1. Preliminary Remarks

The second phase of urbanization which was started in the second half of the first millennium B.C. still continued in the Gupta period. The Amarakosa supplied the following words as synonyms all for urban centre or cities: pur, puri, nagari, pattana, putahedana, sthanuya and nigama. The text states main city and sub-urban centres as mūla-nagara and gākhā-nagara respectively. Kālidāsa states that nobody takes a gem to a village for assessment when a pattana (urban centre) is available. The Amarakosa mentioned the word nigama, which definitely meant a marketplace or merchant town. The Kāmasūtra of Vatsyayana also spoke of nagara, pattana and kharvats. We find mention in the Meghaduta that the village-women were interested only in the produce of their fields and contrasted
them with the sporative glances of the ladies of the town or city. In addition to this, few archaeological references may be mentioned here. Though majority of the urban centres with its monumental buildings, roads etc., were the continuation of the preceding periods, Maurya or of post-Maurya or Kuśāṇa heritage. A road of Kausambi had its origin in circa 300 B.C., and, after being repaired and reconstructed again and again, continued to circa A.D. 300. Similar evidence of a concrete road at Ahicchatra originating in cir. 200 B.C. and lasting upto A.D. 700 with successive rises in its levels or phases is recorded.

From the Gupta age onwards we do not have any celebrated city of a cosmopolitan character. In texts like the Periplus we find mention the names of ports and coastal market towns. These appear to have been big bazar rather than cities in the real sense of the term. Hiuen Tsang described almost all the Indian states of his age with their capitals giving the measurements of their area and the places of interest. But from his description it appears that these cities were administrative head-centres. There are many instances of kings establishing towns or cities after their own names, but most such cities became ruralised within short while.
There were so many factors that hindered the growth of urbanism proper. Some of the main reasons were caste-orientation and exclusive localised productive system. Constant internecine warfare among the states and foreign in roads were also responsible for obstructing the natural growth of the cities which was the existing political system. No kingdom or empire could have lasted for more than three or four generations. There was subdivision of the states, because the law of premogeniture could not always be followed. Struggles for succession created political fragmentation and with the emergence of the new dynasties the administrative centres were constantly shifted.

2. Technology of Potter's Craft.

Pottery was the most essential manufacture for every day life in the Gupta period. For the study of the pottery of this period we have to rely mainly on archaeological evidences. Potters of this period showed much efficiency and skill in moulding, colouring and burning pottery. Pots from Abicchatra were wheel made but moulded pots were also recovered. The most dominant
class of pottery of the Gupta period is called 'red ware'.

Archaeological excavations at Ahicchatra, Hastinapura and Kausambi indicates that the potters of the Gupta period had attained a high skill in baking earthen-ware. Some characteristic feature of the Gupta pottery found at Ahicchatra are as follows:

Wheel-made pots are predominant, but mould-made pots form a fair percentage. Most of the vessels are common red-wares with red or reddish slips. Vessels of special types are micadusted to impart a lustrous and metallic surface and mica is sometimes used as a wash on the decorated hands of mould made jars. Some specimens, not inconsiderable in number, show a polished red ground and are easily distinguishable from the rest by this peculiarity ... Decoration consists mostly of rectilinear or curvilinear geometrical patterns, spirals, zig-zags and pendants of various types. They are imported by mould or stamps or are incised with blunt points. The last device was a favourite method for emphasizing stamped designs.
The above mentioned account indicates that clay-vessels were produced both on the wheel as well as moulding. The use of mica for decoration, the manufacturing of various coloured polished and printing of various designs on jars or pots shows the potter's advanced techniques and excellence in artistic talent. We have numerous specimens of pots, terracotta objects, seals and beads recovered from Rajghat, Ahicchatra, Bhita, Basarh and other sites. These objects may be classified into three separate groups e.g., (a) utensils, (b) terracotta figurines and (c) seals and beads. The pottery includes cooking pots or jars of various shape, different categories of bowls, jars of various sizes, incense-burners, big and small jars (pitcher, for storing liquid like water etc.) a stand for a jar, a goblet, pot lids, a miniature kamandalu (a pot with a spout) with a curved handle on the top, a miniature bottle and a potter's mould. Majority of these objects and decorated with different kinds of patterns, such as rosettes, geometrical figures, bands of lotuses replacing with conches, running boar and elephant designs. Pottery of this period are of various shapes, such as round, ellipsoidal, flat-bottomed, open
at the top and receding at the bottom. The form of the water-pots or jars is that of a long-necked bottle with a bulging belly finished in red polish and furnished with an attractive animal projecting tube (spout). This indicates that decorated pottery had a great consumers demand.

In addition to this we have references to an unique specimen of jug recovered from Ahicchatra. This jug has projecting tube (spout), a loop-handle twisted in imitation of rope, a polished black base and a black core.

To quote Ghose and Panigrahi:

All the characteristics of the jar are alien to the indigenous potter’s craft and suggest that the vessel was an importation, probably from the direction of the Mediterranean.

Likewise, the pottery objects discovered from Kausambi are also of high standard. Pottery of various categories found are bowls, dishes, bowl-cum-basins with ridges and prominent grooves, dish on a stand, and other vessels of numerous shapes. In a rare cases, the rim and the outer side are painted with designs black. The potters made the vessels on a wheel which revolved
gradually and baked them in an inverted position at a low temperature. Few of the vessels from Kausambi shows their Harappan parentage in manufacturing.

