Text-fig. 7. A notable feature of this piece (deduced from the impressions left by it on various discs) was a specially thickened rim or collar round the central aperture, which must have facilitated the passage of the metal from the vertical shaft into the radial canals by making the initial opening somewhat wider (compare Pl. II, fig. 19 with Text-figs. 5, 12, 13). That this model was a metallic piece is shown by the sharp edges of the impressions left by it on many of the moulds (See Pl. II, fig. 42). Such impressions can only be made by a piece of metal cut out of a sheet. Moreover, a piece of this shape could much more conveniently be made out of a sheet of metal than out of any other material, such as wood or clay. The sketch in Text-fig. 7 was reconstructed from several fragments of moulds because no complete disc was available. The arms are not always of equal length, and the ends are sometimes obliquely truncated. But the central hole is always neatly circular. To judge by the depth of the radial channels on the moulds the thickness of the sheet from which these models were cut was about 1·5 mm.



Text-figs. 7-11.

(*All figures approx. actual size.*)

7.—Reconstruction of the radial canal model. Note the collar round the aperture.

8.—A canal sometimes stops short of the coin socket (cf. Pl. II, fig. 19). Note the impression left by the thickened collar round the aperture.

9.—Double impression of radial canal model (error of manipulation; cf. Pl. II, fig. 42).

10-11.—Coin sockets left empty probably because the passage of metal into them was obstructed.

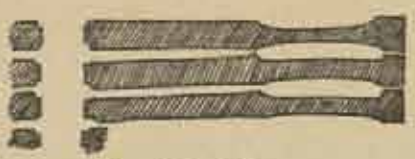
As for the coin models (positives) it is not easy to say whether they were made in clay or in wax, wood, soapstone or other material. The fact that quite a large variety of models was used may indicate that they were probably made in some easily worked material, such as clay or wax. But this need not have been the case because, once the initial trouble of engraving the originals had been taken, actual coins may have been used as models for succeeding generations of coins. We know that this was the practice in Roman times, and this is the commonest and easiest device of forgers down to this day. There is, however, another and better reason for the view that either wax or clay was used for making the original models. A minute examination of the moulds—the bull and elephant as well as the script, particularly where the letters occasionally touch the margin or are cut off by it—suggests a cursive style of writing and a rather free-hand style of design for the bull and the elephant, such as would only be possible in soft material.

It may be that at the very outset a *negative* was made in wax or clay: in the small size of these coins it would be much easier to engrave a negative (with a bluntly rounded stylet) than to carve a positive. If the original negative was in wax, a positive could be made from it directly by casting in fine clay and then

baking the cast so obtained. If it was in clay, it could be baked hard before making a positive from it, and this positive could be made either in clay or metal, to serve as a model. Considering everything, I am inclined to conclude that this was the method adopted at the Bahudhanyaka mint.

To ensure the free flow of metal into the coin sockets any obstructing bits of clay left between the end of a radial canal and a coin socket had to be removed. Pl. I, fig. 4, Pl. II, fig. 38, and Pl. III, fig. 88 show several instances where the removal of this obstruction is evidenced by a roughness of the channel at this point. Failing this precaution some of the sockets would not receive the metal; Text-figs. 10, 11 and Pl. II, figs. 34-36 show a few sockets which appear to have remained empty because the channels were blocked either from the very first, or later, by the fusing of the clay when the mould was baked prior to the casting.

In the great majority of my fragments the channel into the socket is free. But in a few it is not; for example see Pl. II, figs. 19, 32. At first I was inclined to think that these were cases of oversight, but a moment's reflection will show that they may well be intentional. The channel being made up of two opposing counterparts, it would suffice if the passage is cleared only on one of the coupled faces (see Text-fig. 12). In fact this may be an advantage because the kink thereby left in the metal near the edge of the coin would make it easier to break



Text-fig. 12.

Text-fig. 13.

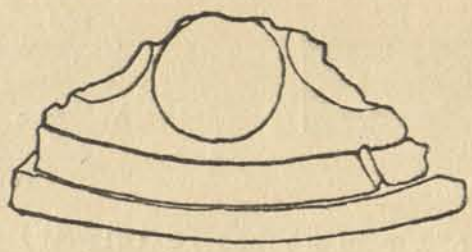
off the coin from the end of the spoke (see Text-fig. 13). A comparison with the Mathura coin moulds described below (see Pl. VI figs. 128-131) leaves no doubt as to the advantage of this procedure, and it is possible that the intelligent Yaudheya coiner may have purposely left these obstructions on one side of each disc.

Many of the fragments have a small irregular bit of brick or stone embedded in the outer border, between the coin-sockets. This foreign object is often seen sticking out like a peg. Other fragments show irregular pits in this position, indicating that such pegs had once lodged there (Pl. I, fig. 4, Pl. II, fig. 43, Pl. IV, fig. 108). This was a tenon-and-mortise device for replacing the discs exactly in their places when coupling the moulds. The irregular shape of the bits made it easy to recognise the pegs (tenons) belonging to their pits (mortises). With more than one tenon on each face of a disc it was important that they should have distinctive shapes. No complete disc has been found, but by roughly reconstructing a number of discs it is possible to say that on each face there were two or three places, either for a mortise or for a tenon.

Another device worthy of note was an oblique groove drawn across the outer edge of each disc (Pl. II, figs. 40, 41, text-fig. 14). As the casting was

done with the discs placed in a vertical column (Pl. VII, fig. 146), these grooves ran obliquely across the outer (cylindrical) surface of the whole set of discs. The groove must have served as an index line to enable the workman to check from outside the positions of the discs when reconstructing a set after the models had been removed. From the appearance of the grooves it is clear that they were made while the clay was still soft or at least unbaked: the edges of the groove are sometimes slightly raised. The smooth surface of the groove shows that it was made with a blunt, rounded instrument like the edge of a well-worn coin. As a rule the groove is about 1 to 1½ mm. wide and about as deep; Pl. II, fig. 14 shows the only specimen in which it was wider and deeper.

Occasionally we come across a fragment which is blank on one face. Sometimes two discs are found sticking together by their blank faces (Pl. II, figs. 40, 41, Pl. IV, fig. 108, Text-fig. 14). On splitting them apart the groove or grooves were frequently seen continued across from the edge on to the blank face (Pl. II, figs. 7, 8, Pl. VII, fig. 146). The blank faces generally show a thin crust of dark grey dusting powder, looking like ash from an oven, which must have been used to prevent the discs adhering firmly It appears that *the complete mould must have contained several sets of discs* placed one above the other, and the dusting powder was spread between the blank faces on the top and bottom of contiguous sets.



TEXT-FIG. 14.—Two discs coupled by their blank faces (cf. Pl. II. figs. 40-41). Approx. actual size.

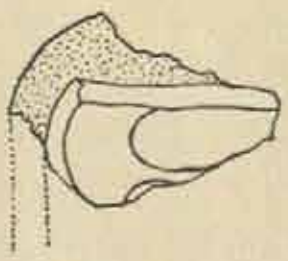
In making up this column the blank top surface of each set was first covered with a thin layer of dusting powder before the next set was placed upon it. Several pairs of disc fragments, including portions of the top and bottom discs of contiguous sets, have been found sticking together by their blank faces, with the remains of the powder still lying between them (see Pl. IV, fig. 108).

Fig. 40, Pl. II shows two adhering discs. One of them has an oblique groove across its rim. The fact that this groove is not continued on to the other disc shows that the discs belong to two consecutive sets in a mould. When they were split apart they disclosed, as expected, two blank faces. On one of these faces the groove was continued across the blank surface (as in Pl. II, fig. 8), this being the top disc of its set; the other, being a bottom disc, had no grooves on its lower face which was in contact with the base-board. Pl. II, fig. 41 shows a similar pair of discs; here one face showed two grooves crossing as in Pl. II, fig. 7.

Among the many fragments of discs were found a few very interesting pieces of coarse and porous burnt clay which no doubt originally formed a plaster jacket round the entire mould (see Pl. VII, fig. 146). This clay luting contained a large admixture of plant material, especially the husk and grains of a cereal. I believe some of the gains are wheat or barley and some are paddy. Of course, the grains as well as the husk are charred, but the microscopic cells of the husk have left clear impressions on the matrix of carbonised clay; and their careful examination may help one to identify the cereal beyond doubt, even in the charred and broken condition[1]. The quantity of plant material thus mixed with the clay contributed to the rather porous condition of the clay: after it was baked the partial combustion of the organic matter left small lacunæ in the body of the clay. We shall see presently that this porosity was of importance to the successful working of the moulds.

The clay here mentioned must have been plastered over the whole pile of discs so as to seal up any chinks between the discs and thereby prevent the molten metal from leaking out. At the same time some porosity was desirable to allow the imprisoned gases to escape as the metal was poured in. Several pieces of the clay luting were found among the mould fragments. A few of these are shown in Pl. II, Figs. 10-13, 21, 22. It is interesting to see on the concave inner surface the impressions of the rims of the discs against which the luting was plastered. From Figs. 21, 22 it is certain that at least 8 or 9 discs were placed one on top of the other; probably the total number in the complete mould was much larger. Luckily, one of these pieces of luting is from a region where the oblique groove ran across the surface of the pile, and, as expected, the groove is here represented by an oblique ridge.

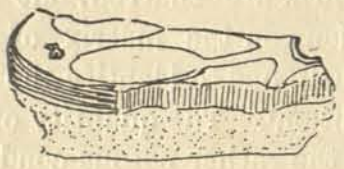
Pl. III, fig. 82 shows a fragment of a disc with a rather thick piece of luting still attached to it. The same fragment is shown in Text-fig. 15, sketched from a different angle, so as to view it in its proper place in the entire mould. From the form and position of the luting, with its curved outer surface, it appears to have belonged to the "shoulder" of the mould (see Pl. VII, fig. 146). Several other fragments of discs have been found similarly encrusted with the remains of the luting, but the outer surface is usually not preserved.



TEXT-FIG. 15.—Diagrammatic sketch of a fragment from the "shoulder" of a mould (cf. Pl. III, fig. 82 and Pl. VII, fig. 146). Approx. actual size.

[1] A minute examination of some of the charred fragments after chemical treatment has made it possible to recognize the microscopic structure of the epidermis of some of the plants.

The disc shown in Text-fig. 16, with an unusually thick luting applied to one surface, evidently belongs to the very bottom of a mould. The flat lower surface must have been formed in contact with the floor on which the pile was placed after the luting was applied. A similar fragment is shown in Pl. II, fig. 6. In Pl. II, fig. 9 a fragment is seen with the luting still adhering to its rim.



TEXT-FIG. 16.—The bottom disc of a mould (cf. Pl. II, fig. 6). Approx. actual size.

Practical considerations.

From the structural details described above it is now possible to say that the casting was done in a complex mould of the kind sketched in the reconstruction (Pl. VII, fig. 146). The metal poured into the crater filled the central canal and thence spread horizontally at different levels through the radial channels into the whorls of coin sockets. The clay luting round the entire mould served to bind the discs into a compact pile and prevented the leakage of metal. At the same time the porous nature of the luting allowed the escape of hot gases in advance of the inflowing metal. The importance of mixing husk and grain with the clay of the plaster will now be evident: when the mould was baked the combustion of the vegetable matter left the plaster in a porous condition and yet strong enough to hold the discs together.

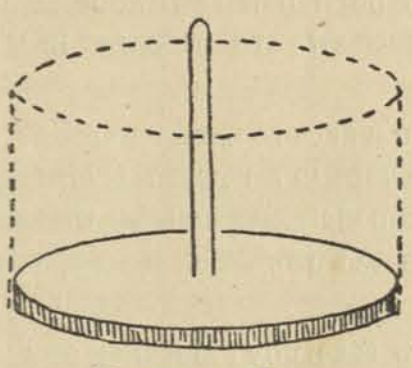
The discs are usually of a dark grey colour, but occasionally their marginal portions grade into red—a result no doubt due to unequal baking. My friend Dr A. C. Chatterji, Reader in Chemistry at Lucknow University, has subjected some of my fragments to high temperatures in an electric oven and he finds that while the grey colour remains unaltered up to about 600°C, above that temperature, say, at 650°C continued for about an hour, it gradually shades into red. The fact that in my discs the red colour is nearly always confined to the peripheral parts shows that the moulds must have been baked at a temperature of over 600°C, but that this temperature was not maintained long enough to turn the central parts red.

In some discs the outer parts are light and spongy, being riddled with gas-holes (Pl. II, fig. 36). A few of these are seen sticking together by their outer spongy portions so as to form a fused mass. The metal must have been poured in while the mould was still hot, to ensure its easy flow through the narrowest channels. Probably the mould was kept in an oven while the metal was poured in, only the top of the mould, with the crater, being exposed.

This is strongly suggested by the fact that fragments of the luting have been found which show signs of having been subjected to great heat. They are not only spongy with gas-holes, but have even become fused with the rims of the discs they covered, and a few have a red colour instead of the usual dark grey.

From the structure of the fragments it is possible to say that the following simple appliances were probably used in making the moulds:—

1. A circular wooden base-board about 87 mm. in diameter, with a cylindrical peg 7 mm. thick fixed in the centre (Text-fig. 17).
2. A hollow cylinder just wide enough to fit round the circular platform (shown in broken lines in Text-fig. 17).
3. A wide-mouthed cup or a little box without a lid, of 23 to 25 cubic centimetres capacity, for measuring out rapidly the quantity of kneaded clay required for each disc. (The volume of a disc has been calculated to be roughly 23 to 25 cubic cm.).
4. A stylet made of wood or metal, with a rounded tip about ½ mm. thick, for engraving in clay or wax.
5. Some flat pieces of metal about 1½ mm. thick, cut into the shape of Text-fig. 7, to serve as models for the radial channels.
6. Fine clay; wax; ash or charcoal dust; bits of stone or brick (to serve as tenons); paddy or other grain with husk.



TEXT-FIG. 17.

It now remains to give a connected account of the steps in the process of constructing and using the moulds.

(*a*) The circular base-plate is dusted with powder, the cylinder is placed over it, and the first disc is prepared round the peg, its circumference being controlled by the cylinder. The 8-rayed model for the radial canals is slipped over the peg and pressed into the clay down to half its own thickness. Then a coin model is similarly pressed in at the end of each of the rays, taking care that all the models have the same face down, whether it is the obverse or the reverse. Two or three small bits of brick or stone are pressed half-way down at intervals near the margin, to serve as tenons.

The first disc is now ready. It is dusted with powder before the second disc comes to lie on it.

(*b*) The second disc is first prepared as a blank on another base board. It is then transferred so as to lie on top of the first disc, over which it is now firmly pressed down at all points. It thus receives on its lower surface the impress of

all the models and of the tenons projecting from the top of the first disc. If the first disc received the obverse impressions of the coins, the second receives the reverse. On the upper surface of the second disc another set of models and tenons is pressed in, and the surface is dusted over as before to prevent adhesion with the third disc, which is next laid on the second; and so on.

(*c*) In this way the discs are erected in a set of, say, a dozen discs. The top and bottom discs being blank on one face, coins would be formed only in eleven whorls.

(*d*) The cylinder is now removed and the oblique groove (which is later to serve as an index line) is drawn across the outer cylindrical surface of the set, cutting the rims of all the discs. Preferably two such grooves are marked, on different sides, and slanting in opposite directions (as in Pl. VII, fig. 146); this would help to distinguish the upper and lower faces of the discs. If these grooves, moreover, are continued across the blank top face (as in fig. 146 and Pl. II fig. 7) they would help to distinguish the top disc from the bottom one which cannot be so marked because it is in contact with the board.

(*e*) For some time this first set of discs is allowed to dry in the sun till the discs are hard enough to be handled without fear of their being deformed. Meanwhile a number of other sets are prepared in the same way and allowed to dry.

(*f*) When the discs in a set are hard enough to be handled freely, they are lifted apart and for a time kept in a row in their regular sequence, all with the upper side up. The coin models as well as the radial canal models are now carefully removed for repeated use. The tenons, however, are all left in their places.

(*g*) Each disc is now carefully examined on both sides to see that the coin impressions on the sockets are clear. It is also important that all channels for the flow of metal into the sockets should be free of obstruction. (But see p. 23 above).

(*h*) When the discs are all in a satisfactory condition they are again built up into the original set but on a plain board (without a peg). With the help of the tenons and mortises, and of the key-lines on the rims, they can easily be replaced in their correct positions.

(*i*) In the same way a number of other sets are built up after removing the models from them.

(*j*) Several of these sets are now placed one over the other to form a column of convenient height. Assuming that there are, say, a dozen discs in each set, four or five sets would make a column about 10 to 12 inches in height.

(*k*) When the column has been made up it is plastered over with a paste of clay mixed with unhusked grain, a funnel-like crater being left at the top to receive the molten metal. The mould is, however, not yet ready for casting.

(*l*) The final step before casting is to bake the mould, with its clay luting, in a furnace. This will harden the discs and burn out the vegetable matter in the luting, thereby making it porous enough for the escape of gases.

(*m*) The casting is then done in the hot mould, preferably with the mould still standing in the furnace, with only the crater exposed.

(*n*) When the mould has cooled it is broken up, the fragments of discs and of the clay luting are discarded while the coins, attached in close-set whorls upon a central axis, are broken off and cleaned.

From the above description it is obvious that none of the discs can be removed intact, and there can, therefore, be no question of their being capable of use for repeated castings. This fact is important for comparison with some of the other coin moulds discussed below which, being of simpler construction, could be used, and may have been used, again and again. While in this fact the simpler moulds had the advantage, the Rohtak moulds were capable of yielding a much larger number of coins at each casting.

It is a pity that no other kinds of relics of the Yaudheyan mint have yet been discovered, besides those shown in the photographs, but it is a matter for satisfaction that a careful examination of the fragments has enabled us to picture with some degree of thoroughness the details of the technique of coining employed in India about a hundred years before the beginning of the Christian era.[1]

So far as I am aware, nothing comparable with the Rohtak material in its interest for the coining technique has been brought to light since the rich discoveries of Roman coin moulds in France, England, Germany and other countries, of which a brief summary is given below.

Were the Rohtak moulds the work of a forger?

With most finds of coin moulds the question arises as to whether they were official or the work of a forger. And this question was put to me by several friends who saw my moulds or read the preliminary account. At Rohtak a magistrate said that clay moulds of more or less similar construction had been produced in his court as exhibits in cases of forgery of modern currency.

It is a curious fact of psychology that the forger comes to mind more often when the *mould* is before us than when the *coin* is being examined. So far as I know, none of the many authors who have described the Yaudheya coins have ever hinted that the coins were spurious, although some of them might well have been cast in the very moulds we are considering.

[1] This work was well advanced when Mr. Dikshit kindly ordered at my instance a deeper excavation of the mint site discovered by me at Rohtak. As a result some further coin moulds and coins similar to those found by me in 1936 were unearthed. From a cursory inspection of this material in the field I could not gather any substantial new facts relevant to our present study, but the collection needs careful investigation.

