A HISTORY OF AGRICULTURE IN INDIA

VOLUME I
BEGINNING TO 12TH CENTURY

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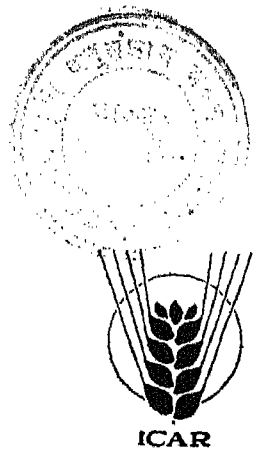

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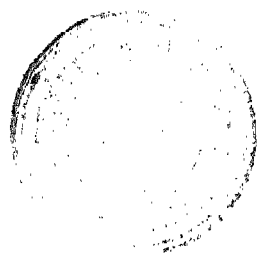

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FOREWORD

THE history of agriculture is inextricably interwoven with the progress of civilization because it was the taking up of agriculture that made it possible for primitive man to live in selected spots, forming a society, and growing a significant portion of his food nearby. In developing crop and animal husbandry, man learned to supplement his own physical capability with that of domesticated animals. This enabled human beings to find a certain amount of leisure to create the initial ingredients of what is known as civilization. A thorough investigation of the history of agriculture is therefore a most important though difficult task to execute. While in some other parts of the world this has been attempted, no such endeavour has previously been made in respect of agriculture in the Indian subcontinent, the home of one of the greatest ancient civilizations. It is therefore gratifying that this has at last been done by Dr M. S. Randhawa with the support of the Indian Council of Agricultural Research. There could have been no better choice for the assignment.

Scientist, educationist, litterateur, art connoisseur, historian, administrator and farmer, Dr Randhawa is a towering figure in many fields of human endeavour but he does not flaunt his remarkable talents. The distinguished American economist, Professor John Kenneth Galbraith, who came to know Dr Randhawa personally during his stay in India as the Ambassador of the United States, says: "He is, indeed, an extraordinary man. His mind has ranged over nearly the whole sphere of knowledge of science and art, from soil conservation to botany, to city management, history, religion, architecture and art. And in none of these has he been content to be an amateur. In every one he has manifested both the instinct and the diligence of the professional. I continue to be puzzled that one mild man could know accurately so much and to such good purpose."

After taking a first class M. Sc. (Hons) degree in Botany, M. S. Randhawa joined the Indian Civil Service, but continued his botanical research on Algae, ultimately earning a Doctorate of Science from the Panjab University. The love of plants which drew him to the study of botany was perhaps the foundation on which were built up his later interests and achievements in the field of floriculture, horticulture and eventually agriculture and all aspects of farming. The scientific training stood him in good stead when dealing with a range of problems whether these were in administration or in handling materials for his outstanding studies on Indian art.

About the latter, Krishna Chaitanya, the well-known art critic, has remarked, "To the presentation of research material on art he has brought

over from a scientific background a precision of analysis and a cogency of argument that contrast sharply with the sprawling and incoherent narration that used to pass as art history in the old days. In scale and quality of illustration and in standards of production, his books have reached the highest international standards." The noted British art critic and historian, W. G. Archer, stated that Dr Randhawa "is proving a cultural missionary of the first order".

As a pragmatic administrator, Dr Randhawa has rendered great service to the country. Entrusted with the work of rehabilitating refugees in Punjab in 1949 by the State Government, he realized that for these thousands of unfortunate human beings, timeliness in settling them was of the utmost urgency, and he completed this difficult task in record time. As Commissioner of the Ambala Division from 1951 to 1953 and then Development Commissioner of Punjab in 1955, his great work in the rural areas brought him a tremendous amount of popularity and renown. When accompanying Dr Randhawa and Professor Galbraith on a tour of the Kangra Valley when they were making a joint study of the centres where some of the priceless Kangra Valley paintings were done, I had occasion to see for myself the very high esteem and affection in which he was held by the people living in the rural areas. As soon as word reached them that the now legendary Dr Randhawa was going to pass through their area, they flocked in their hundreds to the little towns that we passed on the way, and swarmed around Dr Randhawa, whom they almost smothered with garlands of flowers.

In 1945 Dr Randhawa was appointed Secretary to the Indian Council of Agricultural Research and 10 years later he became the Vice-President of the Council with the status of Additional Secretary to the Government of India. He was also Special Secretary in the Ministry of Food and Agriculture of the Government of India from 1964 to 1966, being in charge of the work of intensive agriculture throughout the country. He also held the position of Adviser (Natural Resources) in the Planning Commission. His duties, especially when he was Vice-President of the ICAR, took him to many parts of India, and he seized the opportunity to study with great interest the agriculture and farming systems of each region, the information collected being used for an important series of books on Farmers of India. His tours were always all-encompassing, including in their sweep visits to botanical gardens, horticultural institutions, art galleries, libraries and museums of natural resources of all kinds.

During his tenure of the Vice-Presidentship of the ICAR, many important events in the field of agricultural research and education took place. After Independence the Government of India was naturally anxious to improve agricultural research and education as the backbone for building up a welfare State. Dr Randhawa was the Chairman of the Second Indo-American Team, which was set up to study the organization for agricultural

research and training in India and the USA, and to make recommendations in this regard for the advancement of Indian agriculture. It was at this time also that a rapid development of the Indian Agricultural Research Institute took place, including the setting up of its now well-known post-graduate school in 1958.

On retiring from Government service, Dr Randhawa became the Vice-Chancellor of the Punjab Agricultural University. His service to the University climaxes his life-long service to his state and the country. He developed the Punjab Agricultural University to a position in which it could provide a firm basis for the modernization of agriculture in the state, leading to a breakthrough in agricultural production. He also has stimulated to a considerable extent the arts and crafts of Punjab, the revival of its folk songs and Punjabi literature. He played a major role in the landscaping of the city of Chandigarh and in providing it with the largest and most beautiful rose garden in Asia. But he also served the whole country in many ways and his prominent part in promoting the Green Revolution cannot be forgotten.

I have taken a little more space than usual to write about the author because I felt it was important to indicate his special experience and background for writing a history of agriculture. I have referred only very briefly, in passing, to his remarkable achievements in the field of art, culture and literature because what is most relevant in connection with the present project, of which the history is the outcome, is his scientific training and deep interest in botany and the evolution of life, his experience in agricultural development since 1934, and his involvement with agricultural research and education since 1949. His work with the Indian Council of Agricultural Research, his administration of a premier agricultural university from 1968 to 1976, and his personal experience of farming in the last few years have given him unique qualifications for the undertaking and completion of this formidable task.

Dr Randhawa's book is staggering in the wide sweep of its subject-matter and impressive in the depth of the detailed study which illuminates the pages. This is no ordinary history of agriculture. He himself has said that a history of agriculture "can only be properly understood in the light of the evolution of life and the material culture of man." The book is therefore really a history of the origin and development of man in which agriculture, in its widest sense, has played a role which is inseparable from human life. The author goes back in geologic time to trace the birth of the Indian subcontinent. After giving an account of the soils, climate, vegetation and agricultural regions of India, he goes back to the Tertiary period and deals with the ancestors of man, tracing these from the great Apes, through the earliest known Hominids to the arrival of *Homo sapiens*. After dealing with the period of the hunters and the food-gatherers, the author refers to the discovery of agriculture and the domestication of animals. From then

onward is presented a history of agriculture and man's civilization which go hand in hand. The author looks far and wide for his sources of information; apart from books and treatises, archaeological evidence and evidences from rock paintings, carvings, inscriptions, etc., are all used to build up the history of agriculture. Throughout the book, though reference is made to the world position, the emphasis is on the Indian subcontinent and India in particular.

The later volumes would refer to the development of agriculture during the more recent period, finally presenting the picture of modern sophisticated agriculture based on the many advances which science and technology have made possible. The book will be of interest to a wide variety of persons including all those interested in agriculture, in history, in the early forms of art, the origins of civilization and in the evolution of life. It will, of course, be of special interest to those who wish to understand Indian agriculture. The book, containing an astonishing amount of detailed information, will be a valuable work of reference to scholars and students as well as to the common man who wishes to know more about the beginnings of life and culture in the Indian subcontinent. Dr Randhawa is to be congratulated on having completed a monumental task.

New Delhi B. P. PAL

PREFACE

AGRICULTURE is the source of perpetual creation on which civilization depends. It has a dominant role in the Indian economy. It contributes nearly half of the national income and provides employment to about seventy per cent of the working population in India. It provides raw materials for most of our industry. It also accounts for sizable share of the country's foreign-exchange earnings. Apart from these material considerations, it is a way of life, unique and irreplaceable in human values. It is surprising that in spite of such importance there is no book dealing with the history of agriculture in India.

In most European countries and the U. S. A. agricultural history has been documented by scholars, and there are societies and journals devoted to this subject. In India, however, this subject has not received the recognition it deserved. My association with agricultural development since 1934, with agricultural research since 1945, and with the administration of a premier agricultural university from 1968 to 1976, has given me the necessary background to prepare a work of this nature. When I wrote to Dr M. S. Swaminathan, former Director-General of the Indian Council of Agricultural Research, and a scientist and scholar of eminence who has played a key role in promoting Green Revolution in India, he accepted the need for writing a book on India's agricultural history. The Governing Body of the ICAR at its meeting held on 2 September 1976 sanctioned the scheme, which, for the purposes of funding and administration, was located at the Punjab Agricultural University, Ludhiana.

On 14 January 1977 the Ministry of Agriculture and Irrigation of the Government of India appointed me Chairman of a Committee to examine all agricultural universities in India, so that their working is improved. This assignment enabled me to meet agricultural scientists and farmers all over India and enabled me to fill gaps in my knowledge. On a visit to Bhopal, I saw the newly discovered cave paintings at Bhimbetaka and also met Dr V. S. Wakanker. On the way to Jabalpur, I saw the rock shelters and cave paintings at Adamgarh. I also noticed that whereas in Punjab and Haryana modern agriculture with the use of inputs such as tractors, threshers, electric motors and fertilizers is being commonly practised, in some parts of Madhya Pradesh the old wooden Persian wheel still persists, and threshing of wheat is done by treading the harvested crop under the feet of teams of bullocks tied with a rope to a wooden post, as in the Buddhist period. How the past persists in many parts of India! At Deccan College, Pune, I met Dr H. D. Sankalia, eminent archaeologist of India, who showed me his

finds from Navdatoli and Nevasa. After seeing the new campus of the Agricultural University at Rahuri, I crossed the Pravara River on my way to Aurangabad. It was on the banks of this river that the chalcolithic farmers and hunters of Maharashtra lived. At Bombay I saw the collection of Harappan finds from Mohenjo-daro which the Museum had recently acquired. Apart from pots it also has the terracotta toy representing a plough. On a visit to Hyderabad to see the Andhra Pradesh Agricultural University, I saw the collection of Mughal miniatures in the Salar Jung Museum and discovered some interesting paintings of wild sheep and markhor.

Agriculture can be properly understood only in the light of the evolution of life and the material culture of man. Man is part of an unbroken stream of life. That stream in the dawn of life on earth manifested itself in the form of single microscopic cells. Hundreds of millions of years later, after transformation through forms of polyps, of worm-like creatures, of lancelets, it flowed through thousands of generations in the form of fish. It emerged on land as the amphibian. The amphibian evolved into the reptile. It covered itself with hair, acquired warm blood and fed its young with milk, and it transformed itself to become fully mammalian. Four-footed, tailed and hairy, it took to the Eocene forests. It grew into lemur, into monkey, into ape; and finally hominid. The hominid grew to the dignity of man.

Man learned to control and use fire. He fabricated stone tools for hunting wild animals and skinning them. He domesticated the dog, who became his help-mate in hunting, as well as sheep, goat, pigs and cattle. He learnt to cultivate crops. He invented the wooden plough and learnt the art of ploughing and irrigation. He domesticated the horse, and with its aid acquired command over vast areas. He discovered the secret of smelting iron ore, invented the iron axe and plough-share, and with their aid cut the jungles and conquered hard soil.

Apart from discussing the evolution of man in the light of the most recent findings of research, I have dealt with the evolution of his material culture in this book. This is necessary so that the evolution of man and his culture is firmly linked with the evolution of his animal ancestors. Moreover, the findings of modern archaeology, assisted by the ^{14}carbon-dating method and by palynology, about man's material progress, such as the domestication of plants, are as spectacular as those of geology. Besides, I felt it necessary to provide history with the perspective of geological time so that historians realize how brief is the span of human history. When one considers the vicissitudes through which living beings have passed in the long geological history of the earth, the troubles which the present generation is facing seem insignificant. The findings of geology provide a new background to human history and impel us to discard the old ideas of the golden age in the past, for it has been proved beyond doubt that the material environment of man has progressively improved through the ages, and the comforts which

are now enjoyed by the common man were not available even to the kings in the past.

It is felt that this approach will provide the necessary corrective so that history is not overladen with inconsequential details about kings and their wars. No doubt some of the kings like Chandragupta Maurya, Asoka, Chandragupta I and Harsha were outstanding leaders who gave a new lead in the march of culture. Barring these exceptions many of the rulers were insignificant men, who strutted about on the stage of history, and in due course were lost in oblivion. Their only contributions were internecine feuds and wars and they were constantly nibbling at each other's territory. It is the misdeeds, crimes and conspiracies of such monarchs which figure prominently in traditional history books. What is important is an account of the life of the common people, their crops and cattle, and their food and dress. A culture is powered by the techniques of agriculture and industry. The man who discovered the technique of transplanting rice has done more good to humanity than all the kings put together.

Since man started cultivation of crops and intercourse among people living far apart began through trade, diffusion of cultivars also occurred. Indigenous crops of India are few, viz. rice, *urd*, *moong*, *kulthi*, *sarson*, cotton and sugarcane. As far back as Harappan times wheat, peas and *chana* came from western Asia via Iran. Africa gave us *jowar*, *bajra* and sesamum. The best evidence of this statement is in the finds of foodgrains from archaeological sites and supported by cytogenetic and phytogeographic research. ^{14}Carbon-dating and pollen analysis have further helped in elucidation of the facts concerning ancient plant economy.

Agriculture should not be considered in isolation from the life of the people and the political scene. Emerging from a tribal society, the Hindu kings had to knit together far-flung areas. In the absence of roads and means of communication it was a difficult task. Only a large army, and a bureaucracy to support it, could accomplish this task. As such, large quantities of surplus food had to be produced to feed the army and officials. At that stage it could only be done by bringing larger area under the plough after cutting jungles. This was what happened in Mauryan India. The government had to be kind to the farmers in its own interest. This was no longer the case when India came under the rule of aliens later on.

The history of ancient India has been slowly discovered due to the patient work of scholars, Europeans and Indians. In the first phase Sanskrit classics were translated into English. Sir Charles Wilkins translated the *Bhagvadgita* (A.D. 1785) and the fables of *Hitopdesha* (1787). Sir Willam Jones (A.D. 1964–94) translated the *Code of Manu*. Franz Bopp (A.D. 1790–1867), a German scholar, founded the science of Comparative Philology. In early forties of the nineteenth century, the French Orientalist, Eugene Burnouf, laid the foundations of Vedic scholarship in Europe. One of his pupils

was F. Max Müller (A.D. 1823–1900), who produced the first edition of the *Rig-Veda* in six volumes. Burnouf and Lassen, with the publication of their *Essay on Pali* (1826), laid the foundation of the study of Pali. It was thus that the secrets of Sanskrit and Pali texts were unlocked for the English-reading people.

Between 1834 and 1838 James Prinsep deciphered the inscriptions of Asoka. This laid the real foundations of the superstructure of Indian chronology that has since been erected.

Sculptures and paintings also give us a glimpse of the life of the people in the past. The Buddhist sculptures at Bharhut, Sanchi, Mathura and Amaravati convey to us vividly how the Indians lived, what was their dress, what were their favourite trees and domestic animals. In them we can even identify breeds of cattle as well as flowering and fruit trees.

The records of foreigners who came to India also inform us about the agriculture of ancient India. These authorities are the Greek Megasthenes (*c.* 300 B.C.), the Chinese Buddhist pilgrims Fa Hian (A.D. 399–415), and Hiuen-Tsang (A.D. 629-45), and the Central Asian Alberuni (A.D. 1031).

Following the travel account of Hiuen-Tsang, Alexander Cunningham discovered during 1861–1902 a number of Buddhist monuments in northern and central India. From 1904 to 1939 Sir John Marshall, the first Director-General of Archaeology in India, excavated the sites at Taxila, Nalanda, Sanchi, Sarnath, and Bhita. He also paid attention to Mohenjo-daro and Harappa. He was followed by K. N. Dikshit, who excavated Harappa. During the period since Independence valuable work in digging up the past has been done by A. Ghosh, B. B. Lal, M. N. Deshpande, B. K. Thapar, S. R. Rao, Y. D. Sharma and H. D. Sankalia.

It is for the first time that a synthetic picture of agriculture in ancient India from the very beginning to the twelfth century is presented. It is based on evidence from archaeology, rock paintings, sculptures, coins, ancient Pali and Sanskrit literature, and travel accounts of Greek, Chinese and Central Asian travellers and scholars. Considering the magnitude and complexity of the task, I am aware of the imperfection of this synthesis. At the same time, I feel that it is the best which could be done in the present state of our knowledge of India's past. I hope that in due course persons who are better qualified than me will improve upon the text and fill the gaps in our knowledge. It is better to make a modest start than to wait for perfection.

Kharar (near Chandigarh) M. S. RANDHAWA
2 May 1980

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APPENDICES

LIST OF ILLUSTRATIONS

CHAPTER 1

BIRTH OF THE INDIAN SUBCONTINENT

THE most outstanding fact about the physical geography of India is the natural division of the country with three distinct segments of totally dissimilar character: (i) the Himalayas, the great mountain system to the north, (ii) the Indo-Gangetic alluvial plain of northern India extending from the Punjab to Assam, and (iii) the Peninsula of the Deccan to the south of the Vindhyas—a solid stable block of the earth's crust, largely composed of some of the most ancient rocks, which the denudation of ages has carved into a number of mountain ranges, plateaus, valleys and plains.

Ever since the Cambrian Period, the dawn of geological history, the peninsula has been a land area that has never been submerged under the sea. The mountains are not true mountains of upheaval, but are outstanding portions of the old plateau which have escaped weathering. The Western Ghats form the western edge, and the Eastern Ghats the eastern edge of the plateau, which slopes towards the east.

Whereas the Himalayas and the Indo-Gangetic plain are comparatively young, the peninsula has a long geological history behind it. During the Triassic Period, there were three continents. Of these the North Atlantic continent comprising most of North America, and Angaraland comprising Russia, Siberia and China were in the north. To the south was the large continent of Gondwanaland, which comprised Peninsular India, Africa, South America, Australia and Antarctica. Separating the northern continents from the Gondwanaland was the Tethys Ocean, which covered northern India, Iran, Middle East and northern Africa.

In the Jurassic Period, the Gondwanaland split into two land masses, the eastern comprising Peninsular India, Malagasy (Madagascar) and Australia and the western comprising Africa and South America.

The Cretaceous Period began 110 million years ago and lasted for 50 million years. It was the age of armoured dinosaurs, birds, early mammals and primitive angiosperms.

During the early part of the Cretaceous Period, the Tethys Ocean extended over wide areas. It spread over a great part of Europe. The southward extension of the Tethys flooded much of northern Africa with a series of embayments from Algeria to Egypt. A connection was established with the South Atlantic Ocean across the Gulf of Guinea through Algeria, Libya, the Sudan and Nigeria, converting the Sahara into a great island. In the eastern region, an arm of the Tethys spread over Iran, Pakistan, western India, and lower parts of the Narmada and the Tapti valleys; another arm invaded Assam, whereas embayments spreading northward

from the Bay of Bengal merged with the arm of the Tethys in Assam. The sea at this time washed the east coast of India where the upper Gondwana deposits are locally associated with the marine fauna of the lower Cretaceous Age. The middle and the upper Cretaceous, especially in the Pondicherry-Tiruchirapalli sector, are mainly littoral. The fauna of this sector is similar to that of Malagasy (Madagascar) and South Africa and to that of the southern flank of the Assam range. Along the Narmada Valley on the west coast are some marine fossiliferous beds with fossils showing greater affinity with those of the Cretaceous of southern Arabia and Europe than with those of Assam and Tiruchirapalli regions. The dissimilarity indicates that there was still a sort of land barrier that separated the Bay of Bengal from the Arabian Sea. This land barrier has been called Lemuria, which included Peninsular India and Malagasy. The sea surrounding this long Indo-Malagasy island, with its dinosaur-infested forests, was in free communication with the Tethys to the north, as is shown by the presence of European species, or species with European relationships, in both the Narmada Valley and the Cretaceous of the east coast of India.

The middle and the upper Cretaceous were periods of great marine transgression. A palaeogeographic map of the Gondwanaland during the middle and upper Cretaceous is shown in Fig. 1. While the uppermost Cretaceous beds were being deposited along the south-eastern coast of India, stupendous volcanic outbursts overwhelmed a vast area, comprising the present Gujarat, Maharashtra and Madhya Pradesh, the like of which are not known anywhere else in the world (Fig. 2). Several hundred thousand square kilometres were flooded by the outpourings of extremely mobile lava from fissures. The hills formed by the lava are in some places over 1,200 metres high and are known as the Deccan traps. They are peculiar in appearance, being frequently flat on the top and with steep sides so that they appear from a distance as gigantic steps and, therefore, are called traps, a name derived from the Swedish word, meaning a stair or step. The individual lava flows that make-up the Deccan trap plateau vary greatly from a fraction of a metre to 36 metres in thickness. During the periods of quiescence that intervened between successive outbursts, lakes were formed, probably because the lava streams had blocked the rivers. In these lakes, fishes, frogs, small crustaceans, etc., flourished, whereas the flowering plants, including palms and other vegetation, grew on the adjoining land. In the marshy areas dinosaurs thrived, and on the beaches tortoises crawled. As time went on, the lakes were filled up with sediments washed down from the land. Then came another period of volcanic outbursts and lava flows when lakes were formed again, and plants and animals reappeared. Thus, volcanism and sedimentation were repeated many times until a great thickness of lavas and interbedded sediments, called the Intertrappeans, had accumulated, containing the petrified remains of organisms which bear

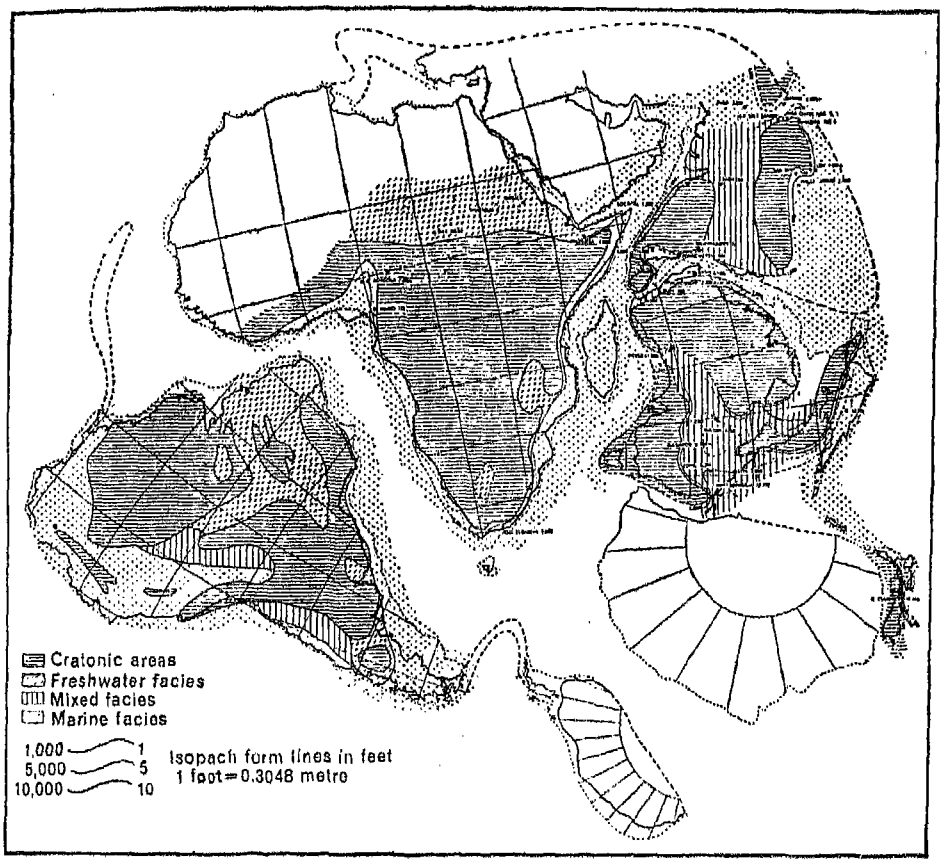

Fig. 1. Palaeogeographic map of Gondwanaland in the middle and upper Cretaceous (After Ahmad)

witness to the fauna and flora that existed during that period.

The continent of Gondwanaland had split up into its integral parts towards the latter part of the upper Cretaceous. The drifting apart of the continents was facilitated by the great overflow of lavas, such as the Stromberg lavas of South Africa, the Serra Geral volcanics of South America and the Deccan traps of India. As a result of these earth movements, considerable parts of the marginal areas of the Gondwanaland broke off and sank into the oceans. The Tethys had already been shallowed in the upper Cretaceous. The intermittent mountain building continued throughout the Tertiary, as a consequence of which the great mountain systems, such as the Atlas, the Pyrenees, the Alps, the Caucasus, the Himalayas and the Malay Arc, were formed.

The formation of the Deccan trap, to which reference has been made earlier, continued in the Tertiary Period. By far the greater part of western India is made up of the Deccan trap covering an area of 322,900 square kilometres. Originally it had a much greater area, probably covering 800,000 square kilometres; outlying patches of the trap occur in Sind, Kutch, Bihar, and the coastal areas of Andhra Pradesh. The formation of the Deccan trap began in the uppermost part of the middle Cretaceous and continued into the Eocene or even later.

The crustal movements that gave birth to the Alps have also been responsible for the formation of the Himalayas. The movement that first outlined the belt along which the Himalayas were uplifted may have begun in the Cretaceous times, but such pre-Tertiary movement was probably mild, producing an incipient island arc, and there is little evidence to show that there was any real mountain-building movement before the middle of the Tertiary Period. The gigantic masses of sediments that had been accumulating upon the gradually sinking floor of the Tethys, since the upper Carboniferous, disturbed the gravitative equilibrium of the crust towards the end of the Eocene, when a series of intense mountain-building movements, separated by periods of some quiescence, started, resulting in the uplift of the Himalayas.

The process was begun by the outpouring of the Deccan trap lava through numerous fissures during the late Cretaceous and the early Eocene. The abnormal tension of the earth's crust caused by the extraordinary sinking of the Tethys thoroughly upset the internal equilibrium of the earth. The equilibrium was adjusted only by the most violent changes starting with great outbursts of volcanism at many centres and ending in gigantic convulsions that forced up the deposits of the Tethys into a great mountain system. It is estimated that about 1,666,000 cubic kilometres of lava, which exceeds in bulk the entire Himalayas, was poured out from the bowels of the earth.

The continued sinking of the Tethys is presumed to have been caused by crustal weakness. During the sinking of the seat, there was a lateral thrust which narrowed the basin. The narrowing of the basin upheaved the sediments, and surplus sedimentary materials were forced up into folds above the basin to form the Himalayan chain. The margin of the upheaved mass also yielded under strain, developing fractures in many places. As the sinking sea floor reached deep into the region of higher temperature and pressure, the lower layers of sediments were melted into "magma", which invaded the crumpled and crushed the overlying sediments as intrusions or as lava flows. These now form the central axis of the Himalayas. Some of the rocks have been squeezed up and out by the lateral forces from two sides and thrust into overturned folds and faults. Many of the overturned limbs are displaced as flat-lying folds known as nappes.