A close examination of the pottery object discovered from excavated sites would indicate that the pot on which the paintings were to be executed, was fully dried in sunlight and at shady place. It was then treated with a wash or slip, burnished, as necessary with a brush using black or any other implement. The object could be painted before and after firing. Besides stamping, making incisions, moulding and applique designs were usually executed on the object when it was off the wheel. Technicians prepared their own stamps bearing various designs and motifs. Stamps of these categories were seen in negative and when the object was stamped, the positive impression appeared before it. Powder-like material such as pounded clay, ash, mica or sand were used to bring it clear impression, otherwise the stamp could not be detached without damaging the object. Such technical perfection indicate the potter's high standard of the time.
Besides clay-vessels, the finding of terracotta figurines from Ahicchatra, Sravasti (Saheth-Maheth), Kosam (Kausambi), Bhitargaon, Bhta and Rajghat in Uttar Pradesh; Sahri Bahlol in the Punjab; Bikanir in Rajasthan; Mirpurkhas in Sind (now in Pakistan); Basarh in Bihar, and Mahasthan (now in Bangladesh), Tamluk and Bangarh in West Bengal shed further light on the highly developed pottery industry. Terracotta figurines were made for the common, and considerable importance was attached to it from the economic and religious points of view. Skilled workers, through the medium of clay, manufactured wonderful terracotta figurines that were highly praised and demanded by common mass. Besides usual types, terracotta now came to be employed in architectural decoration. Apart from the introduction of new structural materials in the field of architecture there started an increased activity in brick making, and the scope of terracotta art was usually broadened.

Architectural pieces like bricks and tiles, with vegetal, human and animal motifs have unearthed from Bikanir (Rajasthan), Mirpurkhas (Sind, now in Pakistan), Sravasti and Bhitargaon (U.P.), Mahasthan (now in Bangladesh), and other places. For making of these carved bricks and tiles, the methods of carving and moulding
was used by the craftsmen/artists. The common mass used to decorate their drawing or sleeping-rooms with terracotta objects which represented amorous scenes and beauty. On ceremonial occasions the demand for terracotta objects increased. Likewise, the high class of people needed them for decorative purposes. Thus in the marriage of Rājyaśri, the king invited innumerable modellers for moulding clay figures of crocodiles, tortoises, fishes, plantains and other objects. Furthermore, the terracotta figures of the gods and goddesses also served the interest of the religious people of the time and even the common mass could easily buy them at a cheaper value than any metallic or stone objects. Terracotta figurines were also manufactured for the children. Kālidāsa refers to a very beautiful clay peacock, which was offered to Bharata in the Sakuntalam. In Mrichahaka-tika we find reference to a clay-toy-cart used for the children.

Besides above mentioned clay objects, other important pottery such as earthen beads, necklaces and earrings have been reported from Ahicchatra. The discovery of baked bricks in most of the excavations gives some idea on the potters craft of the time. So, it
appears that pottery craft played an important role in the civic, religious and economic life of the people during the period under review.

3. Textiles and Weaving Technology

The literary sources of our period mention a large variety of our clothing materials. These are cotton, silk, wool and linen as well as of barks of plants. These data are corroborated by the commentary of contemporary authors in the sixth-seventh century. Besides, some words connected with the textiles and weaving technology i.e., woven, the weaver's loom, the threads and the processes involved in weaving, are referred to by Amarakosa. Two types of clothes were manufactured, one for the aristocrats and other for the down-trodden or common mass. It is said that the quality of cloth was so high that it could be blown away by breathing on it. Yuan Chwang's (who visited India in the 7th century A.D.) description may be cited here. He states that:

The names of their clothing materials, are Kiao-Shey (kauseya) and muslin (tieh) and calico (Pu), Kauseya being silk from a wild silk-worm;
Ch-U(or chu) mo (Ksauma), a kind of linen; Han(or Kan) — polo (Kambala), a texture of fine wool (sheep's wood or goats hair) and Ho-la-li, a texture made from the wool of a wild animal — this wool being fine and soft and easily spun and woven is prized as a material for clothing. In north India where the climate is very cold, closely fitting jackets are somewhat like those of the Tartars (Hu).

Bāṇabhatta, the celebrated author of Harsacarita, also refers to few kinds of fine cloth, manufactured in this period.

With the advance of the textile and weaving industry an usual evolution took place in costumes during the period under review. At the beginning the dress of men and women was very simple. But from the Kusana period onwards it become more and more sophisticated. Yet, it is usually said that "the cut and sewn garments were unknown in ancient India, and that is true as far as the testimony of the early sculpture at Bhārūt and Sāñci goes. It is not true of Ajanta." Hamsavega, a messenger, is described as wrapping an umbrella in a wrapper of white
bark-silk. The male servants portraited in the Ajanta Caves, are depicted as weaving a loose coarse cloth.

A careful examination of the Ajanta frescoes has revealed four separate weaving methods, i.e., gold or silver brocade, "tie and dye work", weaving after separate dying of the warp and the woof, and the spotted muslin. Mention may be made here of the famous centres of the textiles industry from the records of this period.