The question of forgery was raised by Sir John Marshall[1] when describing the Taxila moulds, and Dr. Panna Lall did the same when he described the Mathura moulds (see below). However, in both these cases there was internal evidence for regarding the moulds as forgeries. I can see no special reason to doubt the genuineness of the Rohtak moulds. The burden of the proof rests on those who make the assertion of forgery. Let us discuss the pros and cons in the light of what we know of other cases, Indian and foreign.

It is obvious that where the forger's technique is similar to that of the original coins detection becomes difficult, particularly when the forgery is contemporary with the currency. It is still more difficult where the authorities acquiesce in the practice of forgery as was the case, we are told, in the time of some of the Roman emperors[2]. A number of numismatists in Europe, dealing with the Roman coin moulds found in Britain, France and elsewhere have discussed this question, and the view has often been expressed that many of these moulds must have been forgers' moulds[3]. Another remarkable case of large-scale contemporary forgery is mentioned by Akerman[4]. Writing in the year 1834 he said that in England, at one time, spurious money even exceeded the legal in quantity. He says "It is true that such was the case.....not many years since, when the copper circulation was almost wholly supplied by the forgers of Birmingham."[5]. This shows, by the way, that even the cheapest coins are liable to be forged, and the Yaudheya coin moulds need not be taken as genuine merely on the ground that they cast cheap coins. In fact, it is the cheaper coins that would more often go undetected.

Where the forger's technique is similar to the official we have to rely upon such evidence as the location (which may be different from any of the authorised mint-places), flaws in the construction, differences in the alloy, and so on. With our moulds from Rohtak we have no such evidence of fraud. The fact that the moulds are not quite uniform in the details of their designs and script at first made me suspect them, but I soon discovered that the same lack of uniformity exists in the Yaudheya coins figured by Prinsep, Cunningham, Rapson, Allan and others. Unless there is historical evidence that forgery was as rampant under the Yaudheyas as it was once in the Roman Empire, or in Britain a hundred years ago, there seems nothing to indicate that our moulds did not belong to an authorised mint.

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[1] Marshall (1912-13).

[2] Akerman (1834), pp. vii-x; Akerman (1844), p. 55; Babelon (1931), p. 958.

[3] See, *inter alia*, Akerman (1834), pp. vii-x; Reade (1837-38), pp. 58-59; Reade (1838) under Akerman (1838-39), pp. 161-165; Babelon (1901), p. 955; Schroetter (1930), p. 187 under Falschmuenzerei.

[4] Akerman (1834), pp. vii-x.

[5] According to Schroetter (1930, p. 187) Birmingham had at one time the biggest forgers' plant in the world.

The case is quite different where the technique of the forger is different from that of the authorities. For instance, we know from Panna Lall's work[1], that the Mathura moulds (see below, and Pl. VI, figs. 128-131) were intended to produce by the *casting method* coins of a type known to have been originally struck with a series of different punches one after the other. The same clue gives away the maker of the bronze die found by Cunningham[2] at Eran (Pl. VII, figs. 139-140). This die produced at a single stroke a coin of the punch-marked type, bearing several distinct designs which in the official mint must have been struck with a succession of punches.

Let us now briefly consider forgeries of a type which unfortunately too often vitiates the field of work of the numismatist. I mean modern forgeries of ancient coins meant to cheat the coin collector. We know that this practice was not uncommon in certain parts of Europe where the forger sometimes mixed up (by design or in error) moulds of different reigns or denominations and coupled them into hybrid coins. Professor Pink[3] wrote recently an account of the celebrated engraver Claude Augustin de Saint Urban, a forger of Roman coins who lived in the 18th century.

Quite a novel motive for forgery was suggested by J. G. Pfister[4], writing a hundred years ago about mutilated coins. The subject being not quite relevant to our topic here, I quote his interesting observations in a footnote[5]. It is very unlikely that the Rohtak moulds, dug up from a level three feet below the surface, were forgeries of any of these types.

R. Burn, in a review of my preliminary note, says "Of the Yaudheya coins in the British Museum about half seem to have been struck and the rest cast; so it cannot be said with certainty whether the moulds now found were official or for forgeries"[6]. The large number of moulds found at Rohtak, however, seems to go in support of their being genuine.

Taking everything into account I am inclined to the view that the Rohtak moulds are not the work of a forger. But, of course, as an index of the state of evolution of the technique, the work of a contemporary forger is as good as that of an official mint. If anything, the forger's technique is liable to be simpler

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[1] Panna Lall (1918).

[2] Cunningham (1880). pp. 77-8, Pl. XXIV, figs. 1-3.

[3] Pink (1933), p. 217.

[4] Pfister (1838-39), pp. 65-66.

[5] "Now I consider that the forgery of such coins cannot be done with a pecuniary view, but as a matter of jest. It is perhaps not generally known, that there are proofs of the existence of a species of learned men who are impediments to learning, and who amuse themselves with not merely having imitations sometimes made of scarce coins, but also by fabricating coins which never existed, and on which the inscriptions and symbols are the inventions of the parched brains of these Savans. The object of such miserable conduct seems apparently to be to amuse themselves with observing what numismatists of sound understanding, but not on their guard, may afterwards describe them to be."

[6] See Kern Institute (1938), p. 7.

and more primitive, unless an expert like Claude Augustin de Saint Urban takes to forgery. It is, therefore, interesting to know that in India, a hundred years before the Roman era, we had evolved a complex multiple mould of a type considerably more efficient than any yet discovered in Europe.

b. SUNET.

Having studied these early Yaudheyan coin moulds from Rohtak, of about 100 B.C., we may now pass on to some clay moulds of the later Yaudheyas, in which coins of the 3rd-4th century A. C. were cast. Over 80 specimens of these are now known from Sunet, an old village now a suburb of the city of Ludhiana in the Punjab (30° 55′ N, 75° 51′ E). A brief description with photographs was published recently[1]; several of the moulds are shown in Pl. IV.

Three of these specimens from Sunet were the first coin moulds ever to be described from Ancient India. But, as I have shown in the paper just referred to, their real nature was, until quite recently, unknown; they were mistaken for seals. These three moulds were among a collection of clay objects (mostly seals) which a certain Mr. Carr Stephens of Ludhiana had sent in 1884 to Dr. A. F. R. Hoernle of Calcutta, then Secretary to the Asiatic Society of Bengal. Hoernle exhibited the collection before the Society and wrote a detailed description[2], devoting special attention to these "three exceptional seals;" but unfortunately he gave no figures, and the original specimens can no longer be traced. He showed that these particular "seals" bore the negative impressions of a well-known Yaudheya coin figured by Prinsep[3], and he was convinced that the impressions must have been made by using the actual coins as a die. In this view he was probably right, because coins have often been used as models for moulds. But his conjecture that these clay objects were used as seals or votive tablets was off the mark.

Hoernle's description of the designs impressed on these three specimens is so clear and precise that it is best to reproduce his own words. He writes:

"Their devices are sunk into the clay, showing clearly that they were in *relievo* on the die from which they were taken. Now coins would be exactly that sort of die. Two of the seals show a standing human figure, turned to the right, the right arm raised up before the face, the left held akimbo, and dressed in a long flowing robe reaching to the ancles [*sic*]. Under the upraised arm is a conch shell, by the side of the other, traces of some indistinguishable object; all round the edge of the impression there runs a circle of dots. The third seal shows the standing figure of a man, turned to the front and dressed in a long coat, reaching below the knees; the right arm raised and holding a spear, the left resting on the hip. Along the edge, to the right and left of the

[1] Sahni, B. (1941).

[2] Hoernle (1884), pp. 138-139 (paragraph 3).

[3] Prinsep (1858), Ind. Antiq., Vol. I. This coin was first figured in Prinsep (1835).

figure, there are traces of a rude inscription in Gupta characters, *ya dha* being distinguishable by the side of the left hand of the figure; below that hand are indistinct traces of some object. In this case there is no marginal circle of dots. It would have been desirable to have some more specimens of this class for comparison, but even with the three it is impossible to mistake the class of coins from which the impressions must have been taken. These impressions are the almost exact counterparts (allowance being, of course, made for the fact, that they are *reversed*) of the coins figured in Prinsep's *Indian Antiquities* (ed. Thomas), Plate XXI, Nos. 16 and 17, and Gen. Cunningham's *Arch. Reports*, Vol. XIV, Plate XXXI, Nos. 9, 10, 11. Indeed Prinsep's No. 16 is so strikingly like the impressions, that it appears very probable that a coin of that issue actually served as the die from which these three 'seals' were made. On comparing the figured coins with my description of the seals, it will be seen that the single seal is an impression of the obverse of the coin, while the duplicate seal is impressed from the reverse. It may be also noted that the marginal circle of dots appears only on the reverse of the coin, while it is absent on the obverse, exactly as on the seals. The indistinguishable object on the obverse, below the left hand of the royal figure, is by Gen. Cunningham supposed to be the figure of a cock, and the inscription is read by him: *Jaya Yaudheya gaṇasya, i.e.*, "Hail to the Yaudheya race". (*Arch. Rep.*, Vol. XIV, p. 141). The Yaudheya coins, from which the seals were made, are of copper and of small value; and perhaps it may be conjectured that these fictitious seals were made by poor people who in this way wished to escape payment of a, for them probably, considerable fee chargeable by the temple authorities for the making of a properly stamped votive tablet."

This description is excellent so far as concerns the designs of the coin impressions, but it says nothing about the structure of the specimens, which would have at once given the clue to their real nature. In the absence of figures we cannot say whether the pieces were complete enough to show the channels for the flow of metal, or any of the other features that distinguish coin moulds from seals. But the suggestion that they were used as votive tablets appeared to me unconvincing, and I was making enquiries to obtain a loan of Hoernle's originals from Calcutta when, through a strange coincidence, I received from my friend Rai Krishnadasa of Benares a collection of 38 undoubted coin moulds, also found at Sunet but only within the last two or three years. Rai Krishnadasa had already recognized these objects as coin moulds. These pieces so closely answered to Hoernle's description that I had no longer any doubt that his supposed Yaudheya seals were nothing but coin moulds. Soon afterwards Mr. T. N. Ramachandran of the Indian Museum, Calcutta, kindly sent me (in January 1941) a further series of 41 moulds identical in character with those received from Rai Krishnadasa. These had also been discovered at Sunet. On further enquiry I learned that these 41 specimens had been received by the Indian Museum in 1934, on loan from the Lahore Museum. Some of them had been purchased at

Sunet in 1917 by the late Mr. Daya Ram Sahni, others were purchased in 1922 by Sir John Marshall from a certain Miss Trewby. Hoernle's originals, therefore, are not amongst them. Where they are, or whether they were preserved at all, is unknown, but this is immaterial: his specimens cannot have been different in character.

Thus up to the present we know 82 coin moulds of this type, all from Sunet. We have seen that after Hoernle's first announcement of 1884, further specimens from the same locality had been acquired from time to time by the Archæological Survey, just as Rai Krishnadasa had acquired his 38 moulds over half a century after Hoernle's paper was published. These 38 pieces were purchased from the village people at Sunet, some by Professor Jaya Chandra Vidyalankar in 1938, others by his pupil Mr. Amrit Pal in 1940. They were subsequently placed in Rai Krishnadasa's collection at the Bharat Kala Bhawan (Museum of Indian Art and Archæology) at Benares.

Now, the fact that since the original discovery 60 years ago such a considerable number of moulds of the same type have come to light at long intervals from the same locality indicates, as I suggested in 1941, that Sunet marks the site of another mint of the Yaudheyas. An excavation of the site therefore seems to promise further discoveries of interest.

The antiquity of Sunet.

Although these moulds belong to coins generally assigned to the 3rd or 4th century A.C., there is reason to believe that the antiquity of Sunet goes back much further. As stated in my brief paper of February 1941, Dr. V.S. Agrawala has been able to trace the history of Sunet to about 500 B.C. According to him the modern village must have been formerly known as Saunetra and it probably marks the location of an ancient city founded by Sunetra, who is mentioned by *Pāṇini* (IV, 2. 75) and who, according to the *Mahābhārata* (*Ādiparva* 94, 61) was one of the three sons of the earlier *Dhṛtarāshṭra*. The fact that the name of the Yaudheya republic occurs in *Pāṇini's Ashṭādhyāyī* adds point to the suggestion of Dr Agrawala that the modern Sunet, where these Yaudheya coin moulds have been discovered, must be associated with Sunetra.

Description of the moulds.

Only a few of the more interesting specimens can be illustrated here. From the description and photographs it will be seen that they possess all the essential features of coin moulds. Thus:

(*a*) There is a channel for the inflow of molten metal across the margin, clearly seen in several of the more complete specimens (Pl. IV, figs. 91, 92, 95, 96, 98, 105).

(*b*) A few specimens consist of paired discs, still attached together (*back to back*), with the remains of a plaster casing still adhering round their outer

margins, showing that the moulds were cast in a series of discs which were plastered together into a cylindrical pile (Pl. IV, figs. 94, 102).

(*c*) The raised margin immediately round each coin socket has a rough fractured surface, showing that two coupled moulds have been broken apart, whereas in the case of seals this margin is always smooth and often rounded (Pl. IV, figs. 92, 97, 100, 105).

(*d*) The back of the disc often has a rough, fractured surface such as one would obtain if the pairs of discs mentioned above were to be broken asunder. The surface is not smooth and highly domed, as in many seals, nor is it formed into a ridge to enable it to be held between the thumb and finger; nor, again, are there any string holes in any of the specimens. The roughness is due to the adhering remains of plaster which originally bound the discs back to back by their blank faces (Pl. IV, figs. 103, 104).

Technique.

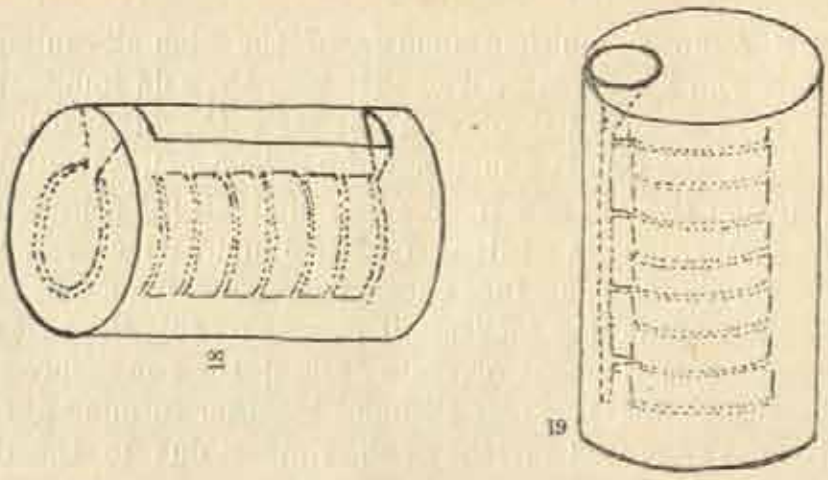
The technique of these moulds was much simpler than that employed by the Yaudheyas at Rohtak several centuries earlier. This is a rather surprising fact. One would have expected the later technique to be more elaborate. As we shall see, the Sunet moulds are in some respects more comparable in structure with Roman coin moulds of about the same period found in Britain, France and other countries.

Unlike the complex multiple moulds of the Rohtak mint, the Sunet moulds are single-coin discs. Moreover, they bear the coin impression (obverse or reverse, as the case may be) only on one face, the other being either flat or slightly convex. The clay is sometimes of a grey colour, sometimes red. The average diameter of the disc is *ca.* 28 mm., and of the coin socket 23 mm. Round the coin socket there is a raised rim 2 to 3 mm. wide which, as already stated, has a rough fractured surface except for a smooth gutter-shaped channel leading across the rim into the socket. It was along this rim that the disc was coupled with another bearing the opposite design; the two appressed rims enclosed the coin socket, the two half-channels together forming a circular inlet for the metal. The fractured surface of the rims is due to the discs having been split asunder to take out the coin.

The material in hand is not quite sufficient to show all the details of the process. But it is clear that the casting was done in a series of discs placed parallel to one another so as to make up a cylindrical pile. This is evident not only from the adhering remains of the plaster on the back of each disc, but also from the fact that specimens have been found which consist of pairs of discs still bound together back to back by their blank faces, with an intervening layer of mortar between them. In two specimens even a part of the outer plaster casing is preserved round the margins of the paired discs (Pl. IV, figs. 94, 102).

Each pair of discs, when coupled face to face, would have its two exposed sides blank. A number of such pairs were placed parallel to each other with a layer of plaster (consisting of clay mixed with fibrous vegetable matter) laid between the contiguous pairs, like mortar between bricks. The whole series was then plastered over on the outside with the same binding material, taking care to leave open all the channels into the sockets. (This may have been done by keeping the channels plugged with sticks before the plaster was laid on).

Thus it appears that there must have been a longitudinal row of openings along one side of the cylindrical mould, each leading independently into a coin socket. But it is difficult to say how this row of canals was supplied with metal. Can it be that the metal was poured separately into each opening, with the cylinder laid horizontally? This would be a very unpractical method. A better plan would be to pour the metal into a single common channel communicating with all the sockets. Such a channel would be either an open trough cut into the side of the cylinder (as in Text-fig. 18) or a single longitudinal canal connecting all the transverse channels, with possibly a funnel-like crater at one end, the metal being poured in with the mould held in a vertical position (as in Text-fig. 19). But in the fragmentary material available there is no evidence either of an open trough or of a longitudinal canal. It must be emphasized that both the diagrams (Text-figs. 18, 19) are hypothetical.



18 19

Text-figs. 18, 19.—Conjectured reconstructions of the Sunet coin moulds. Approximately actual size.

Another possibility is that two or more such cylindrical moulds were joined together round a vertical axis so as to bring all the individual channels into communication with a single axial canal fed through a crater at the top, as in some Roman coin moulds discovered at Lingwell Gate in England[1] (See Pl. VII, figs. 143-145). But among the many specimens that have been examined there is not even one piece showing evidence of two or more discs having been placed side by side in one plane. The unbroken rims of several of the moulds (*e.g.*,

[1] See below.

Pl. IV, figs. 91, 92, 95) also seem to go against such a grouping of the discs. Moreover, if the moulds had been grouped in this manner the channels for the metal would have been more like V-shaped cuts in the rim and not narrow perforations.

One more structural detail should be mentioned. Some of the discs, in addition to having the usual channel for the passage of metal, show one or more narrow grooves marked on their outer edges, that is, on the surface that would be exposed when the discs are put together into a pile (see Pl. IV, figs. 97, 104). Their purpose seems to have been the same as that of the key lines of the Rohtak moulds, namely, to enable the discs to be replaced in their correct positions. These grooves are not deep enough to have served as longitudinal channels for metal, nor are they anywhere seen to communicate with the coin sockets.

c. Nalanda.

From recent excavations at Nalanda in Behar (25° 30′ N, 85° 16′ E) we have three dark grey terracotta moulds of Gupta coins. The moulds belong to three different sets. They have been figured and briefly described by Mr. G. C. Chandra[1].