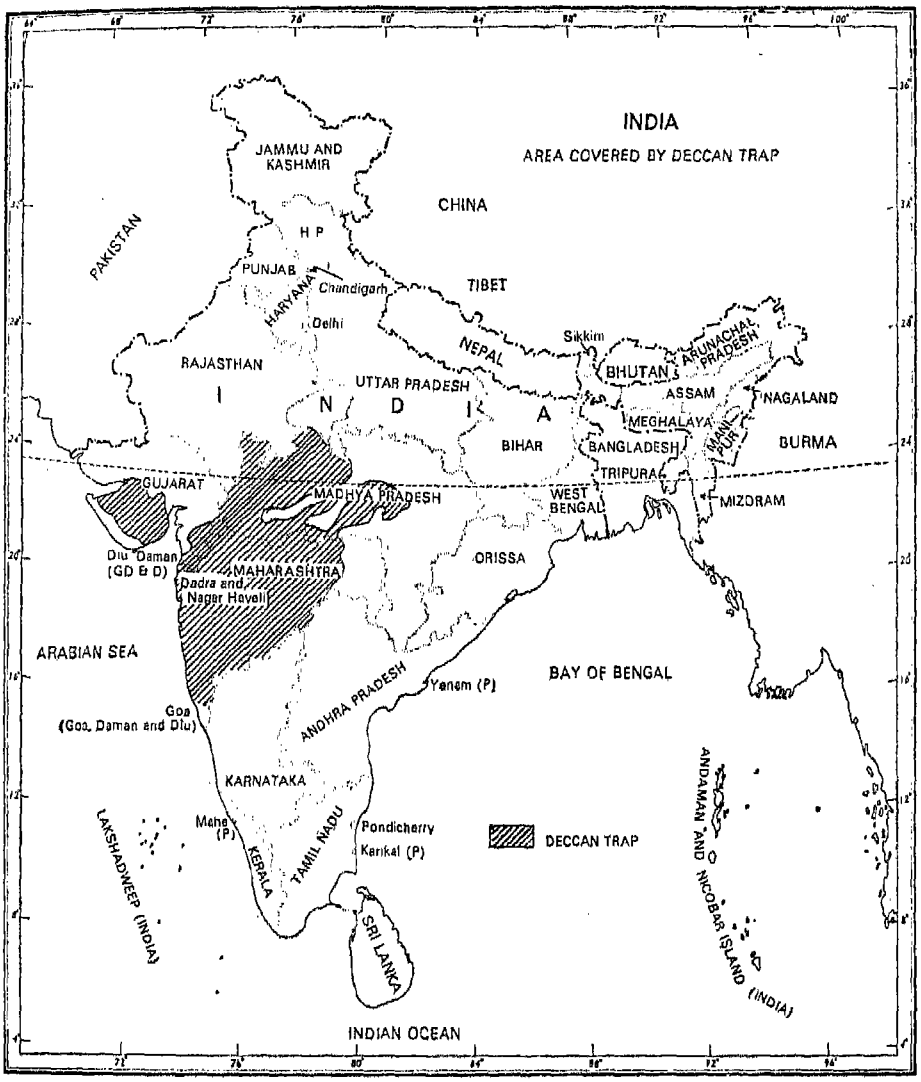

Fig. 2. During the upper Cretaceous, stupendous volcanic outbursts overwhelmed a vast area in what is now Gujarat, Maharashtra and Madhya Pradesh. From the lava, the black cotton soil was formed over the ages

The upheaval of the Himalayas has taken place in three major phases. The earliest phase was at the close of the Eocene, when the Eocene nummulitic limestone and the underlying older strata that had been accumulating on the floor of the Tethys since the upper Carboniferous were uplifted into ranges of considerable altitude (4,500-6,000 metres), found in Kashmir, Hundesh and in parts of eastern Tibet. With this uplift, all traces of the Tethys in the Himalayan region vanished. The next upheaval took place towards the close of the Miocene when the sediments deposited by rivers in estuaries along the flanks of the infant Himalayas were upraised. These now constitute the middle or lesser Himalayas. The last upheaval started after the Tertiary and continued into the sub-Recent through the Pleistocene. The movements involved the uppermost Siwalik freshwater sediments.

It is now generally believed that the uplift of the Himalayan system of mountain ranges was due to movements of two solid continental masses on two sides of the Tethys, directed towards one another. The Central Asian continental mass, Angaraland, slowly moved from the north to the south under pressure from the floor of the Arctic Ocean, and the northern edge of the Indian continental mass, the Gondwanaland, became downwarped by the northward compressive force from the Indian Ocean. The Himalayan portion of the Tethys gradually shifted southward and became narrower, assuming its present trend in the early Eocene time. The presence of tongue-like projections of the Gondwanaland—one in the Kashmir-Hazara region (the Punjab wedge) and the other in the north-eastern extremity of Assam (the Assam wedge)—have moulded the pattern of the Himalayan chain. The effects of these two wedges can be clearly seen in any relief map of India. It will be seen that the Himalayan chain occurs as a huge arc between Nanga Parbat in the west and Namcha Barwa in the east. The convexity of the arc points south towards the Indian peninsula. Though geographically the Himalayas are considered to be limited between these two points, the Nanga Parbat and the Namcha Barwa, the rock formations seem to be suddenly folded round at these points and to turn southward in rather parallel ranges.

Below the Himalayas are the Siwalik Hills, extending from Jammu in the west to Assam in the east. The Siwalik Hills are mainly river deposits of the middle Miocene to the lower Pleistocene Age, folded into arches (anticlines) and troughs (synclines). Many of the anticlines have been broken by faults—dislocations due to the slipping of the rocks along a plane of fracture (fault plane). The fault planes steeply sloping into the hills have given rise to steep scarps facing the plains.

Immediately adjacent to and on the north of the Siwalik Hills lies the sub-Himalayan zone or lesser Himalayas, 65 to 80 kilometres wide and of an average altitude of about 3,000 metres. The rocks here are mostly non-fossiliferous.

Farther north is the central Himalayan zone (the Great Himalayas) of

high ranges with snow-clad peaks. It consists mainly of metamorphosed sedimentary rocks.

The Indo-Gangetic plains, which lie at the foot of the Himalayas from Hazara to Assam, mark the side of a deep basin of estimated depth of 1,050 to 6,000 metres which resulted from the compression exerted on the peninsular margin against the advancing crustal waves from the north. The basin has been filled up with the river alluvium derived from the rising Himalayas as well as from the plateau on the south.

Alberuni (Abu Raihan Muhammed bin Ahmed), a Central Asian scholar, with keen perception, came to northern India early in the eleventh century, and made a remarkable observation on the structure and formation of the Indo-Gangetic alluvium. "If you have seen the soil of India with your own eyes and meditate on its nature," wrote Alberuni, "if you consider the rounded stones found in the earth, however deeply you dig, stones that are of smaller size at greater distance from the mountains, and where the streams flow more slowly, stones that appear pulverized in the shape of sand where the streams begin to stagnate near their mouths and near the sea, if you consider all this, you could scarcely help thinking that India has once been a sea which by degrees has been filled up by the alluvium of the streams."[1]

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CHAPTER 2

SOILS

Soil from the agricultural point of view may be defined as the material comprising weathered rock minerals which, together with organic matter, water and air, provides a medium for the growth of plants. This medium is the basic source of all human and animal food as well as of many industrial raw materials.

The agriculture of a country is dependent to a large extent on the nature of its soils, which, in turn, is influenced materially by climatic factors. Thus the soils of India, which extend from the temperate regions through the subtropical into the torrid regions, display marked differences in character, again reflected in the vegetation pattern of the country.

Although soils undergo important secondary modifications through climate, topography, organic agencies, etc., their fundamental character is determined by their general nature. Certain well-marked rock types give rise to certain definite types of soils; and variations in the rocks cause wide differences in the overlying soils in regard to their consistency, depth and composition.

The foundations of the soils of India have been classified into :

1. *Ancient crystalline and metamorphic rocks* : The oldest rocks constituting the basement of Peninsular India which occur as granites, gneisses, crystalline schists and subordinate rocks rich in ferromanganesian minerals. These rocks have given rise to red soils.

2. *Cuddapahs and Vindhyans* : Being an ancient formation, the soils derived are all highly matured.

3. *Gondwana* : It occurs in the chains of basin-like depressions in the table land of the peninsula filled with old river deposits, sands and silts. The Gondwana rocks have produced comparatively immature soils of less variety and fertility.

4. *The Deccan Trap* : It comprises volcanic lava rich in ferromanganesian and alumina compounds. The typical soil derived from the Trap is the *regur* type or the black cotton soil.

5. *Tertiary and Mesozoic sedimentary rocks of Extra-Peninsular India, occupying small areas of the hilly and mountainous ground in depressions and valley basins* : (i) Mesozoic and Eocene calcareous rocks; and (ii) Tertiary sandy rocks.

6. *Recent and sub-recent rocks, which have given rise to a drift soil, entirely different in origin from the soils of southern India, which are largely residual soils produced from the decomposition products of rocks* : Old Indo-Gangetic allu-

vium, new Indo-Gangetic alluvium; deltaic alluvium, lateritic rocks, and desert deposits.

Meteorological conditions in India, with their wide diversity, have given rise to major secondary modifications in the basic character of soils. The climates are manifold. The conditions in the north are very different from those in the south; the coasts present a marked contrast to the interior; the climate of the West Coast region is different from that of the East Coast tract, and the Himalayan zone is a class by itself. The normal annual rainfall varies from about 11,685 millimetres (460 inches) in the Assam hills to less than 76 millimetres (3 inches) in Rajasthan. During some months of the year, vast areas are deluged; during others, drought prevails. Under the influence of such climatic variations, geological differences have ceased to be of predominant importance, and soils of similar properties cover the most varied rock systems. The more extreme the climate, the more generally will the climatic type of soils predominate. Examples are the black soils derived from different types of rocks.

FORMATION OF SOILS

A mature soil is the handiwork of geoclimatic and geobiological forces operating jointly. How do these forces operate? Soils are formed by the weathering and disintegration of rocks. Soils are either sedentary, i.e. those formed out of the underlying rock, or are transported, i.e. those formed out of the disintegrated parts of rocks, brought down by the action of rivers from a distance. The process of breaking down of rock masses and their gradual development into soil is called weathering. The agencies of weathering are physical, i.e. those that break the rock into smaller pieces, and chemical, i.e. those that change the composition of the minerals forming the rock and, in so doing, exert a marked influence upon its physical character. The work of the physical agencies is called decomposition. Both these processes are complementary to each other.

The agencies operating in the disintegration of soils are: aqueous, atmospheric, physical and organic.

The aqueous agency operating in the disintegration of rocks and soils is the most potent of all. What enormous quantities of solid matter are dislocated by rain and brought down by streams and rivers may be judged from Everest's calculation of silt carried down by the Ganges alone. Everest has calculated that 355,361,461 tonnes of solid matter are carried down annually to the sea by the Ganges. The erosive action of running water is due to sand, pebbles and rocks carried by it. The hardest and heaviest rocks become converted into rounded boulders and pebbles by the action of the moving water containing sand in motion. Water acts not only mechanically in denuding rocks, but it is also a solvent. Potash, soda, silica and lime get dissolved in water, and the rocks are denuded by the solvent action

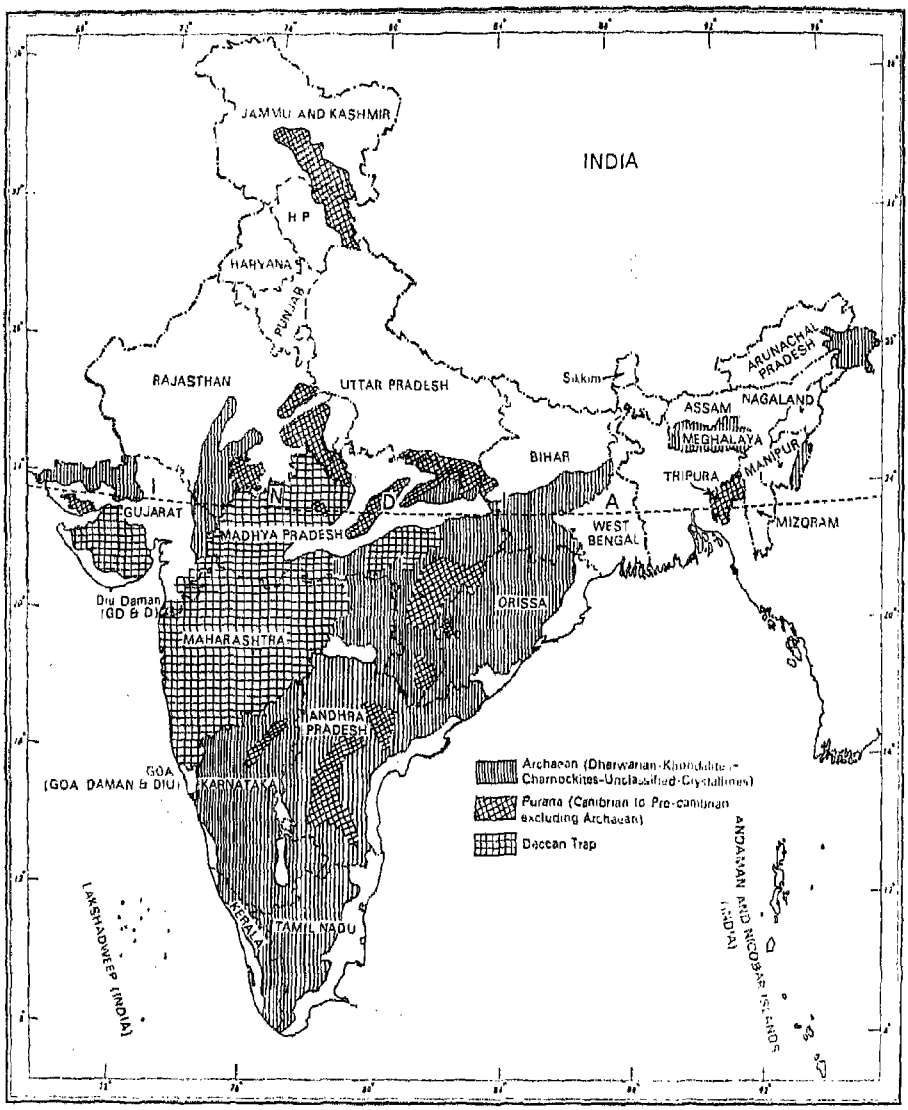


Fig. 3. The occurrence of Archaean and Purana Rocks and the Deccan Trap in India

of water. The solvent action of water and minerals is increased by salts in solution and gases in suspension. Sea waves beating against cliffs also help in the formation of soils. The action of glaciers in tearing down rocks and in the formation of moraines and erratic boulders may be also included under this head. The hydration of rocks in the presence of water may also be mentioned.

The atmospheric agency acts on rocks as follows: The carbon dioxide gas in the atmosphere renders the calcium carbonate soluble. Limestones, chalk and *kankar* thus get dissolved and become available as plant food, and the rain-water from calcareous rocks charged with calcium carbonate flows into the sea, where shell-fish, corals and foraminifera utilize the lime in building up their own bodies, which in time settle in the form of dead shells and form new rocks. The dew and water-vapour of the atmosphere which get into the interstices of rocks in cold regions are frozen and the resulting expansion disintegrates the particles of rocks. When water freezes, it expands, and the volume of ice formed is increased by nine per cent. This increase in volume exerts a force of 1,640 tonnes per square metre. The oxygen of the atmosphere is a very potent agent in oxidizing and disintegrating the surfaces of hard rocks. Strong currents of wind carry sand and finer particles of matter (such as common salt) from the sea-shore and the dry beds of rivers into the interior.

Physical agencies operate in disintegrating soils chiefly in the form of heat. Rocks are poor conductors and hence the effects of heat and cold extend only to a slight depth from the surface. The greater expansion or contraction of the surface produces a strain which causes a layer of rock to break off. Earthquakes, hot springs and volcanoes alter even the superficial layers of the earth's surface.

Action of Plants

Disintegration of rocks takes place by hydration, oxidation and physical action. Nitrification then proceeds with the help of bacteria. Lichens and blue-green algae appear. Gradually, the quantity of soil on the hard surface of the rock increases, and the growth of vegetation becomes more vigorous, mosses, liverworts, ferns and grasses gradually taking the place of lichens. When visible soil accumulates, and fissures and cracks appear on the rock, herbs and shrubs multiply and by their root-action further help to disintegrate the rock to some depth. The formation of soils now goes on apace. Lichens and bacteria are able to draw nourishment from the most insoluble rocks, not only from basalts, granites and schists, but also from quartz. Even quartz gets covered with lichens when exposed long enough to the air. The action of higher vegetation on rocks is partly mechanical and partly chemical. Roots get into the clefts of rocks and tear them asunder. Chemical action is concerned in the solution of some of the ingre-

dients of the rock. The solvent action of roots is partly due to the formation of acids in them which act on the particles of soil.

Action of Animals

The larger rodents, like rats, squirrels and rabbits, burrow into the ground and thus large quantities of partially decomposed rocks are exposed to the agencies of weathering. Earthworms and ants also help to decompose and disintegrate the rocks. They carry down vegetable matter, which on decomposition helps to break down the minerals. Earthworms pass large quantities of soil through their bodies. This passage of soil through their bodies amounts to more than 22 tonnes of soil per hectare. This process greatly helps to mix the soil with the subsoil. Worm-casts are particularly useful to the farmer, as they help to loosen and perforate the soil to facilitate the penetration of roots, water and air. These worms also drag down leaves, pieces of straw, etc., into their holes, thus incorporating organic matter into the soil, and making heavy soils lighter and light soils heavier.

As the soil particles become smaller, their water-holding capacity increases, as each soil particle is surrounded by a film of capillary water. This water is very effective in the decomposition of the soil particles. Hydration, oxidation and carbonation work simultaneously. These decomposition processes are always accompanied with increases in bulk and these tend to disrupt the rock and further assist to disintegrate it.

SOIL TYPES

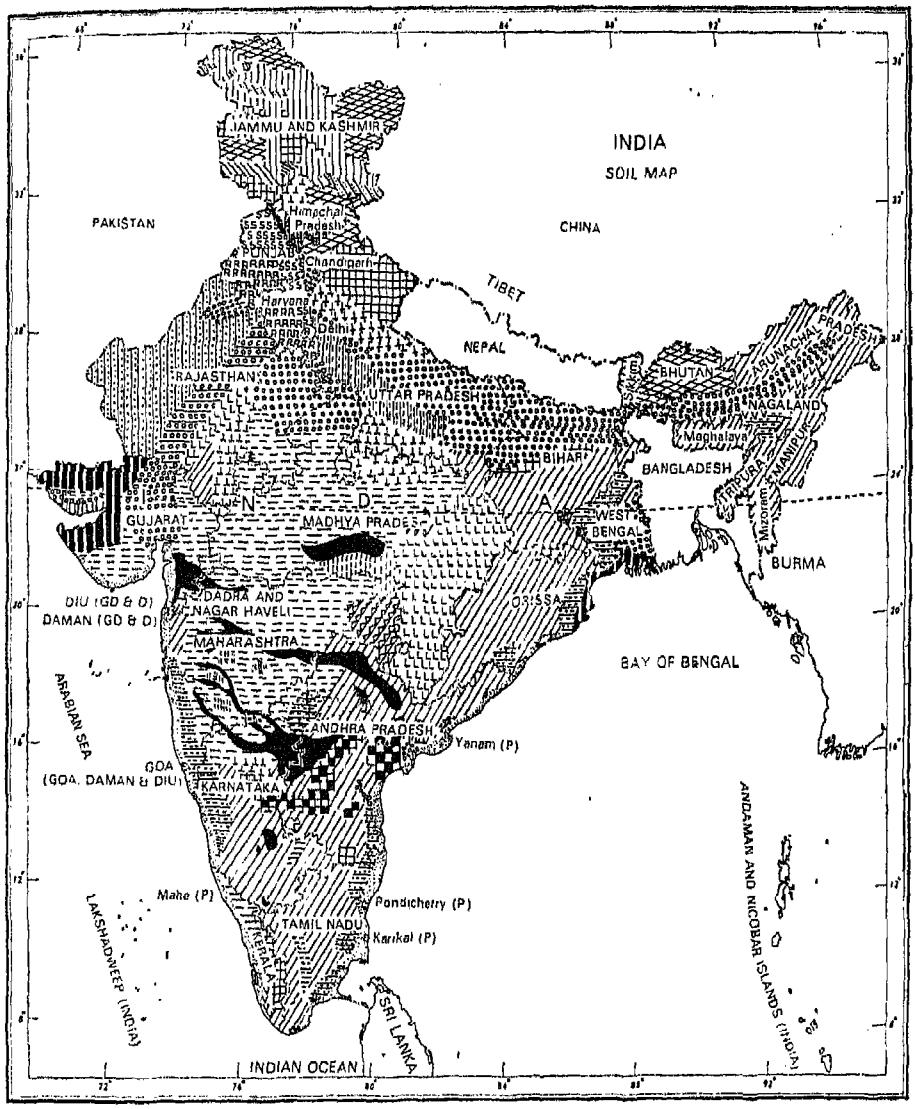
The investigations of Voelcker in 1893, and those of Leather in 1898, led to a classification of Indian soils into four major types: (i) the Indo-Gangetic alluvium; (ii) the black cotton or *regur* soils; (iii) the red soils lying on metamorphic rocks; and (iv) the lateritic soils. Various types of soils, according to the findings of the Soil Survey of India, are shown in Fig. 4.

Indo-Gangetic Alluvium

The Indo-Gangetic alluvium is by far the largest and most important of the soil groups of India. The soils of this group cover about 777,000 square kilometres. They are distributed mainly in the northern, north-western and north-eastern parts, including the Punjab, Haryana, Uttar Pradesh, Bihar, Bengal, and parts of Assam and Orissa. They produce bumper crops of wheat and rice (Fig. 5).

In spite of numerous subordinate variations, the main features of these soils result from their having been deposited as silts by the numerous tributaries of the Indus, the Ganges and the Brahmaputra river systems, which drain the Himalayas, bringing with them the products formed by the weathering of rocks.

Geologically the alluvium is divided into (i) *khadar,* or new alluvium of



1 Alluvial	11. Medium black	21. Brown soil
2. Alluvial (highly calcareous)	12 Shallow black	22. Forest soil
3 Alluvial on coastal alluvium	13 Black soil saline and alkaline	23. Podsolic soil
4. Alluvial on deltaic alluvium	14. Black soil undifferentiated	24. Foothill soil
5. Alluvial and alkaline	15 Red and black	25. Mountain and hill soil
6. Pedocal sierozem	16. Ferruginous	26. Mountain meadow soil
7. Pedocal brown soil	17 Ferruginous gravelly	27. Peat
8 Grey and Brown	18. Red and Yellow	28. Glaciers
9 Desert soil	19. Laterite	29. Soil boundary
10 Deep black soil	20. Laterite and lateritic	30 State boundary

sandy composition, generally light in colour, about 10,000 years old, and (ii) *bhangar*, or the older alluvium of Pleistocene date, of more clayey composition, generally of dark colour, and full of pebbles or *kankar*. The soils differ in consistency from drift sand to loams, and from fine silts to stiff clays. A few pebble beds are also occasionally met with. The presence of impervious clays obstructs the drainage, and also promotes the accumulation of injurious salts of sodium and magnesium, which make the soils sterile.

The formation of hard pans at certain levels in the soil profile as a result of the binding of soil grains by the infiltrating silica or calcareous matter is often observed in these alluvial soils. Layers of *kankar* in the Indo-Gangetic alluvium of Uttar Pradesh and West Bengal, and those composed of impure iron oxides are instances of these hard pans.

The soils of the Punjab and Haryana plains belong to the alluvial class typical of the Indo-Gangetic plains. A majority of the soils are loams or sandy loams, with a soil crust of varying depth. Hardly any profile characteristics are observed. Soluble salts are present in considerable quantities. The lower layers contain *kankar* nodules. The soil character is generally alkaline due to the presence of sodium in the clay complex. The soils are rich in phosphorus and potash, but are deficient in organic matter and nitrogen.

Two broad divisions are distinguished in Bihar: (i) the alluvium found north of the Ganges, and (ii) the alluvium found south of the Ganges. The soils in the first group are clayey, loam to sandy loam, neutral to alkaline, rich in potash, and deficient in P_2O_5, while those in the second group are heavier and finer in texture, with higher K_2O and P_2O_5 contents, and of acidic pH in the southernmost parts.

In West Bengal, the Rarh tract consists mainly of old alluvium. There is hardly any regularity in the manner of deposition of river-borne materials. Some of the early deposits display considerable diversity on account of their long subjection to climatic and other influences.

The alluvial soils of Tamil Nadu are transported soils, found mainly in the deltaic areas and on the coastal line. A section of the profile shows alternate layers of sand and silt. The composition of the strata varies with the nature of the silt brought by the rivers which, in turn, varies with the catchment areas and the tracts through which the streams flow.

The light sandy red and yellow soils found in the Mahanadi basin are of alluvial origin. The formations in the north and on the west coast of Kerala consist mostly of the sands deposited from the sea. They are of low fertility.

Black Cotton Soils

The typical soil of the Deccan Trap is the *regur* or black cotton soil. It is common in Maharashtra, in the western parts of Madhya Pradesh, Karna-

taka, and some parts of Tamil Nadu, including the districts of Ramnad and Tinnevelly in the extreme south. It is comparable with the chernozems of Russia and with the prairie soil of the cotton-growing tracts of the United States of America, especially the black adobe of California. It is derived from two types of rocks: the Deccan and Rajmahal Trap, and the ferruginous gneisses and schists occurring in Tamil Nadu under semi-arid conditions. The former attains sometimes considerable depths, whereas the latter are generally shallow.

The black soil areas have, generally, a high degree of fertility, though some, mainly in the uplands, are of low productivity. The soils on the slopes and the uplands are somewhat sandy, but those in the broken country between the hills and the plains are darker, deeper and richer, and are constantly enriched by deposits washed down from the hills.

Black soils are highly argillaceous, fine-grained, and dark with a high proportion of calcium and magnesium carbonates. They are very tenacious of moisture, and are exceedingly sticky when wet. Owing to considerable contraction on drying, large and deep cracks are formed. They contain much iron and fairly high quantities of lime, magnesia, alumina, and potash. However, they are poor in phosphorus, nitrogen and organic matter. In all *regur* soils, in general, and in those derived from ferromanganesian schists, in particular, there is a layer rich in *kankar* nodules formed by the segregation of calcium carbonate at some depth below the surface and above the weathered rocks. The soils are generally rich in montmorillonitic and beidellitic groups of minerals.

In Maharashtra, the soils derived from the Deccan Trap occupy quite a large area (Fig. 6). On the uplands and on the slopes, the soils are light-coloured, thin and poor. On the lowlands and in the valleys, relatively clayey black soils are found. Along the Ghats, the soils are very coarse and gravelly. The soil is often some 6 metres deep in the valleys of the Tapti, the Narmada, the Godavari and the Krishna rivers. The subsoil contains a good deal of lime. Outside the Deccan Trap area, the black cotton soil predominates in the Surat and Broach districts of Gujarat.

In Madhya Pradesh, two distinct kinds of black soils are found : (i) deep heavy black soil covering the Narmada valley, and (ii) shallow black soil. The cotton-growing areas generally have deep and heavy black soils, though soils of lighter texture are also found.

The black soils of Karnataka are fairly heavy, with a high salt concentration. They are generally rich in lime and magnesia.

Red Soils

Red soils extend practically over the whole Archaean basement of Peninsular India, from Bundelkhand to the extreme south, covering 2,072,000 square kilometres, embracing south Bengal, Orissa, parts of

Madhya Pradesh, eastern Andhra Pradesh, Karnataka, and a major part of Tamil Nadu. These soils also occur in Santhal Parganas in Bihar, and in the Mirzapur, Jhansi and Hamirpur districts of Uttar Pradesh. They were produced as a result of meteoric weathering of ancient crystalline and metamorphic rocks. These soils started developing around the Mesozoic and Tertiary ages.

The colour of these soils is generally red, grading sometimes into brown, chocolate, yellow, grey and even black. The redness is due more to a general diffusion than to a high proportion of iron content.

The soils grade from the poor, thin, gravelly and light-coloured varieties of the uplands to the much more fertile, deep, dark varieties of the plains and the valleys. They are generally poor in nitrogen, phosphorus and humus. Compared with *regur*, they are poor in lime, potash and iron oxide, and are also uniformly low in phosphorus. The clay fraction of the soils is rich in kaolinite.

Red soils can be divided into two broad subgroups: (i) red loams of argillaceous character with a cloddy structure and possessing a few concretions, and (ii) red earths with loose and friable top soil, rich in secondary concretions and sesquioxide type of clay.

More than two-thirds of the cultivated area in Tamil Nadu is covered by red soils. They are *in-situ* formations, produced from the rock below under the influence of climatic conditions. The rocks are acidic, consisting of mica or red granites. The soils are shallow and open in texture. They have a low exchange capacity and are deficient in organic matter and plant nutrients.

The predominant type in the eastern tract of Karnataka is the red soil overlying granite. It is rich in potash, iron and alumina.

The acidic soils in the south of Bihar are red soils. In West Bengal, the red soils, sometimes misrepresented as laterites, are the transported soils from the hills of the Chhota Nagpur plateau. A part of the Jhansi District in Uttar Pradesh also has red soils. A broad strip of area running between eastern and western parts of Coorg is red loam, easily drained, and having fairly dense vegetation.

Laterites

Laterite is a soil type peculiar to India and some other tropical countries, characterized by the intermittent occurrence of moist climate. In formation it varies from compact to vesicular rock composed essentially of a mixture of hydrated oxides of aluminium and iron, with small quantities of manganese oxides, titania, etc. It is produced by the atmospheric weathering of several types of rocks.