Santideva's Śīkṣā-samuchehhva (a text of the seventh century) informs us that 3anaras (Varanasi) retained its traditional reputation as the producer of the best silk garments. Corroborative reference are to be found in the Harsacarita, which refers to the 3aumā cloth of the Pundra country was well known to find its way into the authors village home. Hiuen Taang refers to a fine striped variety of cotton cloth in his time. Besides the silk industry was very developed technically, and we find silk woven with a fine pattern of the figures of swans; some fine fabrics also imported from China to meet the demand of the upper class of society. Red silken garments were worn by upper-class beautiful ladies. In Mṛcchakatika, Vasantasena is described as wearing a red silken cloth with the skirts blowing in the air. Few
youths belonging to upper class families, also used to put on silken shirts. The brother of Vasantasena is described as putting on a silken cloak. From the evidence of silk-weaver’s organisation of Mandasor it appears that many workers would employed in silk manufacturing industry.

Details of silk-weaving technique are referred to in the Amarakosa. Silk threads were prepared from the cocoon (coco shell an envelop often largely of silk which an insect larva forms about itself and in which it passes the pupa stage) and they were woven into fine fabric, which afterwards bleached. The method of separating the fabric is nowhere mentioned. Besides, dyeing and embroidery were developed. From a careful examination of the Ajanta Paintings of the Gupta period we find some well defined coloured designs and embroidery of the garments. Apart from embroideries, at least four surviving techniques have been identified: (i) bandhana or ordinary tie-and-dye work, (ii) double tied-resist dyeing in which warp and woof are dyed separately before weaving according to the pattern required, (iii) brocading and (iv) fine muslin weaving. The dukulam mentioned by Kālidāsa had white impressions of swans distinctly on a blue background to imitate the flight of birds in the wind. It is possible that the figures were sketched
in with wax and then dyed in an indigo vat. S.K. Maity thinks that these figures either painted or embroidered, and in these background dukulam may reasonably indicate fine silk garments.

Bānabhatta refers to a particular method of cloth-dyeing, popularly known as 'tie and die'. He mentions the term bahu-vidha-bhakti, an art in which household women were proficient. Evidence of printing of the designs of leaves and flowers on cloth can be found in the Harṣacharita. The word kutilakramarupapallavaprabha which is compound of four technical terms: (i) kutilakrama, (ii) rupa, (iii) palla and (iv) parabhāga. The above mentioned technical term indicate the proficient worker in this industry of the period under review.

Apart from cotton and silk, the textile-workers manufactured garments from wool and fur. After the necessary carding and cleaning of these two materials, the weavers made warm garments and blankets for the winter season. Likewise, both woollen blankets and furs were jointly used for decorating and covering the chariots. Besides manufacturing clothes from wool, blankets were
also made from the hair of animals. It appears that blankets made of the fur of a deer, or a ram, and of hare were generally used by the aristocrats. Ancient Smriti writers like Narada also refers to blankets made of hair. Enumerating a procession of images in Pataliputra (Patna). Fa-Hien also refers to the seven-storyed chariot, covered with a cloth made of hair. He observes "white and silk-like cloth of hair is wrapped all round it, which is then pointed in various colours."

4. **Leather Industry**

As regards the leather industry the Amarakosa has synonyms for leather-fan, leather bottle for containing oil, leather shoes and boots. Representation of human or divine figures in leather boots and shoes are found in contemporary sculptures and paintings. The Amarakosa refers to leather worker and his knife, with which he manufactured hugely of leather articles such as shoes, leather-fans thongs and whips, bellows, leather-bottles and so on. The above account no doubt shows that leather articles were manufactured on a large scale to meet the
demand of the people. We find in the Ajanta paintings, that some human beings are depicted as wearing shoes and boots.

Likewise, the skins of tigers, deer and other animals were commonly used by ascetics and general people as well. Leather was used for bedding purposes also. Corroborative references to the leather industry are to be found in the contemporary inscriptive sources also. It appears that the leather industry was the monopoly of the State. Even after donating the lands, the government reserved the right to the hides in its own hands. The Chammak copper-plate inscription and the Siwani copper-plate inscription of Maharaja Pravarasena II, clearly indicate the state right to reserve hides at its own hands. The above evidences show that it was through a state trading machinery that individual leather-workers and big merchants received leather for manufacturing purposes.

5. *Ivory Industry*

The ivory industry was also in vogue during the Gupta period. The raw materials were collected both from
living and dead elephants as well. Generally it is manufactured into luxurious articles for the aristocratic section of society.

As regards ivory works repeated references are found in the literary texts of the time, to the use of this material by the masses for a variety of purposes. The manufacturing of ornaments from ivory is one of the sixty four arts to be mastered by a Nagaraka according to Vātsyāyana. Apart from ornaments, pegs in the houses of Nagarakas, for hanging articles, were made of ivory.

Corroborative archaeological evidence throws further light on the ivory-works of the Gupta period. An ivory seal, discovered from the excavated site at Bhita and dated cir. 4th-5th century A.D., tell about the presence of this industry during the period under review. The beautifully inscribed surface of the seal, the surrounding by a headline and the device of a crawling tortoise, show that this is an excellent craftsmanship of the ivory-workers of the time. We find mentions in the Ranchyamśa that seals made of ivory were manufactured in large number.
An idea of the technique of ancient Indian ivory-carving is also available from a notable evidence of a Buddha image from Kashmir. The figure stylistically belonging to the Gupta period was carved in deep relief. Traces of chisel signs on the reverse indicate that a piece of the required size was hewn and sawn out from the tusk, and later it was levelled. The technical knowhow indicates the good craftsmanship of the time.