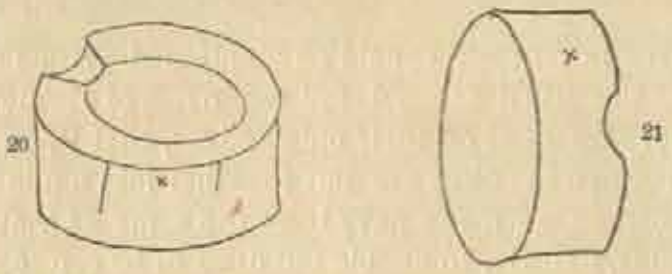
Like the Sunet pieces, these are all single-coin moulds with one side blank, and they are constructed on essentially the same lines. The coin socket was supplied with metal through a lateral channel. The details are best described separately for each mould.

(*i*) *Mould of a coin of Jaya Gupta (reverse). Reg. No. 1. Monastery No. 5 Annexe.*—Discovered in the year 1923-24, at a depth of 10 feet 5 inches. (Pl. IV, figs. 112, 113; text-figs. 20, 21). This is a clay cylinder of *ca.* 3 cm. diameter, 13 to 17 mm. high, with a flat bottom. The coin socket is placed eccentrically on the upper end; it communicates with the exterior through a rather wide channel which expands outward like a funnel, with the outer opening nearly twice as wide as the inner.

One or two rather obscure features of this mould are important from the viewpoint of the technique. Firstly, there are two slightly oblique key-lines on the cylindrical exterior, comparable with those on the Rohtak moulds but much more faintly marked (see text-fig. 20). Secondly, at two points round the cylinder there are small adhering patches of clay, of the same grey colour as the mould itself. It is only a thin crust which on casual observation might easily be passed over as adhering dirt; but it is hard, baked clay. What is more, a pocket lens reveals at four or five spots (see Text-figs. 20, 21) the impressions of vegetable matter, probably the husk of some cereal, with the epidermal cell outlines clearly marked on the crust. I have no doubt we have here the remains

[1] Chandra (1938), p. 52, Pl. XVII (*d*).

of an originally much thicker and complete layer of plaster made up, like that on the Rohtak and Sunet moulds, of clay mixed with fibrous vegetable matter. Evidently, as at Rohtak and Sunet, the mould with the plaster casing round it

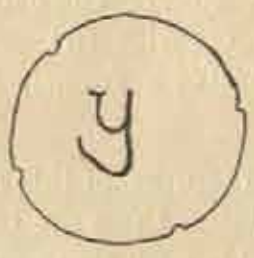


TEXT-FIGS. 20-21.—Coin mould of Jaya Gupta from Nalanda, showing (in fig. 20) two oblique key lines. At × are adhering bits of a luting containing vegetable matter in which cell structure is clearly visible. *See* Pl. IV, figs. 112, 113. Actual size.

was placed in the oven before the metal was poured in. But with only this one piece before us it is impossible to say whether the coins were cast singly or in series.

Mr. Chandra says that many of the coins of Narasimha Gupta and Jaya Gupta bear the marks of filing the lug. The necessity of filing must have arisen from the rather large width of the feed-channel which probably made it difficult to break off the coin from the short thick stalk.

(*ii*) *Mould of a coin of Narasimha Gupta* (*obverse*). *Reg. No. 121. Chaitya site No. 12.*—Discovered in the year 1935-36, at a depth of 5 feet 8 inches (Pl. IV, figs. 115, 116, Text-fig. 22). This disc, 8-9 mm. thick, has a peculiar sign marked on its flat bottom (See Text-fig. 22). The inlet for the metal is very definitely funnel shaped. On the exterior there are four well marked grooves to serve as key lines. No traces of a clay luting are preserved, but the technique must have been essentially the same as in the Jaya Gupta mould just described.



TEXT-FIG. 22.—Coin mould of Narasimha Gupta from Nalanda; bottom of mould. Four key lines; mark on blank face. See Pl. IV, figs. 115. 116. Actual size.

(*iii*) *Mould of a gold coin of Narasimha Gupta* (*obverse*). *Reg. No. 7. Chaitya site No. 13.*—Discovered in the year 1935-36, at a depth of 5 feet 7 inches (Pl. IV, fig. 110, 111). Mr. Chandra writes (*loc. cit.* p. 52) "The gold coin of Narasimha Gupta (¾" diam.) discovered previously at Nalanda, exactly fits in with the clay mould now discovered." Considering that this is believed to be a mould for a gold coin, the workmanship is not particularly neat. The clay is neither so fine as in the first mould described above, nor is it so well baked.

The disc is 6-7 mm. thick. The inlet channel is again funnel-shaped, and there are clear indications of three grooves (key lines). The rim round the coin socket shows at one point a black adhering crust which, according to a museum label accompanying the mould, is a deposit of slag, showing that a coin was actually cast in this mould.

The material from Nalanda is too fragmentary to show the details of the technique, but it seems that essentially it was similar to that followed at Sunet.

d. KASHI

The solitary fragment of a clay mould shown in Pl. IV, figs. 117, 118 was received on loan from Mr. B. M. Vyas, Executive Officer of the Allahabad Municipality. It is stated to have been found at Rajghat (Benares), the site of the ancient city of Kashi. After some digging operations undertaken for the East Indian Railway had revealed some antiquities near the Kashi Station the Archæological Survey took up a systematic excavation of this important site and exposed, as Dr. Agrawala[1] has said, "a charming cross-section of the city's existence during the golden age of the Guptas."

We have no data as to the level at which the mould was found; the specimen was among a number of relics purchased from a Benares dealer.

Nor does the broken fragment throw much light on the technique. The back of the mould is blank and slightly convex. There are no adhering remains of a luting, nor is there any channel for the metal but, of course, the specimen is incomplete. The clay is of a dark grey colour.

Although we are not here mainly concerned with the historical significance of the relics, I may say that Dr. V. S. Agrawala, who has kindly examined the mould and its cast at my request, allows me to quote the following details from a letter dated March 24, 1941: "Of the hundreds of Rajghat finds I consider this as somewhat unique, being a mould for casting an archer type of coin of Chandra Gupta II (375-413 A.C.) of the Imperial Gupta dynasty.....It represents Lakshmi, seated facing on a lotus.....The legend on the right margin reads *Śrī Vikkramaḥ*".[2]

e. TAXILA

From the famous site at Sirkap near Taxila (see Map, Text-fig. 1) Sir John Marshall[3] described some clay moulds for making Saka-Pahlava coins, some of

[1] Agrawala (1941), p. 1.

[2] Allan (1914). Catalogue of Gupta Coins, coin 77, Pl. VII, I. See also Brown (1922) Pl. V, fig. 6. Since the above was written another mould of the identical type has been acquired for the Bharat Kala Bhavan by Rai Krishnadasa. This mould also is said to have been dug up at Rajghat.

[3] Marshall (1912-13), pp. 34-35.

them bearing the effigy of King Azes II. Marshall mentions 28 moulds, of which 8 were complete discs, the rest in fragments. Through the kindness of Mr. Dikshit I have been able to examine 18 of these moulds. I reproduce below a descriptive list sent by Mr. M. Gupta, Curator of the Archæological Museum at Taxila.

1. 5352. Sk' 14-2406. Spoil earth, length 3.25". Fragmentary mould of terra-cotta with portions of five impressions of coins of Maues representing caduceus and Greek lettering. Red burnt clay. Black paint on inner faces. (*See Pl. V. figs. 123-124.*)
2. 5353. Sk' 13-Ala. Outside the Palace and near its S. W. corner. Diam. 4.12". A. S. R' 12, Pl. XXX, *c*. Circular mould of terra-cotta containing 12 impressions of Scytho-Parthian coins. Eight of these represent King Azes on horse-back; the rest show Pallas with spear and shield or some other deity. Light red clay. A channel at the edge for pouring in melted metal. Probably moulds for forging coins. (*See Pl. V, fig. 120.*)
3. 5354. Sk' 12-Ala2. Outside the Palace. Diam. 4.12". Circular mould of terra-cotta with 12 impressions of Scytho-Parthian coins, nearly all of which represent King Azes on horse-back. Probably moulds for forging coins. (*See Pl. V, figs. 119.*)
4. 5355. Sk' 12-Ala3. Outside the Palace. Diam. 3". Circular mould of terra-cotta with six impressions of Scytho-Pathian coins. (*See Pl. V, fig. 121.*)
5. 5356. Sk' 12-Ala4. Outside the Palace. Diam. 3". Circular coin mould of terra-cotta containing six impressions of Scytho-Parthian coins. (*See Pl. V, fig.122.*)
6. 5895. Sk' 12-Ala8. Length 3.5". Fragment of circular mould of terra-cotta with four complete and two partial impressions of Scytho-Parthian coins.
7. 5896. Sk' 12-Ala9. Length 3.25". Fragment of circular terra-cotta mould with two complete and two partial impressions of Scytho-Parthian coins, and channel for pouring melted metal.
8. 5897. Sk' 12-Ala15. Length 2". Fragment of circular terra-cotta mould with one complete and two partial impressions of Scytho-Parthian coins.
9. 5898. Sk' 12-Ala16. Length 2.5". Fragmentary circular mould of terra-cotta containing two impressions of Scytho-Parthian coins.
10. 5899. Sk' 12-Ala17. Length 2.25". Fragmentary circular mould of terra-cotta with two impressions of Scytho-Parthian coins.
11. 5900. Sk' 12-Ala10. Length 2.5". Fragment of circular terra-cotta mould with two impressions of Scytho-Parthian coins.

12. 5901. Sk' 12-Ala11. Length 2.4". Fragment of circular terra-cotta mould containing one complete and three partial impressions of Scytho-Parthian coins.
13. 5902. Sk' 12-Ala12. Length 2.87". Fragment of circular terra-cotta mould with one full and three partial impressions of Scytho-Parthian coins.
14. 5903. Sk' 12-Ala13. Length 2.5". Fragment of circular terra-cotta mould with one complete and three other partial impressions of Scytho-Parthian coins.
15. 5904. Sk' 12-Ala14. Length 2.25". Fragmentary circular mould of terra-cotta with one and a half impressions of Scytho-Parthian coins.
16. 5906. Sk' 12-Ala5. Diam. 8". Circular terra-cotta mould containing six impressions of Scytho-Parthian coins.
17. 5906. Sk' 12-Ala5. Diam. 3". Terra-cotta circular mould containing six impressions of Scytho-Parthian coins.
18. 5907. Sk' 12Ala7. Diam. 3". Circular terra-cotta mould containing six impressions of Scytho-Parthian coins.

Of these, the best specimens are Nos. 1-5; these are all figured in Plate V[1].

Several of the discs seem to have been covered (in the museum) with a varnish to protect the operating surface, but the effect has been unfortunate. The tough film has cracked and is now peeling off, carrying away with it the surface layer of clay from the coin-sockets, with the result that many of the designs described by Marshall are no longer recognisable.

The discs are of two sizes, one about 4 inches (10.7 cm.) in diameter, the other about 3 inches (7.5 cm.) (Pl. V, figs. 119-122). All the discs are blank on one face, and it is possible to couple some of them into pairs. It appears that the casting was done in pairs of discs, the metal being poured in through a funnel-shaped excavation at the edge.

The mode of construction is crude: the clay is not well burnt, or is of a soft, friable variety; the finish is very poor and the discs in a pair do not fit well together. There is no tenon and mortise device. Nor are the channels for the flow of metal likely to have been very efficient. The funnel-like inlet narrows into a fine canal which feeds the nearest coin-socket, and it is from this socket that all the others have to be fed, by equally narrow connecting channels (See fig. 119).

An essentially similar arrangement of sockets and connecting channels is described by Dattari[2] in some Roman coin moulds. As in the Mathura moulds described below the sockets on the opposite face are not connected together by

[1] Subsequently Mr. Gupta sent me ten more pieces, making up the 28 mentioned by Marshall. But most of these are badly preserved fragments.

[2] Dattari (1913) Pl. V, fig. 11.

canals, either in Dattari's moulds or in those from Taxila (Compare fig. 119 with 120).

Except for one very interesting fragment, to be described presently (No. 1 in the above list), none of the moulds show any trace of a luting, but this need not mean that no luting existed at the time of casting.

The exceptional fragment is illustrated in Pl. V, fig. 123. It is a flat piece of red clay about 8 cm. long, bearing on its inner face portions of five coin impressions, of which I reproduce positives in plasticine (fig. 124). The pity is that this piece was not found *in situ*, but only in spoil earth. This mould represents a coin of King Maues.[1] The coin sockets appear to have been painted black, possibly to protect the operating surface.

The interest of this fragment lies chiefly in the fact that, adhering to its outer face, and also along a small part of its margin (at × in fig. 123) there is a layer of clay, about 4 mm. thick, structurally different from the clay of the mould itself. The adhering layer, unlike the clay of the mould, reveals with a pocket-lens numerous impressions of plant fragments mixed with the clay. The exact nature of the plants is uncertain, but the form of the impressions suggests the husk of some cereal, like wheat, barley or paddy. Under a high magnification (see Pl. V, fig. 125) the outlines of the cells are clearly seen. Considering the fact that the clay has passed through the furnace, or perhaps because of this fact, the preservation of the cell outlines is remarkably good.

The coin impressions on this fragment are sharper than those on the other Taxila moulds, and suggest a finer workmanship. The presence of a luting also indicates that the casting was probably done not in pairs of moulds but in piles of a larger number. If this was the case the fragment here described must be either the top or the bottom member of a series, the luted face being blank. But with only this one fragment at our disposal it is unwise to speculate about the details of the technique. It should be noted that the coin-sockets here are not connected by any canals : no doubt the opposing face of the mould bore channels for the metal. How the mould was filled with metal is not known.

Another interesting fact about this mould is that it was not of the circular disc type, but rectangular (see Pl. V, fig. 123), to judge by the small portion of the margin which is preserved.

Except for the specimen just described, the Taxila moulds appear to resemble the Roman moulds described by Dattari more closely than any others I know of. In some respects they also resemble the Mathura moulds described by Panna Lall (see below) but are comparatively very crude in construction. It is also possible that they may have been used repeatedly.

In describing the Taxila moulds Sir John Marshall says that they probably belonged to the plant of a forger, though he does not discuss the reasons for

[1] Brown (1922), Pl. III, fig. 4.

this view. There is internal evidence of forgery in the fact that in several cases one and the same disc bears the impress of two different coins; for example, see Nos. 1, 2 and 4 in Marshall's list (his No. 1 is No. 5353 in the list reproduced above). In an official mint such a procedure would probably never be adopted.

f. Atranji Khera

Pl. VI, fig. 126 is from a natural size photograph of a mould from Atranji Khera, an important ancient site in the Etah District, U. P. This mould is quite different in design from any described above. Fig. 127 shows a positive (cast) made in plasticine.

The mould was kindly sent to me by Rao Bahadur K. N. Dikshit, who writes (5th Feb. 1941) that it was taken out from the side of a ravine in the mound cut by the scouring action of storm water. "The coins represented in this mould are apparently the issues of Huvishka, the Kushan king, who has the unique elephant rider type on the obverse. Some of the figures also show a standing deity, which, again, is different in different impressions, one of which can be recognised as the Moon God."

It is a pity we possess only this one fragment, but enough is preserved of the structual features to enable us to visualise the technique.

Outwardly the mould is of bright red colour, but the fractured edge shows that the clay in the deeper layers is dark grey. We have seen earlier (see p. 26 above) that red terra-cotta indicates a baking temperature of over 600°C maintained for a few hours. This mould seems to have been baked in a furnace at over 600°C but the heat was probably not maintained long enough to turn the colour of the interior, where owing to the paucity of oxygen the combustion of the carbon could only go on slowly.

The interest of this multiple-coin mould lies in its rectangular form and in the arrangement of the feed-channels. In the middle of one of the four sides there is a large expanded opening from which several canals branch out to supply the coin sockets. These canals, however, only feed the nearest sockets, which also communicate with one another through short connecting channels. The sockets further removed from the main opening are supplied indirectly, through the nearer opening.

As the fracture extends right across the width of the mould we have no means of knowing whether it was a square mould, in which case there must have been 16 sockets on each face, or whether it was in the form of a rectangle. The margin of the mould is slightly raised, in order to ensure a closer coupling with the counterpart. At each of the two corners which are preserved there is a tenon still embedded in the clay.

The plasticine cast shown in fig. 127 helps us to picture the coins as they appeared at the time of casting.

Mr. Dikshit suggested that I should look into the question of this mould being the work of a forger. The fact that the coins cast in it were not all of one kind certainly makes one suspect a forgery, as in the case of the Taxila moulds.

There is no indication as to whether at the time of casting the mould was encased in plaster. The surface looks remarkably fresh and clean, with no trace of adhering dust or other signs of the mould having been buried.

g. Mathura

Equally interesting are some compound moulds for making coins of the punch-marked variety, discovered at Mathura and first described by Dr. Panna Lall[1] in 1918. They are stated to have been dug out by Rai Bahadur P. Radha Krishna at the Keshavadeva Katra, one of the oldest sites at Mathura.

These are round discs of very fine red terra-cotta on which the impressions of the punch-marks are very clearly preserved. Each operating face of a disc carries five coin sockets arranged as in Pl. VI, figs. 128-131.

The only complete mould is a set of three discs in which the coins were cast in two layers of five coins each. The middle disc bears coin sockets on both sides; the outer ones are blank on their exposed faces, except that one of them has a sign scratched on it (see text-fig. 23), to indicate that the other face bears the reverse impressions of the coins.

The material, which I have been able to examine through the courtesy of Dr. Agrawala and Mr. M. M. Nagar, consists of ten complete discs and one half. Three of these form the only complete set (labelled A) with the top and bottom discs blank on their exposed faces; two others belong to an incomplete set (B); a second complete set is formed by the 1½ discs labelled F; and there are four odd discs (C, D, E and G). One of these (C) must be the middle disc of a set because it bears coin sockets on both faces. The remaining three (D, E, G) are blank on one face except for a cross scratched on the last two (to indicate that the other face is the obverse); these three (D, E, G) must be the top or bottom discs of other sets, of which there must have been at least two, possibly three.

Assuming that all the sets were made up of three discs each, the 10½ discs between them would represent at least six sets, and possibly seven. But there is, in fact, no evidence that some of the sets were not made up of more than three discs.

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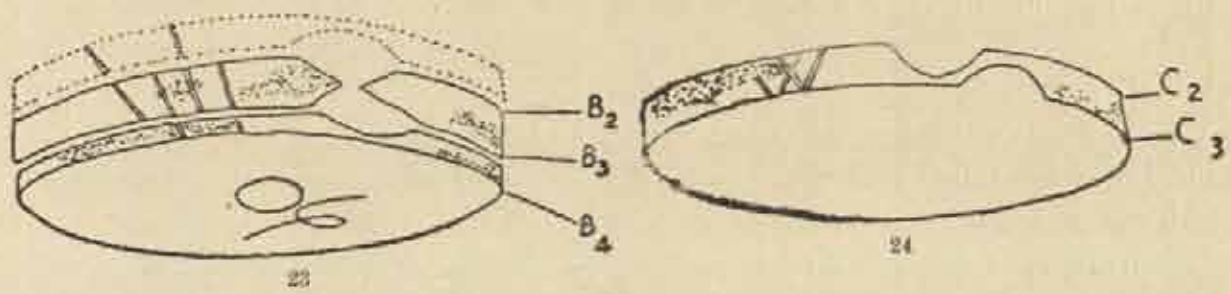
[1] Panna Lall (1918).