Laterites may break and be carried to lower levels by streams. When redeposited, they become a compact mass by the segregative action of the

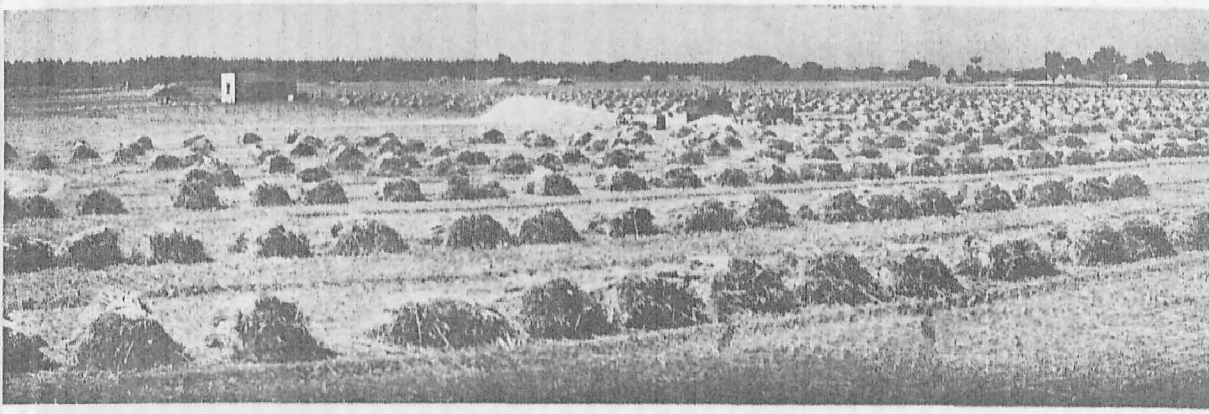
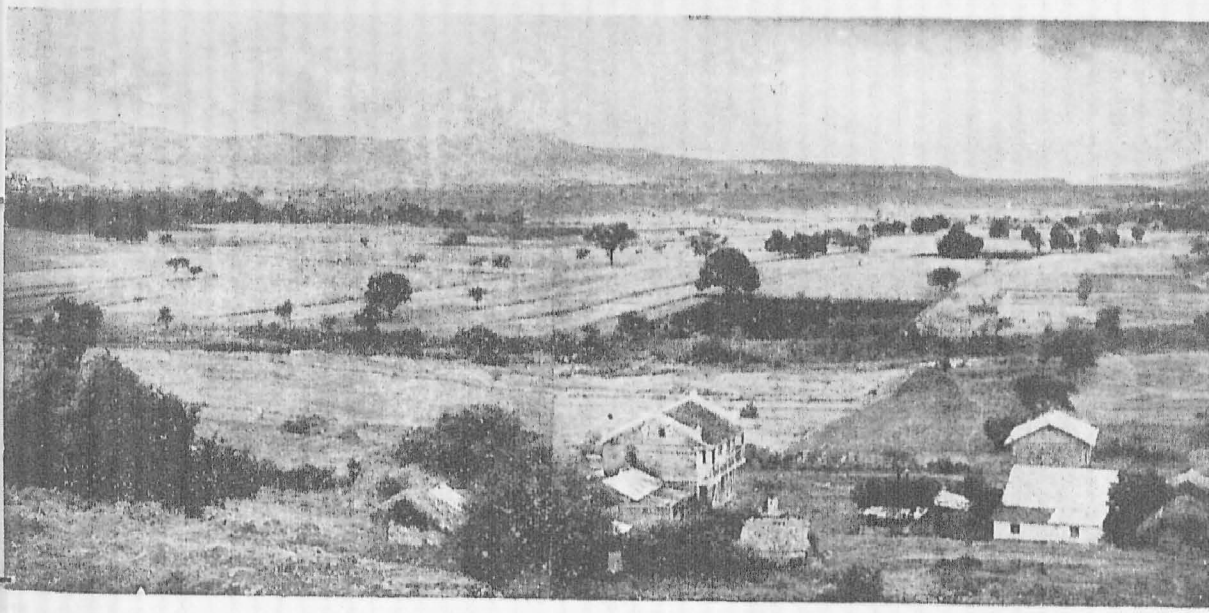


Fig. 5. The Indo-Gangetic plain in the Punjab has a rich alluvial soil, which produces bumper crops of wheat and rice

Fig. 6. The deep black soils in the Pune District, Maharashtra, produce bumper crops of cotton, sugarcane and rice. The fields are dotted with trees of mango and *Acacia nilotica*. In the background are the flat-topped mountains of the Deccan Trap



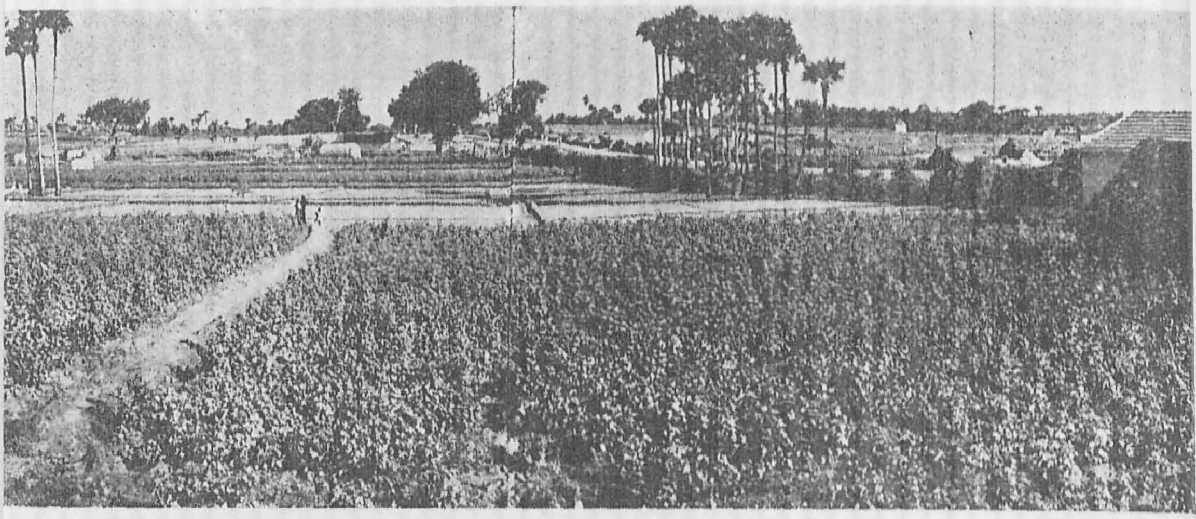
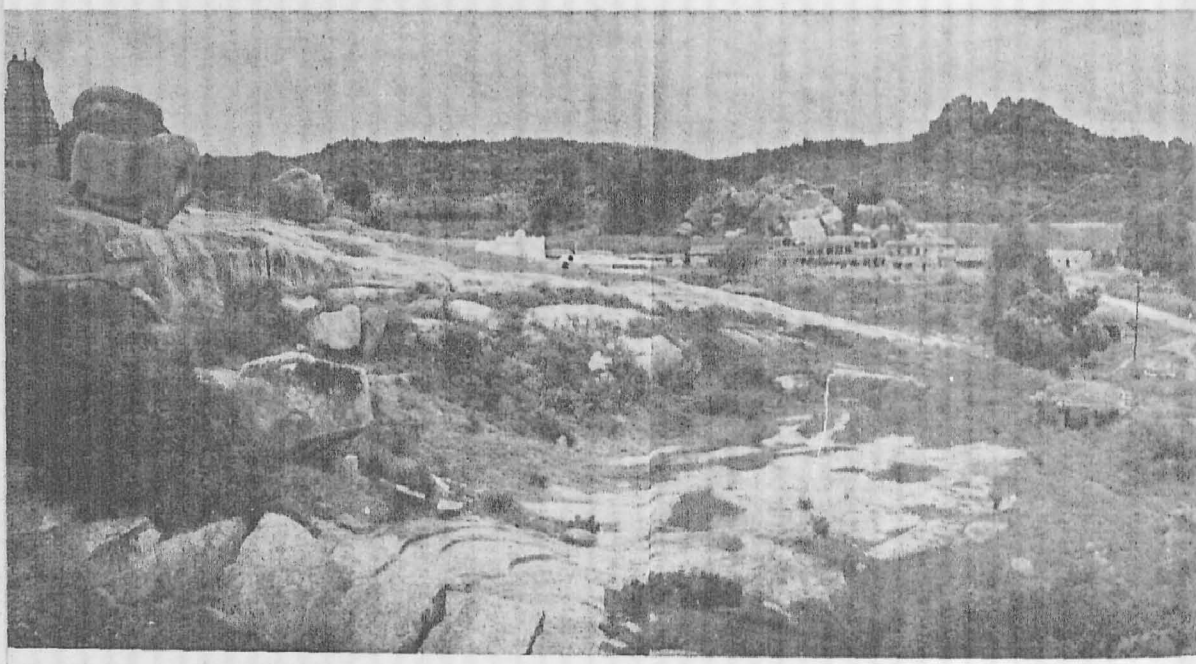


Fig. 7. The medium black cotton soil of trap and gneissic origin in the Coimbatore District, Tamil Nadu, yields rich crops of cotton and sugarcane

Fig. 8. Barren Archaean granite is covered with a thin layer of soil at Hampi, in the Bellary District, Karnataka. Good soil is found only in the low-lying areas



hydrates. Thus there are high-level laterites resting on the rocks, and low-level laterites formed in the usual way of detrital deposits.

Laterites are specially well developed on the summits of the hills of Karnataka, Kerala, Madhya Pradesh, the coastal region of Orissa, south Maharashtra, Malabar and part of Assam. All lateritic soils are generally very poor in lime and magnesia, and deficient in nitrogen. Occasionally, the P_2O_5 content may be high, but there is deficiency of K_2O.

In Tamil Nadu, there are both high-level and low-level laterites which are formed from a variety of rock materials under certain climatic and weather conditions. They are both *in-situ* and sedimentary formations, and are found along the coastal region where rainfall is heavy and the climate humid. The laterites at lower elevations grow rice, whereas those at higher elevations grow tea, cinchona, rubber and coffee. The soils are rich in nutrients and contain 10 to 20 per cent organic matter.

In Coorg, the laterite appears sporadically almost all over the district. In Maharashtra it is found only in Ratnagiri. In the soils of Ratnagiri, coarse material is found in large quantities.

In Kerala, in between the broad sea belt consisting of sandy soil and sandy loams and the eastern regions comprising forest and plantation soils, the mainland contains residual laterite. It is poor in total and available P_2O_5, available K_2O and CaO.

The laterite soils of Karnataka are comparable with the laterites found in Malabar, the Nilgiris, etc. The soils have very low lime content on account of severe leaching and erosion.

In West Bengal, the area between the Damodar and the Bhagirathi is interspersed with some basaltic and granitic hills with a laterite capping.

In Bihar, the laterite occurs principally as a cap on the higher plateau, but is also found in fair thickness in some valleys.

The laterites of Orissa are largely found capping hills and plateaus, occasionally in considerable thickness. Two types of laterites have been distinguished: (i) the laterite murrum, and (ii) the laterite rock. These are also found occurring together.

Other Soil Groups

In addition to the four principal groups of soils described above, mention may be made of four more groups.

Forest and Hill Soils: The soil formation is governed mainly by the character of the deposition of organic matter derived from the forest growth. Broadly, two conditions of soil formation may be distinguished: (i) soils formed under acid condition, with acid humus and low base status, and (ii) soils formed under slightly acid or neutral condition, with high base status, which is favourable to the formation of brown earths.

The soils of the hill district of Assam have a high content of organic

matter and nitrogen. This may be due to the virgin nature of these soils.

In Uttar Pradesh, the sub-Himalayan tract comprises three distinct parts, viz. *bhabar* area immediately below the hills, *tarai* and the plains. The *tarai* areas are characterized by extreme unhealthiness owing to excessive soil moisture and prolific growth of vegetation.

The weathering of metamorphic rocks in Coorg has produced deep-surface soil of great fertility, as it receives annually the decomposed products of the virgin forest. The areas towards the west are for the greater part reserved forests and mountain areas. The land surface is full of pebbles, is easily drained, and has a laterite bed.

Desert Soils: A large part of the arid region of Rajasthan and the Punjab and Haryana, lying between the Satluj and the Aravallis, is affected by desert conditions which, geologically, are of recent origin. This part is covered under a mantle of blown sand, and is dominated by conditions which inhibit soil growth. Some of the soils contain a high percentage of soluble salts and varying percentages of calcium carbonate, and possess high pH. They are, however, poor in organic matter. Reclamation is possible only ifproper irrigation facilities are made available.

Saline and Alkaline Soils: These soils are extensively distributed throughout India in all the climatic zones. Many parts of the dry tracts of the north, especially in Bihar, Uttar Pradesh, the Punjab, Haryana and Rajasthan, give rise to saline and alkaline efflorescences in the same way as the soils capping the Upper Tertiary rocks do. There are many yet undecomposed mineral fragments in these alluvial clays and silts, which on weathering liberate salts of sodium, magnesium and calcium. The injurious salts are confined to the top layers, being deposited there by the capillary transference of saline solutions from the lower strata.

It has been estimated that nearly 850,000 hectares in Uttar Pradesh and over 200,000 hectares in the Punjab and Haryana have been affected by *usar*. Over 10,000 hectares are being affected every year in the Punjab and Haryana. Alkali soils are met with all over Maharashtra.

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CHAPTER 3

CLIMATE AND AGRICULTURAL REGIONS

AGRICULTURE is largely conditioned by weather, including rainfall. In India, the success of agriculture depends principally on the monsoon rains.

The areas of very heavy rainfall in India are to the windward side of the Western Ghats, the hills of Assam, and the great Himalayan barrier. These are the watersheds from which originate the major river systems of the country. Elsewhere, in the plateau of the Deccan, the Gangetic plains of northern India, and the plains of southern India, the effects of orography are less pronounced or are completely absent, and the rainfall is only moderate. In the north-west, the Punjab, Haryana, Rajasthan and the adjoining tracts to the north and west constitute the driest area of the country.

The year may be divided into four seasons, viz. winter (December to February), summer or pre-monsoon period (March to May), monsoon (June to September), and the post-monsoon period (October to November).

MONSOON

India is truly the land of the monsoon. With the exception of Kashmir, and south-eastern Tamil Nadu, a very large percentage of the annual rainfall over the country occurs during the south-west monsoon period (June to September). In the extreme north, a good proportion of the annual rainfall is contributed by winter precipitation, whereas in south-east Tamil Nadu nearly half the annual rainfall occurs during the post- or retreating monsoon period (i.e. after September).

With the advance of summer, associated with the 'northing' of the sun, insolation increases rapidly over the higher latitudes so that by the end of May the region of the highest air temperature and the lowest atmospheric pressure lies over north-western India and the adjoining areas of Pakistan, Afghanistan, Iran and Central Asia. This low-pressure system takes over control, as it were, of the air currents over Asia, so that the south-east trade winds from the south of the equator, after being diverted into the Arabian Sea and the Bay of Bengal, appear suddenly over the west coasts of India and Burma, respectively, as the south-west monsoon. The Arabian Sea branch of the south-west monsoon, while crossing the Western Ghats, gives copious precipitation over that region, and continues to drift eastwards across the Deccan and the central parts of the country, meeting the bay branch of the monsoon along the trough of low pressure which extends from Orissa to north-western India. The bay branch is deflected by the Arakkan Yomas and turned in its course so as to skirt the northern side of

the low-pressure trough while moving along the submontane tracts to the south of the great Himalayan barrier.

The monsoon does not behave as a steady phenomenon. If that were so, the rainfall would always be orographic, i.e. to the windward side of the mountain barriers along the West Coast, the Arakkan mountains, and the Himalayas. Fortunately, the monsoon currents pulsate with a series of eastern depressions, originating in or reviving over the head of the Bay of Bengal, and moving in a westerly to north-westerly direction across the northern and central India. These depressions occur at intervals during the monsoon season, and divert the humid currents into the central and north-western tracts, thus bringing about a more equitable distribution of rainfall all over the country.

By mid-September the south-westerly monsoon rapidly withdraws and is termed the 'retreating monsoon'. This withdrawal gradually leads to the north-easterly air current assuming full sway over the subcontinent and the adjoining seas by January. The north-easterly monsoon, as it is called, is associated with rainy weather over the southern parts of Peninsular India, particularly over Tamil Nadu, from November to the end of January.

Eastern Depressions

Fluctuations in the intensity of the monsoon are to a very large extent associated with a series of depressions which mostly originate from (or, when they are coming from farther east, are strengthened at) the head of the Bay of Bengal, and travel in a north-westerly direction across the country towards north-western India, causing heavy rainfall along their track. The frequency of such depressions is three or four per month during the monsoon period (June to September). In some years, the frequency of these depressions comes down very much, and then the monsoon rainfall tends to become 'orographical' (i.e. confined to the hills and mountains). This phenomenon shows the importance of the depressions for securing a proper spatial distribution of the rainfall over the plains of northern and central India. In years of only a few depressions, droughts occur in the interior regions of the country, chiefly in the north-western and central parts.

Western Depressions

During November to May, a series of western depressions enter India through the North-West Frontier Province and Baluchistan, and move eastwards across northern India towards north-eastern India (Assam-Bengal). These depressions cause cloudy weather and light rains in the plains, and snowfall in the Himalayas, and are followed by cold waves. The frequency of these western depressions is, on an average, two in November, four or five per month during December to April, and about two in May.

Cyclonic Storms

The more severe cyclonic storms usually form in the Bay of Bengal and the Arabian Sea during the transition periods, i.e. April to June, and October to December. They enter inland and cause considerable precipitation and damage owing to high winds and, occasionally, tidal waves in the coastal tracts.

Monsoon Behaviour

To begin with, we may consider the total rainfall during the entire south-west monsoon season, i.e. from June to September. If the deviation of the actual precipitation in a year in a subdivision is more than twice the mean, that year may be defined as a year of flood or drought according as the departure is positive or negative. Generally speaking, the number of floods and droughts tend to equalize over long periods. It is the area with very low rainfall, e.g. Rajasthan, which experiences the greatest number of abnormalities. On the other hand, in areas like Konkan, Malabar and Bengal, where the monsoon rainfall is over 1,000 millimetres, abnormalities are fewer.

The years 1877, 1899 and 1918 stand out prominently as years of general drought. Such country-wide droughts occur once in about 20 years. These were actually the years of great famine and distress. The years of general flood were 1878, 1892 and 1917. There is, however, no regular periodicity in the occurrence of floods and droughts.

AGRICULTURAL REGIONS

The following agricultural regions are defined on the basis of climate, crops and stock animals:

I. THE TEMPERATE HIMALAYAN REGION

The Temperate Himalayan region may be divided into two subdivisions:

1. The Eastern Himalayan Region: This region includes Mishmi Hills in upper Assam, Sikkim, Bhutan and Nepal. Rainfall is heavy in the outer ranges and there are thick forests of *sal*. This is mainly a tea-growing area. Cultivation of rice is done in some places. Forests are the main source of wealth in this subregion.

2. The Western Himalayan Region: This region includes Kumaon, Garhwal, Himachal Pradesh and Jammu and Kashmir. As compared with the eastern Himalayas, the climate is dry. In the northern parts, there is more of winter rainfall, and the climate is almost of the Mediterranean type. Horticulture, particularly the growing of apples, almonds, cherries, apricots, peaches, pears and plums, occupies a prominent place in the agricultural economy of this region. Other cultivated crops

are potato, wheat, maize and rice. Goats and sheep are the principal domestic animals. Diminutive black cattle provide milk as well as draught.

II. THE DRY NORTHERN WHEAT REGION

This region comprises the Punjab, Haryana, western Uttar Pradesh, western Madhya Pradesh and parts of Rajasthan. The annual rainfall is less than 760 millimetres, and in many places less than 200 millimetres. The soil is alluvial, having been deposited by a large number of rivers in geological times. Wheat, barley, gram, maize and cotton are the chief crops. Cattle are mainly of the Hariana breed. Buffaloes are of the Murrah breed. They give a high milk yield. Camels are exclusively found in this region.

III. THE EASTERN RICE REGION

This region comprises Assam, West Bengal, Bihar, Orissa, eastern Madhya Pradesh, eastern Uttar Pradesh and parts of Andhra Pradesh. The soil is mainly alluvial. The annual rainfall of the region is over 1,500 millimetres. The main crops are rice, jute, sugarcane and tea. Buffalo is the favourite domestic animal. Male buffaloes are used for ploughing in preference to bullocks. The milk yield of buffaloes and cows is low.

IV. THE MALABAR COCONUT REGION

This region comprises Kerala, the Western Coast strip, Karnataka and the adjoining areas. The annual rainfall of the region is over 2,280 millimetres. The soil is lateritic. This region is important from the point of view of plantation crops, e.g. coffee and rubber. However, the predominant crop is coconut. Other important crops are tapioca, black pepper and cardamom. Rice is the main food crop. Cattle are of poor quality.

V. THE SOUTHERN MILLET REGION

This region comprises the Jhansi Division in southern Uttar Pradesh, central Madhya Pradesh, western Andhra Pradesh, western Tamil Nadu, eastern Maharashtra and parts of Karnataka. The rainfall of the region is 500-1,000 millimetres. The soil is partly black cotton and partly lateritic. Sorghum, pearl-millet, cotton and groundnut are the chief crops. The principal animals are sheep. The cattle give a poor milk yield.

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CHAPTER 4

VEGETATION

INDIA possesses a greater variety of vegetation than any other country. This is because of her geographical position (8° N to 37° N latitude and 63° E to 97·5° E longitude) as well as variations in altitude and climate. Immigration of plants from countries such as Malaya, China, Japan, Siberia, Arabia, Africa and Europe has also contributed to the variegated character of her flora. However, except at very high altitudes and in dry desert areas, the vegetation is essentially arboreal.

A comparison of the Indian flora with the floras of the adjacent countries indicates that there is considerable Malayan element. The European element is represented in the western Himalayas by several genera and species. The African element comes next in the order of dominance. The Tibetan and Siberian types are confined to the Himalayas, and comprise mainly alpine herbs and shrubs. The Chinese flora is strongly represented throughout the temperate Himalayas by species of oaks and rhododendrons.

The vegetation types described in this chapter concern largely the trees and shrubs under Phanerogams, together with a few Gymnosperms, which give character to the forests. It may be mentioned that within the areas under each type of vegetation, the occurrence and predominance of species are considerably influenced by physical factors, such as altitude, climate and soil.

India can be divided into five regions on the basis of vegetation types. These are as below.

1. *The Temperate Himalayan Region:* This region is further divided into two subregions, viz. the western Himalayas and the eastern Himalayas.

2. *The Tropical Thorn Forests:* They occur in the Indus Plain Region comprising the Punjab, Haryana, Gujarat and Rajasthan west of the Aravalli Hills.

3. *The Dry Deciduous Forests:* They occur in Rajasthan east of the Aravallis, southern Uttar Pradesh, Madhya Pradesh, central Maharashtra, a large part of Andhra Pradesh, Tamil Nadu and Karnataka.

4. *The Tropical Evergreen Rain Forests:* They occur in the western face of the Western Ghats—the Konkan, Kanara, Kerala, Annamalais and the Nilgiris.

5. *The Mangrove and Beach Forests:* They occur along the coastal region.

These five regions and their vegetation types are described in the following account :

1. THE TEMPERATE HIMALAYAN REGION

This region includes Assam (the Mishmi Hill tracts), Sikkim, northern Bengal, Kumaon and Garhwal, Himachal Pradesh, and Jammu and Kashmir. Rainfall is heavy in the outer ranges of the eastern portion. The northern portion is comparatively dry, though with more of winter rainfall, and the climate is almost of the Mediterranean type. There are thick forests of *sal* in the eastern portion.

i. The Western Himalayas. In this region are included Kumaon, Garhwal, Himachal Pradesh, and Jammu and Kashmir. The western Himalayan region to the west of the Satluj differs from the eastern in its greater length, higher altitude, cooler and drier climate and far greater breadth of the mountainous masses. In the *tarai* area grow stately forests of *sal* (*Shorea robusta*) (Fig. 9). Above 1,220 metres the climate is temperate and humid and forests of *chir*-pine, *Pinus roxburghii*, are commonly found (Fig. 10). In the dry regions, e.g. Chini in Himachal Pradesh, *Pinus gerardiana* lends character to the landscape. Other common trees are the Indian horse-chestnut, maple and walnut.

The *chir*-pine forests extend up to 1,980 metres and in their upper limit gradually get mixed up with white oak. The forest floor on the dry, south-facing slopes of the outer Himalayas are unusually open and grassy. On very exposed areas, *Euphorbia royleana* is common.

From 1,830 metres upwards, *Quercus incana* becomes characteristic, associated with *Rhododendron arboreum* and *Lyonia ovalifolia* (*Andromeda elliptica*), with the straggling *Rosa brunonii* (*R. moschata*) covering them. Shrubs, such as *Indigofera gerardiana, Spiraea bella, Deutzia* sp., *Leycesteria formosa, Piptanthus nepalensis, Pyrus ursina, P. pashia, Rosa sericea, R. macrophylla, Viburnum foetens, Berberis, Ribes glaciale, Lonicera parviflora, Rubus lasiocarpus* and *Prunus padus* are common.

At altitudes ranging from 2,130 to 3,050 metres, the characteristic trees are *Quercus semecarpifolia, Q. dilatata, Abies pindrow*, and *Cedrus deodara*. The typical oak forests consist of tall straight trees, laden with the lichen, *Usnea barbata*. The abies are also tall and stately, often reaching 61 metres in height. The principal associates of quercus-abies forests are *Arundinaria* sp. and *Taxus* sp. A few climbers, such as *Vitis semicordata, Clematis montana* and *Hedera nepalensis*, are also common. *Cedrus deodara* is the most stately tree in the Himalayas (Fig. 11). At about 2,740 to 3,050 metres *Pinus wallichiana, Picea smithiana* and *Cupressus torulosa* also occur in some localities. These forests usually grow on moist north-facing slopes, the sunny south-facing slopes being usually barren.

Rhododendron campanulatum, with its pink and mauve flowers, occurs at about 3,050 metres. Interspersed with rhododendrons are *Taxus baccata, Betula utilis* and clumps of dwarf *ringal* bamboo, *Arundinaria falcata*. They mark the end of the tree zone at about 3,660 metres.

The Alpine zone extends from 3,355 to 4,575 metres or sometimes even higher. Small bushes of *Juniperus recurva, Ephedra gerardiana, Rhododendron anthopogon* and *R. lepidotum* occur at 3,660 metres. Above 3,810 metres *Primula* occurs commonly, along with *Corydalis, Gagea* and *Aconitum lycotonum* (*A. laeve*). *Meconopsis aculeata,* the blue poppy, the pride of the Himalayan Alpine meadows, makes its appearance in July and August, along with the rare *Nomocharis,* which has purple-spotted yellow flowers. The cushion-like growth of *Arenaria festucoides* and some members of Caryophyllaceae and Crassulaceae are striking examples of xerophytic adaptations at high elevations. Gentians are represented by two species, and anemones by two, viz. *Anemone polyanthes* and *A. rupicola.* About eight species of *Potentilla* with all shades from deepest red to bright yellow, three species of *Primula,* light purple to deep, *Hackelia uncinata* (*Cynoglossum uncinatum*), *Androsace lanuginosa* and *Myosotis sylvaticus* (*M. pallens*) are also found in this zone.

Most of the plants have thick hairy leaves and this characteristic is observed in the members of Saxifragaceae, Crassulaceae and Compositae. The cushion-like habit is seen in *Arenaria musciformis* and *Thylacospermum rupifragum* and in *Caragana pygmaea.* The carpet-like habit is to be met with in *Rhododendron anthopogon, Salix sclerophylla* and species of *Cotoneaster.*

Another characteristic of Alpine vegetation in the trans-Himalayas is that the plants have brightly coloured flowers.

ii. The Eastern Himalayas. In the Eastern Himalayas are included the regions of Sikkim, Bhutan, the Balipara Frontier Tract, and the outlying Patkai, Barail, Khasi and Garo ranges. The evergreen types of vegetation found in these areas are distinguishable into the following subzones.

(a) *The Assam and Brahmaputra and Surma Valleys.* Along the eastern Himalayas and in the upper Brahmaputra and Surma Valleys, this forest type is represented by Meliaceae, Lauraceae, Myristicaceae, Magnoliaceae and others. The following species are typical of the lower slopes of the hills in upper Assam to the north of the Brahmaputra and the Naga Hills to the south of the river: *Dipterocarpus macrocarpus, D. gracilis, Artocarpus chaplasha, Shorea assamica, Cinnamomum cecidodaphne, Dysoxylum binectariferum, Altingia excelsa, Mesua ferrea, Pterygota alata, Michelia champaca, Amoora spectabilis, Toona ciliata* and *Kayea assamica.*

Along the lower slopes of the Cachar, Khasi and Jaintia Hills and around the Surma Valley are found: *Dipterocarpus turbinatus, D. macrocarpus, Pterygota alata, Mesua ferrea* and *Bombax insigne* (*Salmalia insignis*). *Artocarpus chaplasha* and *Quercus* (oak) are also found in these belts.

(b) *The Northern Bengal Region.* The northern Bengal region is characterized by *Schima-Bauhinia* in association with *Toona ciliata, Stereospermum personatum* (*S. tetragonum*), *Alilanthus grandis, Castanopsis indica, Tetrameles nudiflora, Michelia champaca* and *Gmelina arborea.* The undergrowth is composed of *Phoebe, Machilus, Amoora, Actinodaphne, Mesua* and *Polyalthia.*

Bamboo thickets of *Bambusa arundinacea, Dendrocalamus hamiltonii, Oxytenanthera nigrociliata* and *Melocanna bambusoides* are also noticed in these forests.

(c) *The Eastern Sub-Himalayan Tract.* This tract is humid, supporting a tropical flora up to an altitude of about 1,525 metres. The tropical evergreens are represented by species such as *Michelia champaca, Schima wallichii, Artocarpus chaplasha, Dillenia indica, Talauma hodgsonii, Aesculus assamica* (*A. punduana*), *Terminalia alata* (*T. tomentosa*), *T. myriocarpa, Bombax ceiba* (*Salmalia malabarica*), *Pterospermum acerifolium, Cinnamomum glanduliferum, Canarium sikkimense,* along with canes, climbers and an impenetrable undergrowth of evergreen shrubs.

At lower elevations, *Magnolia* sp. and *Michelia champaca* are met with and at higher elevations *Castanopsis indica, Alnus nepalensis* and *Bucklandia populnea* are found.

(i) In the Sub-Himalayan Tract of Bengal and the adjoining regions of Assam, however, the typical wet evergreen is only locally recognizable in places. *Sal* forests have established themselves in much of the area, rendering the type as one of wet mixed forests. In these areas, the species associated with *sal* are: *Michelia champaca, Schima wallichii, Anogeissus latifolia, Terminalia alata* (*T. tomentosa*) and *Dendrocalamus hamiltonii.* In the Tista Valley of Sikkim, they are *Garuga pinnata, Terminalia bellirica, Schima wallichii, Lagerstroemia parviflora, Tetrameles nudiflora, Sterculia villosa, Toona ciliata, Bauhinia purpurea, Mallotus philippensis* and *Callicarpa arborea.*

(ii) The laurel forest (approximately 1,830 to 2,135 metres) consists characteristically of *Machilus edulis, Beilschmiedia* spp., *Cinnamomum obtusifolium, Litsea* spp., *Alcimandra cathcarti* (*Michelia cathcartii*), *Magnolia campbellii, Engelhardtia spicata, Schima wallichii, Lithocarpus spicatus* (*Pasania spicata*), *Prunus nepalensis, Mallotus nepalensis, Betula alnoides, Acer laevigatum, A. campbellii, Eurya acuminata, Symplocos theaefolia, Castanopsis tribuloides* and members of Araliaceae.