6. Working in Wood, Bamboo and Cane

The techniques of wood-carving have been practised in India since a long time. In constructing places, temples and individual houses, wood was the chief materials used. Though these were mostly constructed in perishable wood, little remains to comment of its antiquity. The technique of wood-carving finds mention in the ancient literary texts. It is mentioned in the Kāmagūṭra as one of the sixty-four arts. In the description of a house, inhabited by a Nagaraka, the text prescribes a separate compartment in the lonely part of the home, to be fully reserved for wood-workings or wood-industry. The above evidence clearly suggests
that beside professional wood-carvers, wood-carving was popular as a cottage industry.

However, the *Amarakosa* does not mention any more about the skill of the craftsmen, but gives a somewhat detailed account about the division of carpenters and their manufacturing tools and apparatus. The text mention two kinds of carpenters i.e., those hired by the villagers and those who carried on their industry freely. In the industry, there was a *sthāpati* (i.e., the head-carpenter), under whose guidance many other craftsmen done their work. The text also mention carpenter's tools which were a chisel, saw, and work-bench.

Apart from manufacturing furniture and other articles of daily use, the craftsmen would made large images of wood. Fa-Hien observes that the people of Darel, on the western bank of the Indus, worshipped an image of Lord Buddha which was eighty feet high, the folding legs of this image measured eight feet across.

It would not possible for a ordinary carpenter, certainly done by a master craftsman. It is possible that much of the carving have been done by free hand
assisted, by rough outlines drawn on wood. Even a stencil would only give the outlines, while relief carving as well as low and deep undercutting used to depend on the skill of the craftsmen. The craftsmen translated the shape in his imagination into perfect form in wood with extraordinary deftness. Furthermore, before beginning his job, he had in his mind clear preconception or image of the final shape of the object.

Besides this, timber, bamboos and canes were used for building materials and for household furniture. The Kāmasūtra includes the manufacturing of chairs from cane and reeds among the 64 arts. Vetrasana (cane-chairs) were offered to guests to sit on. Baskets were also manufactured out of canes and bamboos to meet the demand of the people. According to Fa-Hien, bamboo was commonly used for making carts, to be taken in queues on festive occasions. He observes:

Regularly every year, on the eighth day of the second-moon, they have a procession of images. They made a four-wheeled car of five storeyed by lashing together bamboos, and these storeys are
supported by posts in the form of crescent-bladed halberds. The car is over twenty feet in height, and in form like a pagoda; and it is draped with a kind of white Kashmere which is painted in various colours.

The review of working in wood, bamboo and cane bears ample testimony to the fact that the craftsmen made a great contribution to the economic development of the country through their highly developed skills, techniques and proficiency.

7. **Technology Some of the Stone Images**

During the Gupta period, plastic art reached a stage of beauty and perfection, it never had before. A style was developed which contained the various elements of earlier Indian art traditions, eliminating or modifying features which suggested foreign origin. The craftsmen guided by a sublime idealism and carved images full of charm and dignity, shining upon a spiritual delightfulness or pleasure. A complete balance was contained between the realisation of the form as a plastic mass and the
severe exquisition and perfection in the carving of ornamental accessories. The craftsman introduced adornment to hide the charm of the flesh. The sculpture indicates delicate excellency of execution and a high degree of skill possessed by its craftsman. "All Gupta sculpture is marked by a finished mastery in execution and majestic serenity in expression that have seldom been equalled in any other school of art." Although some of the important foreign invaders, yet whatever has survived represents the greatest masterpieces.

Gupta sculptures reveals the high accomplishment and depth of human insight of the craftsman. The Gupta art is at its best both in Buddhist and Hindu images. The Buddha image reached its highest degree of excellency, both at Sarnath and at Mathura. The main characteristic feature of the sculpture of the period is the outward expression of internal dreams. The figure of Buddha at Mathura standing in benigh majesty is in abhava mūdra (asking the universe not to fear). Besides, the Saranath Buddha, represents the Master, enthroned and expounding his doctins, while a group of disciples at his feet, are shown as worshipping the wheel of Law.
The expression of an inner serenity and an outer comparsion, the restraint and repose of the vibrant body and the divinely-lit smile on the face are executed with such mastery and skill that it stands most unquestionably as on of the noblest and the finest works of art.

The beautiful head of the Buddha in the National Museum, New Delhi, has the same calm repose as the Buddha from Sarnath. A similar severity of expression can be traced to the image of Buddha, discovered at Mankuan in karchana Tahsil, Allahabad district and dedicated in A.D. 448-449 in the reign of Kumara Gupta I. In these master-pieces, the art of the time found its highest degree of perfection.

The Gupta period saw the revival of Brahmanism which found full revelation in the art working of Brahmanical divinities. An excellent Visnu image from Mathura is a superb example. The face reveals a severe spiritual delicacy. Cave temples in the Udayagiri hills, one of which bears an inscription of 401 A.D. has some vigorous sculptures showing the incarnation of Lord Visnu as Varaha and also female deities, Ganga and
Yamuna. Not a from Udayagiri at Pathari, is a temple which has a large and heavy relief on the birth time of Krishna revealing the new born lying by the side of his mother watched by five accompanions. It is recognized by the art historians as one of the finest Indian art of forming figures in relief.