There are tenons and mortises on the coupled faces which enabled the operator to replace the discs in position after the models had been removed; and on the rims of most of the discs oblique key-lines recalling those on the Rohtak discs can be easily made out. In the incomplete mould B there are four such lines, arranged in two interlocking pairs as shown diagrammatically in Text-fig. 23.

In disc C the two pairs of key-lines cross each other like two overlapping V's (see Text-fig. 24).



23 24

TEXT-FIG. 23.—Mathura coin mould, partially restored. The incomplete set B (with the missing third disc dotted) showing the way in which the three discs were cut or excavated at the margin so as to make the inlet for the metal. The positions of the key lines (in two interlocking pairs) are also indicated. Traces of luting shown in dotted patches. In the centre of the bottom (blank face) the circle indicates the position of the rough patch discussed in the text, which is seen photographed in Pl. VI, fig. 132. By the side of this circle (in the text-figure) is a sign which indicates that the other face bears the reverse impressions. In Pl. VI, fig. 132 there is, instead of this sign, a scratched cross and on the other face of this disc the coin impressions are those of the obverse. (Diagrammatic). Actual size.

TEXT-FIG. 24.—The rim of the middle disc of mould C (Mathura); coin-sockets omitted. Luting shown dotted. For further explanation see text. (Diagrammatic). Actual size.

In the rough sketches just referred to, parts of the rims of the discs are shown shaded with dots. These dotted areas represent adhering traces of a luting which in places covers and more or less completely conceals the key lines. It is only a very thin, almost film-like, crust, which I had at first overlooked. But examination with a pocket lens showed unmistakably that it is a layer distinct from the substance of the disc, and it was then found to be present on the rim of every one of the eleven pieces, covering more or less of the surface, and sometimes completely concealing from view the oblique grooves or key-lines. In some places the material of the luting just fills up the groove, and the surface of the rim appears smooth and even.

The luting is composed of a relatively coarser clay than the unusually fine clay of the disc, but the most searching examination has failed to show any traces of mixed vegetable matter, such as might have been expected from our experience of the other moulds described above. Traces of the luting are also seen continued over the edge, on to the blank face. This is well seen on disc F_1

(Pl. VI, fig. 132) where it forms a well-preserved border, about 3 mm. wide, passing nearly all round the blank face. It is sufficiently regular in width to suggest that it was applied by rotating the set of discs on a turn-table like a miniature potter's wheel. Indeed the discs themselves may very probably have been moulded on such a turn-table.

An interesting feature of some of the blank faces is the presence, in the centre, of a usually circular patch, just under a centimetre across, where the surface is in some discs slightly raised (*e.g.*, discs G and B_4), in others slightly depressed, but always comparatively rough (see Text-fig. 23 and Pl. VI, fig. 132) I am unable, at present, to say with confidence how these patches were caused, but everything seems to suggest that they had something to do with the use of a wooden turn-table of which the exposed axle-end might have been not quite flush with the table. On disc F_1 the surface of the circular area is exactly such as might be caused by the end of a roughly sawn, but not yet planed, wooden rod.

The metal was poured in at the side, into a peculiarly shaped opening cut through the edges of the discs where they met. In the only complete set we possess (A) the edge of the middle disc was cut away into a V-shaped notch, with a straight channel on each face leading from the notch to a point just beyond the centre.[1] From this main channel four short branch channels came off at right angles, two from either side of it. The ends of these four channels, and that of the main channel itself, communicated with the five coin sockets. To complete the opening at the edge of the triple mould the two outer discs were excavated on their inner sides into shallow depressions which either fitted opposite each other, on either side of the notch in the middle disc (see Text-fig. 23 for set B), or lay obliquely on the two sides of the middle disc (as in set C, Text-fig. 24).

The workmanship of the discs is very neat. They fit very well into each other and their perfectly circular rims, with their smooth surface, support the idea that they were moulded on a turn-table.

It is possible that, as in the case of the Rohtak moulds, two or more sets of discs were combined to make a longer series, all cast at one time. But of this there is no clear evidence.

The clay of these moulds is of an unusually fine grain, and the discs are perfectly made. Very likely the same discs were used again and again. With the luting applied in such a thin layer it must have been possible to dismantle the mould without damaging the discs.

As stated above, the straight canal leading from the funnel gives off branches to right and left to supply the sockets, but an interesting point in the

[1] The surface of this main channel is always longitudinally striated, indicating that the channel was made on the soft clay with the end of a roughly broken stick drawn firmly across the disc.

technique is that these channels were only made on *one* of the two coupled faces (compare Pl. VI, fig. 128 with 129 and 130 with 131). On the other face the coin sockets have no canals leading to them. In fact, they are not required on both faces, as I have already explained above in describing the Rohtak moulds (see Text-figs. 12, 13 and p. 23 above).

The main interest of these moulds is that they were evidently designed to produce in a single operation coins of a kind which must normally have been struck with a series of punches. For this reason they must be regarded as the work of a forger.

Dr. Panna Lall considered these moulds to be as old as the era when this type of coinage was current in India. Since, then, however, the moulds have been studied in detail by Mr. Durga Prasad, an acknowledged authority on Indian punch-marked coins. His opinion is that they are not older than the 2nd or 1st century A.C. This opinion Mr. Durga Prasad recorded in a note (dated Dec. 1936) addressed to Dr. V. S. Agrawala, who has very kindly allowed me to quote the following details:—

"The moulds bear impressions of pre-Mauryan, Nanda and Mauryan coins of three different periods, ranging from 5th to 3rd century B.C.....All the impressions were made from worn out coins...as is evident from the *rounded* edges.....The same worn coins have been used to produce impressions on separate moulds.....The impressions on the moulds are from known punch-marked coins of silver. None of the coins show the symbol groups of the *Śūraseni* coins of Mathura of the 7th or 6th century B.C. It appears that some ingenious person made an attempt to fake silver punch-marked coins by casting, and prepared these compound moulds from very fine clay, but he made the impressions from worn coins which are now available, not knowing that he was using coins of three different periods.....On the above grounds I am convinced that these moulds were made for faking silver punch-marked coins of the known variety within recent times."

As Dr. Agrawala points out, Mr. Durga Prasad's estimate of the date of these moulds accords with the fact that their construction generally resembles that of the Taxila moulds and of those from the Roman sites in Europe and Africa, all of which belong to the early centuries of the Christian era.

Whether the forger used an inferior silver alloy to make his work pay, or whether he cast the coins in copper and then covered them with silver, it is not possible to say.

As we are not here interested in the purely historical aspect I shall content myself with reproducing only a few plasticine casts from some of the best preserved coin sockets (see Pl. V, figs. 133-138). I understand that Dr. Agrawala proposes to publish the note by the late Mr. Durga Prasad and to illustrate it with photographs.

h. Sanchi

During a brief halt at the remarkably well preserved Buddhist monument at Sanchi, early in January 1944, I noticed among the minor exhibits preserved in the museum four specimens labelled as follows:

No. 9. "Clay seal (die) found 1′ 8″ below surface."
No. 10. "Clay seal (die)."
No. 13. "Seal of clay."
No. 14. "Clay seal."

I am grateful to Dr. H. R. Taimuri, Director of Archaeology in the Bhopal State, for permission to describe them here. Dr. Taimuri has done me the great favour of sending me photographs as well as plasticine casts made at my request, but as the plates for the present memoir had already been printed, a fuller account of these moulds must be reserved for a future occasion. Dr. Taimuri informs me that they were all found at the Devī Vihāra.

Like the Sunet coin moulds described above, these have been wrongly labelled as "seals". They are all single-coin discs of terra-cotta, about 21 mm. in outer diameter, and show the characteristic fractured surface of the rim round the coin-sockets, by which the discs were originally coupled. They all possess on one side a U-shaped cut leading to the socket, to serve as an inlet for the metal. The coin sockets vary from 13 to 13.5 mm. across. An interesting point is that the marginal cut goes right across the thickness of the disc, suggesting that the discs may have been combined, as in some Roman moulds (Pl. VII, figs. 143-145), into two or three piles, with a central crater at the top.

Dr. V. S. Agrawala, who has examined the casts and photographs, sends me the following note, which I reproduce with his kind permission:

They seem to have been used for casting coins of the rulers of the Western Kshatrapa dynasty (*ca.* 150 A. C.—*ca.* 388 A. C.). The obverse type shows the king's bust to right on the coins (to left on the moulds), and the reverse has a Chaitya symbol with a wavy line below and a crescent and star by the side. The legend is written round the margin on the reverse side. It was not possible for me to make out the letters from the faint impressions except in the case of No. 14, where the king's name is *Kshatrapa Viśvasena* (विश्वसेन), whose dates as known from other specimens are *Śaka* 216-226=294-304 A.C. This legend, in Brahmi characters, reads: *rāj̃ño. mahā.....kshatrapasa Viśvasenasa.* "राज्ञो महा·····क्षत्रपस विश्वसेनस". On another impression the following can be made out: *putrasa rāj̃ño* पुत्रस राज्ञो·····

i. Kondapur

At Kondapur in the Hyderabad State (17° 35′ N, 78° 1′ E), Mr. K. M. Ahmad made what is probably the most interesting discovery of coin moulds since the finding of the Yaudheya mint site at Rohtak.

An illustrated account by Mr. Ahmad was published in the Proceedings of the Hyderabad Archaeological and Historical Society for 1941, and a brief reference was made in a recent article by Mr. G. Yazdani (1942); but a detailed description of the coin moulds, and of the technique employed, is still awaited.

Through the kindness of Mr. Ahmad I have had an opportunity of making a cursory examination of some of these moulds during a brief visit to the Hyderabad Museum. Apart from numerous coins of which the date is estimated as *ca.* 1st—2nd century A.C. (corresponding to the *Kushāṇa* period in northern India and to the Andhra period in the south) Mr. Ahmad unearthed coin moulds among which there were some for casting punch-marked coins, some for casting Andhra coins and others for casting coins of the Kshatrapa dynasty.

It is interesting to compare some of these moulds with those from Mathura, described above, which were likewise meant for duplicating by the casting process coins which must normally have been struck with punches.

The other moulds examined by me are all single-coin discs, like those from Nalanda, Sanchi and Sunet, and from some of the old Roman sites in France and England, figured by Akerman, Cesano, Dattari and others (*vide infra*). But I must not anticipate the detailed work of Mr. Ahmad on this aspect of his discovery, to which numismatists will look forward with interest.

j. KADKAL

Another find of coin moulds from southern India, briefly announced in the Annual Report of the Archaeological Department of the State of Hyderabad-Deccan for the year 1936-37, was also made by Mr. K. M. Ahmad (see Yazdani, 1939, pp. 16-18, 20, 77-78, and Pl. XIV). These moulds were exhibited at the Annual Meeting of the Numismatic Society of India held at Mysore in 1935, and a passing reference to the discovery was made by Rai Bahadur Prayag Dayal in a presidential address to the Society (Prayag Dayal 1941). Trial trenches made near the village of Kadkal (16° 12′ N, 76° 31′E) disclosed furnaces, slag and ash-chutes as well as broken pieces of terra-cotta moulds and coins of unpublished varieties. The Nagari script of the legend on the coins suggests that the coins range between the eleventh and fourteenth centuries A.C. Most of the coins were found in ash-chutes along with their moulds. Evidently we have here the site of still another old mint.

Although of comparatively recent date, the material here discovered would well repay detailed investigation for a comparison of the technique with those followed in "Ancient" times.

k. ERAN

(Bronze die)

Although not a mould in the ordinary sense, a bronze die for making punch-marked coins, described by Cunningham[1] in 1880, may also be appropriately considered here. I have not been able to examine the original specimen, but reproduce Cunningham's figures. (*See* Pl. VII, figs. 139, 140.)

The specimen was found at Eran, in the Saugor district, about five miles from Bina. It was a broken die about half an inch thick, with a depression at the back which no doubt received the end of the punch.

As Cunningham writes, the most curious fact about this relic is that it was evidently made to strike at a single blow the several different designs carried by the coin; whereas, so far as we know, in all typical punch-marked coins the different designs were stamped successively by so many different punches. This fact suggested that, like the Mathura moulds just described, this may have been a forger's apparatus. Cunningham says that it may have been employed "for the purpose of stamping pieces of copper to be afterwards plated in imitation of the true punch-marked silver coins." The alternative view suggested by him, that it was "one of the earliest dies which immediately preceded the use of a single type die" seems to me a far-fetched one, because the single type method is obviously the simpler and more primitive method and it is unlikely that it was preceded by the complex multiple-type process. I say this because in the first place the earliest punch-marked coins carry only a single design, and, secondly, on the later coins (with multiple designs) we sometimes see one symbol overlapping another.

COMPARISON WITH THE TECHNIQUE OF ANCIENT ROME AND CHINA.

(i) Roman Coin Moulds.

For comparison with the Indian techniques described above we have to consider, as first in importance, the Roman technique as revealed in moulds discovered in large numbers in many parts of the old Empire.

The literature on this subject is vast, and it is out of the question here to give more than a cursory review.[2]

The bibliography at the end of this paper does not claim to be complete: with several exceptions (marked*) only those works are cited which I have seen

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[1] Cunningham (1880), Pl. XXIV, fig. 1 and pp. 77-78.

[2] Some of the more prominent authors may be named in alphabetical order: J. Y. Akerman (1834 and later); F. Poey d' Avant (1838), E. Babelon (1901), Bacher (1747); M. Bahrfeldt (1904), Baronius (1729), Bulliot (1897); Camdem, Caylus, L. Cesano (1912), G. Dattari (1913), Eckhel, H. de Flamare (1899, 1900), Harcher (1764), Hettner, G. F. Hill (1881), Hiver (1838), Hollenfeltz (1920), Lenormant, Mahudel (1746), Mayer, I. G. Milne (1905), Mommsen, Mowat (1908), Antoine le Pois (1579), J. B. Reade (1837-38), Schneemann (1861-62), F. von Schroetter (1930), S. Sharp (1871), van Vlevten (1879), de Witte (1902).

myself. For fuller information about the literature the reader should refer to the detailed paper by Cesano.

From all accounts it appears that by far the commonest practice was to cast the coins between discs of terra-cotta[1] which were piled up into a cylinder. Another method commonly in vogue was to arrange the coin sockets on the branches of a tree-like system of canals, the fused metal being poured into the base of the tree. According to Cesano[2] discoveries of Roman coin moulds date as far back as the year 1500. The earliest record known to me refers to the discovery in 1579 by Antoine le Pois[3] of clay coin moulds at Lyons. Other early finds mentioned in the literature are dated 1697, 1706, 1820, 1830, all from Lingwell Gate[4] in England, where they were brought to light from time to time as they were turned up by the farmer's plough. An important discovery of 1704 at Lyons is described by Babelon[5]; and Hiver[6] records the even more interesting find of an old Roman mint site near Lyons discovered in the year 1830.

Discs have sometimes been found still joined together, with virgin coins lying in their original sockets, *e.g.*, at the castle of Damery (Marne), at Bernard, Coulonche, Châteaubleu (Seine-et-Marne) and Treveri, all in the old Roman province of Gallia; also in England at Lingwell Gate near Wakefield, and at Edington in Somersetshire[7].

Each disc, except the two end ones in a series, usually bore the impress of the coin's obverse on one face, of the reverse on the other. On the blank face of some of the end discs the grain or roughly planed surface of wood has been found impressed[8], suggesting that a wooden board was used as a base for preparing the moulds.

The margin of each disc was notched in the form of a V[9] or ⌣[10] and the discs, carefully coupled, were placed together so as to form, with all the notches in one line, a single trough-like channel for the metal, opening into all the coin sockets[11].

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[1] According to Cesano (1912), footnote 2, p. 18, van Leuten (1874) suggests that certain coin moulds found at Bonn and at Tholey were made of a substance composed of iron and carbon, such as was used for making crucibles. I have not been able to see van Leuten's paper.

[2] Cesano (1912), p. 9.

[3] Antoine le Pois (1579) as cited in Cesano, *l.c.*, p. 9; also Babelon (1901), p. 955.

[4] Akerman (1838-39); Reade (1838-39), pp. 161-165.

[5] Babelon (1901), p. 958.

[6] Hiver (1838-39), p. 156.

[7] For references see Cesano. *l.c.*, p. 21.

[8] Sharp (1871), p. 39.

[9] Akerman (1838-39), fig. 3; Babelon (1901), pp. 958-960; Sharp (1871) fig. 1.

[10] Akerman (1834), pl. 14 (frontispiece).

[11] Babelon (1901), fig. 36.

Cesano[1] writes that at Susse [? Sousse (prov. proconsularis), in N. Africa] fragments have been found of a bronze tube in which the series of moulds were placed for the casting. She gives no details as to how the metal was poured in, but perhaps these are to be found in a paper in the *Bull. des antiq. de France* 1899, p. 368, to which she refers on p. 11, but which I have not seen.

By far the commonest method, however, was to encase the series of moulds in a luting of plaster, with a wide opening at one end leading into the interior. The entire mould, with the luting, was hardened by baking before the metal was poured in.

Babelon[2] writes that discs have been found still sticking together in cylinders, luted together in a layer of baked clay, and kept in place by a ligature of iron wire. He figures one such specimen (*l.c.*, fig. 36), now preserved in the Cabinet des Médailles, Paris, which is said to have been found at Lyons about the year 1704. In the series of 8 discs, here shown tied together by a piece of wire[3], Caylus is said to have cast fresh coins, showing that these moulds were capable of repeated use. Coins have also been cast by J. B. Reade in some old Roman moulds.

In several places definite evidence has been found of two or three cylindrical series of discs having been combined into a single mould somewhat resembling the multiple mould of the earlier Yaudheyas of Rohtak. In a sketch by S. Sharp, reproduced in Akerman's Numismatic Chronicle[4], two such cylinders are shown put together so as to combine their two trough-like channels into a single canal running vertically between them; at its upper end the canal expands into a crater for receiving the metal which also is seen still attached in position. This specimen is said to have been found at Lingwell Gate in England. At the same place was also found a clay crucible believed to have been used as a receptacle for fused metal.

Triple moulds, built essentially on the same principle, have been discovered at Damery, Lyons (Fourvières) and Treveri[5]. Those from the first two places are made up of three groups of 12 moulds each; one of these is preserved in the British Museum, the other is in the Paris Cabinet. The structure is illustrated in diagrammatic sketches published in the Numismatic Chronicle[6] which were later reproduced by Cesano[7].

[1] Cesano (1912), p. 21.

[2] Babelon (1901), p. 958; *see* also Hiver (1838-39), p. 156.

[3] As for the iron wire shown in Babelon's figure I am personally rather sceptic about its authenticity. It is desirable to enquire critically as to whether it was originally found tied round the discs. I suspect that it was supplied much later, in the museum, in order to keep the discs together. If the discs were to be luted together with clay, the use of the wire is not easy to understand.

[4] Akerman's Numismatic Chronicle (1838-39), fig. 5.

[5] Cesano (1912), p. 21.

[6] Akerman's Numismatic Chronicle (1838-39), figs. 1, 3.