(iii) The buck-oak forest (approximately 2,135 to 2,440 metres) consists of *Quercus lamellosa, Acer campbellii, Castanopsis tribuloides* and *Michelia* sp.

(iv) The high-altitude oak forest (approximately 2,440 to 2,745 metres) has *Lithocarpus pachyphyllus* (*Quercus pachyphylla*), intermixed with many of the buck-oak associates.

(v) In the Alpine zone (above 3,655 metres) in the eastern Himalayas the prominent families are Compositae, Scrophulariaceae, Primulaceae, Saxifragaceae, Cruciferae, Caryophyllaceae, Ranunculaceae, Cyperaceae, Gramineae and Fumariaceae. The principal bushes are those of rhododendrons. The most widespread genera are *Pedicularis, Primula, Corydalis* and *Saxifraga.* The few trees, scattered at the lower limits of this zone, are birches and pyri. Junipers, and species of *Ephedra, Berberis, Lonicera, Caragana, Rosa, Cotoneaster, Spiraea* and dwarf willows also occur. The

flowering plant recorded at the highest altitude is *Festuca* at about 5,580 metres. In the drier valleys above 4,570 metres, several species of *Arenaria* occur, and form hard, hemispheric or globose, white, cushion-like structures. The most striking plants of this zone are *Meconopsis* sp., *Rheum nobile*, *Primula* spp., *Tanacetum gossypium*, *Saussurea obvallata*, *S. gossypiphora* and the odorous *Rhododendron anthopogon*.

2. THE TROPICAL THORN FORESTS

These forests are characterized by a xerophytic flora of low and open formations, with many species adapted to xerophytic conditions. Thorny trees and plants are very common. Forests of this type are distributed over the Indus Plain region in southern Punjab, Haryana, Gujarat, Rajasthan, the Upper Gangetic Plains and in the Deccan Plateau.

The Indus Plain Region. This region includes the Punjab, Haryana, Gujarat and Rajasthan to the west of the Aravalli Hills. With a few exceptions, all trees in this region are deciduous, and most of the herbs are desiccated and burnt in the hot season. The vegetation of this region is typically xerophytic. The principal indigenous trees are: *Tamarix aphylla* (*T. articulata*), *Sterculia urens*, *Grewia damine* (*G. salicifolia*), *Aegle marmelos*, *Moringa oleifera*, *Dalbergia sissoo*, *Butea monosperma*, *Prosopis cineraria* (*P. spicigera*), *Acacia nilotica* (*A. arabica*), *Salvadora persica*, *S. oleoides*, *Anogeissus pendula*, *Cordia dichotoma* (*C. myxa*), *Terminalia alata* (*T. tomentosa*), *Tecomella undulata*, *Ficus lacor* (*F. infectoria*) and *Morus indica*.

Among the shrubs, the most conspicuous are the isolated clumps of the columnar, almost leafless *Euphorbia royleana* and *E. neriifolia*. Of special interest in this region are two species of cotton, *Gossypium stocksii* and *G. herbaceum* (*G. wightianum*). The other more or less prevalent shrubs and undershrubs in certain districts are: *Capparis decidua* (*C. aphylla*), *C. zeylanica* (*C. horrida*), *C. spinosa*, *Flacourtia ramontchi*, *Tamarix dioica*, *T. troupii* (*T. gallica*), *Grewia* sp., *Fagonia cretica* (*F. arabica*), *Rhamnus pentapomica* (*R. persica*), *R. virgata*, *Ziziphus nummularia*, *Z. jujuba* (*Z. vulgaris*), *Z. oenoplia*, *Dodonoea viscosa*, *Alhagi pseudalhagi* (*A. maurorum*), *Edwardsia mollis* (*Sophora mollis*), *Cassia auriculata*, *C. tora*, *C. obtusa* (*C. obovata*), *Mimosa rubicaulis*, *Pluchea lanceolata*, *Reptonia buxifolia*, *Carissa spinarum* (*C. diffusa*), *Rhazya stricta*, *Nerium indicum* (*N. odorum*), *Orthanthera viminea*, *Periploca aphylla*, *Calotropis procera*, *C. gigantea*, *Withania coagulans*, *Adhatoda vasica*, *Calligonum polygonoides*, *Pteropyrum oliveri*, *Salsola baryosma* (*S. foetida*) and species of *Kochia*. The fleshy *Suaeda* and *Salsola* grow on saline soils and *Calligonum polygonoides* on sandy soils.

In the Thar Desert, the fleshy *Euphorbia neriifolia* is the most characteristic species. It is poisonous and is not eaten by cattle. This explains its widespread occurrence. Trees are also indicators of soil types to a large extent. *Salvadora persica* and *Prosopis cineraria* (*P. spicigera*) grow on loam.

Tamarix aphylla (*T. articulata*) grows on saline soil, and, in areas where it grows, wells too have saline and bitter water. *Butea monosperma* grows on *usar* and *reh* lands impregnated with calcium bicarbonates on which no other trees can thrive.

The trees found in the xerophytic forests of Rajasthan are those with reduced leaf surface or with fleshy leaves. Various species of *Acacia* and *Prosopis*, the commonest being *Acacia nilotica* (*A. arabica*) and *A. leucophloea*, are associated with *Prosopis cineraria* (*P. spicigera*) and the exotic *P. chilensis* (*P. juliflora*). *Acacia catechu* is found in considerable numbers in Kutch. In the southern Aravallis, *Anogeissus pendula* occurs in fairly homogeneous patches. Other typical species are *Salvadora oleoides*, *Tamarix aphylla* (*T. articulata*), *Ziziphus mauritiana* (*Z. jujuba*), *Grewia tenax* (*G. populifolia*) and *Ehretia laevis*. The undergrowth consists of *Capparis decidua* (*C. aphylla*), *C. spinosa*, *Asclepias* and *Calotropis*, with the fleshy *Suaeda* and *Salsola* growing on saline soils, and *Calligonum polygonoides* on sandy soils. *Euphorbia nivulia*, with a thorny stem, is also very characteristic at the foot of dry mountains.

3. THE DRY DECIDUOUS FORESTS

These consist of low forests almost entirely of deciduous trees in all canopies. The following regions support a similar type of forests.

The Upper Gangetic Plains. These plains include Rajasthan to the east of the Aravalli Hills, Bundelkhand, Malwa in Madhya Pradesh, and the Jhansi Division of western Uttar Pradesh. The indigenous vegetation of this subregion is that of a dry country. The trees in the dry season are leafless for the most part and the grasses and herbs get desiccated and burnt up in the hot season. The principal forest is that of Ajmer, flanking the Aravallis and other hills which bound the subregion on the west. The average rainfall is 635 millimetres. At the close of winter, temperature rises rapidly during March, and humidity goes down. High temperature shooting up to 45·6°C in the shade, and desiccating hot westerly winds from the rocky Aravalli Hills and the sandy deserts of Rajasthan, often accompanied with dust-storms in May and June, have produced a typical desert vegetation of xerophytes, with adaptations to guard against dry conditions and with devices to conserve moisture. The commonest trees are the leafless *Capparis decidua*, *Salvadora oleoides*, with tough leathery leaves, *Acacia nilotica* (*A. arabica*), *Prosopis cineraria* (*P. spicigera*), *Balanites aegyptiaca*, *Diospyros cordifolia*, *Ficus rumphii* and several species of *Tamarix*, with reduced scaly leaves. The wastelands between the villages are more or less barren, with only occasional patches of *Ziziphus nummularia* and *Salvadora persica*. Other trees more or less restricted to western India are *Moringa oleifera*, *Acacia senegal* and *Prosopis cineraria* (*P. spicigera*) accompanied with the common trees of the drier parts of India, especially *Butea monosperma*. Considerable

Fig. 9. A forest of sal (*Shorea robusta*), Dehra Dun. Sal forests are found at the foothills of the Himalayas from Uttar Pradesh to Assam. They are also found in the forest belt comprising southern Bihar, western Orissa and eastern Madhya Pradesh
(Courtesy: Forest Research Institute)

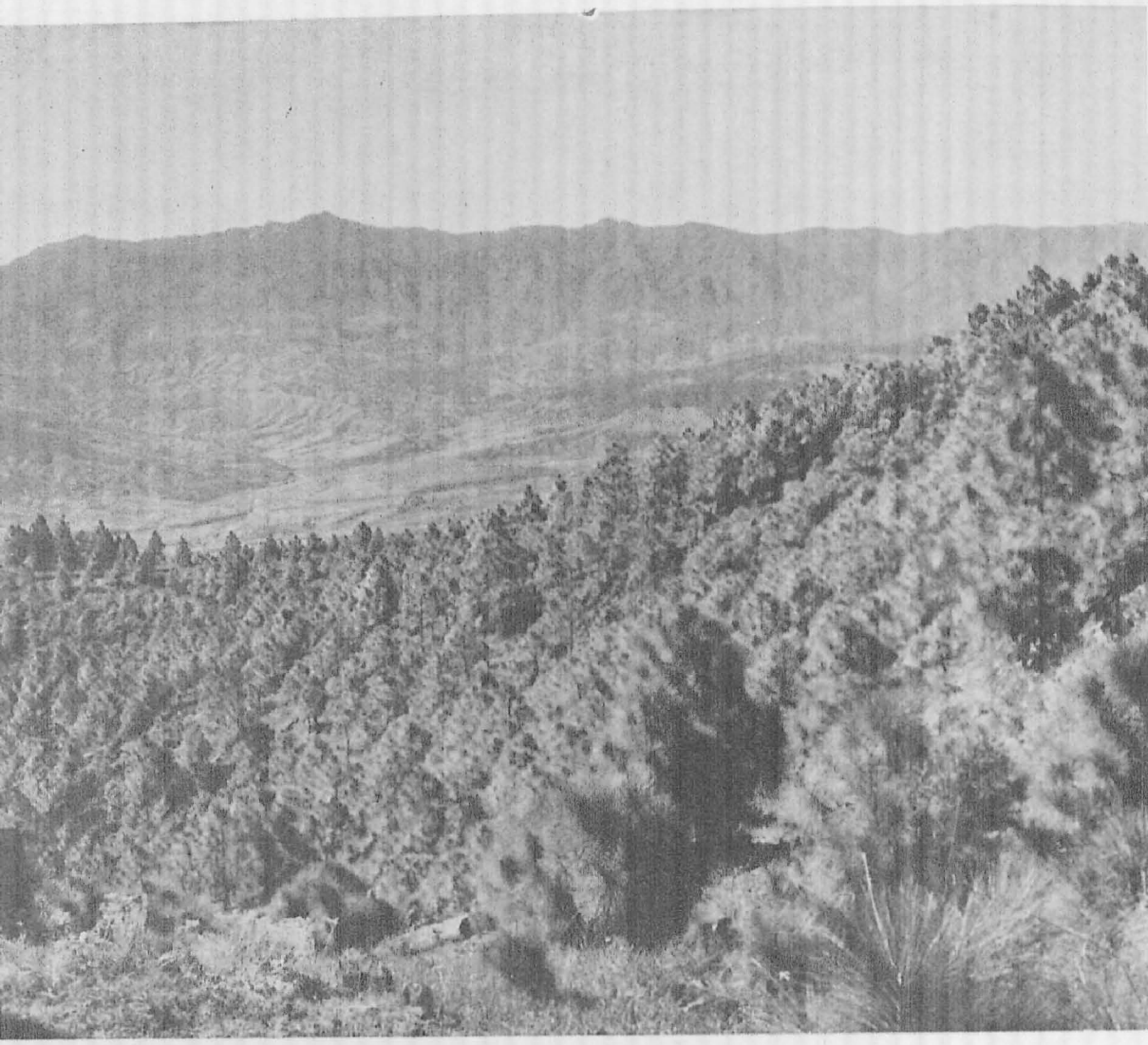

Fig. 10. A young forest of *Pinus roxburghii* in the Siwaliks, Uttar Pradesh (Courtesy: Forest Research Institute)

Fig. 11. A forest of *Cedrus deodara* near Simla, 2,134 metres above sea-level. *Cedrus deodara* is the most stately tree in the forests of the western Himalayas
(Courtesy: Forest Research Institute)

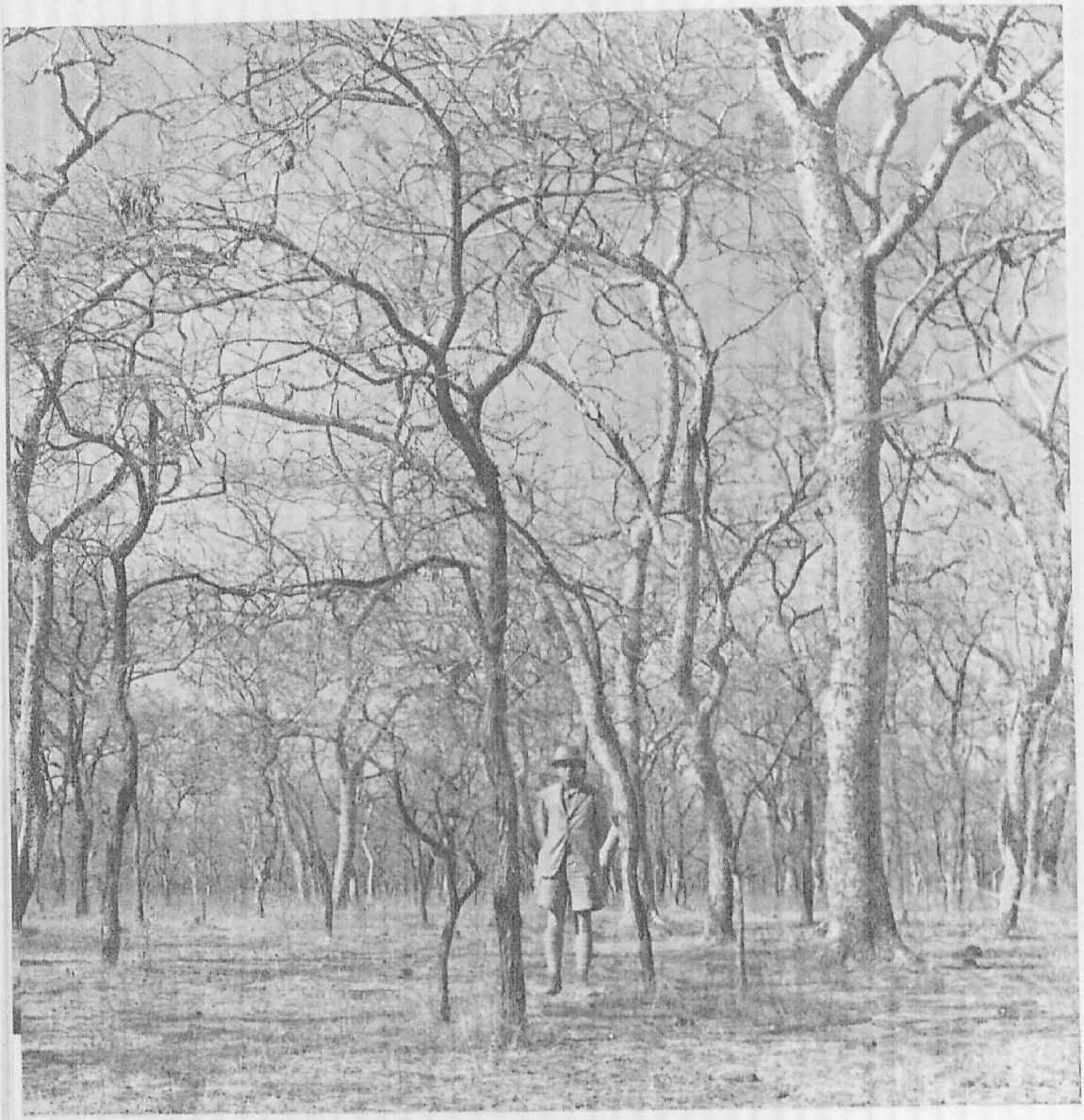

Fig. 12. A dry deciduous forest containing *Boswellia serrata* and *Acacia catechu* in Madhya Pradesh
(Courtesy: Forest Research Institute)

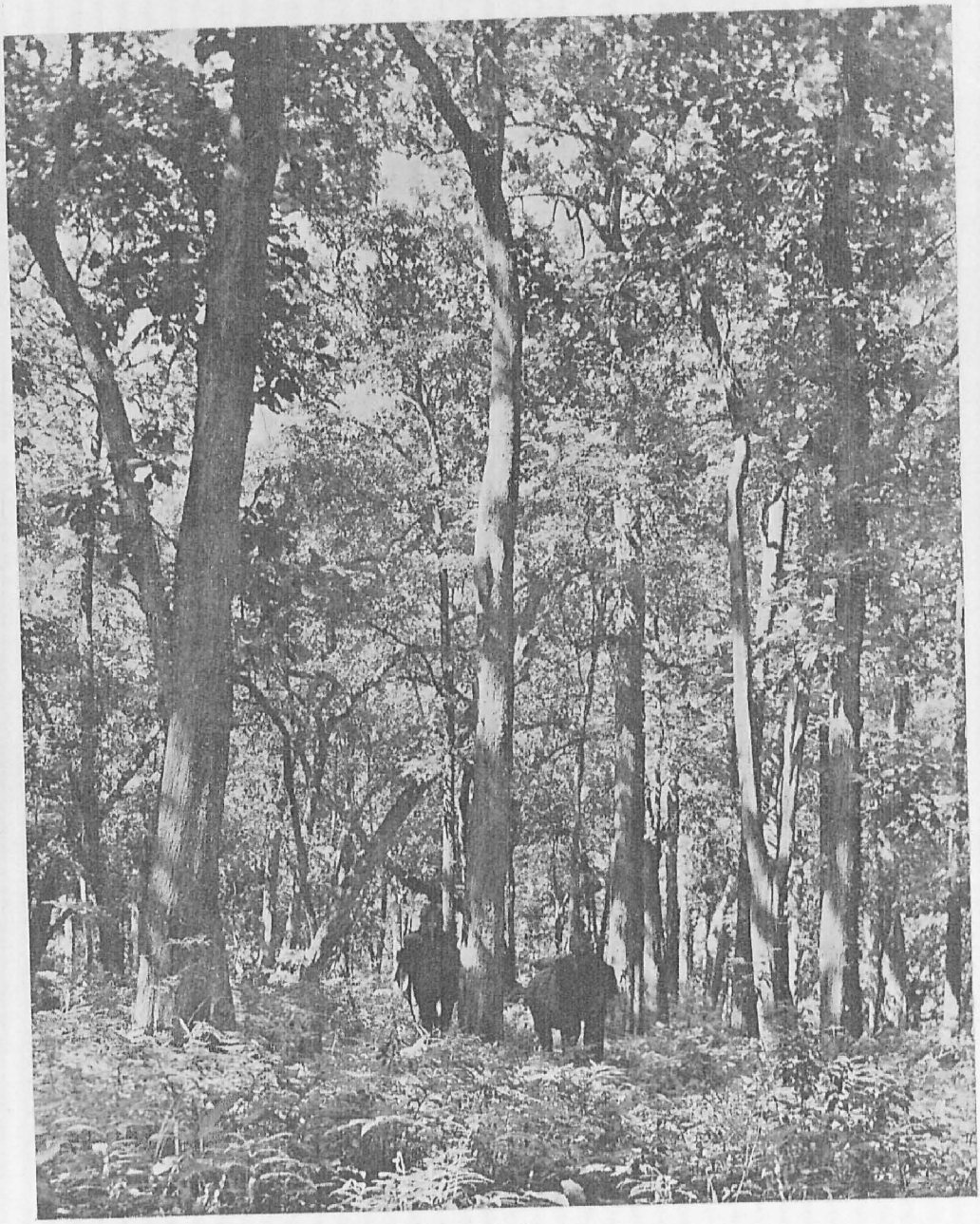

Fig. 13. A forest of teak (*Tectona grandis*) in Madhya Pradesh
(Courtesy: Forest Research Institute)

Fig. 14. A tropical wet evergreen forest in Kerala. *Left to right:* small *Dipterocarpus bourdillonii*, *Vitex altissima*, large *Dipterocarpus*, large *Kingiodendron pinnatum* and *Polyalthia* sp. Shendurney Coupe V, Shencottah Division, Kerala
(Courtesy: Forest Research Institute)

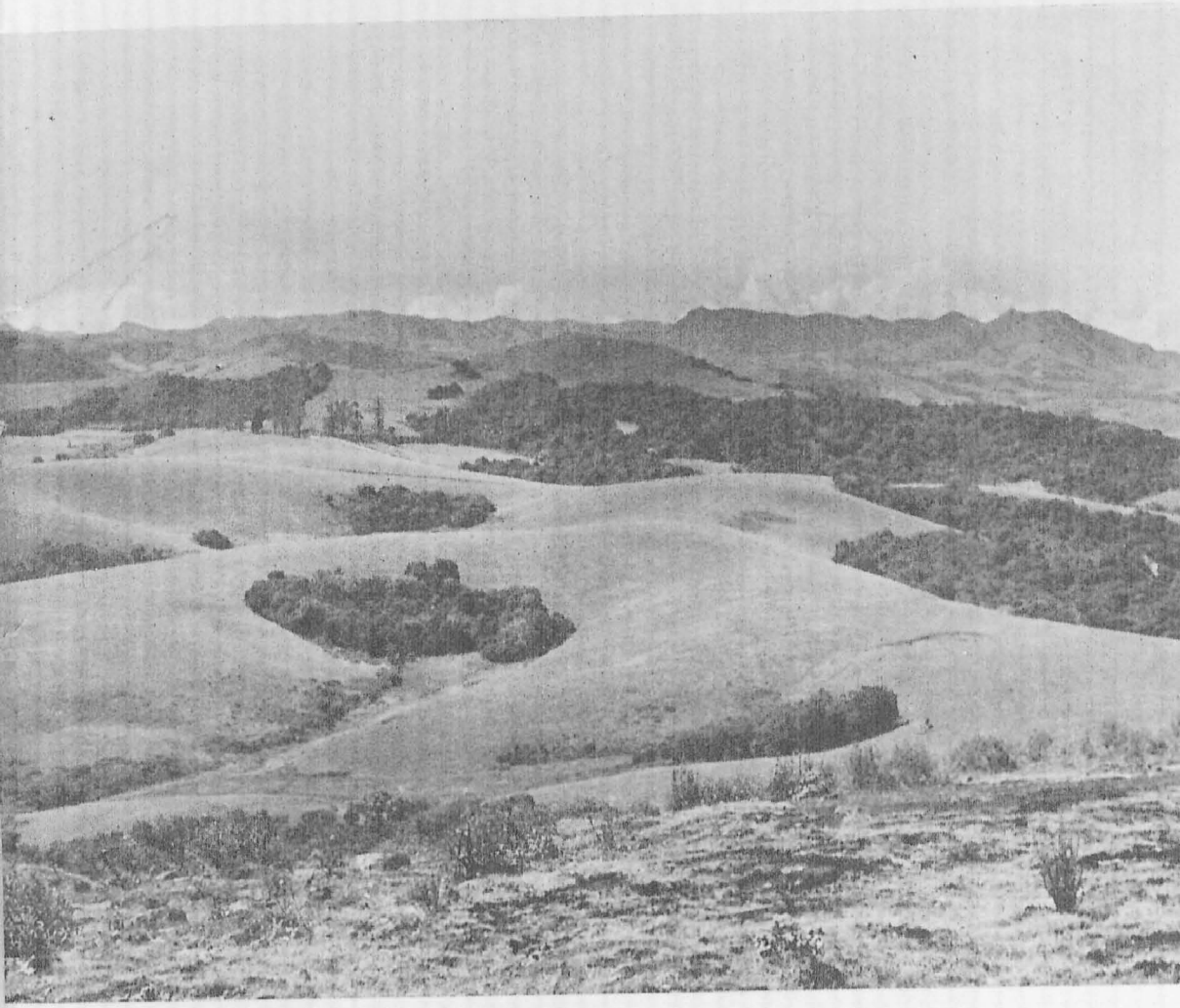

Fig. 15. The Nilgiri *sholas* and grassland, Ootacamund, Tamil Nadu. The *shola* forests are a living fossil community limited to the hollows, especially the heads of water-courses. Once destroyed, they do not regenerate
(Courtesy: Forest Research Institute)

Fig. 16. Pure *sundri* forest (*Heritiera fomes*), Sunderbans, West Bengal, showing dense pneumatophore growth and buttressing of trees
(Courtesy: Forest Research Institute)

areas of this subregion are occupied by the *usar* or *reh* land which, being impregnated with alkaline salts, are converted into swamps in the rainy season and into deserts in the dry season. *Salvadora persica* and *Butea monosperma* are the only trees that succeed on saline soils. The rocky areas are covered with hardy shrubs, e.g. *Anogeissus pendula*. Among the herbaceous vegetation we find such interesting xerophytes as *Leptadenia spartium* with erect, cylindrical, almost leafless branches, the spiny *Alhagi pseudalhagi* (*A. camelorum*), and the deep-rooted *Arnebia hispidissima*. In the shade of the prickly bushes of *Capparis sepiaria* grows the inconspicuous drought-resistant *Ceropegia bulbosa*, whose bulbous perennating stem is roasted and eaten by cowherds. Besides these, we find succulent herbs, such as *Portulaca oleracea* and *Salsola foetida*, which store up a large quantity of water in their leaves, and rosette plants with tough perennating rootstocks, such as *Boerhaavia diffusa* and *Euphorbia thymifolia*. Of the herbaceous plants, a few perennial-rooted grasses are the only ones which thrive.

Central India. The commonest species are *Anogeissus acuminata*, *A. latifolia*, *Erythrina suberosa*, *Mangifera indica*, *Syzygium cumini*, *Albizzia odoratissima*, *Boswellia serrata*, *Lannea coromandelica*, *Sterculia urens*, *Terminalia bellirica*, *Ficus glomerata* and *F. religiosa*. The most conspicuous trees are *Boswellia serrata* and *Sterculia urens*. In the leafless condition, *Boswellia serrata*, with its peculiarly twisted branches and yellow stem, is a remarkable sight (Fig. 12). Its wood is used in manufacturing matchboxes, matchsticks and paper pulp. *Sterculia urens* yields gum *katira*, which is used in cosmetics. The commonest bamboo is *Dendrocalamus strictus*, which is also used for the manufacture of paper pulp. The following trees comprise the lower canopy of these forests: *Mallotus philippensis*, *Flacourtia ramontchi*, *Carissa spinarum*, *Emblica officinalis*, *Wrightia tomentosa*, *Bauhinia retusa*, *B. racemosa*, *Caesaria tomentosa*, *Butea monosperma*, *Holoptelea integrifolia* and *Dendrocalamus strictus*.

The South-east Deccan. This region comprises the Eastern Ghats, Tamil Nadu, a large part of Andhra Pradesh and Karnataka. The vegetation is of a dry, thorny, stunted type. The commonest species are *Acacia planifrons*, *A. sundra*, *Mimusops* sp., *Azadirachta indica*, *Albizzia amara*, *Acacia latronum*, *Cailliea cinerea* (*Dichrostachya cinerea*), *Chloroxylon swietenia*, *Prosopis cineraria* (*P. spicigera*), *Bombax insigne* (*Salmalia insignis*) and *Osyris arborea*. The fleshy evergreen *Euphorbia* sp. also constitutes a characteristic feature of the vegetation. *Cassia auriculata* and *C. fistula* occur here and there, and the chief among the thorny shrubs are *Capparis* sp., *Carissa spinarum*, *Aristida adscensionis* and *Ziziphus* sp.

Karnataka. The forests in the Karnataka region form an intermediate stage between the monsoon and xerophytic forests. The commonest forest tree is sandalwood. Other representatives are *Tectona grandis* and the associated *Terminalia* spp. and *Anogeissus latifolia*. Other species include

Dillenia pentagyna, Kydia calycina, Lagerstroemia lanceolata, Adina cordifolia, Madhuca indica (*M. latifolia*), *Grewia asiatica, Pterocarpus marsupium, Lannea coromandelica, Bombax ceiba* (*Salmalia malabarica*), *Butea monosperma, Bridelia retusa, Diospyros melanoxylon* and *Emblica officinalis.* The chief bamboo is the well-known commercial variety, *Dendrocalamus strictus.*

Grand forests of teak (*Tectona grandis*) grow in southern Madhya Pradesh (Fig. 13), Maharashtra, and the mountainous areas of Karnataka, Andhra Pradesh, Tamil Nadu and Kerala.

4. THE TROPICAL EVERGREEN RAIN FORESTS

These forest types are developed in regions of very heavy rainfall and are characterized by the great variety and luxuriance of their vegetation, composed largely of dense mesophytic evergreens. Many trees attain great height and girth, and in these forests, three or four canopy layers or storeys are noticeable, dependent on the varying heights of the trees. Some species also develop characteristic buttressed stems at the base. Generally, the tree trunks are densely clothed with a thick felt of leafy Jungermanniales and mosses. The ground in these forests is usually covered with a dense growth of shrubby vegetation and ferns. Large woody climbers, tree-ferns, palms, bamboos and cane-breaks are also characteristics of these forests. Epiphytes are common.