The Gupta art style attained its culmination in a temple at Deogarh in the Jhansi district of early 6th A.D. It is adorned with good sculptures, full of voluptuous grace and simple linear movement. The technical perfection observed by Percy Brown as follows: "Few monuments can show such a high level of workmanship, combined with ripeness and rich refinement in its sculptural effect as the Gupta temple at Deogarh." Some of the panels in the temple representing Nanda and Yasoda, Balaram and Krishna, Devaki and Krishna and Vasudeva and Krishna. All are shining with joy at the miracle. Likewise, the serenity of the face in the Eka-mukha-linga in the ruined temple, on the road from Kho to Parasamania, in Nagod state, is the finest evidence of the sculptures in the Gupta period.

Inscriptions assigned to the period Chandra Gupta II, Kumaragupta I and Skanda Gupta have been traced in a
temple at Garwal in Allahabad district which is adorned with beautiful sculptures. The reliefs are refined and vigorous. Cunningham enumerates them thus:

The undulating stem of a creeper, with large curling and intertwining leaves and small human figures, both male and female, climbing up the stem, or sitting on the leaves in various attitudes. The whole scroll is deeply sunk and very clearly and carefully carved; and is one of the most pleasing and graceful specimen of Indian architectural ornament.

Likewise, some images, found in some caves like Virasena’s cave and the Sanakanika cave, belonging certainly to the reign of Chandragupta II, suggests that the art of stone-carving had reached the peak of excellency of the time.

Apart from the Guptas, the Vākātaka of northern Deccan also were great patrons of art and are associated with Ajanta caves of the fifth and sixth centuries. An inscription in cave No. 16 refers to the name of Varaha deva, the minister of Vākātaka king Hariṣena (cir. A.D. 475-500). The images of Ajanta have the characteristics of Gupta art. These are of considerable dignity and high
The temptation scene of Lord Buddha is executed in a masterly form. The sculpture of the Buddha's Mahāparinirvāṇa depicts Buddha reclining on his right side on a conch. His face indicates calmness and serenity. The plastic art reached the peak of perfection in these sculptures. The images carved at Ellora and Elephanta are of extreme beauty. To quote Shanti Swarup:

For reliefs high and low, for sculpture in the round, for impressive individual figures, for arabesques, as well as for architectural renderings in sculpture, Ajanta offers some of the best example of advanced craftsmanship. The post of Buddha's images, the figures of disciples and monks, kings and queens, birds and animals, have all been carved with rare artistic skill.

The foregoing passages reveals that the technique of plastic art had attained a high standard during the period under review.
8. **Metal Technology of the Gupta Period**

The mineral wealth and the reserve forests were the absolute monopoly of the state, as we come across from the Poona and the Riddhapur plates of Prabhavatigupta, who donated lands, except mines. This evidence is also supported by the record of the Siwani and Chammaka copper plates of Pravarasena II. The extensive regions of South Bihar are the main sources of metallic ores in north India. Gold occurs in two forms: (1) As 'placer' metal (alluvial or detrital gold) it is found in the auriferous sands and gravels on a large number of rivers which pass over auriferous rocks, as in Madhya Pradesh, Maharashtra, Bihar (especially in the districts of Singhbhum and Manbhum and the valleys of the Suvarnarekha river); (ii) Important sources of gold in the form of quartz veins or reefs are the Kokar gold mines which produce 99% of India's gold output. In addition, the Hutti gold mines in the district of Raichur, Ramagiri area in the district Anantapur and Wynaad area in the district Nilgiri also deserve mention. Likewise, the remains of stone implement in the dumps indicate that the extraction of copper was carried out with their assistance.
The existence of mines is referred to in the accounts of Kalidasa and Amarakosa. The Amarakosa furnished a long list of metals, including gold, silver, copper, iron, brass, lead and tin. So, it appears that the art of metal working was enormously advanced in the Gupta period. The Kāmasūtra of Vatsyayana also refers to metal-works in the sixty-four arts. Brhaspati mention the workers in various metals like gold, silver, and base metals.

Among all the metals, iron was the most valuable in daily use. But the archaeological data for the iron technology in the Gupta period is very scanty, possibly due to the tropical climate they corrode very quickly. Furthermore, iron materials has been found entirely corroborates out literary evidence, since archaeology has produced implements similar to those described in different texts. The blacksmiths as one of the most indispensible workers in the rural areas. Kalidasa has thrown some light on the blacksmith activities, as to how by heating and beating a piece of iron with a steel hammer, he used to manufacture various objects of metals. He manufactured spades, sickles, ploughshares, chairs,
iron plates and pans, swords and other iron weapons.
The discovery of so many iron objects of the Gupta period are hammers, different categories of chisel, axe, a padlock, a plate of iron with holes, a door ring, a spoon, a dagger, a hatchet and a small iron pot.