[7] Cesano (1912), p. 19.

Some of these diagrams are again reproduced here (*see* Pl. VII, figs. 143-145). The three series of discs, so combined, would enclose a canal with a cross-section like a 6-rayed star: the three notches in the discs would alternate with V-shaped gaps where the three circular discs meet round the canal (fig. 143). See page 48, under Sanchi.

From the castle of Damery (Marne), which stands on the ruins of the old Roman city of Bibé, near Epernay, and which no doubt marks the site of a Roman mint, Hiver[1] describes some interesting relics found in 1830: several vases full of coins, as well as clay moulds still containing virgin coins; and (from the point of view of the technique) most interesting of all, an ingot of metal from a triple mould of the type above described. This last specimen, shown as fig. 2 in vol. 1838-39 of the Chronicle, consists of a funnel-shaped or cup-shaped piece of metal attached to the upper end of a rod of metal. This rod originally filled the central canal of the mould; it consequently shows 6 longitudinal ribs, some of which bristle with points marking the notches through which the metal flowed out into the coin sockets. Hiver says that there are 12 points on each of the bristly ribs, and suggests that 36 coins must have been cast at one operation. If this was the case, the number of moulds in each of the three series must have been 13, not 12 as stated by him. Twelve discs would only yield 11 coins.

In 1871 Sharp[2] figured some relics from Duston, near Northampton. These are also of considerable interest, as showing that the technique of casting was similar to that employed at Damery and Lyons. At Duston, Sharp says, "about a pint of coin moulds" were found, as also fragments of an earthen vessel with a partial vitreous glaze on the exterior and with indications that the interior had contained molten metal. This was no doubt a crucible. He figures also a cone-shaped piece of metal, apparently a casting of the crater mouth (*l.c.* fig. 6) as well as a piece of terra-cotta (*l.c.* fig. 5) which very likely was a part of the crater itself. On some of the discs a V-shaped notch is seen (*l.c.* fig. 1). Sharp finds that many of the moulds must have been impressed from the same coin or from coins cast in the same disc, as we have seen to have been the case with many of the Yaudheya moulds from Rohtak.

The date of the Duston moulds is given as probably between 292 and 306 A.C., that is, three to four centuries subsequently to that of the Rohtak moulds of the early Yaudheyas, and roughly contemporaneous with the Sunet moulds of the later Yaudheyas. The fact may perhaps be of some significance that some of the Sanchi moulds, which suggest a technique similar to that of Lyons, Damery and Duston, are of about the same date as these Roman relics.

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[1] Hiver (1838-39), pp. 154-161.

[2] Sharp (1871), pp. 28-41, figs. 1-8.

Writing about some coin moulds from Behnesa, an old Roman colony in Egypt, I. G. Milne[1] says (according to Cesano 1912, p. 20), that he found traces of wax on four discs still united together and not yet used, and he suggests that the method of the *cire perdu* must have been employed there (see p. 55).

Dattari (1913) describes from the Roman empire in Egypt some large clay discs, with a number of intercommunicating coin-sockets, very similar to the much earlier moulds from Taxila (see p. 39).

In 1920 Hollenfeltz[2] described some Roman coin moulds from the museum at Arlon. Apart from several terra-cotta moulds of the usual type, each bearing the impress of a single coin only, he figured a unique type of mould in two counterparts, made of *lead* (*l.c.* Pl. I, fig. 7 and Pl. II, two unnumbered figures). This specimen is said to have been found in 1898 near Schadeck in Belgian Luxemburg, at an old Roman site. Each of the two pieces of the mould is 5 to 8 mm. thick, and of a rectangular shape, with as many as 44 coin sockets on the inner face, arranged in four rows of 11 each. Along the narrower side of the rectangle, where the four rows of sockets start, there are four long conical inlet canals, placed parallel to one another and each leading to the nearest socket of its own row.

The interest of this mould lies partly in its rather unusual shape but chiefly in the fact that it is made of such a soft material as lead. The question is, What could have been the metal used for casting in such a mould? Hollenfeltz considers bismuth and tin the only possibilities, and suggests that probably an alloy of these metals was used, because it is well known that alloys always melt at a lower temperature than the two members do individually. I am not aware of any coins made of an alloy of bismuth and tin, but the point is worthy of inyestigation.

Although not coin moulds in the ordinary sense we may also consider briefly some moulds for casting Roman Tesserae, described by Rostowzew[3] in 1903. In principle these are similar to the Mathura coin moulds, though the form is different. Rostowzew figures half-a-dozen different moulds. One large rectangular mould carries five sockets arranged (as in the Mathura moulds) in two pairs, one on either side of a median canal, with the end of the canal itself opening into the odd socket. In another mould, also rectangular, there are two feed channels, through the longer side of the rectangle. One channel serves a group of five large sockets arranged as just described; the other supplies nine much smaller sockets, placed in four pairs with an odd one at the end of the canal. At two diagonally situated corners of this mould there are circular pits which no doubt served as mortises to receive tenons from the counterpart of the mould.

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[1] Milne (1905). See also Proc. Num. Soc. 1904, p. 12. I have not been able to see either of these papers.

[2] Hollenfeltz (1920), pp. 5-9, Pls. I-II.

[3] Rostowzew (1903), Pl. XII.

(ii) Chinese Coin Moulds.

Owing to my ignorance of the Chinese language I have only an indirect and meagre acquaintance with the coining technique of that country, which must be very ancient[1], for the Chinese have for thousands of years practised and perfected the art of casting as no other nation has. But my main sources of information, namely, the works of Terrien Lacouperie[2] and of Schloesser[3], are probably antiquated, for it is more than likely that the recent revival of archaeological studies in China[4] has brought forth new material which is directly relevant to our theme.

The techniques of casting coins in China have been studied from many ancient as well as recent moulds, some of which are in stone, others made of bronze, earthenware or clay (beaten or sun-dried); some are made of iron.

The coins were cast either singly, in pairs, or in clusters. Lacouperie (p. xxv) mentions coins cast in a circle, but I have not seen any clear description or figures and cannot say whether the sockets in such moulds were fed from a central canal, as in the Yaudheya moulds from Rohtak, or otherwise. The same author (p. xxviii) also describes a stone mould for casting ten *Pao luh kwa* coins "arranged like a tree whose stem and branches are the rivulets for the metal and fruits or leaves the coins". Clay moulds of the *P'an liang* coin issued in 221 B.C. have been found; they cast single coins. Under the T'ang dynasty the technique of the *cire perdu* was practised. A model of the coin, made in wax, was embedded in a clay matrix and connected to the exterior by means of a channel. The matrix was then heated to melt the wax, which flowed out of the channel, leaving a socket into which metal was then poured.

Bushell[5], who has compared the Roman and Chinese coinage, figures a Chinese mould in stone, with the coins arranged on the branches of a tree-like

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[1] Since this chapter was written a Chinese botanist, Professor Jen Hsü of Kunming, Correspondent Fellow of the Sino-Indian Culture Society, has very kindly brought me as a present a series of old Chinese cast coins. From these I have gained the only direct information I possess concerning the techniques employed in ancient China. I am also indebted to Professor Hsü for obtaining through the courtesy of Professor Y. T. Sun of Kunming valuable data which have corrected my previous ideas on the antiquity of Chinese coinage, based upon a reading of European authors.

[2] Lacouperie (1892).

[3] Schloesser (1935).

[4] See C. Li (1931), pp. 184-193.

[5] Bushell (1872), pp. 117, 118, as cited by Lacouperie.

system of canals, such as was commonly adopted in ancient Rome, and was also in use in Japan. He figures a similar Roman mould in stone.

It is possible that at times coins were cast in moulds carved out of bricks. Two bricks of fine grained clay were ground smooth on one side, and the negatives were carved out of the smooth faces which were then coupled for casting. This process, according to Lacouperie[1], writing in 1892, was still followed in China for small brass castings, and he suggests that it may have been employed for casting coins as well.

Lockhart[2] describes a large rectangular mould (2 ft. × 1 ft.) made in a series of layers of founder's sand, enclosed in wooden frames, which were placed one above the other and firmly bound together. The coin models were placed at the ends of a tree-like model about 1½ ft. long, of hard pewter, the basal end of the main stem being placed at the edge of the mould.

The following details of the technique are taken from Schloesser (p. 17). The casting was at first done singly and only on one face of the coin; later coins bear designs on both faces, and they were cast in groups arranged in a form or mould. Either the coins were cast directly in a negative mould (matrix) of clay, stone or bronze; or the more practical way was chosen of using positives (patrices) of bronze from which matrices were printed in clay in pairs, which then were coupled so as to form several coin sockets at a time. These clay matrices were dried and probably baked before they were used for casting. Since, from the first bronze positive (model or patrix), it was possible to print as many negatives as one liked, one could cast an endless number of identical coins; with the bronze or stone negative this was impossible.

The original bronze positives (patrices) of many Chinese coins have been discovered. They often bear on their back significant inscriptions giving details, such as dates, etc.

Schloesser[3] has published some of these bronze models from the collection at Dorsten in Westphalia. One of them, dated as late as 561 A.C., is a rectangular piece of bronze carrying eight coin models in two rows of four each, connected together by short branches coming off to right and left from a median longitudinal stem. Each coin model has a square hole in the centre.

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[1] Lacouperie (1892), p. xxviii.

[2] Lockhart (1861), as cited by Lacouperie.

[3] Schloesser (1935).

CONCLUSION.

While the coins of Ancient India have long been a subject of study, the coining techniques have received only scant attention. In the present work an attempt has been made to reduce this gap in our knowledge by describing some of the modes of casting coins in Ancient India. From what has been said above it is clear that a vast field lies open for future work on this neglected aspect of Indian numismatics.

It may be useful to review briefly the salient points brought out in this work. The material here described comes from eleven localities, most of them in the Indo-Gangetic basin. According to Dr. V. S. Agrawala it may provisionally be arranged in the following chronological order:

(*i*) Bronze die from Eran (*ca.* 3rd Century B.C.)

(*ii*) Rohtak moulds (*ca.* 100 B.C.)

(*iii*) Taxila moulds (*ca.* 15 B.C.)

(*iv*) Mathura moulds (probably not older than 2nd or 1st Century A.C.)

(*v*) Atranji Khera mould (*Kushāṇa* period: 2nd Century A.C.)

(*vi*) Sanchi moulds of the Western Kshatrapa dynasty (within the limits *ca.* 150 and 388 A.C.)

(*vii*) Kondapur moulds for punch-marked, Andhra and Kshatrapa coins.

(*viii*) Sunet moulds (*ca.* 3rd Century A.C.—post-*Kushāṇa* and pre-Gupta).

(*ix*) Kashi mould of the reign of Chandra Gupta II (375-417 A.C.).

(*x*) Nalanda moulds (Gupta period: Narasimhagupta *ca.* 500-550 A.C.; Jayagupta *ca.* 625-675 A.C.)

(*xi*) Kadkal moulds (11th-14th Century A.C.)

i. ERAN.

The Bronze die from Eran is the only specimen of its kind known from India. As Cunningham pointed out in 1880 this must be a forger's apparatus because it duplicated in a single stroke punch-marked coins which normally must have been made by a series of hammer strokes with different punches.

ii. ROHTAK.

The Rohtak material represents by far the richest find of its kind yet recorded from any part of the world. It consists of several thousand fragments of clay moulds which, thanks to their fine preservation, have enabled us to reconstruct in detail the technique employed in India over 2,000 years ago (pp. 18-29, Pl. VII, fig. 146). We now know that at Rohtak, a hundred years before the

Christian era, there was in use a coining apparatus more complex in structure than any yet discovered anywhere, and indicating a high degree of skill and intelligence. The main points of interest are:

(*a*) The arrangement of the coin sockets in rings, at the ends of radial channels leading from a central vertical shaft which opened upwards into a funnel-like crater. These moulds are unique in to having the coin sockets placed on perforated discs, at the ends of long radiating canals which enabled one to accommodate as many as eight coins in a ring.

(*b*) The piling up of several *sets* of discs in a single column, the successive sets being separated by a dusting powder spread between their blank contiguous faces. This must have enabled a great number of coins to be cast in a single operation.

(*c*) The tenon-and-mortise device, for the accurate re-coupling of the discs after the models had been removed.

(*d*) The key-line device, for checking the composition of each set.

(*e*) The use of a luting (plaster jacket) composed of clay mixed with a large proportion of vegetable matter. When the mould was baked the combustion of the vegetable matter left the jacket both firm and porous, so as to allow the gases to escape.

(*f*) The use of a special model (cut out of a sheet of metal) for making the eight radial canals at one operation. The "collar" round the central aperture (see page 21) shows attention to a detail of manipulation.

(*g*) The simultaneous use of a number of distinct models, both for the obverse design and for the reverse, though the designation of the coin remains the same. The fact that these models had no fixed orientation in the ring, and the number of chance couplings thus made possible, must have resulted in an endless variety of coins, of which probably no two were exactly identical.

From a comparison of the technique of the Rohtak moulds with that of some Roman moulds described from England, France and elsewhere, several interesting points emerge. I have had no occasion to examine any Roman moulds, but to judge from published accounts the Rohtak technique, which was of distinctly earlier date, was comparatively finer and more efficient. The Romans do not appear to have employed some of the devices described above. The coin sockets were placed singly on small roundels of clay notched on one side and these were combined into double or triple piles so as to combine the notches into a central shaft. The pile was then luted over with clay but it is not known

whether vegetable matter was mixed with the clay[1]. The probability is that vegetable matter *was* mixed by the Romans, as it was at the Rohtak mint some centuries earlier, and by the forgers at Taxila about the beginning of the Christian era. The central channel opened upwards into a crater.

The Roman moulds are believed to have been capable of use for repeated casting, because the roundels, it seems, could be separated without damage while the mould was dismantled after the first casting. If this was the case, they had in this respect an advantage over the Rohtak moulds which could not have been used a second time. On the other hand the Rohtak moulds, which were in use at least a couple of hundred years earlier, were of distinctly finer construction and were capable of producing a much large number of coins at a single casting. We have not enough data to theorise, but on the evidence at hand it would not seem rash to suggest that the general similarity of the Roman moulds with the Rohtak ones indicates Indian influence on the Roman technique.

iii. TAXILA.

The Taxila moulds, originally described by Marshall and rightly regarded by him as forgeries, are interesting chiefly because of their close resemblance in structure with some Roman coin moulds described and figured in 1913 by Dattari from Egypt (see p. 41). This comparison, however, refers only to the circular moulds (cf Pl. V, figs. 119-122).

The mould of King Maues shown in Fig. 123 must have been quite different in shape, because it shows at least a portion of the straight margin—an unusual feature which this mould shares with only one other yet discovered in India, namely, that from Atranji Khera. This straight-sided mould is also interesting because of the luting (mixed with vegetable matter) which Marshall does not mention, but which is seen applied to the mould in a fairly thick well preserved crust (fig. 123).

The Taxila material, unfortunately, is insufficient for a proper appreciation of the mode of casting. The fact that of the Indian localities Taxila lies geographically nearest to the Egyptian outpost of the Roman empire may or may not have any significance in the comparison with Dattari's moulds, which are of a considerably later date than the Taxila ones and are in any case separated by a long distance. We need more material, and material from a larger number of localities, to know whether the Roman technique as seen in Dattari's moulds was or was not influenced by Taxila.

iv. MATHURA.

The Mathura moulds, first described by Panna Lall, are again undoubtedly the work of a forger (because they duplicated punch-marked coins by casting). A critical study of the punch-marks by the late Mr. Durga Prasad has established

[1] The Roman coin moulds deserve to be subjected to a more minute examination than they appear to have received.

the fact that coins of three different periods were used as models,—an irrefutable piece of evidence for regarding the moulds as a forgery. They are compound disc moulds which were made up into sets of three discs each, sometimes possibly more than three. Being intended to reproduce the fine details of punch-marks, they are made of exceptionally fine clay. The device of the tenon-and-mortise was combined with the key-line device. The intelligent Mathura forger, moreover, appreciated the practical advantage of not completing the feeders to the coin sockets on both the coupled faces (Pl. VI, cf. figs. 128 with 129 and 130 with 131). The mould was filled through a peculiar shaped opening excavated at the edge of the combined set of discs (Text-figs. 23, 24).

Another interesting fact about these moulds is that they reveal evidence of the use of a wooden turn-table, like a miniature potter's wheel. The luting is only a thin film-like crust, without any admixture of vegetable matter. That it was probably applied with the mould rotating on a wheel is suggested by the rather uniform width of the border which this luting forms where it passes over to the blank face of the disc (see Pl. VI, fig. 132). This is also indicated by the presence, on the blank face of some discs, of what I believe is the impression of the roughly sawn end of the axle which was not planed flush with the surface of the wheel (Pl. VI, fig. 132 and p. 46).

The thinness of the luting may have enabled the mould to be dismantled without damage to the discs, which could then be used for repeated castings. This is suggested by the perfect condition of all the coin sockets.

v. Atranji Khera.

The forger's mould from Atranji Khera (Pl. VI, fig. 126) is remarkable for its rectangular form (seen elsewhere in India, so far as I know, only in the Taxila mould of King Maues) and for the arrangement of the feed channels, which spread out like the fingers of a hand immediately from the marginal opening. The usual tenon-and-mortise device was adopted here, as in other compound moulds, like those found at Rohtak and Mathura, and in the Roman moulds for casting Tesserae, described by Rostowzew (see page 54).

vi. Sanchi.

Until the Sanchi material has been examined more closely it would be difficult to make a comparison. But as indicated above the deep V-shaped cut at the margin, taking in the entire thickness of the disc, recalls some of the Roman single-coin discs, *e.g.*, those shown in Pl. VII, fig. 143. The dates of the Western Kshatrapas also correspond roughly with those of the Roman moulds mentioned on page 53. (*Postscript added Sanchi 4 January 1945.* While correcting the proof of this chapter I have had occasion to pay a second visit to Sanchi, where I have been able to ascertain that the four Sanchi moulds all belong to one set which probably consisted of five discs. No. 9 couples with 14, and 10 with 13, while the middle disc is missing. The end faces of 9 and 13 are blank

(flat). When the two pairs were coupled the marginal cuts fell into alignment, forming a deep lateral channel from which short funnel-like passages led into the coin sockets. At the same time the rims of all the four discs showed faint indications of key-lines which also fell into alignment; these are partially concealed under a thin crust formed by the remains of a luting. How the mould was filled is unknown. There is no evidence that these cylindrical sets were combined into triple moulds after the Roman style shown in Pl. VII, fig. 145.)

vii. KONDAPUR.

Kondapur is interesting as being one of the few localities in Southern India where coin moulds have been discovered. While some of these moulds, like those described from Mathura, were meant for fabricating punch-marked coins, others recall those from Sanchi, Sunet and Nalanda, which in general resemble some of the Roman moulds from France and England. But no really useful comparison can be made until we have a fuller knowledge of the material.

viii. SUNET.

The Sunet moulds, which were originally mistaken for seals or votive tablets by Hoernle (1884), show several unmistakable characteristics of coin moulds, *e.g.*, a channel for the inflow of metal to the coin socket; the remains of a clay plaster which served to bind the discs into a cylindrical pile; a marginal groove or key line, and other features proving that they are not seals. These Sunet discs were, in fact, the first coin moulds ever described from this country, but their real nature had long remained a mystery.