Typical evergreen forests are to be found along the West Coast of Peninsular India, particularly on the western face of the Western Ghats, the Konkan, Kanara, the Kerala, Annamalais and the Nilgiris. The greater part of it is hilly and mountainous, and the western face of the Western Ghats supports a dense vegetation of Malayan type, chiefly represented by members of Sterculiaceae, Tiliaceae, Anacardiaceae, Meliaceae, Myrtaceae, Melastomaceae, Vitaceae, Gesneraceae, Piperaceae, Zingiberaceae, Orchidaceae and Araceae. The species commonly met with in this region are: *Dipterocarpus indicus, Hopea parviflora, H. wightiana, Calophyllum elatum* (*C. tomentosum*), *Cullenia excelsa, Palaquium ellipticum, Dysoxylum malabaricum, Syzygium cumini, Actinodaphne ungustifolia, Canthium dicoccum, Terminalia chebula, Carvia callosa, Toona ciliata, Vateria indica, Canarium strictum, Tetrameles nudiflora, Mesua ferrea, Mangifera indica, Pterygota alata, Acrocarpus fraxinifolius, Olea dioica* and *Xanthophyllum tomentosa* (*Pouteria tomentosa*).

Forests of *Dipterocarpus* sp., *Kingiodendron pinnatum* and *Polyalthia* sp. provide timber to the people of Kerala (Fig. 14).

Palms are represented by the species of *Arenga, Caryota* and *Corypha* with the cultivated *Areca catechu* and *Cocos nucifera* in places. Among undershrubs, *Strobilanthes* is important, and many species are noted for flowering at long intervals of 4, 6, 12 or even 15 years. Among herbaceous plants, *Impatiens* with about 60 species is conspicuous. In the mountain torrents in the Ghats, species of the family Podostemonaceae occur.

The evergreen rain forests in the Western Ghats and those of Assam have much in common and also with the flora of Burma and Malaya. The cumulative effect of the Quaternary climatic and edaphic changes has reduced these forests to their present restricted distribution along the Malabar coast and in Assam. These forests now exist in the narrow belt of the country, more than 80 kilometres broad in the Western Ghats from Goa to Cape Comorin through Kanara and Coorg to the highlands of Kerala in the south and to parts of Tamil Nadu towards the east. In the drier parts, teak and sandalwood occur in these regions. The higher mountains are populated by species of *Ternstroemia, Microtropis, Michelia, Gordonia, Syzygium, Photinia, Rhododendron*, etc., along with the shrubs of Oleaceae, Rubiaceae, Rutaceae and various climbers and lianas. The patches of the forests in the ravines are called the *sholas*. Since the region is characterized by high humidity and abundant rainfall, it is in fact the pluvial flora that had advanced and retreated during the pluvial and interpluvial periods in Peninsular India and in Assam. Successive fluctuations must have occurred between the wet-evergreen and the dry-deciduous forests until their present distribution was attained. An interesting result of the Quaternary events and changes in climate is the reduction of the *shola* forests in the Nilgiris to the status of a living fossil community to which the present environment is so inimical that it has stopped regenerating itself (Fig. 15). Any injury to the *shola* forest is a permanent injury from which it never recovers.

5. THE MANGROVE AND BEACH FORESTS

Throughout the tropics, particularly in the littoral regions in the estuaries of rivers, in creeks and lagoons of low-lying areas, is to be found a peculiar type of vegetation known as the mangrove vegetation or the mangrove swamp. In India and Pakistan, the mangrove forests are developed in suitable localities along the coastal region, from the Indus Delta in Sind southwards, along the West Coast of Peninsular India down to Kerala, and from the Sunderbans southwards along the East Coast of the Peninsula. They are also seen along the coast of the Andamans and the adjacent islands. The mangrove formations extend up rivers, sometimes for miles.

The more common families represented in our typical mangrove forests are Rhizophoraceae, Meliaceae, Leguminosae, Combretaceae, Lythraceae, Rubiaceae, Myrsinaceae, Acanthaceae, Verbenaceae, Euphorbiaceae and Palmaceae.

The following are some of the species met with in the mangrove forests of India and the Andamans: *Rhizophora mucronata, R. apiculata* (*R. conjugata*), *Ceriops tagal* (*C. candolleana*), *C. roxburghiana, Kandelia candel, Bruguiera conjugata* (*B. gymnorhiza*), *B. sexangula* (*B. eriopetala*), *B. cylindrica* (*B. caryophylloides*), *Xylocarpus granatum, Cynometra ramiflora, Aegialites rotundifolia, Xylocarpus molluccensis, Lumnitzera racemosa, L. littorea* (*L. coccinea*), *Sonneratia apetala,*

S. alba, S. caseolaris (S. acida) Scyphiphoya hydrophyllaceae, Aegiceras corniculatum, Acanthus ilicifolius, Avicennia officinalis, Excoecaria agallocha, Nipa fruticans and *Phoenix paludosa.*

As regards the distribution of the species in our mangrove forests, along the East and West Coasts of India and the Sunderbans and the Andamans, it is seen that whereas some species such as *Rhizophora mucronata, Bruguiera conjugata* (*B. gymnorhiza*), *Sonneratia caseolaris* (*S. acida*) and *Aegiceras corniculatum* are common to all these areas, a few others have rather a restricted distribution on the East Coast of Peninsular India and in regions east of it. Among this category may be mentioned *Xylocarpa molluccensis Scyphiphora hydrophyllaceae, Nipa fruticans* and *Phoenix paludosa.*

One of the most extensively developed mangrove forests in India is in the Sunderbans in the Ganges Delta. In this forest belt, there are about 50 species of trees which may be conveniently classified into: (1) purely estuarial species, and (2) species common to other parts of India. Among the purely estuarial species are: *Hibiscus tiliaceus* (*H. tortuosus*), *Thespesia populnea, Brownlowia lanceolata, Amoora cucullata, Xylocarpus molluccensis, X. granatum, Bouea burmanica* (*B. oppositifolia*), *Erythrina variegata, Afzelia bijuga, Rhizophora apiculata* (*R. conjugata*), *R. mucronata, Ceriops roxburghiana, Kandelia candel, Bruguiera conjugata* (*B. gymnorhiza*), *B. parviflora, Lumnitzera racemosa, Barringtonia racemosa, Sonneratia apetala, S. caseolaris* (*S. acida*), *Aegialites rotundifolia, Aegiceras corniculatum, Cerbera odollam, Avicennia officinalis, A. alba, Excoecaria agallocha, Sapium indicum, Casuarina equisetifolia, Nipa fruticans* and *Phoenix paludosa.* To these may also be added *Hibiscus tiliaceous, Dalbergia spinosa, D. candenatensis* (*D. torta*), *Mucuna gigantea, Derrissinuata* and *D. trifoliata* (*D. uliginosa*), *Finlaysonia obovata, Sarcolobus globosus, Acanthus ilicifolius* and *A. volubilis.*

Of the species common to inland Bengal, the following may be mentioned: *Kleinhovia hospita, Micromolum pubescens, Aegle marmelos, Ziziphus mauritiana* (*Z. jujuba*), *Lannea coromandelica, Cassia fistula, Pongamia pinnata, Acacia tomentosa, A. nilotica* (*A. arabica*), *Barringtonia acutangula, Ixora arborea* (*I. parviflora*), *Morinda bracteata, Diospyros montana, D. peregrina* (*D. malabarica*), *Cordia dichotoma* (*C. myxa*), *Dolichandrone spathacea* (*D. rheedii*), *Vitex trifolia, V. negundo, Drypetes assamica* (*Cyclostemon assamicus*), *Croton oblongifolius, Antidesma ghaesembilla, Trewia nudiflora, Streblus, Trema* and *Ficus.*

The root-system of mangroves is characterized by special adaptations to their environments, which are often water-logged and poorly aerated. Some species as *Rhizophora* have a system of aerial stilt roots to support the trees; others, e.g. *Bruguiera,* send up peg-like projections from their roots; still others, e.g. *Heritiera, Lumnitzera* and *Kandelia,* produce aerial 'knee roots'; and yet others, e.g. *Avicennia,* have pneumatophores or breathing roots. In the Sunderbans are found 'pure *sundri*' forest (*Heritiera minor, H. fomes*) with dense pneumatophore growth (Fig. 16).

The members of Rhizophoraceae exhibit a peculiar phenomenon known as vivipary. Owing to this phenomenon, while the fruit is still attached to the parent tree, the embryo begins to grow, the hypocotyl protrudes, and the seedling hangs vertically from the fruit itself.

Beach Forests. Before concluding this chapter, a brief mention may also be made of a narrow belt or strip of vegetation seen along the coast, and a little farther from the high-tide limits, known as the beach forests. In this belt, the trees are partly evergreen and partly deciduous. In places, *Casuarina equisetifolia* is cultivated extensively.

Among the more common species may be mentioned: *Mimusops littoralis, Pongamia pinnata, Morinda citrifolia, Erythrina variegata, Calophyllum inophyllum, Terminalia catappa, Barringtonia asiatica* (*B. speciosa*), *Cordia subcordata, Thespesia populnea, Vigna marina* (*V. retusa*), *Mucuna gigantea, Colubrina asiatica, Calotropis gigantea* and *Pandanus odoratissimus* (*P. tectorius*).

CHAPTER 5

THE TERTIARY PERIOD : MIOCENE-PLIOCENE EPOCHS

APES, RAMAPITHECUS, THE EARLIEST-KNOWN HOMINID, AND AUSTRALOPITHECINES

With the disintegration of the Gondwanaland towards the end of the Cretaceous, the continents acquired their present features, their shapes, the great mountain systems, the courses of the rivers, the great plains, and the climatic zones. The Cenozoic Era that followed the Mesozoic is continued up to the present. It began about 60 million years ago.

The Cenozoic Era is divided into two periods—the Tertiary and the Quaternary. The Tertiary is subdivided into five epochs. The name of each epoch ends with the suffix *cene* (Greek, *recent*), and refers to the progress of life. Originally it was done on the basis of the percentage of living species of molluscs found in the rocks, but later certain marked palaeontologic characters as well as physical events were included. The Tertiary Period has been studied in greater detail than any other period, partly because its flora and fauna bear close similarities to the living forms, but mainly because of economic reasons, viz. search for petroleum, of which more than 50 per cent of the world production comes from the Tertiary rocks.

The subdivisions of the Cenozoic Era are shown below with their approximate durations:

Cenozoic Era	Quaternary Period	Recent Epoch	10,000 years	
		Pleistocene Epoch (most recent)	1 million years	Neogene Period
		Pliocene Epoch (more recent)	7 million years	
		Miocene Epoch (less recent)	12 million years	
	Tertiary Period	Oligocene Epoch (little recent)	15 million years	Paleogene Period or Nummulitic Period
		Eocene Epoch (dawn recent)	15 million years	
		Paleocene Epoch (ancient recent)	10 million years	

Middle Miocene to Lower Pleistocene—the Siwalik System. The Siwalik Hills extend for 1,600 kilometres along the Himalayas from Balu-

chistan to Assam. They are 16 to 59 kilometres wide, and rise to a height of 1,600 metres. They are composed of fine sand and pebbles, and were formed from the mid-Miocene to the Pleistocene. The Siwalik system has been split into three divisions as follows :

Upper Siwaliks	Boulder conglomerate beds	First Glaciation
	Pinjor sandstones	Lower Pleistocene
	Tatrot sandstone	Pliocene
Middle Siwaliks	Dhok Pathan—gravels, brown sandstones, shales and clays	Upper to middle Miocene
	Nagri—grey sandstone and shales	
Lower Siwaliks	Chinji—bright red shales and sandstones	Middle Miocene
	Kamlial sandstones	

The Siwalik or Indobrahm River. From the north-eastern corner of Assam, a mighty river flowed in the western direction along the foot of the Himalayas as far as the Pothohar or Rawalpindi plateau in Pakistan, where it joined the Indus which emptied itself into the Arabian Sea, then lying farther inside Sind. This river has been called the "Indobrahm" or the Siwalik River. It received on its right bank the rivers of the Gangetic system as well as the Punjab rivers of the Indus system. On its left bank, it might have received the ancient Son, Chambal, etc., from Peninsular India. The Indobrahm flourished from the Miocene to the Pliocene for about 20 million years. During this period, its basin, 6,000 metres deep, was filled with mud, sand, gravel, boulders, logs of wood and skeletons of dead animals that lived in the neighbourhood. An excessive thickness of sediments accumulated as the basin was gradually sinking in response to the rising Himalayas in accordance with the principle of isostasy.

Although there can be no doubt about the existence of the Siwalik River from the vicinity of Naini Tal to the Arabian Sea, its continuation farther eastwards along the whole length of the Himalayan base to Assam is less substantiated.

Climate. General fluctuations of climate during the Tertiary comprised progressive warming up from the lower Eocene, approaching the maximum warmth in the later Eocene, Oligocene and the early Miocene when besides the warm, the wet and humid climate existed and supported tropical rain forests. From the upper Miocene to the Pliocene, the climate gradually cooled again and progressively approached its climax towards the close of the Pliocene. In this general trend of climatic changes, it may be remarked that the warm to wet tropical climate almost uniformly existed all over India during the early and mid-Tertiary and it was more moist than now.

The Fauna. The fauna provides a glimpse of the geographical conditions that generally prevailed during the Siwalik Period in the riverain tracts along the foot of the rising Himalayas. The dinotheres and primitive trilophodonts were water-loving animals, characteristic of warm and humid lowlands, because their teeth were adapted to eating only succulent herbage. The occurrence of the aquatic tragulids and hippopotamuses suggests the presence of rivers. A savannah or swamp-type environment is indicated by *Hipparion*, whose broad hooves were exceptionally adapted to it, whereas *Equus* was better adapted to harder ground and harsher herbage. The presence of antelopes indicates prairies, steppes, or deserts, whereas goats and oxen, with "cloven hooves" were suited for moving on the soft forest soils. The majority of the pigs and Canidae were forest-dwellers, though a few from the Chinji to the Dhok Pathan show striking adaptation to the growing arid conditions. *Giraffokeryx* had a preference for the forest, and the giraffe, with its characteristic feet and teeth structure, preferred the open grassland with scattered trees. In the words of Edwin Pascoe, "In general, therefore, we may visualize, during most of the period, belts of luxuriant forest and open grass plains, with a great river winding through one or the other."

The presence of hippopotamuses, antelopes, giraffes, and giraffe-like animals indicates a link with Africa, where these animals still exist, whereas they have become extinct in India. It seems there was an effective land-link between India and Africa in the Tertiary Period.

EVOLUTION OF PRIMATES IN INDIA

Africa, India and South-East Asia are the areas where the evolution of primates has been going on for a long time. Of the Prosimii, the common tree shrew, *Tupaia*, is found north of the Ganges, and *Anthana*, the Madras tree shrew, in the tropical forests of southern India. Two species of *Loris* are also found in India, *Nycticebus coucang* in the forests of Assam, and *Loris tardigradus* in southern India. The rhesus monkey (*Macaca mulatta*), bonnet monkey (*Macaca radiata*), and the langur (*Presbytis entellus*) are found in many states. The commonest of them is the rhesus (Fig. 19). Of the Hominoids, the gibbon (*Hylobates hoolock*) inhabits the tropical forests of Assam and the Naga Hills.

The Apes. The genera *Parapithecus*, *Apidium*, and *Oligopithecus* are among the oldest specimens of higher primates from the Oligocene Period found near Fayum in Egypt. Other discoveries from the upper levels of the middle and upper Oligocene of Fayum belong to the genera *Propliopithecus* and *Aegyptopithecus*. *Propliopithecus* had a smaller skeleton, much smaller than that of today's gibbons. *Aegyptopithecus* was larger, and was about the same size as the gibbon, and dates back to 34 million years. According to Simons, *Aegyptopithecus* relates directly with the genus *Proplio-*

pithecus and is the nearest relative of today's pongids. Other authors would like to accept the genus *Propliopithecus* as the forerunner of the Pongids, that is, the basic ancestor of the Hominoids.[1]

Pliopithecus has been known since 1837 from the Miocene and Pliocene periods in France. Almost complete skeletons of *Pliopithecus* were found in Czechoslovakia. *Pliopithecus* had seven lumbar vertebrae (the other Hominoids, including the gibbons, have only five) and the development of the sacrum at the lower end of the spine, indicating that it had a long tail of 15 to 19 vertebrae.

L. S. B. Leakey discovered a fossil ape from the lower Miocene from around Lake Victoria in East Africa. Hopwood named it *Proconsul africanus*, after the chimpanzee 'Consul' from the London Zoo. The structure of the limbs leads to the assumption that *Proconsul* moved about on all fours.

Pilgrim is the pioneer of research on fossil anthropoid apes in India. In 1910, he recorded *Sivapithecus indicus* from Chinji, *Dryopithecus punjabicus* from Haritalynagar near Bilaspur and *Semnopithecus asnoti* from Aasnot in the Salt Range, Pakistan. In 1922, Brown established three new species of *Dryopithecus*. Of these, *D. pilgrimi* was collected from Kirmu and Dal Sar, near Ramnagar, a town 103 kilometres east of Jammu. These sites are shown in Fig. 17. In 1965, Simons and Pilbeam, after a comparative study of all specimens, classified all African and Siwalik material into two genera—*Dryopithecus* and *Ramapithecus*. *Dryopithecus* includes *Sugrivapithecus* and *Sivapithecus* as well as *Proconsul* and is considered to be an ape in the Pongidae. Apart from India, *Dryopithecus* is kown from Europe, Spain, France, the European parts of the USSR, the Caucasus, North Africa and Anatolia.

Recently, specimens of *Dryopithecus sivalensis* have been described by Chopra (1975) from Haritalynagar.

It has sometimes been assumed that the genus *Dryopithecus* could be connected with the gorilla (*Gorilla gorilla*) and with the chimpanzee (*Pan paniscus*), whereas the orang-utan (*Pongo pygmaeus*) of Borneo and Sumatra has a direct phylogenetic relationship with the family of *Sivapithecus*.

In 1956, a complete lower jaw of *Gigantopithecus blacki* was found in Lintscheng cave in the Lan-tschai-schan mountain in the central area of Kuang-si in China. Recently, Pei found a second jaw, several teeth, and another complete lower jaw of this ape. *Gigantopithecus* was an enormous ape which lived in the middle Pleistocene. The lower jaw is exceptionally large. Pei states that *Gigantopithecus* was significantly bigger than the gorilla, and thinks that it might have been approximately 3·5 metres tall and was the largest-known primate.

Simons and Chopra (1969) described a new species *Gigantopithecus bilaspurensis* from the lower Pliocene period in a formation, five to ten million

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[1]Jelinek, J. *The Pictorial Encyclopedia of the Evolution of Man*, p. 23

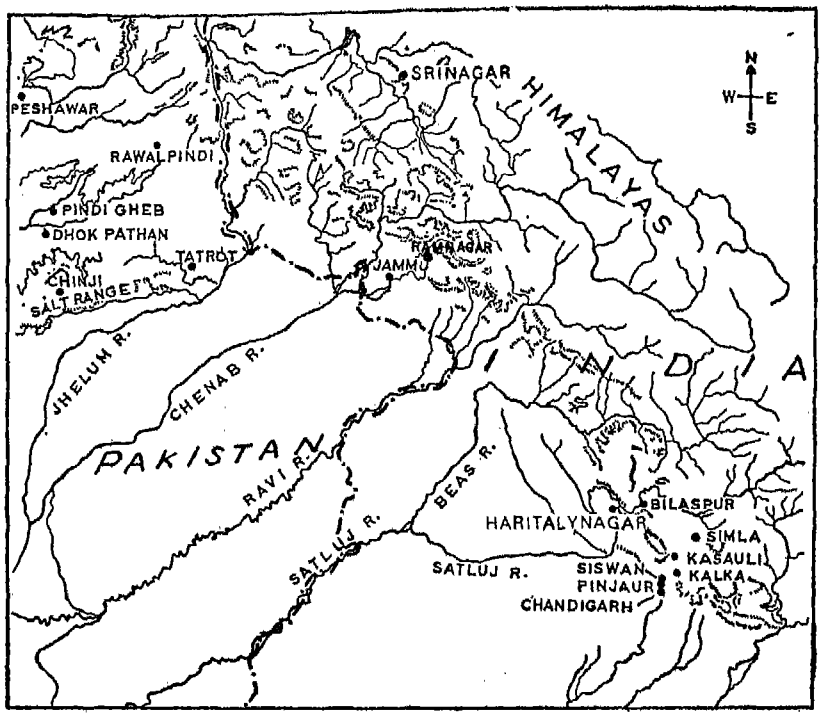

Fig. 17. Hominoid sites in the Siwaliks in India and Pakistan: Haritalynagar near Bilaspur (Himachal Pradesh), Kirmu and Dal Sar near Ramnagar (Jammu), and the Salt Range in the Attock and Jhelum Districts, Pakistan
(After A. P. Khatri)

years old. This find was a lower jaw recovered from the Dhok Pathan horizon of the Siwalik series, towards the east of the village of Haritalynagar in the Bilaspur District of Himachal Pradesh. Haritalynagar is named after the villages of Talynagar, situated at the bottom of the valley, and Hari at the top. It is about 30 kilometres north-west of Bilaspur. This area in the past was a lake. Hari-ka-Tibba, close to the village of Hari, is a veritable treasure-house of primate fossils. Chopra believes that this specimen shows a greater affinity with the pongids then with the hominids, and was about the size of the gorilla. However, a marked reduction in the front teeth and canines has important evolutionary implications. The appearance of such hominid traits in the Pliocene Period is of significance.

HOMINIZATION

What are the changes involved in the process of the development of man, also called *hominization?* Jelinek thus sums them up: "One characteris-

tic is the straightening up of the body, gaining an erect posture, so that changes occurred in the spine, the pelvis, and the long-bones of the limbs. Hands and feet changed considerably. The structure of the sole of the foot changed, and developed a double vault. The facial skeleton became more flattened. The brain and the brain-case grew larger. One of the most important characteristics which accompanies the develoment of man is the rounded, or parabolic, form of the dental arcade and the hard palate."[2]

The development of man was also determined by climatic and marked environmental changes. Tropical forests were replaced by steppes (grassland), and this seems to have been the point at which man began to adopt an erect posture. The ancestors of man, the herbivorous great apes, had to change their feeding habits to include meat because vegetation had become sparse. Besides, meat provides more concentrated protein diet. Hunting speeded up the development of the upright posture of the body, stimulated the growth of the brain, and strengthened all other functions. The ancestor of man developed into an omnivorous creature. Man's ancestors were neither fast enough nor strong enough to overpower hunting animals easily or to catch up with them. They had to be cunning and use stones and clubs to kill animals. The hand became an important instrument, and the activities of the brain were stimulated.

Ramapithecus, the earliest-known Hominid. Pilgrim (1910) established the species *Dryopithecus punjabicus* on the basis of the rami of a mandible recovered from the Chinji beds of the Salt Range, Pakistan.

Lewis (1934) reported a new genus *Ramapithecus* and proposed two species of this taxon. The name *Ramapithecus brevirostris* was assigned to the type consisting of a right maxilla and premaxilla, the alveolus of the canine, the root of I^2 and the alveolus of I^1, found 400 metres east of Chakrana which is situated about 6·5 kilometres east of the village of Haritalynagar in Himachal Pradesh. The other species, *Ramapithecus hariensis*, was assigned to the type consisting of a "fragment" of the right maxilla containing the first and second molars. This was found about 400 metres east of the village of Haritalynagar in Himachal Pradesh. The reconstruction of the skull of *Ramapithecus* is shown in Fig. 18.

In 1960, Simons checked these finds and came to the conclusion that the lower jaw described by Pilgrim to be that of *Dryopithecus punjabicus* did not belong to *Dryopithecus*. He included *Dryopithecus punjabicus* and *Ramapithecus brevirostris* under the name *Ramapithecus punjabicus*.

In 1961, Leaky discovered two pieces of an upper jaw from Ternan in South-West Kenya, Africa, which he named *Kenyapithecus wickeri*. Later studies showed that *Kenyapithecus* was a different form of *Ramapithecus*, and it was renamed *Ramapithecus wickeri*.

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[2]Jelinek, J. *The Evolution of Man* pp. 45, 46

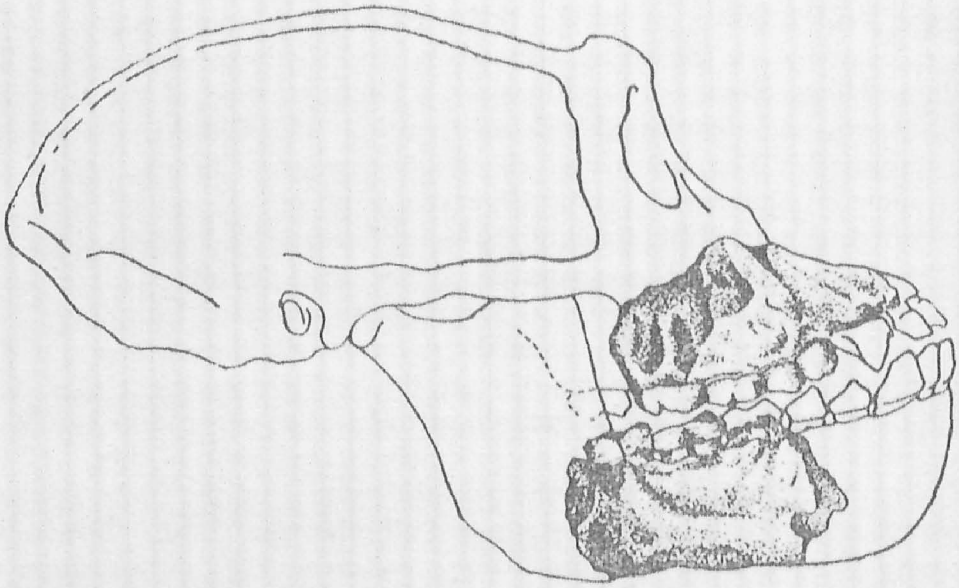

Fig. 18. Reconstruction of the skull of *Ramapithecus*
(After Jelinek)

Another *Ramapithecus* discovery, i.e. two single molars, was made in China, at a place called Leiyan. It is referable to *Ramapithecus punjabicus*. *Ramapithecus* finds have also been reported from the Swavian Alps of Europe.