Gupta iron technology excelled in foregoing enormous masses of iron into huge pillars and large beams showing high resistance to corrosion. The classical example is the celebrated 4th century iron pillar at Mehrauli in Delhi, belonging to the period of Chandragupta II, testifies again to the excellent craftsmanship in iron work. Its dimensions are: length 7.20 m, above ground 6.70 m, under ground 0.50 m, upper diameter 0.30 m, lower diameter 0.40 m. the total estimated weight is over 6096 kg. Its percentage chemical composition is: iron 99.768; carbon 0.23; silicon 0.026; phosphorus 0.180; manganese nil; sulphur, trace; and nitrogen 0.065. The specific gravity is 7.747 and the metal is wrought iron. The pillar is believe to be made by successively forge-welding-blooms of wrought iron. The corrosion resistance of this pillar has been an enigma to scientists. It is generally
ascribed to: (i) the purity of iron, high phosphorus, low sulphur and absence of manganese; (ii) cinder coating formed on the surface and better conditions in the surface roughness; (iii) better forge-welding; and (iv) drier and uncontaminated atmospheric conditions.

Iron-workers, besides supplying tools to cultivators, gardeners, carpenters, wood-cutters and grass mowers, manufactured different kinds of weapons for warfare. The mention of various war-implements in the Allahabad stone pillar Inscription of Samudragupta indicate the highly sophisticated craftsmanship of the time.

Besides, the goldsmiths were mostly confined to the urban centres and meet the demand of the aristocrat. That the society of the Gupta age was very fond of ornaments is proved by the literary evidence, contemporary epigraphs and the account of the foreign travellers of the period. The Mudrārāksasa refers to Viṣṇudāsa who was a prominent jeweller in the city of Kusumapura. Their work were excellent one, and, at least in this period they knew their art very well. In the Kāmasūtra, some technical terms such as rūparatnaparikṣa (testing and valuing of precious stones etc.), dhatuvāda (combination
and purification of metals) and maniragakarajnanam
(knowledge of precious stones) etc., are included in his
sixty four arts. The references to chudamani, muktacuna,
kirita, karnabhusana, mutavali, tarahara, angada,
etc., show that gold ornaments were manufactured on a
large scale in the Gupta period.

The custom of wearing ornaments was not only in
vogue among the women but men too equally decorated them­
selves with ornaments. Yuan Chwang observed that:

The dress and ornaments of the kind and grace
are very extraordinary. Garlands and tiaras with
precious stones are their head ornaments; and
their bodies are adorned with rings, bracelets,
necklaces. Wealthy mercantile people have only
bracelets. They bore their ears ... such are
they in outward appearance.

These references clearly indicate that gold-made articles
were popular.

The working of other metals such as silver, copper,
bronze and brass was also in vogue during the period under
review. Apart from iron, copper was probably the most
precious metal at that time, as described in the *Amarakosa*. Copper and bronze were mainly used for making statues and household articles. Beautiful statues were made of bronze have been excavated by the archaeologist—such as a seated Buddha made in bronze from U.P. standing Buddha in bronze from Bihar (by cast process), and from Bhita near Allahabad, one standing female figure of copper, a cup of copper, one circular lid of copper, one cooking pot (handi) of beaten copper, and two bangles of copper. Marshall thinks that the above articles were manufactured in most cases by casting, but few of the objects were hammered after heating.

The real development of the *cire-perdue* process took place during this period. Of the solid and hollow cast bronze and copper images discovered from Mathura, Sarnath and some other regions of eastern, northern and western India, special mention may be made of the Sultan-ganj - Buddha which is considered to be the most noteworthy and excellent bronze image of the period. The image:

Was cast in pure copper in two layers which are clearly visible and the inner layer was moulded on an earthy, cinder-like core composed of a
mixture of sand, clay, charcoal and paddy husk. The segments of this inner layer were held together by corroded iron bands originally three-quarters of an inch-thick. The outer layer of copper seems to have been cast over the inner one, presumably by cire-perdue process.

Likewise another bronze find of the Gupta period is the unique Buddha figure, previously belonging to the Boman Behran collection, Bombay. The image with its virile and bold characteristics of the usual classical idiom is remarkable for its proportions and spontaneous gracefulness. Another notable bronze figure of this period is the Brahma from Mirpurkhas in Sind, now preserved in the Lahore Museum, Pakistan. This shows the high craftsmanship of the Gupta period in the 5th century A.D. Metal figures of Brahma in bronze are very scarce and this is not only important from that point of view, but also as a rare work of Gupta sculpture in metal.

Besides, the Agnipurāṇa and the Matsyapurāṇa of the Gupta period gives detailed description the technique of casting bronze images. Likewise the earliest Śilpaśāstra that enumerates the lost-was process is the
Madhuchchnishtavidhānam as recorded in the 68th chapter of the Mānasāra believed to have been compiled in this period. The techniques as laid down in this treatise as follows: The proposed image should also be completely visualised and realized in the mind of the sthāpati through contemplation until it is finally ready to be modelled in the 'prepared wax' according to the instruction of the chief sthāpati. When the wax image is completed it should be purified with the five powder pigments (Pancha-varaṇa). In preparing the wax models of the images, at the jointures of the component parts of the body they should be reinforced (before being covered by the clay mould) with copper rods or nails; and although the wax model will melt away (during furring) there should be no objection to using those supports (since they can be chiselled off after the murti (image) is cast). The finished wax model of the idol should then be taken in procession to the sthāpati's foundry or workshop to be cast. The chief sthāpati must first calculate what allowances should be made for the constraction or expansion of the wax model (during casting of it) and enlarge it accordingly by adding wax to the extent necessary. The wax model is then ready to be covered with layers of mud.
(moulding sand) and (when dry) must be heated and thereby the wax expelled. After casting, the mould should be sprinkled with water to cool it so that it (the cast iron) may be removed after it is broken open.