The Sunet moulds are single-coin discs, sometimes still seen joined together back to back, but the details of the mode of casting are not clear. This much at least is certain that they were not combined into double or triple piles like the Roman coin mould shown in Pl. VII, fig. 145, but were cast in single cylinders supplied with metal either through one end or from the side.

It is interesting to observe that in comparison with the Sunet technique of the Yaudheyas their Rohtak technique was far more complex and efficient. Actually the Sunet moulds are more comparable in structure with some of the contemporary Roman coin moulds found in England, France and elsewhere. One would have expected the later technique of the same people to be the more elaborate. But the data are insufficient for drawing any definite conclusions concerning the evolution of the coining technique of the Yaudheyas.

In one repect the Sunet technique may perhaps be regarded as an improvement upon the Rohtak one because, if the moulds were dismantled carefully, it is quite possible that they could be used repeatedly. There is, however, no evidence that they were actually so used, any more than there is in the case of the Roman moulds.

ix. KASHI.

The small fragment of a mould from Kashi is an incomplete single-coin disc from which very little can be gathered concerning the mode of casting. Its chief interest is historical: it was meant for casting an archer type of coin of Chandra Gupta II.

x. NALANDA.

The three moulds from Nalanda are again all single-coin discs. In each case there is a broad channel at the side leading into the coin socket, the other face being blank. It is not known whether the discs were piled into a cylinder, but one of the moulds (Jaya Gupta, see Text-figs. 20-21 and Pl. IV, fig. 112) shows round the rim adhering traces of a luting containing impressions of plant fragments with clearly preserved cell structure. This mould also has two oblique key lines. In the mould of Narasimha Gupta (Text-fig. 22; Pl. IV, fig. 115) there are four grooves across the rim to serve as key lines. The Gupta technique as revealed in these three moulds is again much simpler as compared to that of Rohtak.

xi. KADKAL.

Kadkal is the southernmost, and at the same time the most recent, of the old mints that we yet know from India. It should therefore be of special interest from the point of view of the evolution of coining techniques.

From the above account it is clear that a great deal of material has yet to be discovered before we can draw any general conclusion concerning the evolution of the technique of casting coins in ancient India or concerning the relative antiquity or superiority of the Indian techniques as a whole. We must also know more about the techniques followed in other countries, particularly about those in China. But from the evidence at present before us one fact seems to stand out prominently, and that is the high degree of technical skill revealed in the coin moulds of the early Yaudheyas of Rohtak, although these happen to be the earliest of all the coin moulds we yet know from India. Probably these were preceded by still earlier moulds of a simpler type somewhere, not necessarily *coin* moulds, from which the Yaudheyas evolved their complex technique.

To Dr. Agrawala I owe the observation that the Indian coin moulds fall into two categories: (*a*) those from Rohtak, of which the construction was such as to make their repeated use impossible, and (*b*) the simple roundels of later dates, from Sanchi, Kashi, Nalanda etc., and even the compound moulds, like those from Mathura, all of which, it appears, could be employed for repeated castings. In the first case, the sockets were fed by metal poured through a central canal perforating all the discs, which therefore had to be broken up before the coins could be removed. In the second category the metal was

poured in from the side, so that the moulds could be neatly dismantled by merely breaking open the jacket of luting, thus making it easy to remove the coins without damage to the sockets. This consideration suggests that the complicated Rohtak technique may have been purposely given up in favour of the simpler moulds which could be used again and again. But the practical value of this idea can perhaps be assessed only after an actual attempt has been made to produce coins by coupling some of the old roundels.

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INDEX

General

Personal Names

Place Names

Printed by C. O. Foregren at the Lucknow Publishing House, Lucknow.—(530)—747—12-43.

PLATE I.

(Except where otherwise stated, the photographs are of the actual size and from untouched negatives.)

(ROHTAK.)

FIG. 1. View of part of Rohtak city near the Circular Road, showing old walls below road level, and the mound on which the modern city stands.

FIG. 2. View (looking west) of part of the Khokrakot mound showing at × the Yaudheya mint site. The lower broken line marks the level at which the dump of coin moulds was found embedded in a horizontal layer. The upper broken line marks the original surface before excavation.

FIG. 3. The Dehri Gate on the Circular Road, made up of robbed bricks of various periods.

FIG. 4. Reconstruction of a disc (mould of the obverse face). The fragments belong to different discs. On the right is seen a tenon, on the left a mortise. The central aperture has been completed in pencil on the print.

FIG. 5. Reconstruction of a disc (cast of the reverse face). The depressions on the mould were first filled with white powder and a plasticine cast was then taken. This reconstruction is based upon fragments belonging to several different discs, and considerable portions have been restored. Note the great variation in the elephant design, and the fact that though the elephant faces right it has no fixed orientation with regard to the centre of the disc. The size of the coin also shows some variation. The white mark on the top left was a pit (mortise) which in the cast appears as a peg (tenon). In reconstructing this disc one or two such pits or pegs have been inadvertently omitted.

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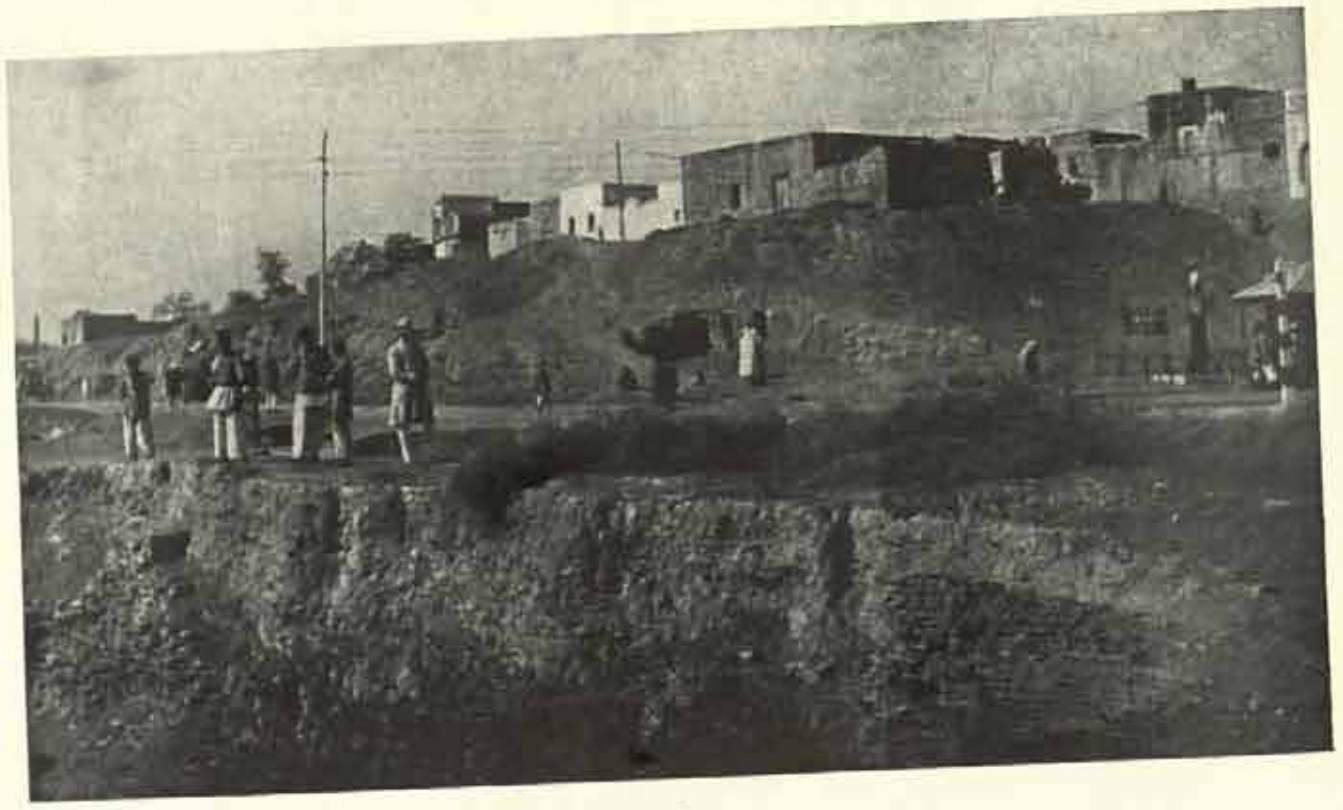

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1—5, ROHTAK.

B. S., K. N. K. & R. V. S. phot.

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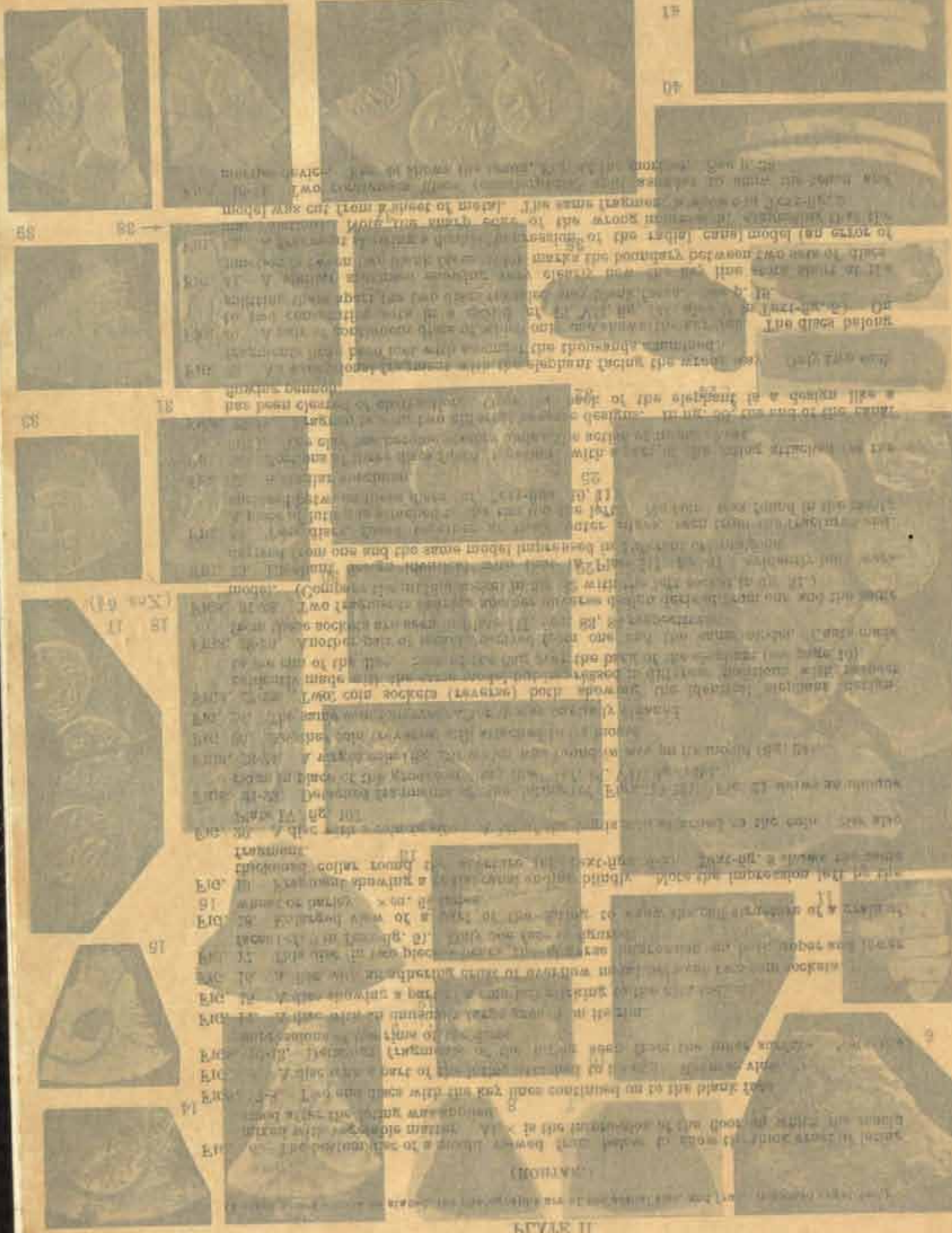

PLATE II

PLATE II.

(Except where otherwise stated, the photographs are of the actual size, and from untouched negatives.)

(ROHTAK.)

FIG. 6. The bottom disc of a mould viewed from below to show the thick crust of luting mixed with vegetable matter. At × is the impression of the floor on which the mould stood after the luting was applied.

FIGS. 7-8. Two end discs with the key lines continued on to the blank face.

FIG. 9. A disc with a part of the luting attached to its rim. Reverse view.

FIGS. 10-13. Detached fragments of the luting seen from the inner surface. Note the impressions of the rims of the discs.

FIG. 14. A disc with an unusually large groove on its rim.

FIG. 15. A disc showing a part of a coin left sticking to the coin socket.

FIG. 16. A disc with an adhering crust of overflow metal between two coin sockets.

FIG. 17. This disc (in two pieces) bears the obverse impression on both upper and lower faces (cf. 0 in Text-fig. 5). Only one face is figured.

FIG. 18. Enlarged view of a part of the luting to show the cell structure of a grain of wheat or barley. × *ca.* 6½ times.

FIG. 19. Fragment showing a radial canal ending blindly. Note the impression left by the thickened collar round the aperture (cf. Text-figs. 6-9). Text-fig. 8 shows the same fragment.

FIG. 20. A disc with a coin *in situ*. A bit of the lug is still attached to the coin. *See* also Plate IV, fig. 107.

FIGS. 21-22. Detached fragments of the luting (cf. Figs. 10-13). Fig. 21 shows an oblique ridge in place of the groove or "key line" (cf. Pl. VII, fig. 146).

FIGS. 23-24. A virgin coin (fig. 23) which was found *in situ* on its mould (fig. 24).

FIG. 25. Another coin (reverse) still attached to its mould.

FIG. 26. The same coin (obverse) after it was partially cleaned.

FIGS. 27-28. Two coin sockets (reverse) both showing the identical elephant design: evidently made with the same model but impressed in different positions with respect to the rim of the disc. Sign of the flag over the back of the elephant (*see* page 10).

FIGS. 29-30. Another pair of sockets derived from one and the same model. Casts made from these sockets are seen in Plate III, figs. 83, 84 respectively.

FIGS. 31-32. Two fragments bearing another obverse design derived from one and the same model. (Compare the middle socket in fig. 32 with the left socket in fig. 31.)

FIG. 33. Elephant design identical with that in Plate III, fig. 81 : evidently both were derived from one and the same model impressed in different orientations.

FIG. 34. Two discs, fused together at their outer edges, seen from the fractured end. A piece of luting is attached to the rim (on the left). No coin was found in the cavity enclosed between these discs (cf. Text-figs. 10, 11).

FIG. 35. A similar specimen.

FIG. 36. Portions of three discs fused together, with a part of the luting attached (at the left). The clay has become spongy under the action of intense heat.

FIGS. 37-38. Fragments with two different reverse designs. In fig. 38, the end of the canal has been cleared of obstruction. Over the back of the elephant is a design like a flowing pennon.

FIG. 39. An exceptional fragment with the elephant facing the wrong way. Only two such fragments have been met with amongst the thousands examined.

FIG. 40. A pair of contiguous discs of which only one shows the key line. The discs belong to two consecutive sets in a mould (cf. Pl. VII, fig. 146; also B in Text-fig. 5). On splitting them apart the two discs revealed only blank faces. See p. 19.

FIG. 41. A similar specimen showing very clearly how the key line stops short at the junction between two blank faces which marks the boundary between two sets of discs.

FIG. 42. A fragment showing a double impression of the radial canal model (an error of manipulation). Note the sharp edge of the wrong impression, suggesting that the model was cut from a sheet of metal. The same fragment is shown in Text-fig. 9.

FIGS. 43-44. Two contiguous discs (counterparts) split asunder to show the tenon and mortise device. Fig. 44 shows the tenon, Fig. 43 the mortise. See p. 23.


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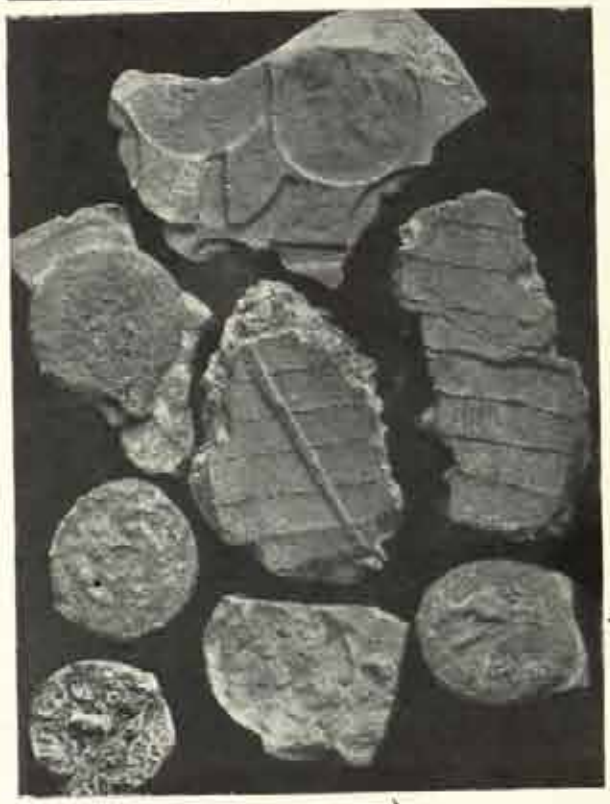
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6—44, ROHTAK.