Simons and Pilbeam (1965) gave the following generic diagnosis of *Ramapithecus*, pointing out the main features in which it differs from *Australopithecus* and *Dryopithecus*:

"Slightly smaller overall size (except *Proconsul africanus*, which they renamed *Dryopithecus africanus*), shallower mandible, less complex patterns of tooth crenulation, little or no evidence of cingula or Carabellis' cusps and shorter face. Incisors and canines reduced in relation to cheek-tooth size when compared to *Dryopithecus* but not as markedly as in *Australopithecus*; incisor procumbancy intermediate. Differs from *Dryopithecus* and other apes in showing more widely spaced and much lower molar cusps, so that the central or occlusal fovea of the molars covers more of the crown surface of the tooth (even so these features show some variability in *Ramapithecus* and *Dryopithecus* as well as in modern *Homo* and *Pan*); sides of the upper molars, particularly, are more vertical; also differs from *Dryopithecus* in showing a larger and lower canine fossa, an arched palate, arcuate tooth row and a much shorter rostrum."[3]

The facial and dental morphology of *Ramapithecus* shows distinct hominid characteristics. Goodall observes: "The principal human characteristics

[3]Chopra, S.R.K. *Presidential Address. Anthropology and Archaeology*, Indian Science Congress, Nagpur, 1974

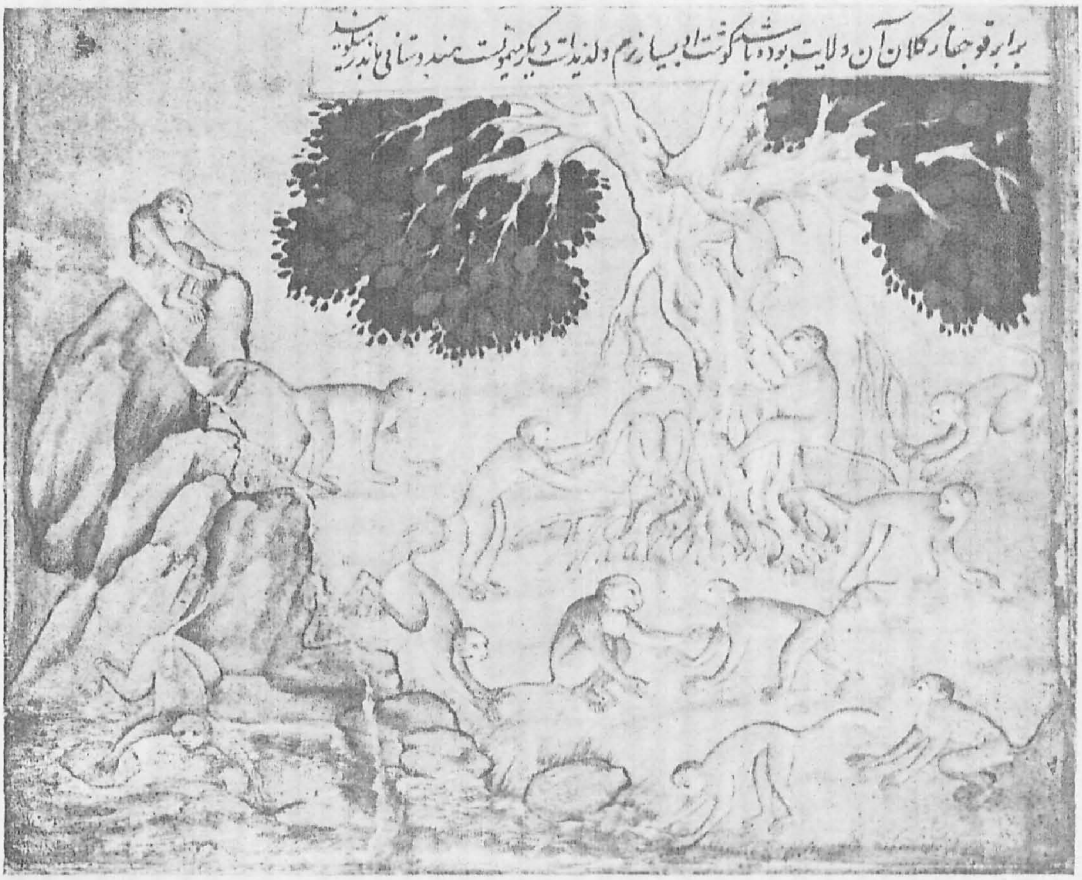

Fig. 19. A group of rhesus monkeys, Mughal, A.D. 1596
(Courtesy: National Museum, New Delhi)

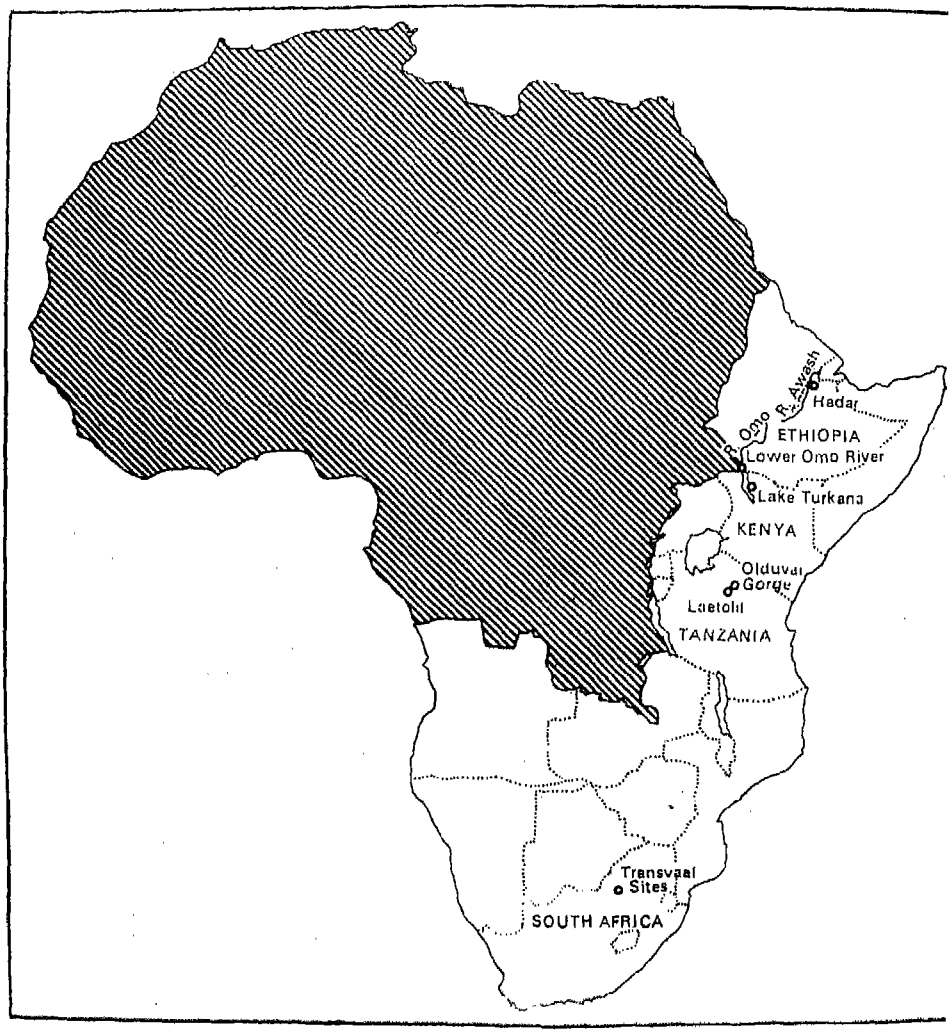

Fig. 20. Principal deposits of fossil man in Africa. (i) Transvaal Sites: *Australopithecus africanus* and *Australopithecus robustus*, about 2 million years old; Dart, 1924, and Broom, 1936; (ii) Olduvai Gorge: *Australopithecus boisei* (1959) and *Homo habilis* (1961), both 1.8 million years old; Louis and Mary Leakey; (iii) the lower Omo River: early hominids, ranging from 1 million to 4 million years old; Howell and Coppens, 1969; (iv) Lake Turkana: *Homo* skull, 2 million to 3 million years old (1972), and 1.5-million-year-old *Homo erectus* skull (1975); Richard Leakey; (v) Laetolil; 3.35- to 3.75-million-year-old *Homo* jaw-bones and teeth; Mary Leakey, 1974-75; and (vi) Hadar: "Lucy", 3-million-year-old *Australopithecus* skeleton, and *Homo* "family"; Johanson and Taieb, 1974-75

of the teeth of *Ramapithecus* are the small size and the lack of prominence of the canines, the broad flat molars showing interstitial wear, and relatively small incisors. These characters are in striking contrast to the teeth of the contemporary dryopithecine apes with their huge, overlapping canines, large shovel-shaped incisors and a distinctive wear pattern.

"The lower face indicates that the jaws did not protrude to form the muzzle, as in the apes, but were flattened, as in Australopithecines, particularly the robust forms. The facio-dental complex shown by *Ramapithecus* suggests that it was a ground feeder, dependent for survival on such food items as grasses, seeds, rhizomes, bulbs and fleshy plants—quite a different menu from the fruit diet of the dryopithecines.

"From the evidence provided by fossil seeds and the remains of other mammals of the Nagri Formation of the Siwalik area, it seems that *Ramapithecus* lived in a region of mixed forest interspersed with open areas around lakes and water-courses."[4]

We have no knowledge of the rest of the body of *Ramapithecus*. Nothing is known about its skull, brain-size, and its hands and feet. It is not known whether it stood upright. Circumstantial evidence, however, suggests that *Ramapithecus punjabicus* might have been a partial biped.

As regards its age, Khatri states that *Ramapithecus punjabicus* lived in India from the upper Miocene to the early Pliocene, 14 to 8 million years ago. The question is which of the finds of *Ramapithecus*, Indian or East African, is older? Goodall observes, "The African species at about 14 million years is slightly older than the Indian form at 12 million years." Edey states, "Leakey's Fort Ternan find locates *Ramapithecus* in East Africa at least two million years before it appeared in India— and, most important, in a country where Australopithecines of great age are beginning to turn up. It seems most sensible to continue to argue the case for Africa as the breeding ground of man. *Ramapithecus* populations may well have radiated out from Africa—to India and perhaps to other places—over a period of several million years. But this is no guarantee that they went on to produce hominid descendants in those places. Until fossil evidence confirms that they did, it seems more logical to assume that early hominid evolution was confined to the place where the fossils are: Africa."[5]

AUSTRALOPITHECINES

The oldest find of *Australopithecus* skeletons is from the Hadar Lake near the Awash River in Ethiopia by Johanson and Taieb[6] (1974-75). It is about three million years old. The discovery of a part of a leg-bone and the lower end of a thigh-bone indicated that these were of a bipedal creature.

[4]Goodall, V. *The Quest for Man*, p. 102
[5]Edey, M.A. *The Emergence of Man, The Missing Link*, p. 52
[6]Johanson, D.C. Family of Early Man, *National Geographic*, Dec. 1976

The jaws were rounded in front, and the front and back teeth were evenly proportioned. A skeleton of a female was also discovered. The angle of the thigh-bone and the flattened surface of its knee-joint end prove that she walked on two legs. The narrow incisors of the lower jaw resemble those of *Australopithecus*. Close to the remains of a child lay those of five adults, near the lake margin. It seems that a family of six got buried by a flash flood.

From the point of view of age, the next finds are from Transvaal, *Australopithecus africanus* and *A. robustus*, about two million years old (Dart, 1924; Broom, 1936). From the Olduvai Gorge in Tanzania, *Australopithecus boisei* (1959) and *Homo habilis* (1961), both 1·8 million years old, were discovered by Louis and Mary Leakey. From Lake Turkana in Kenya, a *Homo* skull, two to three million years old, and a 1·5-million-year-old *Homo erectus* skull were discovered by R. Leakey (1975). From Laetali in Tanzania, 3.35- to 3.75-million-year-old *Homo* jaw-bones and teeth were discovered by Mary Leakey (1974-75).

The subfamily Australopithecinae is divided into two genera, *Australopithecus* and *Paranthropus*.

Paranthropus was more robust, and his height is thought to be between 1·5 and 1·55 metres and his weight about 70 kilogrammes. Some characteristics of his long bones indicate that his posture was not completely erect, and that he carried his head lower than *Australopithecus*. *Paranthropus* persisted for nearly three million years without any further fundamental development, and was adapted to living in closed woodlands, with a vegetarian diet.

The representatives of the genus *Australopithecus* were more gracefully slight in build; they might have been about 1·2 metres tall, and weighed about 40 kilogrammes. The dentition of Australopithecines comes closest to that of man, with *Dryopithecus* pattern in the relative dimensions of the molars, and especially the small incisors and canines, which do not project above the occlusal line. Dentition suggests that they were omnivorous.

The profile of the skull has a characteristically shortened face, which is more upright than that of the apes; the brow-ridges are highly developed. The maximum volume of the brain-case of the large anthropoid apes is 480 cubic centimetres. The volume of the Australopithecine brain-case varies between 428 and 530 cubic centimetres. The Australopithecines were bipedal, and moved in more or less erect posture.

Homo habilis. Louis and Mary Leakey (1961) discovered the remains of *Homo habilis* from the Olduvai Gorge in Tanzania. *Homo habilis* was about 1·25 metres tall, and weighed 40 to 50 kilogrammes. According to the dentition, he was omnivorous. His cranium was higher and noticeably rounded at the back of the head. The brain volume of *Homo habilis* was larger than that of an Australopithecine.

The study of the bones of the foot showed two typical characteristics of man. Firstly, the big toe, which *Homo habilis* was able to move vertically. Secondly, *Homo habilis* possessed a double vault of the sole, a requirement for proper walking which the apes do not have.

The stone tools found with the skeletal remains of *Homo habilis* are the most primitive of tools, and the hand of the maker must have been very similar to that of man. It has been suggested that *Australopithecus* used tools of natural objects of the shape suitable for the task. *Homo habilis*, however, used naturally shaped objects, and also manufactured real tools.

The radiometric dating of *Homo habilis* shows that he is between 1·6 and 1·9 million years old. He lived at the same time as *Paranthropus boisei* in the Olduvai Gorge area.

The findspots of the fossil man in Africa are shown in Fig. 20. It is also noteworthy that two apes which are nearest to man, viz. the chimpanzee and the gorilla, are also found in Africa.

The Olduvai hominid sites are littered with bones of horses, zebras, and antelopes, some with their skulls cracked open. Shells of snails and tortoises are also found. In the faeces of these hominids are skeletal fragments of mice, shrews, lizards and small birds. This indicates that they were eaten whole. The long bones of animals might have been used as weapons, and the jaws with teeth as scrapers.

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CHAPTER 6

THE QUATERNARY PERIOD

THE PLEISTOCENE—THE ICE AGE

THE ARRIVAL OF *HOMO SAPIENS*

MANUFACTURE OF STONE TOOLS AND CONQUEST OF FIRE

THE Quaternary, the shortest of all the geological periods and unparalleled climatically in its development of the Ice Age, commenced about a million years ago. It is subdivided into the Pleistocene (the glacial age) and the Holocene or Recent (the post-glacial age). The Holocene began about 10,000 years ago. Russian scientists, however, recognize three subdivisions of the Quaternary, namely the Eopleistocene (Q_1), the Pleistocene (Q_2) and the Epipleistocene (Holocene, Q_3). Though moraines were first discovered in the Swiss Alps in about 1800, most of the Quaternary deposits have been known for a long time as products of flood, to which Buckland in 1823 gave the name Diluvium. The Holocene was formerly known in Germany as Alluvium. Venetz in 1829 first suggested that glaciers formerly existed in northern Europe. Evidences of extensive glaciation in northern North America were found some years later. About a century ago, it was discovered that the Kashmir Valley and its adjoining northern parts were also heavily glaciated in the past (Fig. 21).

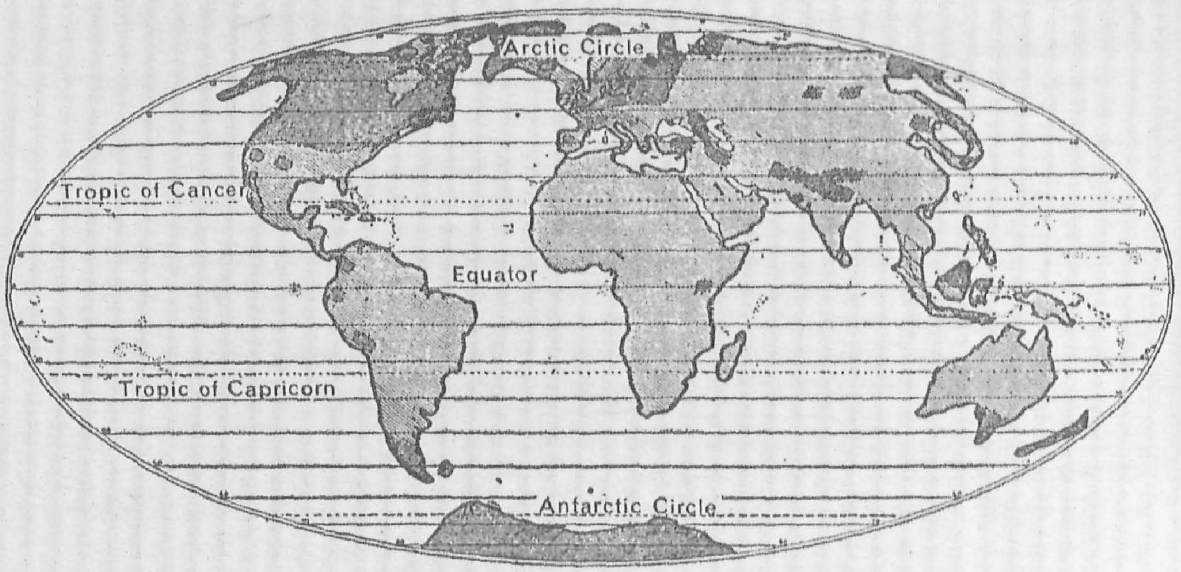

Fig. 21. The world in the middle part of the Quaternary period. The darker areas were glaciated. The Himalayan glaciers descended into lower valleys

Fig. 22. Discovery of fire and fashioning of pebble tools were the major achievements of Peking man, about half a million years ago
(Reconstruction from the Museum of Evolution of Life, Chandigarh)

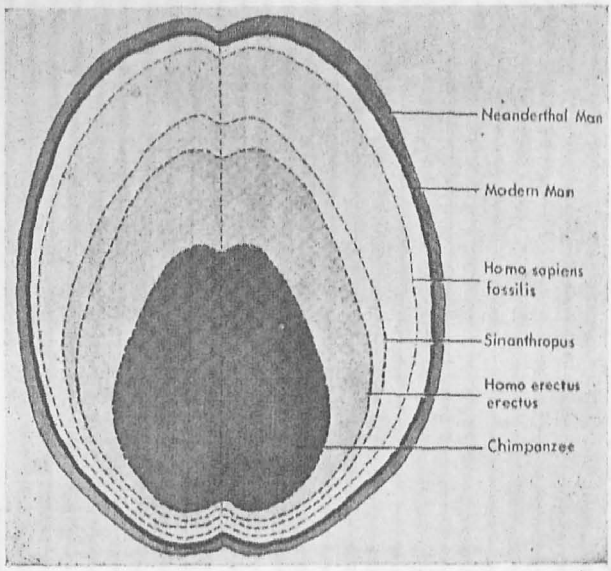

Fig. 23. A comparison of the cranial sizes: chimpanzee 400 cc; *Homo erectus erectus* 860 cc; *Sinanthropus* 1,075 cc; *Homo sapiens fossilis* 1,300 cc; modern man 1,400 cc; Neanderthal man 1,550 cc

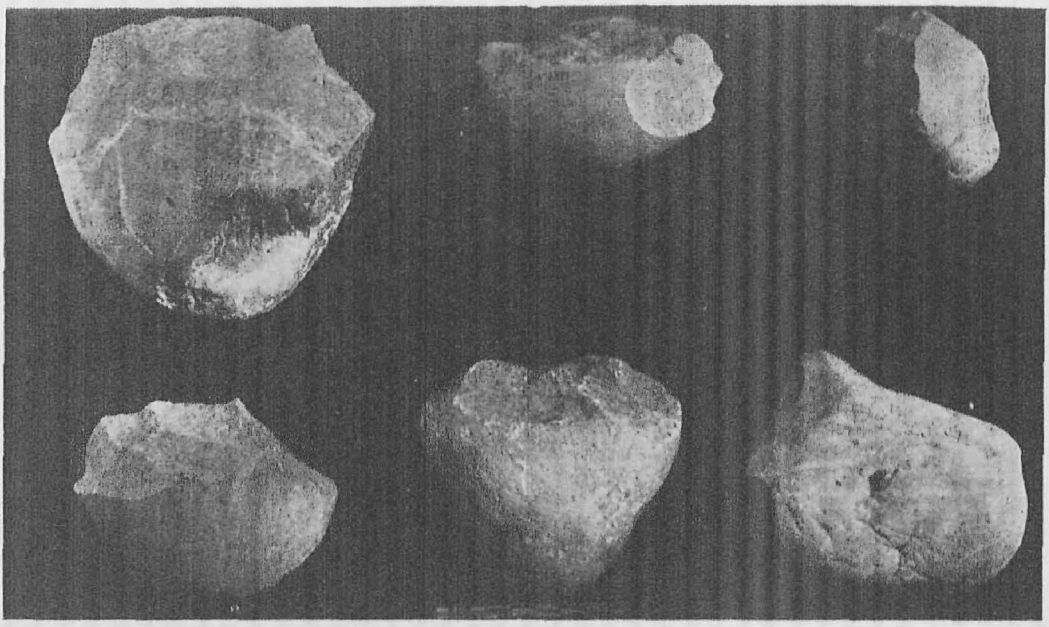

Fig. 24. The most primitive Palaeolithic stone tools are choppers from Soān, Pothohar Plateau, West Panjab, Pakistan. They were cutting-tools and were used for cutting chunks of meat and to scrape hides. They are about half a million years old

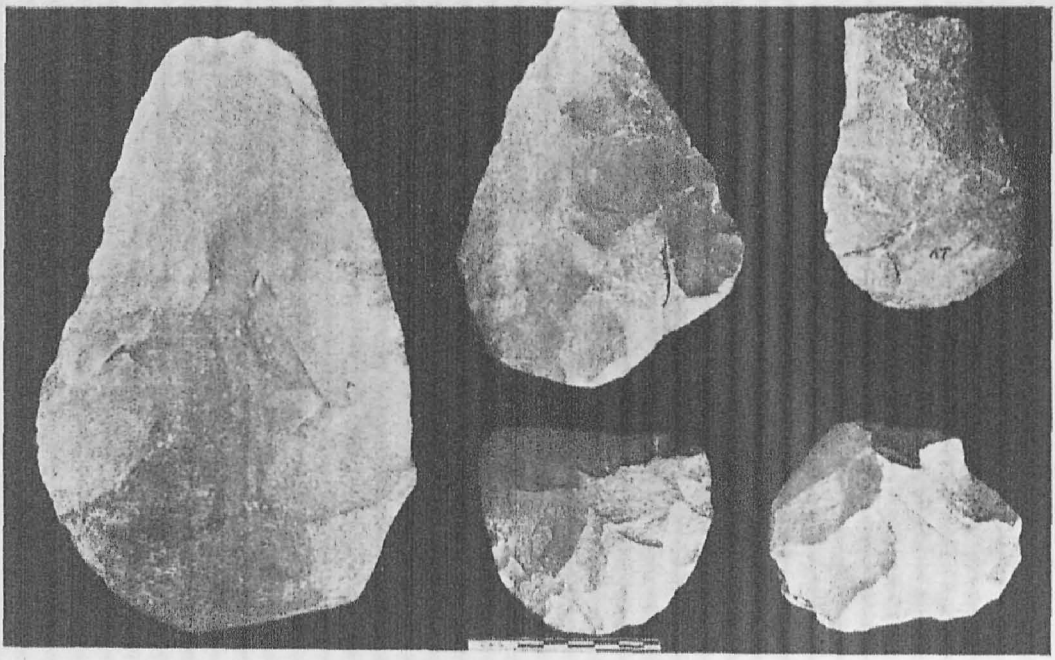

Fig. 25. Acheulian hand-axe complex from Attirampakkam, Chingleput District, Tamil Nadu, approximately 200,000 years old. A cutting-tool edged on both sides, it was used for digging, chopping and cutting

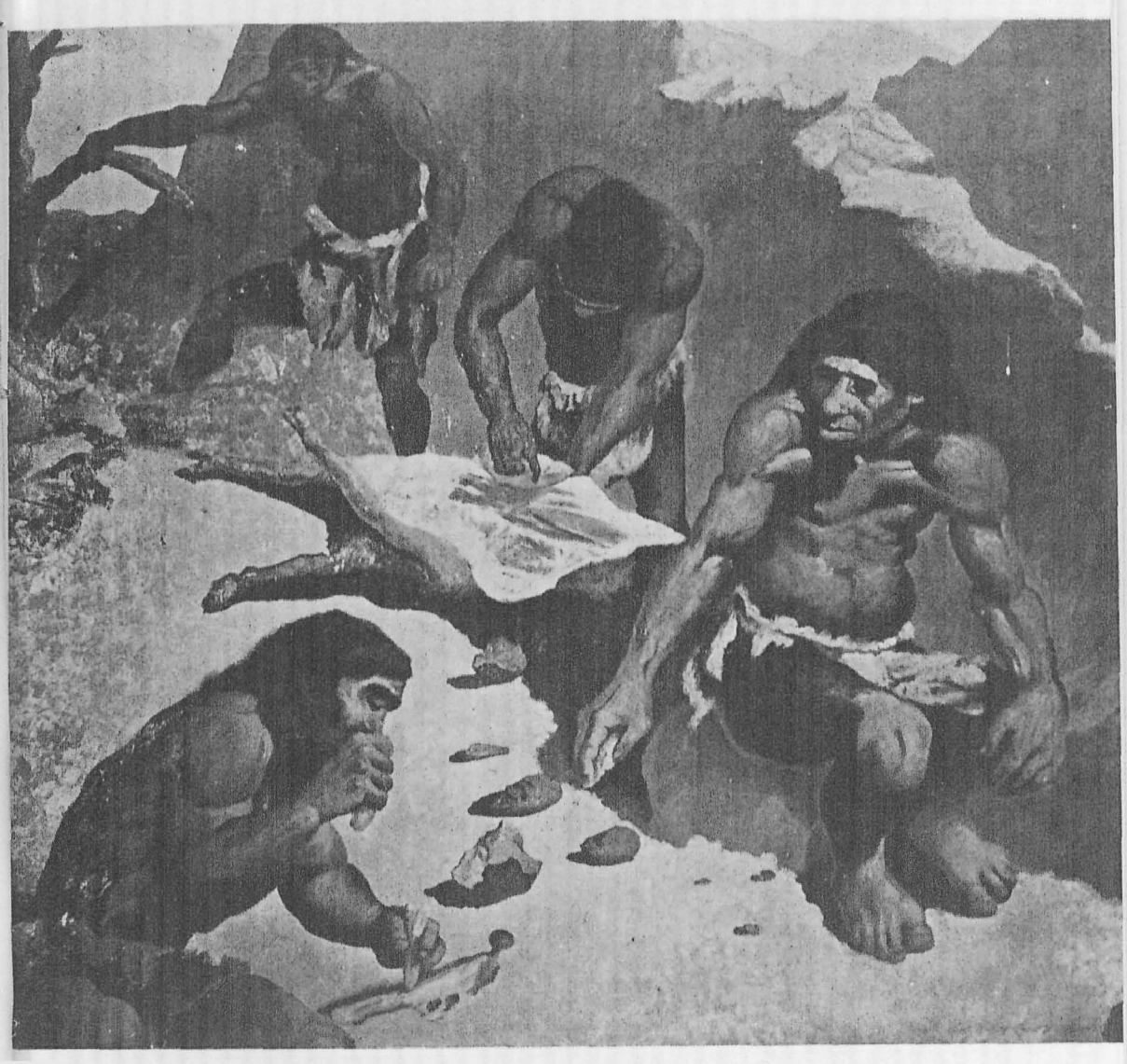

Fig. 26. Primitive men fashioning Acheulian stone tools, about 200,000 years ago. One of them is flaying a hunted animal with a hand-axe
(Reconstruction from the Museum of Evolution of Life, Chandigarh)

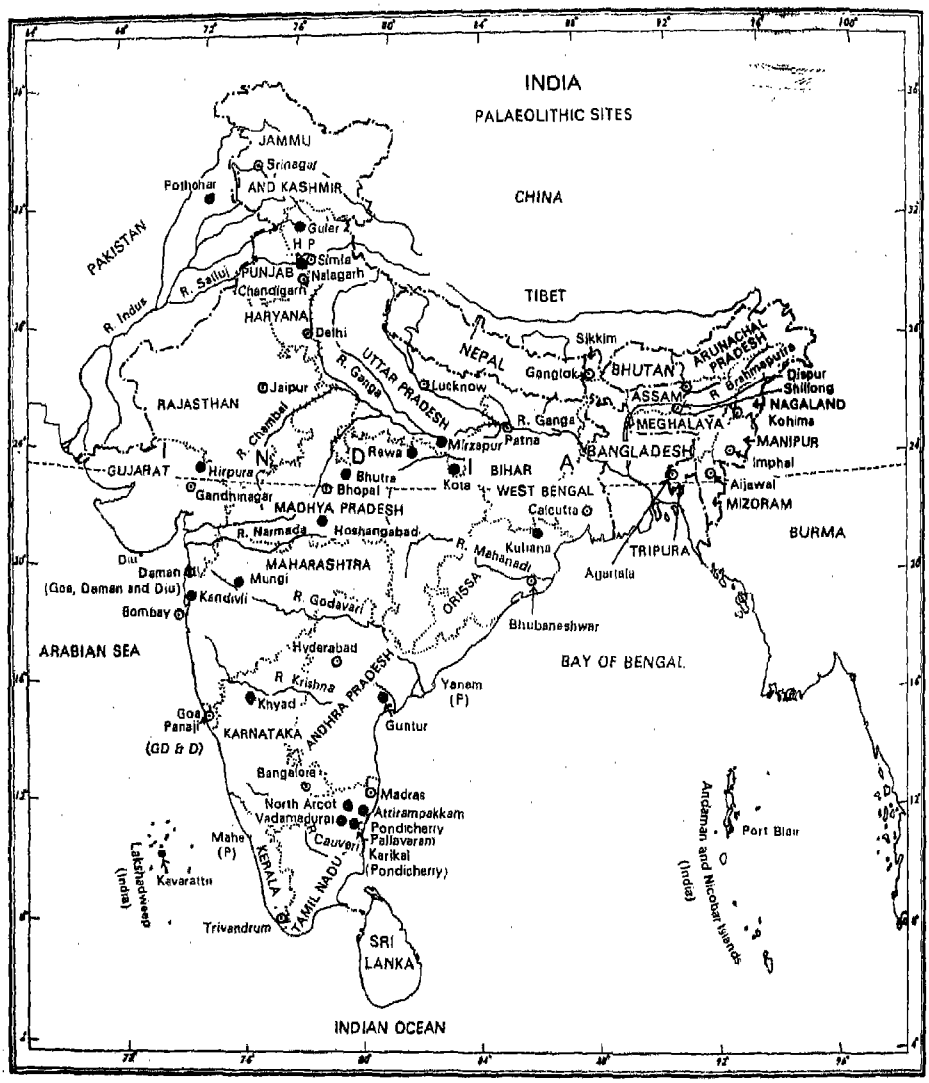

Fig. 27. Important sites from which Palaeolithic tools have been discovered in India and Pakistan. Apart from the sites shown in this map, stone tools have been discovered from numerous other places
(Courtesy: Archaeological Survey of India)

The presence of ice in the past is inferred from the occurrence of boulder clay or glacial boulders which are often scratched and angular, the polished and striated pavements caused by the movements of glaciers over them, and the glacial moraines left behind after the recession and melting of ice. Other indicators are the U-shaped valleys carved out by glaciers, the widespread glacial debris over most of the glaciated area, the terraces formed along the banks of rivers by the fast-moving waters released from the melting glaciers, and the fluctuations in the sea-level, if not due to tectonic movements. Together with these physical evidences, the alternation of the cold-loving and warmth-loving plant and animal populations in response to climatic changes provides ancillary proofs of past glaciation.

During the Pleistocene, there were four major glaciations, popularly known as Gunz, Mindel, Riss and Wurm. The glacial periods were separated by three interglacials of varying periods of duration. In addition to these four major glaciations, there were several periods of glacial advances and retreats and warm climate (inter-stadials) during the glacials.

Glaciation in the Himalayas

In the lesser Himalayas of the Punjab, glaciers from the Dhaula Dhar Range spread out into piedmonts, the outflow from which reached the present level of 700 metres in the Beas Valley during the first advance. Two later advances, which did not descend to such a low level, could still transport vast blocks of granite. Glaciated land forms are recognizable in some places in the Siwalik foothills.