Another text namely the Uttarabhāga of Śilparatna definitely belonging to this period also contains valuable information about the image making by both solid and hollow casting methods. The first chapter of text deals with the process of preparing the clay, while the second chapter deals with the methods of casting.

The Gupta period of Indian history gives us with a remarkable coinage which consists of abundant gold issues and comparatively rare silver and copper pieces. Majority of the coin had attained an artistic standard where no other Indian coin could meet. The gold coinage of the Guptas is abundant and purely Indian but extremely varied in type, besides being high artistic quality. The king is shown in an infinity of roles and Hindu deities appear as a matter of course. The legends betray a tendency to transform the coins into something not far removed from commemorative medals. The Guptas issued some silver to serve in western India only and very little copper.
This could be due to the emergence of self-sufficient rural economy in mid-India and the decline set in trade and commerce and consequently in money economy in the countryside.

The numismatic art of this period, greatly creative, as it was, full of originality and vitality. It is true that initially Gupta coins exposed to Kusana influence. However, the artists of the Gupta mint overcame the influence of the Kusana coins and established themselves on their own feet. They created on coins flans a galaxy of tiny high reliefs which depicts gorgeous details of various achievements of their royal chief. Gupta gold coins display superb craftsmanship and are masterpieces of design and artistic technique.

A complicated pattern in high relief, like that on many Gupta gold coin, would involve much time of work whereas a less complicated design could be engraved in a matter of minutes. It is probable that major dies were made directly, so that each ore distinguished from its fellows roughly, but hubbed and cast dies were sometimes made. In a large mint operating under an Imperial government die-sinking would be entrusted to one or more experts.
Sometimes dies made at a central mint would have been distributed to provincial mints. Dies once made could be repaired and changed. The type and inscription on a work-out die could be recut, the outlines of the design and the letter being sharpened by the use of a graving tool; a cracked die would be strengthened and in part make again. Since the upper die wears out more rapidly than the lower one it is possible that they were supplied in sets rather than in a set of two, two or more upper dies being attested with each lower portion. When dies wore out as when the coin type was replaced by another the earlier dies would be formally detaced, as seals were detaced on the death of their owners. Finally, the earlier dies would become liquid.

A requisite rudimentary to the making of the coin blanks was the preparation of a debase. How the blanks were made would depend upon the final shape of the coin. The blanks for the large and heavy coins were usually cast in a globular form, which analyses the density and rounded borders of the coins. Others were cast in terracotta moulds, either individually or in groups. An alternative technique would be to cast the metal in long strips and cut them up with chisels into pieces of appropriate
size, which were then grasped with tongs, reheated and worked by hammering into circular discs. The blanks were then treated with acids. After this the weights of individual pieces were adjusted to conform with the mint prescriptions, which in the case of gold and silver coins meant individual blank by blank. Next the blanks were struck either hot or cold, both techniques with advantages and disadvantages. Ultimately they were submitted for verification and then put in circulation.

The first two Gupta rulers followed the weight standard of 7.840 of for their gold but Chandragupta II issued in three different weight standards of 7.840, 8.035 and 8.229 gm. Kumargupta I issued more in 8.229 gm. and less in 7.840 gm. Skandagupta abandoned all these and first issued at 8.553 gm. and later adopted the Indian suvarna weight standard and issued coins weighing between 9.200 and 9.395 gm. The Gupta coins were known as dinaras, but it is likely that the later coins were called suvarnas. No submultiples like half or quarter dinaras were issued. Their silver followed the Western Kshatrapa standard of 1.944 gm. It is difficult to detect any denominational scheme in the Gupta coppers.
9. **Other Minor Industries**

During the Gupta period looking-glass was an important article of use, and was largely manufactured. We do not know what kind of metals were highly polished and used as mirrors. In the *Amarakosa*, a well-known Sanskrit Lexicon, several glass articles like *singhara* (a glass-vessel), *Sikyākāca* (glass-cup) and *Katcasthāli* (glass-dish) have been mentioned. In the *Raghuvaṃsa*, however, there is a reference to a mirror made of gold. Such type might have been used by the aristocrat, but the poorer section of society could not have such costly looking glasses. Gopinath Rao thinks that highly polished metal plates of different designs were used as mirrors in that period. He also observes that:

> In a place called Aramula, in Travancore, such mirrors are still manufactured; and the mirrors made by the workmen of this place are so true that they do not show distortion in reflection.

Likewise, from the Ajanta frescos, according to Prof. Codrington, the only "metal articles recognisable are mirrors. They are circular and have a central knob behind, pierced to take a ring or cord." Dr. B.B. Lal
have discovered two blue beads from Tripuri dated circa. A.D. 200 - 400, which have been found to contain 3 to 5% barium and a high proportion of lead. Barium has not been found in any other Indian glass specimen.