K. N. K. & R. V. S. phot.

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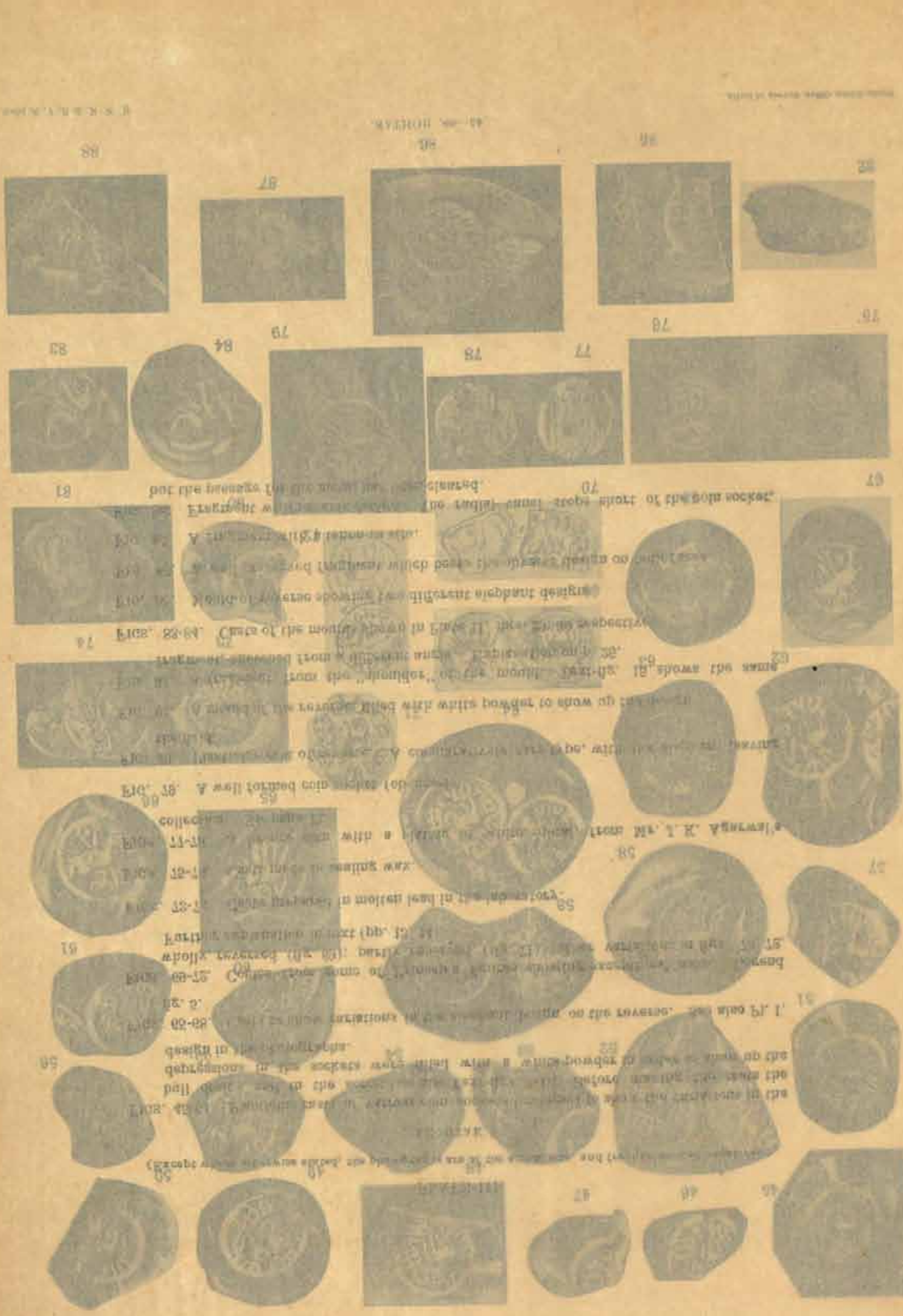

PLATE III.

(Except where otherwise stated, the photographs are of the actual size, and from untouched negatives.)

(ROHTAK.)

FIGS. 45-64. Plasticine casts of various coin sockets (obverse) to show the variations in the bull design and in the script (*see* also Text-figs. 3-4). Before making the casts the depressions in the sockets were filled with a white powder in order to show up the design in the photographs.

FIGS. 65-68. Casts to show variations in the elephant design on the reverse. See also Pl. I, fig. 5.

FIGS. 69-72. Copies from some of Prinsep's figures showing exceptional coins. Legend wholly reversed (fig. 69); partly reversed (fig. 71); other variations in figs. 70, 72. Further explanation in text (pp. 13, 14).

FIGS. 73-74. Casts prepared in molten lead in the laboratory.

FIGS. 75-76. Casts made in sealing wax.

FIGS. 77-78. A bronze coin with a plating of white metal, from Mr. J. K. Agarwal's collection. *See* page 11.

FIG. 79. A well formed coin socket (obverse).

FIG. 80. Plasticine cast of reverse. A comparatively rare type, with the elephant leaving the field.

FIG. 81. A mould of the reverse, filled with white powder to show up the design.

FIG. 82. A fragment from the "shoulder" of the mould. Text-fig. 15 shows the same fragment, sketched from a different angle. Explanation on p. 25.

FIGS. 83-84. Casts of the moulds shown in Plate II, figs. 29, 30 respectively.

FIG. 85. Mould of reverse showing two different elephant designs.

FIG. 86. A well preserved fragment which bears the obverse design on both faces.

FIG. 87. A fragment with a tenon *in situ*.

FIG. 88. Fragment with reverse design. The radial canal stops short of the coin socket, but the passage for the metal has been cleared.


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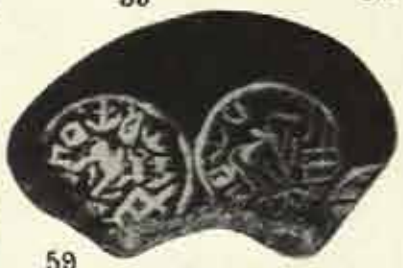
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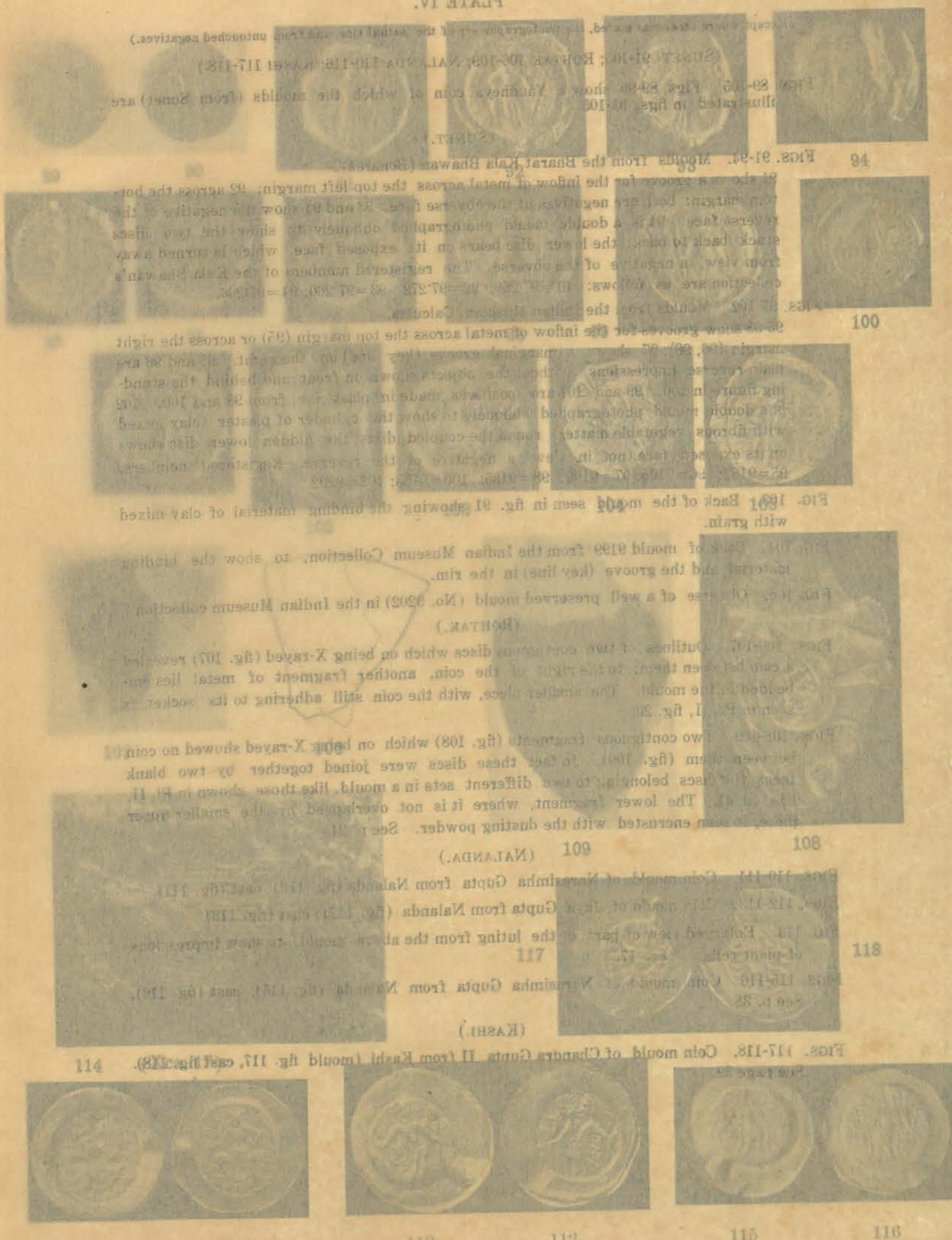
45—88. ROHTAK.

Photo.-Litho. Office, Survey of India.

K. N. K. & R. V. S. phot.



89—105, SUNET; 106—109, ROHTAK; 110—116, NALANDA; 117-118. KASHI.

R. V. S. phot.

PLATE IV.

(Except where otherwise stated, the photographs are of the actual size, and from untouched negatives.)

(SUNET 91-105; ROHTAK 106-109; NALANDA 110-116; KASHI 117-118.)

FIGS. 89-105. Figs 89-90 show a Yaudheya coin of which the moulds (from Sunet) are illustrated in figs. 91-105.

(SUNET.)

FIGS. 91-94. Moulds from the Bharat Kala Bhawan (Benares).
91 shows a groove for the inflow of metal across the top left margin; 92 across the bottom margin: both are negatives of the obverse face; 93 and 94 show the negative of the reverse face. 94 is a double mould photographed obliquely to show the two discs stuck back to back; the lower disc bears on its exposed face, which is turned away from view, a negative of the obverse. The registered numbers of the Kala Bhawan's collection are as follows: 91=97·269; 92=97·272; 93=97·260; 94=97·266.

FIGS. 95-102. Moulds from the Indian Museum, Calcutta.
95-98 show grooves for the inflow of metal across the top margin (95) or across the right margin (96, 98); 97 shows a marginal groove (key line) on the right. 95 and 96 are plain reverse impressions, without the objects shown in front and behind the standing figure in 100. 99 and 101 are positives made in plasticine from 98 and 100. 102 is a double mould photographed obliquely to show the cylinder of plaster (clay mixed with fibrous vegetable matter) round the coupled discs; the hidden lower disc shows on its exposed face (not in view) a negative of the reverse. Registered numbers, 95=9162; 96=9165; 97=9199; 98=9195; 100=9183; 102=9202.

FIG. 103. Back of the mould seen in fig. 91 showing the binding material of clay mixed with grain.

FIG. 104. Back of mould 9199 from the Indian Museum Collection, to show the binding material and the groove (key line) in the rim.

FIG. 105. Obverse of a well preserved mould (No. 9202) in the Indian Museum collection.

(ROHTAK.)

FIGS. 106-107. Outlines of two contiguous discs which on being X-rayed (fig. 107) revealed a coin between them; to the right of the coin, another fragment of metal lies embedded in the mould. The smaller piece, with the coin still adhering to its socket, is seen in Pl. II, fig. 20.

FIGS. 108-109. Two contiguous fragments (fig. 108) which on being X-rayed showed no coin between them (fig. 109). In fact these discs were joined together by two blank faces, the discs belonging to two different sets in a mould, like those shown in Pl. II, figs. 40, 41. The lower fragment, where it is not overlapped by the smaller upper piece, is seen encrusted with the dusting powder. See p. 24.

(NALANDA.)

FIGS. 110-111. Coin mould of Narasimha Gupta from Nalanda (fig. 110); cast (fig. 111).

FIGS. 112-113. Coin mould of Jaya Gupta from Nalanda (fig. 112); cast (fig. 113).

FIG. 114. Enlarged view of part of the luting from the above mould, to show impressions of plant cells. ×ca. 17.

FIGS. 115-116. Coin mould of Narasimha Gupta from Nalanda (fig. 115); cast (fig. 116). See p. 38.

(KASHI.)

FIGS. 117-118. Coin mould of Chandra Gupta II from Kashi (mould fig. 117, cast fig. 118). See page 39.

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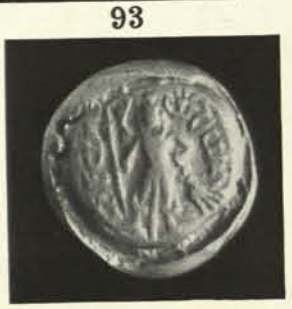

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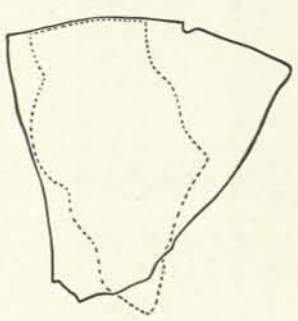

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114 (Xca. 17)

117 118

110 111

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89—105, SUNET; 106—109, ROHTAK; 110—116, NALANDA; 117-118, KASHI.

R. V. S. phot.

Photo.-Litho. Office, Survey of India.

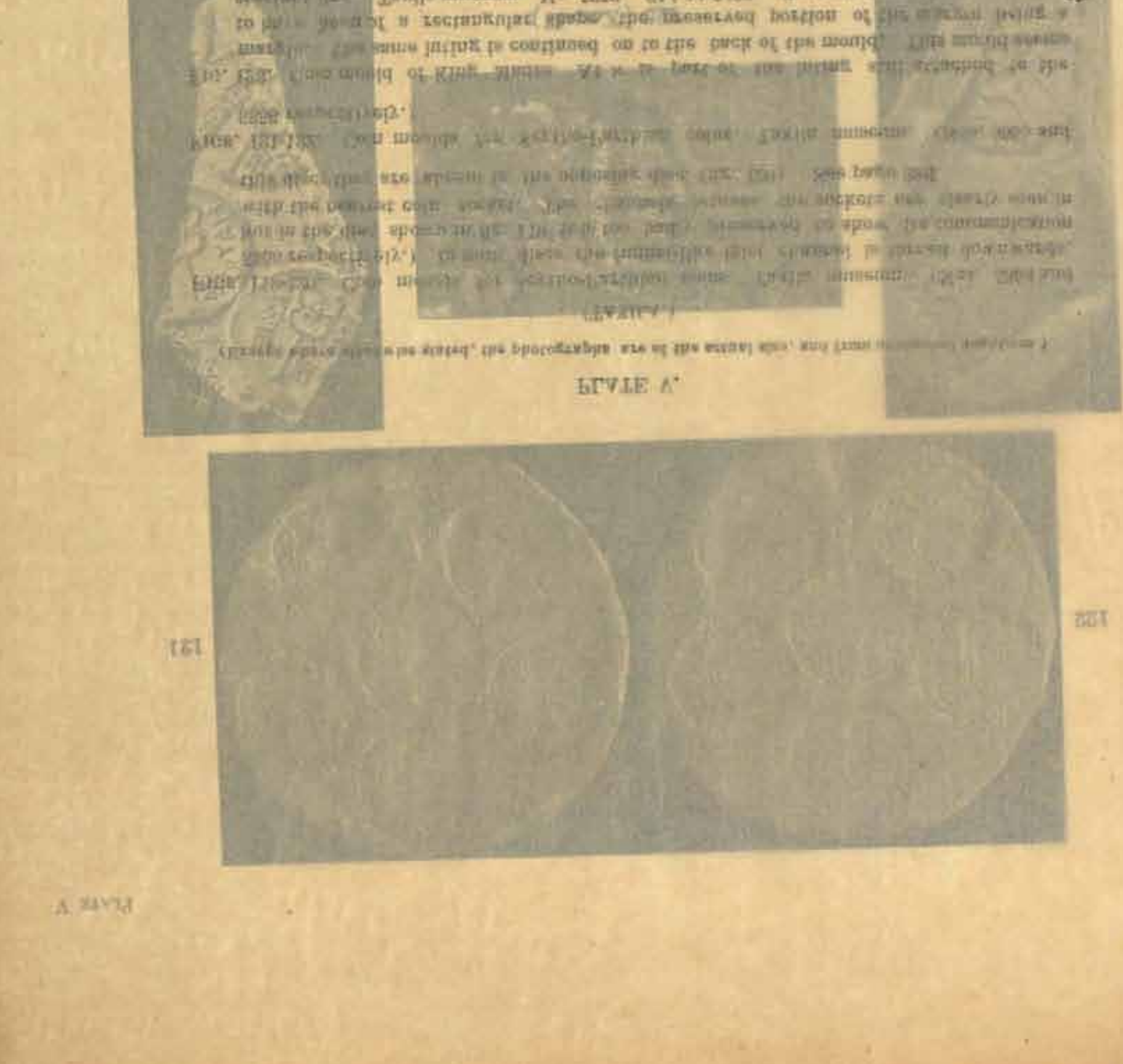

FIG. 131. Enlarged view of part of the lateral trace of the same mould, to show cell-outlines.

FIG. 132. Enlarged view of part of the lateral trace from the same mould, to show cell-outlines.

PLATE V.

(Except where otherwise stated, the photographs are of the actual size, and from untouched negatives.)

(TAXILA.)

FIGS. 119-120. Coin moulds for Scytho-Parthian coins. Taxila museum. (Nos. 5354 and 5353 respectively.) In both discs the funnel-like inlet channel is turned downwards, but in the disc shown in fig. 119 it is too badly preserved to show its communication with the nearest coin socket. The channels *between* the sockets are clearly seen in this disc; they are absent in the opposing disc. (fig. 120). See page 39ff.

FIGS. 121-122. Coin moulds for Scytho-Parthian coins. Taxila museum. (Nos. 5355 and 5356 respectively.)

FIG. 123. Coin mould of King Maues. At × is part of the luting still attached to the margin. The same luting is continued on to the back of the mould. This mould seems to have been of a rectangular shape, the preserved portion of the margin being a straight line. Taxila museum, No. 5352. Sk' 14-2406. *See* text page 42.

FIG. 124. Plasticine cast from the above mould [cf. Brown (1922) Plate III, fig. 4].

FIG. 125. Enlarged view of part of the luting from the same mould, to show cell-impressions of a cereal. ×*ca.* 17.

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125 (Xca: 17).