Of all the four major glaciations in the Jammu and Kashmir, the second was of maximum intensity with the glaciers descending the foothills. There were two glacial advances during the second glaciation and four during the fourth. The intervening interglacial periods were of much longer duration than the glacial periods. In the adjoining region of the outer Himalayas, the Siwaliks, river terraces corresponding to glacial and interglacial stages have been recognized. Various kinds of sedimentary rocks belonging to the Pleistocene are clays, silts, sandstones and loess. The clays may be varved and the silts generally laminated. Large stretches of deep alluvial terraces comprising sands, gravels and clays occur in the Satluj Valley in Hundesh beyond the central Himalayas.

Conditions in Other Parts of the Indian Subcontinent

Peninsular India was never under glaciation, but in several of its river valleys, such as of the Narmada, the Godavari, the Krishna, and the Korta-layer, gravel beds or conglomerates are found intercalated with silts and clays. Constituting the river terraces, these alluvial deposits are believed to show events in the peninsular region corresponding to those in the glacial regions. Some of these deposits have been correlated with the glacial

and interglacial phases on the testimony of animal fossils.

Sands, silts and clays, many hundred metres thick, with occasional gravel beds and lenses of peaty matter, occur in the great alluvial tracts of the Ganges, the Brahmaputra and the Indus in the depression between the peninsular and extra-peninsular regions. The deposits show a succession from the upper Eocene to the Holocene.

Pleistocene Fauna

In the Boulder Conglomerate, the highest horizon of the Siwalik system and referable to the lower Pleistocene, the modern ox, camel and horse make their first appearance, whereas *Stegodon ganesa*, *Rhinoceros*, *Hippopotamas*, *Sivatherium*, *Hyaena* and *Felis* are the survivors from the previous faunas. *Bos acutifrons*, an extinct relative of the buffalo, lived in the Siwaliks of the Punjab during the Pleistocene. A fauna consisting of *Elephas antiquus* and *Equus namadicus*, with extinct species of *Rhinoceros*, *Hippopotamas*, *Cervus*, *Bos*, *Sus*, etc., has been found in the middle Pleistocene alluvium of the Narmada Valley.

Bones of vertebrates of the middle Pleistocene age are sometimes found in the Godavari Valley. One of the species identified is the gigantic *Elephas antiquus* (*namadicus*) with thick and long tusks. The circumference of a tusk measured 75 centimetres at its proximal end. The animal must have been about five metres in height.

From the upper drainage area of the Krishna, teeth of *Mastodon pandionis* have been found. Portions of the cranium and the mandible of *Rhinoceros deccanensis*, and the remains of an undetermined bovine have been obtained from the bank of the Ghataprabha near the town of Gokak in Karnataka.

In the Narmada Valley between Hoshangabad and Narsinghpur, there are old river terraces rising some 36 metres above the stream. Mammalian bones were found from the base of the upper gravel and sand, equivalent to the Potwar silt, whereas pre-historic implements have been discovered abundantly in the layers of gravel. Fossils of the Quaternary fauna were discovered in two distinct beds. In the lower one, which also yielded pebble tools, was found a well-preserved 2·5-metre-long tusk of the *Elephas antiquus*. The upper bed contained the *Hippopotamas*, *Equus*, *Bos*, and *Bubalus*, along with late Acheulian tools made of jasper, chalcedony and fine-grained quartzite. Mammalian fossils include the following:

Ursus (*Helarctos*) *namadicus*
Bubalus (*? Buffelus*) *palaeindicus* (allied to the modern Indian buffalo)
Boselaphus namadicus (related to the modern 'blue bull' or *nilgai*, *B. tragocamelus*), *Bos namadicus* (from the Siwaliks)
Cervus duvanceli (allied to the modern *barasingha*)
Sus namadicus

Hippopotamas palaeindicus (belonging to a subgenus, now only found in Africa)
Hippopotamas namadicus (probably from an earlier Siwalik ancestor)
Equus namadicus (from the Siwaliks)
Rhinoceros unicornis (a living species)
Elephas antiquus (*namadicus*) (probably identical with the European *E. antiquus*)
Stegodon insignis (Siwalik species)
Stegodon ganesa.

Homo erectus

Important discoveries of *Homo erectus* have been made in the Pleistocene deposits of Java, China, Europe and Africa. These discoveries can be put into two groups. The first group includes the more primitive forms, approximately a million years old. *Homo erectus modjokertensis* from the Djetis layers in Java, *Homo erectus lantianensis* from Lantian in China, *Homo erectus capensis* from Swartkrans and *Homo erectus heidelbergensis* from Mauer in Germany belong to this first group. In the second group, their ages range from about 700,000 to 500,000 years. These include *Homo erectus erectus* from the Trinil deposits of Java, *Homo erectus pekinensis* from Chou-kou-tien in China, *Homo erectus mauritanicus* from Ternifine in North Africa, *Homo erectus leakeyi* from the Olduvai Gorge in East Africa and *Homo erectus palaeohungaricus* from Vertesszollos in Hungary.

Near Trinil, in central Java, Dubois found in 1891 a right upper molar, a skull cap, and a left thigh-bone with man-like characteristics. The skull cap was thick, heavy, and flattened in front, and the region above the eyes was prominent and ape-like. The tooth was man-like and the thigh-bone indicated an erect posture. Dubois named his find *Pithecanthropus erectus*. The age of these Trinil deposits has been estimated at 700,000 years.

Von Koenigswald discovered an infant skull at Modjokerto, west Java, near Surabaya, related with Dubois's *Pithecanthropus*. This find was named *Homo modjokertensis* and probably dates back to the period between the lower Pleistocene and the middle Pleistocene. Its age is estimated at about a million years.

Research on *Pithecanthropus* discoveries led to the conclusion that they were undoubtedly man-like skeletons, all of which belonged to the genus *Homo*, and they were described as *Homo erectus* (Dubois, 1894). This 'early man' was about 1·65 to 1·75 metres tall. The structure of his thigh-bone is the same as that of the modern man and proves that he had an erect posture when walking.

The Java man is placed between *Australopithecus* and the modern man. The volume of the skull varies from find to find. *Pithecanthropus I* and *Pithecanthropus II*, from the Trinil deposits, had cranial capacities of 900 cubic

centimetres and 775 cubic centimetres respectively. The average brain size is 883 cubic centimetres.

From a cave near Chou-kou-tien, about 40 kilometres south-west of Peking, fossil teeth were found. Black named it *Sinanthropus pekinensis*. Until 1937, many skeletal remains, and teeth, of over 30 Peking man males, females, and children, were found in this area. These remains are younger than those of the Java man found in the Trinil deposits and may belong to a later phase in the middle Pleistocene. Their actual age is estimated at between 500,000 and 400,000 years. *Sinanthropus pekinensis* is now *Homo erectus pekinensis* (Black).

The body structure of *Homo erectus pekinensis* was similar to that of the Java man. His posture was erect and he was 1·55 to 1·60 metres tall. The Peking man had a strong skull, with a thick brow-ridge. The lower jaw of *Homo erectus pekinensis* was a little lighter, but the most noticeable difference was the volume of the skull. The cranial capacity was 795-1225 cubic centimetres.

The early men from Java, China and Lantian had very similar ways of life. Their dentition indicated that they were omnivorous. This was confirmed by the remains of animal bones and fruits which were found in their living-sites. They used stone tools, choppers and scrapers of the Soān type. The cave deposits of Chou-kou-tien contained clear evidence of the use of fire. It was the oldest domestic fire and the ash layer reached a thickness of six metres, indicating the occupation of the cave over a long period. The control of fire is the first great human achievement, for which credit goes to the Peking-man. Fire was the first step towards man's emancipation from the bondage of his environment. With fire he could endure cold, explore caves for shelter, scare away dangerous animals and cook meat (Fig. 22).

The first European discovery of *Homo erectus* came in 1907 from the Mauer sand-pit near Heidelberg. It is called 'Heidelberg lower jaw', and dates back to the middle Pleistocene.

Another European discovery was made in 1965 at Vertesszollos near Budapest, in Hungary, where several isolated molars and an occipital bone were found. Its age is about 600,000 years. This early man was named *Homo erectus palaeohungaricus*.

Discoveries which confirm the existence of *Homo erectus* in Africa are from the north. In 1954 and 1955 at a site south-east of Oran, near Ternifine, three lower jaws were found. The parietal bone and teeth belonged to a young person and resembled those found at Chou-kou-tien. The Ternifine find is dated from the middle Pleistocene.

Another important discovery comes from Swartkrans in South Africa—a lower jaw, with three molars on the left side and fragments of the upper jaw. It has been named *Homo erectus capensis*.

Homo erectus was also found in the Olduvai Gorge. Leakey and his wife

found a well-preserved skull without a facial skeleton in the upper layers of Bed II. Its structure indicated that it was connected with the Java man and the Peking man. The discovery included the typical tools belonging to the Abbevillian (Chellean) culture which further confirmed the dating and classification. The skull has a powerful brow-ridge, and its volume is about 1,000 cubic centimetres. It has been named *Homo erectus leakeyi.*

Skulls were also found at Steinheim and Swanscombe. The capacity of the Steinheim skull is about 1,150 cubic centimetres, and of Swanscombe skull between 1,250 and 1,300 cubic centimetres. The capacity of the skull found at Ehringsdorf (Germany) is between 1,400 and 1,450 cubic centimetres. In the modern man, the capacity of the skull is usually between 1,350 and 1,500 cubic centimetres.

The major sites where the remains of *Homo erectus* have been found are shown in Fig. 28. Skirting the mountain barriers and the deserts, *Homo erectus* spread from the tropics of East Africa, northern India, Java and China to the temperate lands of Asia and Europe over a million years.

Changes in the body activity involved in the establishment of man as a species are summed up thus by Peake and Fleure: "Increase of the period of gestation; increase of brain-growth; reduction of jaw-growth and jaw muscle, following elaboration of the hands and perfecting of the thumbs; development of stereoscopic vision and of refinement of the ear, and of the memorization of sights and sounds; all accompanied by marked alterations towards a more erect posture, which was nevertheless still imperfectly attained in the case of many early men; reduction of hair on the body; and the differentiation of labour between sexes. The reduction of jaws, connected with the evolution of the hands and implements to share their work, carried with it especially the reduction of the canine teeth previously large and interlocking, and the lower jaw was thus enabled to move far more freely instead of simply up and down and from side to side obliquely as it seems to have done among the apes. It seems likely that this increased freedom of the jaws is a factor of the elaboration of speech. An increase of size, and with it probably an increase of the periods of life both before and after birth, may be assumed to have occurred in the common stock whence man and these apes have sprung, and the tendency seems to have continued to develop in man, for the period of gestation in the latter is 280 days as against 220 or less among ancestral apes. This lengthening of the embryonic period has carried with it delay in the hardening of the skull, and so increased growth of the brain, enabling it to register more and more delicately facts of vision and hearing especially. Not only has the pre-natal period been lengthened, but the human body has become increasingly dependent for a longer time; thus the scope of maternal devotion has increased."[1]

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[1]Peake, H. and Fleure, H.J. *Apes and Men*, pp. 52, 61

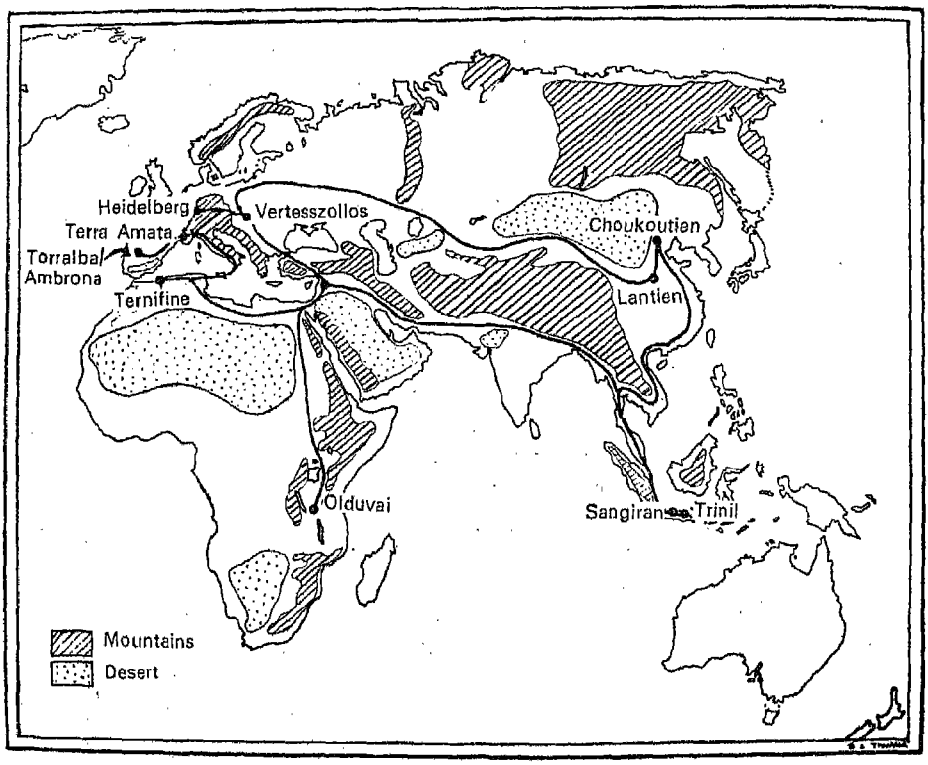

Fig. 28. Major sites where the remains of *Homo erectus* have been found. Skirting mountain barriers and deserts, *Homo erectus* spread from the tropics of east Africa, northern India, Java and China to temperate lands of Asia and Europe over a period of a million years

Among females, oestrus was lost, and in its place they acquired menstruation. This led to frequent sexual intercourse, and a rapid rate of reproduction.

In Fig. 29 a comparative idea of the sizes of skulls and brains from an ancient lemur to man can be had. Increase in the size of the brain and its complexity in man is notable (Fig. 23).

Palaeolithic Hunters and Food-gatherers

The notion of three Ages, viz. Stone, Bronze and Iron, was first set out by the Danish archaeologist Vedel-Simonsen in 1813. Following him, Christian Jurgensen Thomsen, the first curator of the National Museum of Danish Antiquities, Copenhagen, classified and arranged the collections into three groups, as they represented three chronologically successive ages.

Interpreting the exact role of pre-historic archaeology, Sven Nilsson stated: 'It demonstrated that notwithstanding apparent or partial retrogression, the human race was constantly undergoing a gradual and progressive development.'

Subsequent scholars split up the Stone Age into Palaeolithic, Mesolithic and Neolithic. Lord Avebury split up the Palaeolithic into three subdivisions—lower, middle and upper.

The Palaeolithic of the archaeologists corresponds with the period from the middle to the upper Pleistocene. The most striking feature of the Palaeolithic industries is their immense duration from about 500,000 to

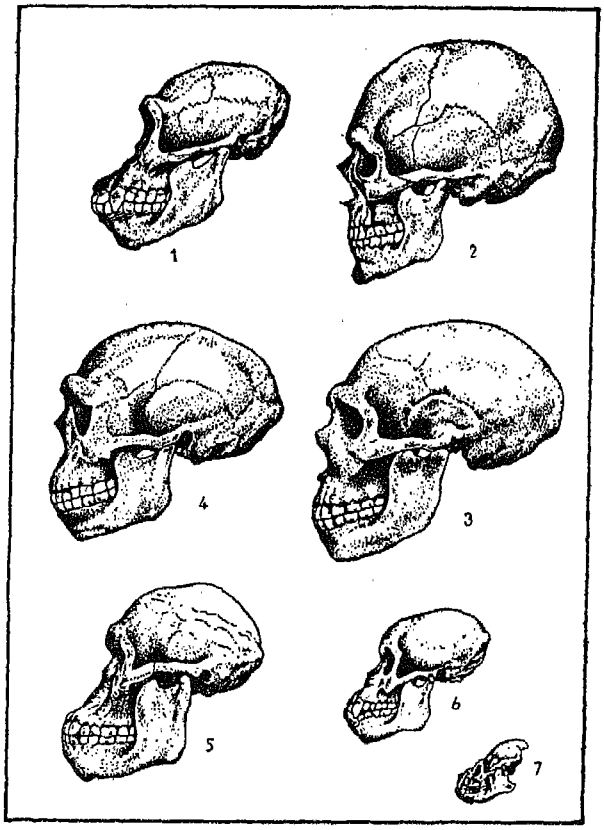

Fig. 29. Skulls of : 1, modern chimpanzee; 2, modern man; 3, Neanderthal man; 4, Peking man; 5, *Australopithecus* (hominid); 6, *Proconsul africanus*; 7, *Adapis parisiensis*, an ancient lemur. An increase in the size of brain and its complexity and a reduction in brow-ridges in man as compared with hominids is noteworthy
(Courtesy: UNESCO)

10,000 years ago, the end of the last glaciation. During the middle Pleistocene, the Siwalik Hills were certainly inhabited (Fig. 22) by the early man resembling the *Homo erectus pekinensis*. No actual fossil remains have been recovered, but stone tools, choppers and crude scrapers, which are 500,000 to 300,000 years old, have been discovered. The surest way to distinguish the earliest men from fellow-animals was in the acquisition of intelligence and skill for making tools. With the capacity to manufacture stone tools, man stepped into a higher plane of concentration and manipulative skill.

Pre-Soan Culture

In the topmost gravels of the Boulder Conglomerate, the first true prehistoric tools appear in 11 localities in the Siwaliks in the Punjab. This industry has been named Pre-Soān. The tools are made of crude split pebbles and large flakes of quartzite chipped on one side, mainly with large bulbs of percussion, small striking platforms and marginal flake scars. They resemble the Cromerian flake industry of the early Palaeolithic in East Anglia, England. Their age is assigned to the last phase of the second glaciation.

Soan Culture

The Early Soān sites in Pakistan are found in the Valley of the Soān at Adiala, Khaslakalan, Chauntra and Trap near the junction of the Soān and the Indus rivers; also in the Indus Valley at Ghariala at the confluence of the Haro and the Indus, at Khushalgarh, Makhad and Injra.

At the beginning of the Second Interglacial, in the then gravels of Soān terraces near Rawalpindi, characteristic pebble tools were discovered by de Terra (Fig. 24). They were possibly used for cutting chunks of meat and to scrape hides. They were also used for breaking nuts and for making notches in tree trunks as an aid to climbing. They resemble the palaeoliths associated with the Peking man, and the Oldowan pebble tools from east Africa.

De Terra and Hawkes found palaeolithic pebble tools from Chitta, near Rawalpindi, in northern Punjab, at Rampore near Jammu, and at Kargil, beyond the main Himalayan range on the trade route over the Zojila Pass. From the presence of stone flakes in localities lying across the Great Himalayan range, the interesting conclusion arises that the Himalayan passes have become much higher now (the Zojila Pass being 3,445 metres now), and when the Kargil-man flourished, the passes were much lower and migration across the Himalayan mountains was easy. Geologists are of the opinion that the passes which have become inaccessible or difficult now were low and easy and mark some of the most ancient routes trodden by the early man. That the Himalayan mountains are still rising is a common belief among geologists. They have risen appreciably since the advent of Man

in northern India, and now have become a serious barrier between China, Central Asia and India. Godwin-Austen was of the opinion that since the advent of Man, the Himalayas have been thrown up by 2,440 to 3,050 metres.

Attributable to the second interglacial age as the early Soān is another industry of equal antiquity but of a different tradition, known as the hand-axe complex. Typologically, this is similar to the lower Palaeolithic Abbevillio-Acheulian series observable in the Peninsular India, with its primary focus at Madras. Section 15 at Chauntra in the Soān Valley is in many respects the most important locality from an archaeological point of view. This is the only site in Pakistan which shows a parallel development of the Madras (hand-axe) industry of the south with the Soān flake and pebble industries.

Palaeolithic sites on the terraces of the right bank of the Sirsa below Nalagarh were discovered by Olaf Prufer in 1951. The tools were made of light-coloured quartzite and consist of pebble tools and flake tools. The pebble tools include choppers and scrapers.

B. B. Lal (1955) discovered pebble tools, viz. unifacial and bifacial choppers, and a few hand-axes from the river terraces of the Banganga near Haripur Guler, on the Beas near Dehra Gopipur, and at Dhaliara and Kangra.

Y. D. Sharma (1955) discovered quartzitic palaeoliths, mainly choppers, scrapers and flakes, from Dher Majra, Dhang, Dadhi and Merhanwala along the Sirsa River, which joins the Satluj above Rupar. Similar implements were also found about 1·5 kilometres north of Daulatpur on the Beas branch of the Soān River and also showed affinity with the late Soān tradition. The existence of such artefacts in the Sirsa and the Soān valleys considerably enlarges the area of the Soān industry.

Pebble tools were reported by Sahni and Khan (1964) from a terrace of the Ghaggar River near Chandigarh, and by Joshi and Khanna (1974) from a terrace of the Markanda in the Sirmur District, Himachal Pradesh. Recently, B. C. Verma (1975) discovered pebble tools and hand-axes in the Kheri area in the Siwaliks along the southern bank of the Sirsa River, five kilometres south of Nalagarh, in Himachal Pradesh. Associated with the stone tools were fossils of *Equus sivalensis*.

It seems that the Paleolithic hunters roamed along the river valleys in the hilly areas of India and Pakistan. Here, apart from game, they had plenty of pebbles from which they could fashion their stone tools.

Central India

Acheulian hand-axes and Soān-type choppers and scrapers have also been discovered from Pleistocene formations along the Narmada, at Bheraghat near Jabalpur, in Madhya Pradesh. They are found associated with the mid-Pleistocene *Elephas namadicus, Bos namadicus, Equus namadicus, Hippopotamas, Bubalus, Sus* and *Cervus*. The Soān-type tools have also been discovered in Kurnool, in Andhra Pradesh, and in Orissa, Maharashtra,

northern Gujarat and southern Rajasthan. In Fig. 27 are shown the sites from which Palaeolithic tools have been discovered in India.

The Madras Hand-axe Industry (or Madras-Acheul)

The Soān industry with its primary focus in the north produced pebble choppers and flakes and cores of Clacto-Levalloisean types, and evolved on its own lines. The other tradition is the core-tool or the hand-axe tradition with its primary focus in the peninsular portion, especially around Madras. The terrace at Attirampakkam in the Kortalayar Valley in the Chingleput District, Tamil Nadu, shows the stratigraphic evolution of the Acheulian culture. The tools are prolific. According to Krishnaswamy, 'the hand-axes are reminiscent of *very* late Acheul types of Eur-Africa and even simulate Micoque forms, being thin, flat and elongated and made on flakes. Cleavers are abundant and of varied forms. Both show the Vaal technique of South Africa. Along with the dominant bifaces, there are cores and flakes exhibiting Soān technique.'[2]

The tool type of the Madras industry is pear-shaped or oval, flaked on both faces in such a way as to produce a continuous cutting edge (Fig. 25). The pointed heavy-butted hand-axes were used for digging roots and rhizomes. Some of them may have been used as lance-heads, or even thrown as bolts. The tools of the Madras Industry have been found as far south as the Cauveri and Vaigai rivers, in the west at Kandivili near Bombay and north of the Narmada, and north-east as far as the upper reaches of the Son, a tributary of the Ganges (Fig. 30). This technique of tool-making covered a vast area—India, South Africa, and western Europe.

Maharashtra

Lately, Palaeolithic Acheulian hand-axe tools have been discovered at a number of sites in Maharashtra. Fossils of hippopotamus, rhinoceros, elephant, gaur (wild cattle), horse, deer and buffalo have been found at Patne. Fragments of an ostrich egg were discovered in association with the upper Palaeolithic tools at Patne. The eggshell had engravings of criss-cross lines. This is the earliest evidence of the upper Palaeolithic art discovered in India and has been dated to 25,000 B.P.

The lower Palaeolithic sites in Maharashtra are Gangapur, Nandur, Madhmeshwar and Kalegaon on the Godavari River, Sakri at the Kan River, and Nevasa at the Pravara River. Besides, a number of middle Palaeolithic sites have been discovered at Godavari, Tapti, Wainganga, Krishna, Pravara, Ghod and Zarpad rivers.

A striking feature of the distribution of Palaeolithic hand-tools in India is the predominance of chopper-type pebble tools in northern India,

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[2]Krishnaswami, V.D. Stone Age in India, *Ancient India*, Jan. 1947

and of Acheulian hand-axes in southern India. Outside India, the Anyathinian culture of Burma, the Choukoutienian culture of China, the Tampanian culture of Malaya and the Patjitanian culture of Java are dominated by chopper-chopping-tools. Pebble tools also occur in the pre-Stellenbosch, early Olduvan and Kafuan stages in South and East Africa. This distribution tends to suggest that even on a world-wide basis the chopper-chopping-tools on the one hand and hand-axes and cleavers on the other represent two different cultures. The chopper-type is more primitive and older than the Acheulian hand-axes.

Sites from where Palaeolithic tools have been discovered are near rivers, small streams or lakes. Wild animals that the stone-age man hunted lived in jungles along the rivers and lakes. When they came for drinking water, Palaeolithic hunters had an opportunity to kill or trap them. Apart from wild animals, fish from lakes and rivers were also a source of food for them. These men moved in small bands and apart from hunting collected fruits, leaves of edible herbs and the roots and tubers of wild plants. For digging roots and tubers, pointed sticks and hand-axes of the Acheulian type were used.

Neanderthal Man (Homo sapiens neanderthalensis)

The earliest find of the Neanderthal skull is from the fortification of Gibraltar in 1848. Fragments of a skull and a skeleton were later discovered from the late Pleistocene deposits in the Neanderthal Valley near Dusseldorf in Germany. Skulls and skeletons of the Neanderthal man were subsequently discovered from various places in France, the Island of Jersey, Belgium, Spain, Yugoslavia, Hungary, Czechoslovakia, North Africa, Israel, Iran and Iraq (Fig. 32).

From these discoveries, it appears that the Neanderthal man lived in Europe, Africa and western Asia some 72,000 years ago. He was short, had a low receding forehead, protuberant brows, long arms and bent thighs; he walked with a stoop, and had a matted coat of hair. His brain-case was large, but the brain was poorly developed. The cranial capacity was between 1,350 and 1,700 cubic centimetres with the average at about 1,400 to 1,425 cubic centimetres. He must have been strong and well-built, about 1·55 to 1·65 metres tall. His lower limbs were shorter than those of the modern man and his thigh-bones were slightly arched. He hunted a variety of animals, including cave-bears and hairy mammoths, and cooked their meat on fire.