During this period, diamonds, pearls, other valuable stones, corals and conch-shell were also massively used. Varahamihira refers to the quality, quantity and values of the different classes of diamonds, pearls and rubies. The *Amarakosa* mentions emerald, ruby, pearl, pearl oyster, conch-shell, coral etc. There are so many references to precious stones in our ancient texts of this period. *Raghuvamśa* refers to mani (valuable stone), diamond, topaz and sapphire. In one passage of *Mrččha-katika*, we find that the goldsmiths are seen consulting among themselves about certain jewels, like lapis lazuli, pearls, coral, blue sapphires, rubbies, emeralds etc.

Besides, the pearl-fishery was a very flourishing industry in south India during the Gupta period. On the presence of Raghu, the chief of the Pandiya country offered him the best of pearls recovered from the surface of the Tamrapani river. Thus our ancient poet refers to the earlier practices of pearl-fishery, which continued on the same manner near the port Tuticorin, below Tanjore.
The sea at the mouth of the rivers, which is still considered to be one of the most important centres of pearl-fishery in the world. The *Amarakosa* mentions various types of pearl necklaces together with other precious stones.

Another industry which thrives under the Vākāṭakas in south India was salt industry. Salt is an important article of daily use. It was commonly obtained from the saline water of rivers, lakes and seas. *Amarakosa*, refers to two categories of salt, - one from sea water and the other from rock. The epigraphic account of Vākāṭaka rule indicate that the salt industry was the monopoly to the state, and the state no doubt made heavy profit from this industry.


3. Amara-kosa, 11, 9, 78 (Ed. Haradutta Sharma, 1941)

4. Kāmasūtra, 1, 4, 3.

5. Kalidasa's Megha-duta, 1, 16; 1, 27.


   (A. Ghose and Panigrahi's Essay).

10. From Bhita - ASI(AR) 1911-1912, p. 84, Pl.XXX, No. 78 and AI, Vol. 1, p. 48, type 51.


12. AI, 1, p. 44, type 31, 34; p. 47 type 46 (Ahicchatra), p.48, type 51.

13. AI, Vol. 1, p. 48, type 49-50(Ahicchatra), and ASI(AR) 1911-12, p. 84, Pl XXX, 73 and 77.


15. ASI(AR) 1911-12, p. 84, Pl. XXX, No.70,71 and 72(Bhita).

16. Ibid, P. 84, Pl.XXX, No. 76(Bhita).

17. Ibid, p. 84, No.82.


21. ASI(AR), 1911-12, p. 85, Pl. XXX, No. 90.

22. AI, 1, 1946, p. 48, type 52.


27. Agrawala, *op.cit.*, Gupta Art Plate, VIII, Fig.10.


35. *Raghuvamsā*, XVI, p. 43

36. Yuan Chwang, *op.cit.*, 1, p.150.


40. For textiles in Ajanta frescoes, see the Paper of Codrington in *IA*, 1930, pp. 162-69.


42. *Harsacarita*, IV, Kshauma of Pundra Country and Textiles from Kamarupa.


45. Fleet, p. 85.


54. *Nārada*, 1, 64.


68. *Kāmasūtra*, l. ch. 111, p. 23.


75. Vatsyayana's *Kāmasūtra*, l, 3, p. 86.

76. *Kumara*, VI, 53.


82. R.N. Salotore, *op. cit.*, p. 441.


87. Mathur, *op.cit.*, see Pl. 21, 22.
89. Shanti Swarup, *op.cit.*, p. 38.
91. Fleet, p. 246, l. 29 and p. 238, l. 28.
95. *Kāmasūtra*, Book, 1, Ch. 111, p. 23.


100. *ASI(AR)*, 1911-12, p. 92, No. 11 (One Chisel Found).


102. *ASI(AR)*, 1911-12, p. 91. Old Type of Padlock Traced - No. 7.

103. Ibid., p. 92, No. 13.

104. Ibid., p. 92, No. 15.

105. Ibid., p. 92, No. 14.

106. Ibid., p. 92, No. 18.

107. Ibid., p. 91, No. 9.

108. Ibid., p. 92, No. 16.

109. Fleet, p. 139.


115. Meghdūta, I, 48; Rāghuvamśa, XVI, 18.
117. Ibid., V, 65.
118. Ibid., XIII,48.
119. Ibid., V, 52.
120. Ibid.,VI, 73.
122. Amarakosa, 10, 8, p. 227.
123. The Arts of India & Pakistan, p. 48 (Prof.Codrington), No.197.
124. Ibid.,No. 199.
125. ASI(AR),1911-12, p. 89-91.


129. Dutta, M.N., *'Agripurana*' (translation), Calcutta, 1903-1904, Ch. 38.


138. IA, 1930, p. 172, Articles on Ajanta Frescoes.


140. Brhat Samhita, Chs. LXXX - LXXXIII.


142. Raghuvamsa of Kalidas, 111, 18; XIII, 53, 59; XIX, 45; VI, 19; XVII, 32; XIII, 54; XVI, 65; XVIII, 42; and Kum. VIII, 75.


144. Raghu, IV, 49-50.

145. Maity, S.K., op.cit., p. 141

146. Amarakosa, 6, 104-106, p. 156.


148. Fleet - p. 238, 1.28 & p. 246, 1.29;

The Chammak and Siwani Plates of Pravarasena-11.