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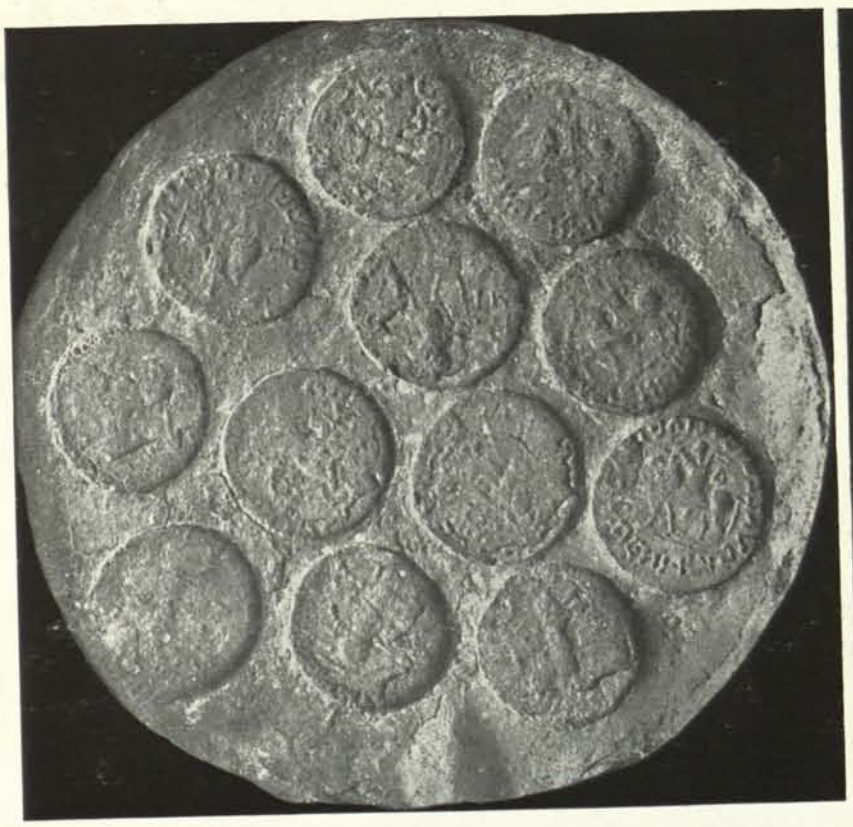

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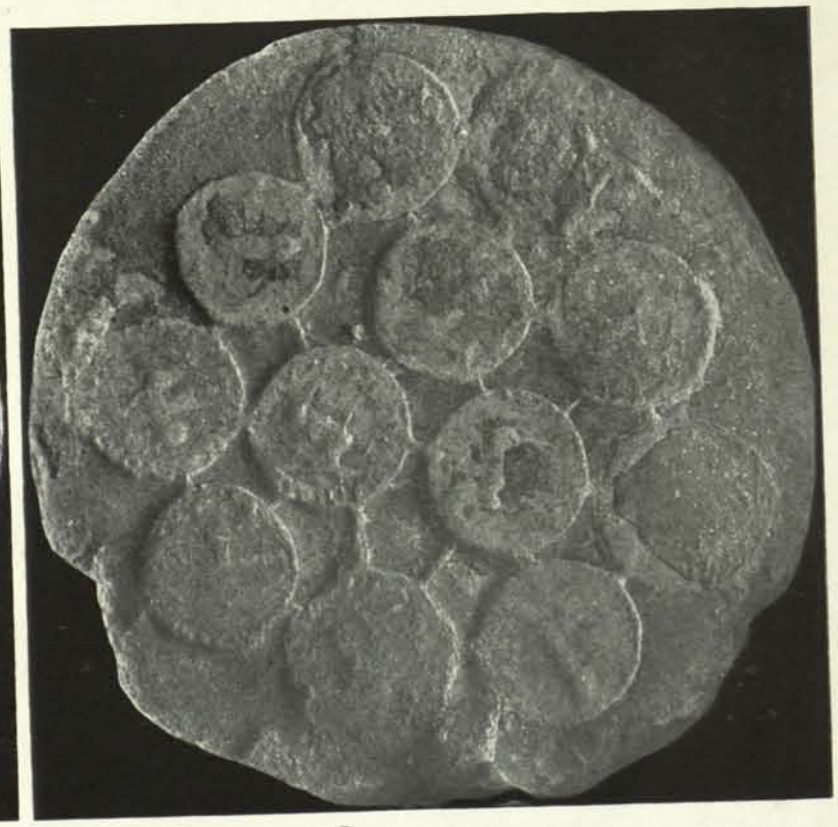

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119—125, TAXILA.

R. V. S. phot.

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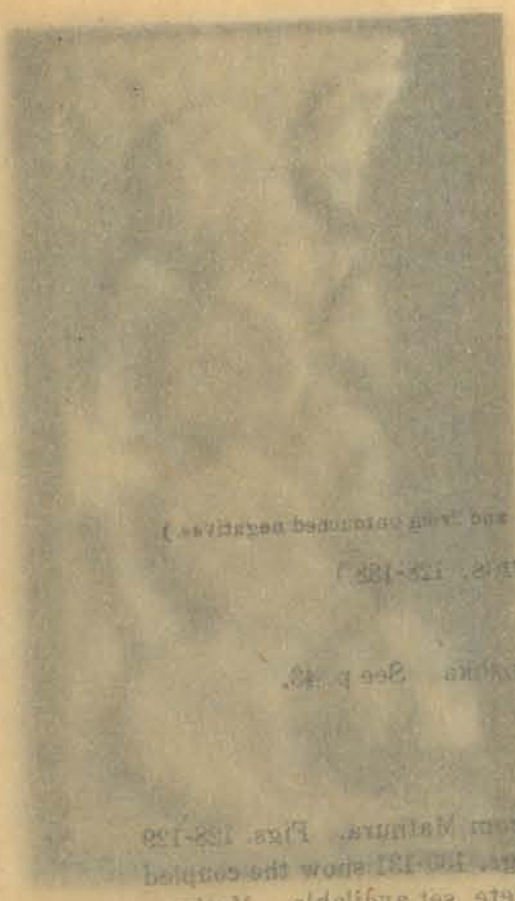

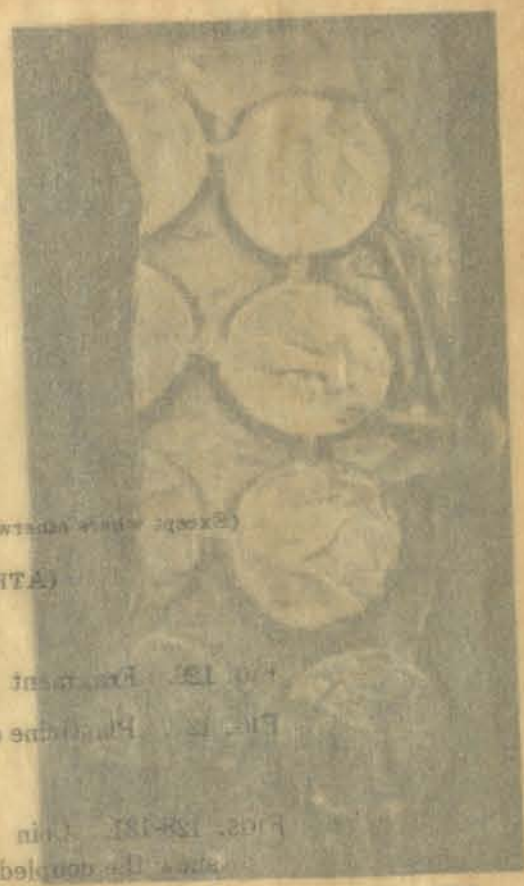

PLATE VI.

(Except where otherwise stated, the photographs are of the actual size, and from untouched negatives.)

(ATRANJI KHERA FIGS. 126-127; MATHURA FIGS. 128-138.)

ATRANJI KHERA.

FIG. 126. Fragment of a rectangular coin mould of King Huvishka See p. 43.

FIG. 127. Plasticine cast of the above.

MATHURA.

FIGS. 128-131. Coin moulds for forging punch-marked coins, from Mathura. Figs. 128-129 show the coupled faces A1 (obverse) and A2 (reverse); figs. 130-131 show the coupled faces A3 (obverse) and A4 (reverse), of the only complete set available. Mathura Museum. See p. 44.

FIG. 132. Blank face of disc F1. For explanation see pp. 44-45 and legend to text-fig. 23.

FIGS. 133-138. Casts from selected coin sockets in the Mathura moulds. Fig. 133 is from coin socket A3, 2; Fig. 134 is from F1, 2; Fig. 135 is from D1, 1; Fig. 136 is from A1, 5; Fig. 137 is from C3, 3 and Fig. 138 is from C3, 1.

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126-127. ATRANJI KHERA. 128—138. MATHURA

R. V. S. & K. N. K. phot.

Photo.-Litho. Office, Survey of India.

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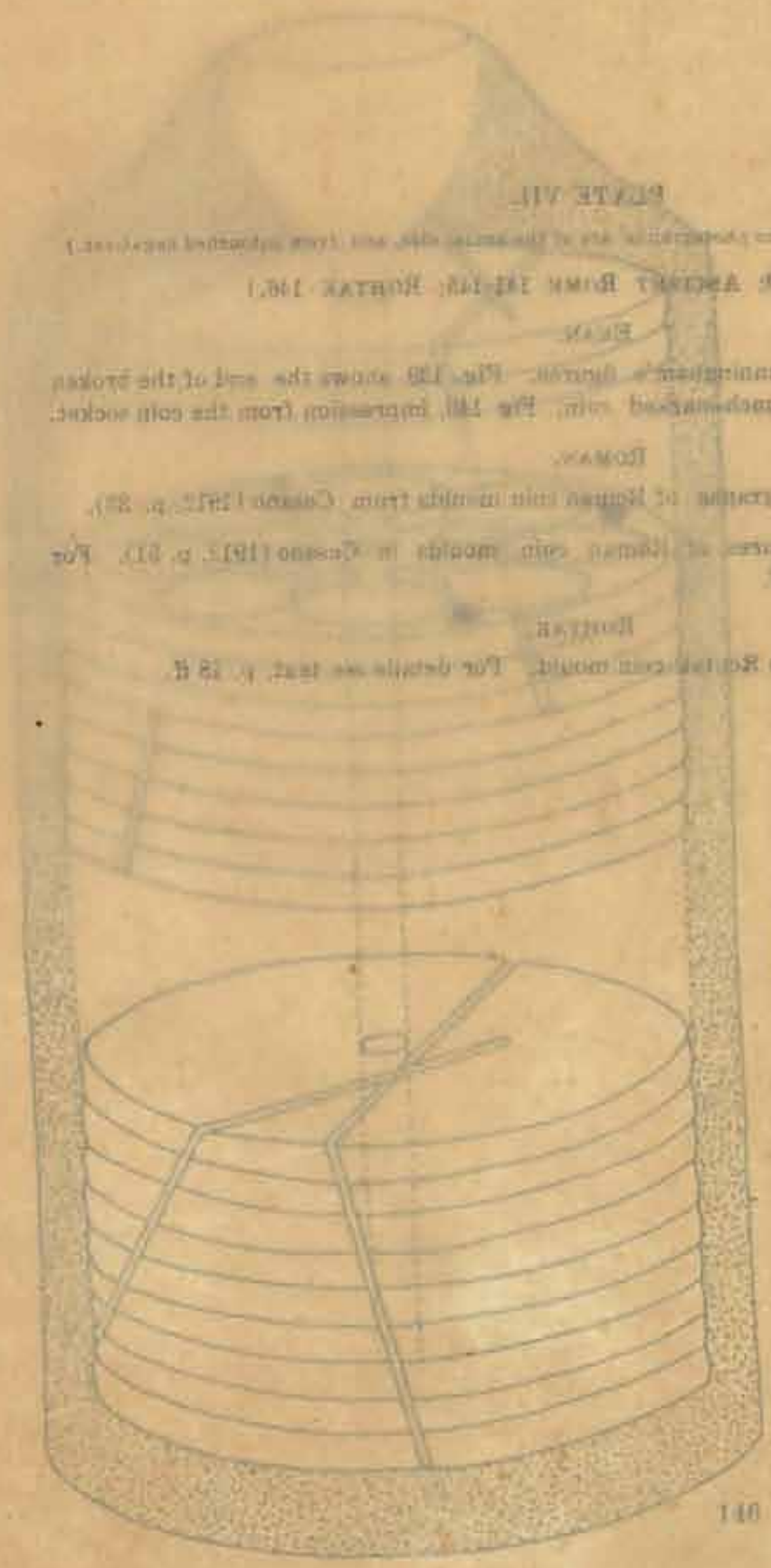

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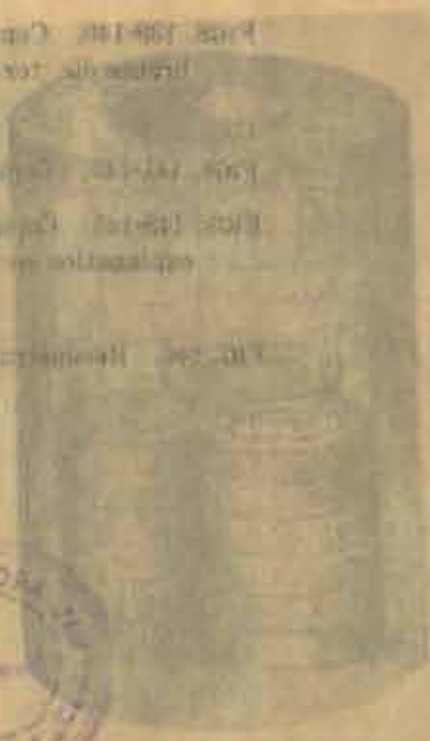

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PLATE VII.

(Except where otherwise stated, the photographs are of the actual size, and from untouched negatives.)

(ERAN 139-140; ANCIENT ROME 141-145; ROHTAK 146.)

ERAN.

FIGS. 139-140. Copies from Cunningham's figures. Fig. 139 shows the end of the broken bronze die for faking a punch-marked coin; Fig. 140, impression from the coin socket.

ROMAN.

FIGS. 141-142. Copies of photographs of Roman coin moulds from Cesano (1912, p. 33).

FIGS. 143-145. Copies from figures of Roman coin moulds in Cesano (1912, p. 51). For explanation *see* text, p. 50ff.

ROHTAK.

FIG. 146. Reconstruction of the Rohtak coin mould. For details *see* text, p. 18 ff.

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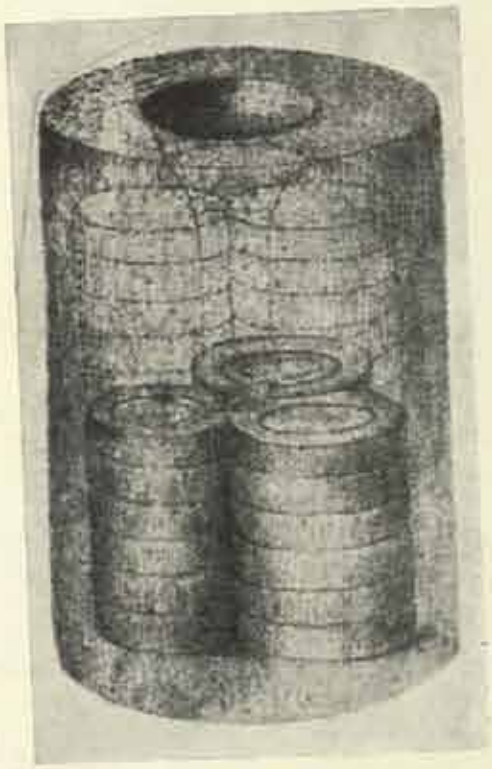

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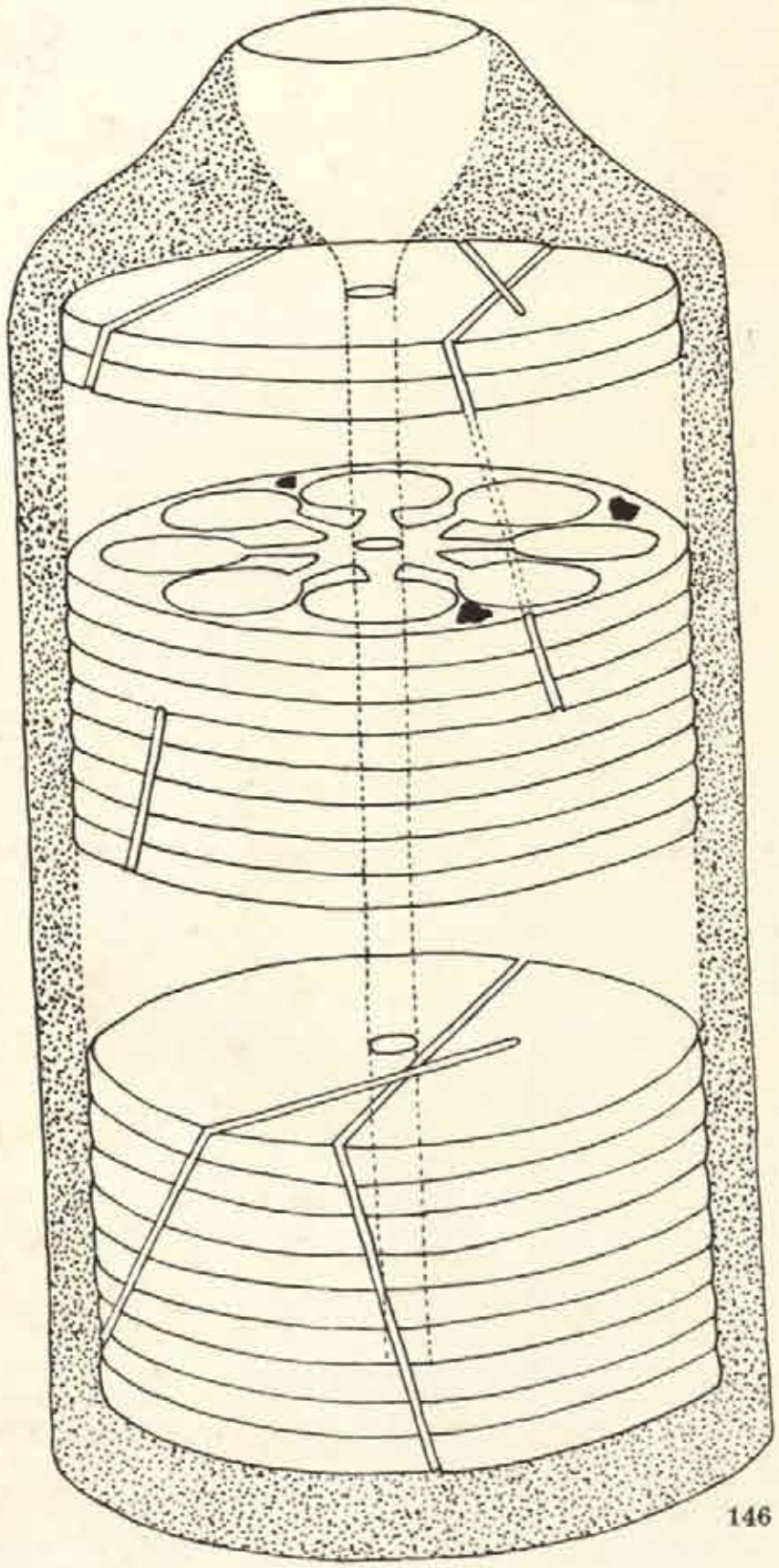

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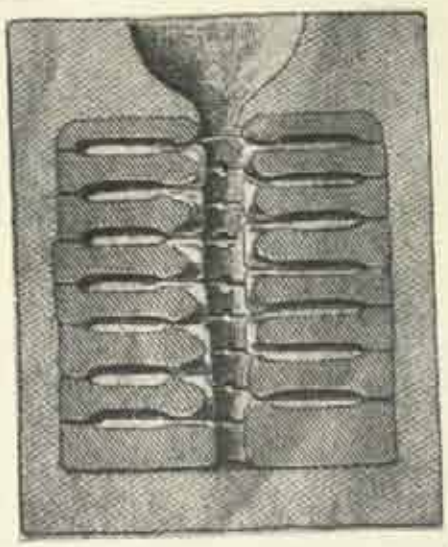

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139-140, ERAN; 141—145, ROMAN; 146, BOHTAK.

Fig. 146 B. S. & R. V. S. del.; photo-copies, R. V. S.

Photo.-Litho. Office, Survey of India.

Coins >< Casting