The Neanderthal men hunted mammoths, the woolly elephants of Europe. Their weapons were boulders, and spears of wood tipped with blades of flint. Hunting in a pack requires organization, planning and strategy. In this respect, they showed a great advance over *Homo erectus*, who probably relied on individual skill in hunting. The Neanderthal man

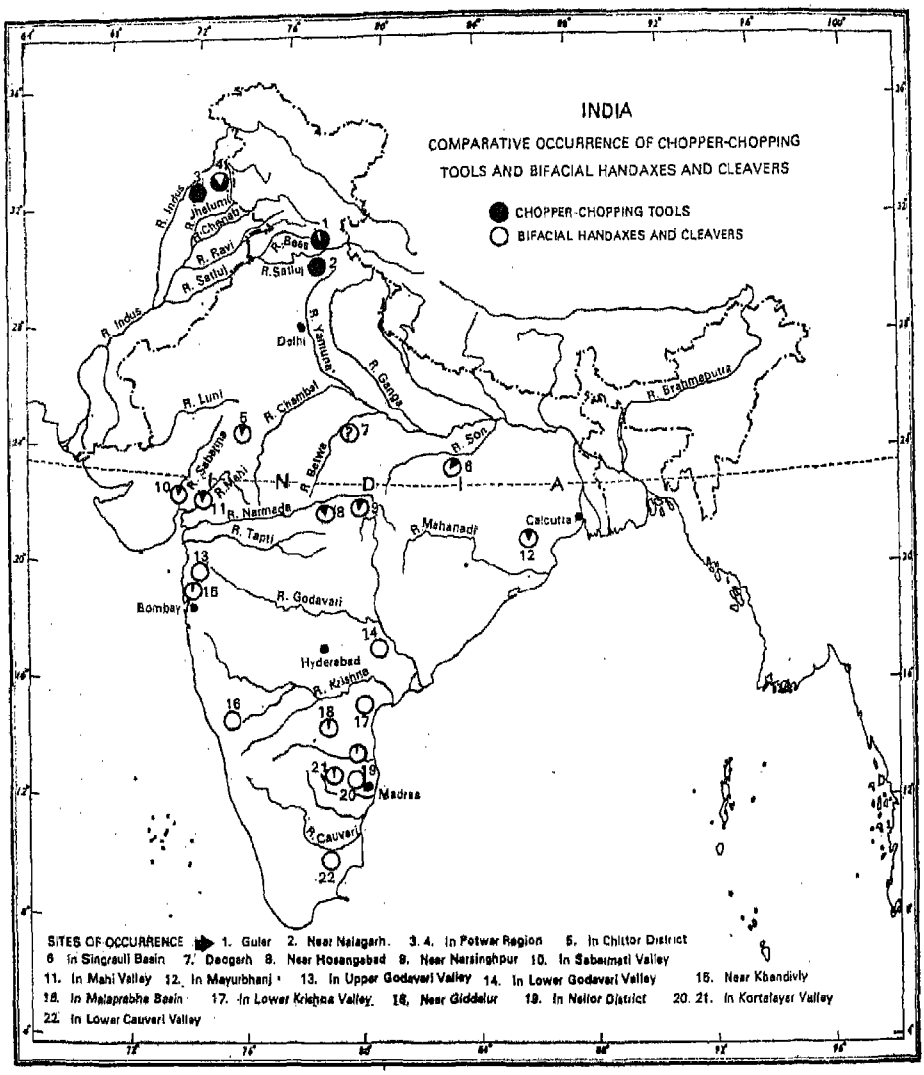

Fig. 30. The comparative occurrence of chopper-chopping tools and bifacial hand-axes. Chopper-chopping-tools were more common in the Siwaliks of India and Pakistan. Bifacial hand-axes predominated in the south
(Courtesy: Archaeological Survey of India)

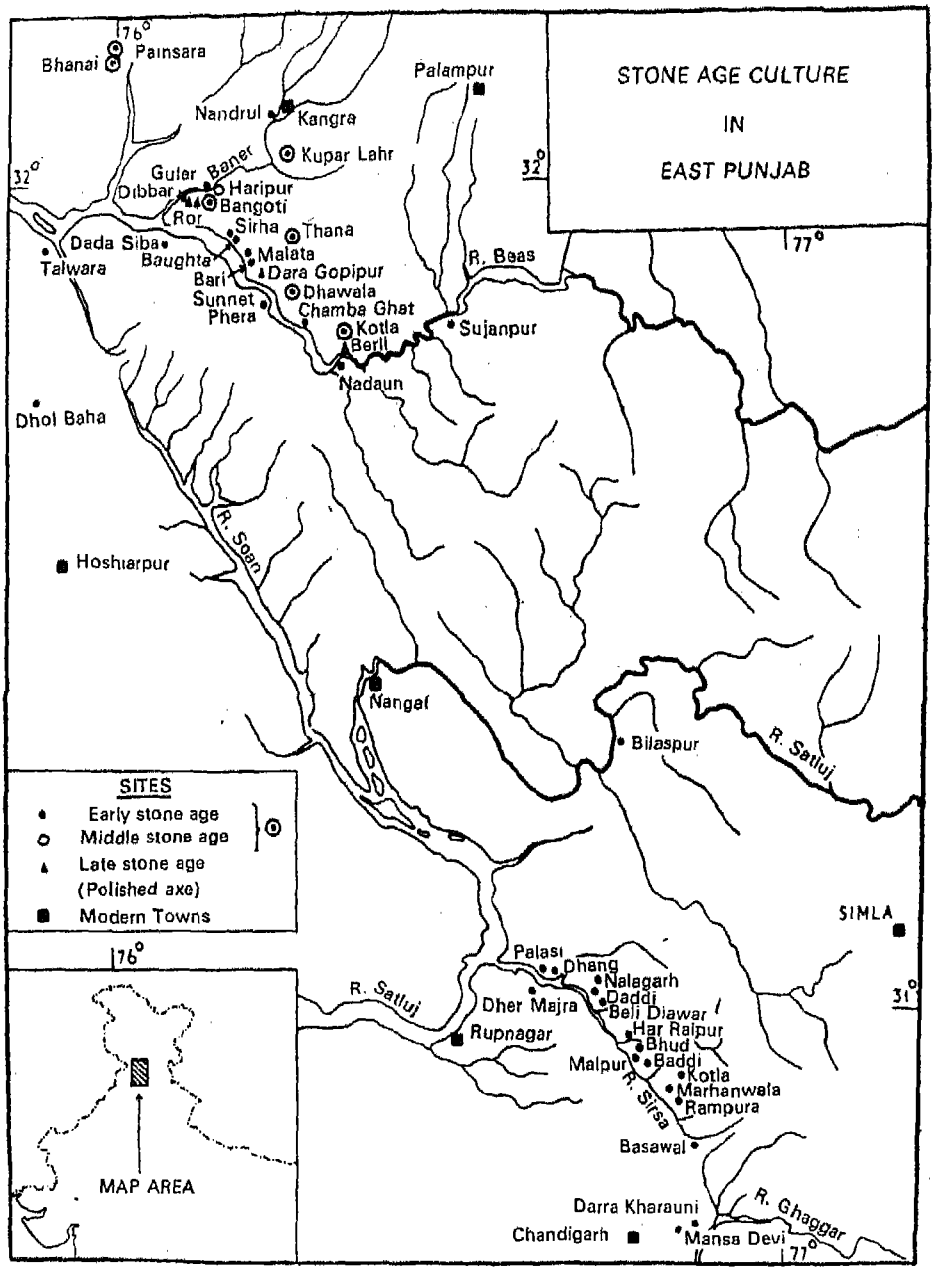

Fig. 31. The Stone Age sites in Himachal Pradesh and Punjab. A number of such sites have been discovered in the Kangra Valley in Himachal Pradesh and in the Valley of the Sirsa River above Chandigarh
(After H.D. Sankalia)

also used stone-tipped arrows and buried his dead with great ceremony. In the cave of La-Chapelle-aux-Saints, the corpse was accompanied with Mousterian implements and joints of meat. His social and cultural achievements comprised middle Palaeolithic civilization.

Gradually, however, he increased his stock of tools by adding knives, spearheads, awls, scrapers and the like, all made from chips struck from the original core of flint used in making the hand-axes. He also used the spear and the sling as his weapons. He also began to use bones and horns. To meet the growing demand for flint, he sank shafts to get at the subsurface deposits when those on the surface were exhausted. Such advances represented major steps towards a greater control over the physical environment. He made his clothing from the skins of animals, using bone needles and sinews for binding them. He could also make fire. He made the mouths of caves his permanent habitations.

In material culture, the Neanderthal man was far ahead of the early stone-age man. The invention of fire-making gave him the most powerful weapon against wild animals. Clothing made from skins of hunted animals also symbolized advance. Progress was due largely to the challenge of the hostile environment he had to face in the last Glacial Age.

We can appreciate the important changes that took place, as man began to eat meat, as he started using fire to prepare meat and warm himself, as he constructed his first homes and made his tools. The activities of these early Palaeolithic hunters can be deduced from the remains of animals they hunted. The remains of more than 1,000 mammoths were discovered in Predmosti in Moravia. In Solutre (France) numerous bones of wild horses were found, and in Ambrosievka (Ukraine) the remains of hundreds of bison have been discovered. These discoveries indicate organized hunts in which large parties of hunters participated. The spear was their most important weapon, and the spearheads of stone, bone, and mammoth ivory were in use. These Palaeolithic hunters also used wooden traps, fishing-nets and hooks.

The recent discovery of nine Neanderthal skeletons from the Shanidar cave in Iraqi Kurdistan by Ralph S. Solecki has greatly improved the image of the Neanderthal man. Solecki estimates that the Shanidar cave was first occupied about 100,000 years ago, and, over a period of 60,000 years, groups of the Neanderthals made it their seasonal home. These Neanderthals were more like *Homo sapiens* in skeletal structure, and there was not much difference between them and the modern man. The discovery of the remains of lame and disabled persons from two of the caves indicates that they were kept alive by their fellows, till they met their death by an accidental rockfall. 'These were the first stirrings of the concept of man caring for his own, a sense of belonging and family,'[3] observes Solecki. Pollen analysis of the soil samples

[3]Ralph S. Solecki, *Shanidar*, New York, 1971, pp. 33, 34

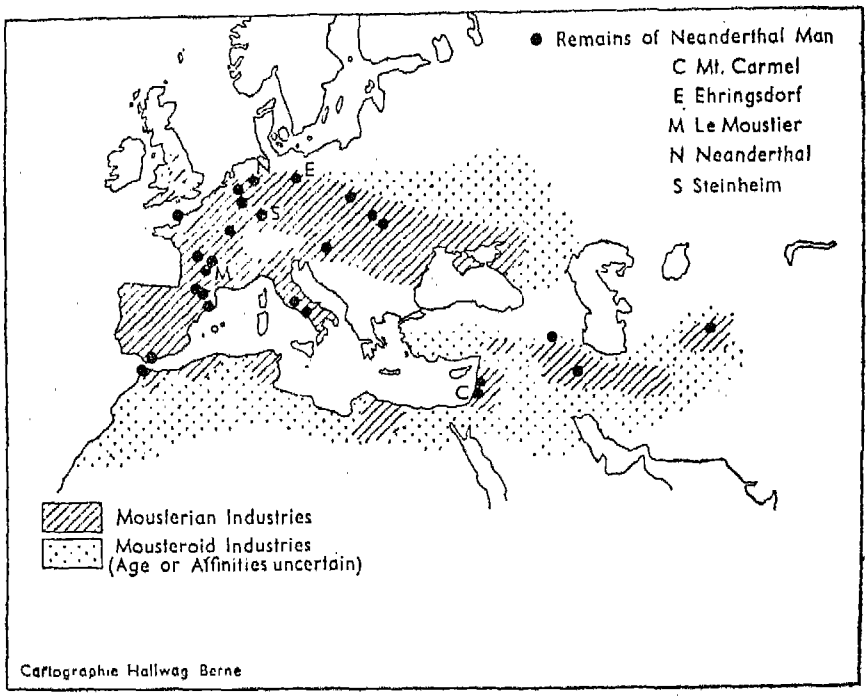

Fig. 32. The distribution of Neanderthal man
(After Charles Singer *et al.*, *History of Technology*, Vol. I, 1954. The Clarendon Press, Oxford)

around the skeletal remains of one person showed that it had pollen of eight species of flowers. This indicates that they buried their dead with flowers, and these Neanderthals were the first Flower People.

Homo sapiens sapiens

Particularly important are the remains of the Neanderthals found at Mugharet et-Tabun and Mugharet es-Skhul near Mount Carmel in Israel. Many skeletal remains from the sites in Israel show clearly developed characteristics similar to those of the modern man. The thigh-bones are straight and quite long. The brow-ridge is still fairly prominent. The example of the Neanderthal man from Israel indicates how *Homo sapiens neanderthalensis* developed into the present-day form of *Homo sapiens sapiens*, who first appeared at the end of the first Wurm Glaciation about 30,000 to 40,000 years ago. This early type of man shows no marked differences in the skeleton, including the structure of the skull, from the modern man. Even the capacity of the skull had reached the same level as that of the

modern man. The only noticeable morphological differences can be found in the geologically early discoveries, which showed that the early man had a more robust body structure than the modern man. The most famous sites of this man are: *Cro-Magnon*, Cro-Magnon-man, and Combe Capelle in France; Oberkassel in Germany, Predmosti, Mladec and Dolni Vestonice in Moravia, as well as a number of other sites.

About 25,000 years ago, the glacial climate in Europe improved slightly for a while. The Neanderthal man unaccountably passed out of the Pleistocene picture and his place was taken by the Cro-Magnon-man, the modern species, *Homo sapiens*. More than 100 specimens of Cro-Magnon-man have been collected in western and central Europe. His cranial capacity was equal to that of the present-day man. In the evolution of brain we notice the upward march of living matter from the scattered nerve cells of coelentrates to the highly complex human brain, which is one of nature's marvels and is the seat of soul or spirit of man. As Jacquetta Hawkes sums up, 'Throughout this vast stretch of time the increase in the size and complexity of the neo-pallium or New Brain makes the central theme; in the fossil skulls which are our principal record for the human epic we see the forehead and vault rising, their capacity swelling. Here, housed within the curved bone plates of the skull, is the most subtle and complex instrument in the world, which, at the command of the whole man, has created the rich and varied cultures, the superb individual works of art, the inspiring if never final systems of thought, that make the history of mankind.'

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CHAPTER 7

THE HUNTERS AND FOOD-GATHERERS OF THE MESOLITHIC PERIOD

THE transitional period between the end of the Palaeolithic and beginning of the Neolithic is called Mesolithic. It began about 10,000 B.C. and ended with the rise of agriculture and polished stone tools in the Neolithic Age from 7500 B.C. to 1710 B.C. It is characterized by tiny stone implements called microliths.

Microliths are widespread throughout the Indian subcontinent. Gujarat (Langhnaj), Madhya Pradesh (Adamgarh, Barasimha, Nimkhera, Sakri, etc.), the region between the central Indian hills and the Gangetic plains (Barakaccha, Sidhpur, Lekhania in the Mirzapur District, and Morhana Pahar), Birbhanpur on the Damodar in West Bengal, Karnataka (Raichur, Jalahalli, Kibbanahalli and Belgaum), and Andhra Pradesh (Nagarjunakonda) are particularly rich in Mesolithic sites. Mesolithic sites are common in Maharashtra. Microliths occur in the sands of the Godavari and the Wainganga rivers, on the hill surfaces at Ellora, and in the caves at Pachad and Hathkambha in Konkan. The tools comprise a large number of indeterminate flakes, blades, burins, geometric forms like the lunates, trapezes and triangles, scrapers and discoids, and small chopping-tools, and points of various types, including a few pressure-flaked bifacial ones.

The Adamgarh Hill near Hoshangabad in Madhya Pradesh has rock-shelters and cave-paintings (Fig. 33). It has yielded 25,000 microliths. The earliest finds were palaeoliths, comprising hand-axes, cleavers, ovates, discoids, scrapers, flakes and cores showing predominantly Acheulian characters. The occurrence of flakes and cores in the same deposit indicates that the tools were made on the spot. The tools comprised simple, backed and saw-edged blades, lunates, points, awls and a few burins. A few potsherds and bone-pieces were also obtained from the uppermost layer of the black soil. In trenches which lay under the cave-like shelters, both the tool industries were encountered: the lowest levels comprising red clays yielded palaeoliths, and the upper layers of black or dark-brown soil had microliths. ^{14}Carbon dating of shells from Adamgarh carried out at the Tata Institute of Fundamental Research has placed the beginning of the Mesolithic age in that area at 5500 B.C. at Lekhania. The Mesolithic age was as late as 1710 B.C.

Here it would be relevant to explain the technique for estimating the age of rocks and prehistoric objects. The so-called radioactivity method has been applied to the study of rocks. It is based on the fact that the emanations of radioactive bodies, such as radium, uranium, and so on, are transformed first into helium and then into lead. The amount of helium that

issues, for example, from a given quantity of uranium during a fixed period has been calculated. Since the rate of disintegration of the uranium atom is known, the evaluation of the respective proportions of uranium, helium and lead in a mineral whose age it is desired to find gives some idea of the time that has passed since its formation.

'The same principle is employed in the ^{14}carbon method, which is, however, limited to the later periods of prehistory. This method is based on the discovery that alongside normal carbon, with an atomic weight of 12, all living organic matter contains various isotopes of this carbon, one of which is radioactive and is, therefore, known as radio-carbon, or, because its atomic weight is 14, as ^{14}carbon. After death, ^{14}carbon disintegrates progressively at a rate that has been measured and is believed to be constant. The older a bone or an archaeological object is, the less the radio-carbon it contains, and it is accepted that by the end of 25,000 years the radio-carbon will have totally disappeared. In the case of any object below this age, the quantity of ^{14}carbon present gives a rough idea of its antiquity. In fact, when applied to articles taken from the Egyptian tombs, whose age is well established, this method has given exact figures. It may be assumed that it is equally accurate for older material.'[1]

The Teri sites in the Tinnevelly District, Tamil Nadu, are mostly along the eastern coast of the tip of the peninsula and are dated 4000 B.C. by Zeuner.

On the basis of the available collection, a sequence of three industries is postulated: (i) an earlier Teri industry consisting of flakes and core tools; (ii) a later—the main—Teri industry, similar to the former, but including blades and geometric forms; (iii) a Neolithic blade industry, often accompanied with stone axes. The first two are generally made on quartz and chert and are heavily stained with red hydrated ferric oxide.

According to Sankalia, these tools must have been made by hunting and fishing people living in temporary camps on or near the coast. The geological context and the presence of certain tool-type might make the industry upper Palaeolithic and might be placed towards the close of the late Pleistocene, but provisionally it has been given a date of 4000 B.C., which is certainly very conservative.[2]

Equally ancient is the Birbhanpur microlithic industry, which was investigated by B.B. Lal. The tools are non-geometric and include irregular, free flaked cores, fluted cores, blades, lunates, points, borers, scrapers and burins (Fig. 34). The material is mostly milky quartz, though occasionally crystal, chert, chalcedony, quartzite and fossil wood are used. Lal's studies indicate

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[1]Boule, M. and Vallois, H.V. *Fossil Men*, p. 60

[2]Sankalia, H.D. *From Food Collection to Urbanisation*, in *Indian Anthropology*—Essays in Memory of D.N. Majumdar, p. 77

that the climate when the microlithic people occupied the site must have been comparatively dry and mild. It succeeded the last wet phase during which dense forests existed in the region. This mild climatic phase was followed by a period of aridity, and the habitation layers were covered with wind-blown sand.

An important site in Karnataka is at Jalahalli, near Bangalore. Here, Todd found, in a reddish soil horizon, microliths of quartz, rock crystal and one of red jasper. Seshadri groups the collection on typological basis into two categories: (i) Jalahalli microlithic industry with a preponderance of crescents, points and arrowheads, indicating a hunting economy and environment; and (ii) Brahmagiri microlithic industry consisting primarily of parallel-sided flakes, and Gravettian-like pen-knife blades, implying a semi-urban culture in which arrowhead, crescent, etc., are absent.

Sankalia states that the people of Langhnaj who lived in the sandy undulating plains of northern and central Gujarat manufactured microliths, e.g. blades, lunates, trapezes, triangles, scrapers, points and a few burins, fluted as well as amorphous cores. The material is chert, agate, carnelian and only occasionally quartz. Heavy tools so far are very few—only one mace-head of a digging stick of quartzite was excavated. They hunted rhinoceros (*Rhinoceros unicornis*), hog deer (*Axis porcinus*), Indian buffalo, antelope (*Boselaphus tragocamelus*), black buck (*Antilope cervicapra*) and wild dog.

The Langhnaj people occupied elevated areas—sand-dunes—formed during the previous dry period and enclosed on three sides by small inundation lakes. They lived by hunting and fishing. Large quantities of cut animal bones were found in their habitations. These animals included cattle, *nilgai*, deer, rhinoceros, mongoose, pig, squirrels, rats, tortoises and fish. Animal flesh was cut with tiny tools, awls, scrapers of various types, blades and gravers or burins. Arrowheads of stone indicate that they used bows and arrows (Fig. 35).

Small quantities of potsherds suggest acquaintance with pottery. Quern fragments are so small that these could hardly have been used for grinding the grain of wild grasses. Among the few ornaments are round flat beads, and beads of dentalium shell. They buried their dead in a flexed posture in the north-south direction.

The microlithic industries of India seem to represent the arrival of new people, probably from the West. According to Sankalia, physically or racially they were fairly tall, with long head, slightly protruding lower lip and recall the Hamitic people of Egypt.

DOMESTICATION OF THE DOG

The domestication of the dog (*Canis familiaris*) is the major achievement of the Mesolithic hunters. Wolves often hang around human dwellings as scavengers, feeding upon bones and crumbs of flesh. The earliest dogs were

probably like the Indian pariah-dogs and the Javanese chow. These types followed the Mesolithic hunters round the world, breeding with other local species, e.g. the wolf, which, though distinguished as Linnaean species, are still interfertile. That the dog entered into the ecological system of man very early is borne out by the fact that man and the dog are universally distributed together, even in remote regions like Australia, Greenland and Alaska.

According to Zeuner, in northern Europe the dog had become a companion of man by about 6000 B.C. The Natufians of Palestine (named from one of their camp-sites in the Wadi-el-Natuf in Jordan) had the domesticated dog. The radio-carbon age of the Natufian layers in the tell of prehistoric Jericho is 8840 B.C. An early dog is from the Belt cave in Iran, *c.*9500 B.C. Harlan mentions a 12000 B.C. dog find from Iraq, which is the earliest at present. The very fact that the Harappans had well-domesticated breeds of dogs indicates that domestication of these animals must have taken place at least two to three millennia earlier. In the Harappan period the domesticated dog had already developed two distinct races. Marshall, who discovered terracotta figures of dogs from Mohenjo-daro, concluded that the cultivators of the Indus Valley had a dog resembling the pariah, another a terrier, and yet another the modern mastiff (Fig. 36). Baini Prashad identified the bones of a greyhound type of dog from Harappa, which he considers to be allied to *Canis tenggeranus*, which was widely distributed in the Oriental Region in Diluvial times, and was the ancestor of the pariah-dog. The Harappa dog, according to Baini Prashad, shows distinct affinities in the shape of its skull with the Indian wolf, *Canis lupus pallipes*. The Indian wolf, as Blanford relates, is rarely, if ever, heard to howl, and it sometimes barks like a pariah-dog. The young of the Indian wolf are born with drooping ears and are readily tamed. Moreover, all varieties of domesticated dogs have the wolf-type teeth. Studer derives the pariah from the dingo, which was widely distributed in southern Asia in former times.

Discussing the origin of the domesticated dog, Zeuner observes, 'The evidence so far available suggests that the domesticated dog sprang from one of the geographical races of the wolf. The possibility of an originally wild, dingo-like form now completely absorbed into the domesticated stock cannot be excluded, but such form would have been extremely close to the Indian wolf. In any case, however, the Mesolithic dogs of northern Europe already were introduced stock which appears to have been dingo-like (*C.f. poutiatini*) and which inter-bred with northern wolves (*C.f. inostranzewi*). These large dogs, from which Eskimo or other polar-dog breeds are ultimately derived, continue through the Neolithic. *C. f. poutiatini* gave rise to the sheep dogs of the Bronze Age and later to *C.f. matrisoptimae*, and to the hounds (*C.f. intermedius*)'.[3]

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[3]Zeuner, F.E. *A History of Domesticated Animals*, p. 27

The early men hunted wild horses, deer and wild cattle with the help of their rough traps, spears, bows and arrows. It is probable that wolves were their camp-followers and frequented the heaps of bones of wild animals which accumulated around the early Mesolithic camps. It is likely that out of fun the early men captured their cubs and tamed them. Young wolves captured in jungles were kept as pets and their utility as guardians of camps and hunters was the result of generations of enslavement and selective breeding. Women probably played an important role in developing the domesticated breeds of dogs on account of their inherent gentleness and patience. Very likely, these early animals became sufficiently tame to be harmless, but did not breed in captivity. Only when they began to breed in captivity and yielded themselves to selective breeding by man that they became truly domesticated and developed in intelligence and utility.

These domesticated dogs were of great help to the Mesolithic hunters, and fleet-footed animals, such as deer, antelopes, foxes, jackals, and rabbits, were more easily available for the camp pot. Thus the food supply available greatly increased, and this might have led to an increase in the population of the early man. The domestication of dogs was a revolutionary advance in the life of the hunters and food-gatherers and opened out new possibilities of living with abundant and more variable dietary.

Apart from hunting wild animals, the domestication of the dog led to still more useful results. As Zeuner observes, 'Once the dog had become a member of the human society, the control and later domestication became possible of certain small ruminants which had always constituted an important part of the diet of the dog's ancestors'. These are the goat and the sheep. The frequent occurrence of bones of dogs in the Bronze Age sites in Europe is connected with the increasing importance of sheep-keeping.

CAVE PAINTINGS

The best evidence of the life and activities of the Mesolithic man lies in the paintings in cave-shelters. Numerous painted cave-shelters have been located in India. Haematite paintings on rock-shelters situated near Singanpur, in the Raigarh District, Orissa, represent hunting-scenes and dances with masked figures, resembling those at Cogul in Spain. One of them depicts kangaroos, animals now restricted to Australia. Representations of horse and deer in Singanpur cave-shelters are very much like the Spanish drawings of the same age. Rock engravings at Ghatsila, in the Singhbhum District, Bihar, are remarkable for their Australian character. According to Mitra, these facts point to the existence of an ancient Indo-Australian culture extending from the upper Palaeolithic to the Neolithic.

Cockburn discovered numerous painted cave-shelters in the Kaimur ranges in the Mirzapur District in Uttar Pradesh. Here, hunting scenes show men, armed with harpoons having stone shaftheads, attacking rhinoce-

roses. These paintings may be attributed to the end of the Palaeolothic period. In the Bellary District, more than 20 groups of animal drawings and hunting-scenes with men armed with javelins and shields are painted in cave-shelters.

The most exciting discoveries of the Stone Age paintings are from Madhya Pradesh, and the scholar who discovered them is V. S. Wakankar. A group of fantastic rocks on the northern fringe of the Vindhyas facing the plains of Malwa could be seen from Obaidullaganj, about 42 kilometres from Bhopal, in the Raisen District of Madhya Pradesh. They are called Bhimbetaka, or the seat of Bhima (Fig. 37). Wakankar first saw them in 1957, but started the study of their paitings and stone tools in 1972. There are 754 rock-shelters, out of which more than 500 have paintings. Apart from Bhimbetaka, there are cave paintings at Bhopal, Jaora, Raisen, Kharwai, Narwar, Chhoti-Badi Dant, Pachmarhi, and Modi in the Mandsaur District, in Madhya Pradesh.

The floor of one of the caves at Bhimbetaka was dug (Fig. 38). At the lowest level, pebble tools of the Soān type were found, followed by Acheulian hand-axes. Above them were middle Palaeolithic (30,000 to 100,000 B.P.) cherts and jaspers, followed by the upper Palaeolithic non-geometrical microliths, in which blades and burins were prominent. The next layer relates to the Mesolithic Period (10,000 to 7,000 B.P.) in which geometrical microliths and bone tools were found.

Wakankar has classified the drawings and paintings into seven different periods. Out of them, the first three are tentatively dated as follows :

Period I — Terminal upper Palaeolithic 20,000 to 10,000 years B.P.
Period II — Mesolithic 10,000 to 4,000 years B.P.
Period III — Chalcolithic 4,000 to 2,500 years B.P.

Period I. The earliest paintings at Bhimbetaka are green and dark red. The green ones are fine outline drawings of dancers and hunters. The paintings fall into two groups. One group, possibly earlier, consists of drawings of elephants, wild cattle, boars, tigers, rhinoceroses, etc.

Period II. The subject-matter of the second, and possibly of the later group, is more varied, and the drawings are small. Some of them portray hunting-scenes. Animals shown are wild cattle, elephant, tiger, wild boar, deer, antelope and birds. The hunting-weapons include barbed spears, pointed sticks, bows and arrows. It is rarely that the drawings are truly realistic, but sometimes the artists succeeded remarkably in capturing the natural grace of the animals.

What is the purpose of this art in which animals figure so prominently? It seems it was magico-religious to ensure good hunting. Representations of large animals in strategically situated rock-shelters, such as the horned bull of Kanwala, boar, tiger, rhinoceros, fish, tortoise and mythical bull from Bhimbetaka, buffalo and elephant of Adamgarh, bull from Ramgudiwar

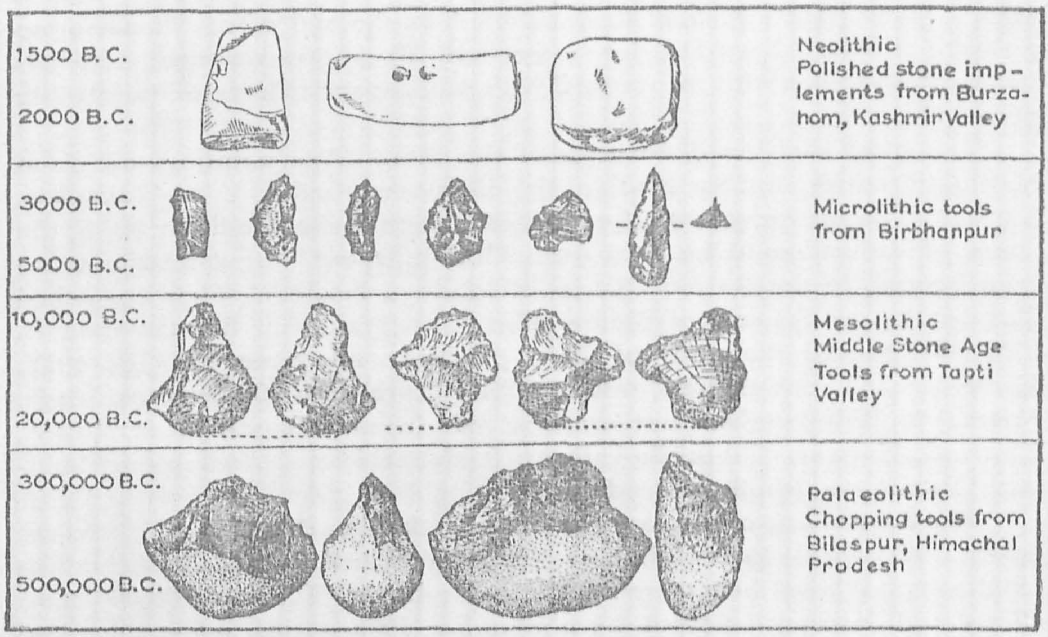


Fig. 39. Stone-tool types from the Palaeolithic to the Neolithic age

Talkoli of Badami, and elephant of Edakal caves, do indicate that these animals were deified and were painted oversize to create a feeling of awe in the spectators.

The Mesolithic paintings are red. They depict hunting-scenes and are marked by vigour. The human figures are elongated and are shown holding bows, arrows and barbed harpoons, surrounding their quarry, deer in this case. In a corner, a group of men are shown fleeing from an attacking rhinoceros, while one of them is climbing a tree. Men are naked or wear a skirt of leaves or bark (Fig. 45). Resemblance with the Spanish cave paintings from Cueva de Val del Charco del Agua Amarga is obvious.

A cave painting from Bhimbetaka shows a device which the cave-dwellers adopted for hunting. They used to scare herds of deer standing on rocks, with a steep fall below. In a painting deer are shown falling into a chasm from a ledge. The carcasses of dead or wounded deer were collected and eaten after roasting on fire.

Wakankar published a group of paintings from Bhimbetaka which depict the activities and the social life of these hunters and food-gatherers. Two paintings depict love-making. Another shows a pregnant woman, and yet another the birth of a child, who is depicted between the legs of the mother. There is a charming group of children frolicking. There are

Fig. 33a. Adamgarh rock-shelters near Hoshangabad, Madhya Pradesh. These cave-shelters were occupied by Palaeolithic and Mesolithic hunters. The lower levels yielded palaeoliths, and the upper microliths

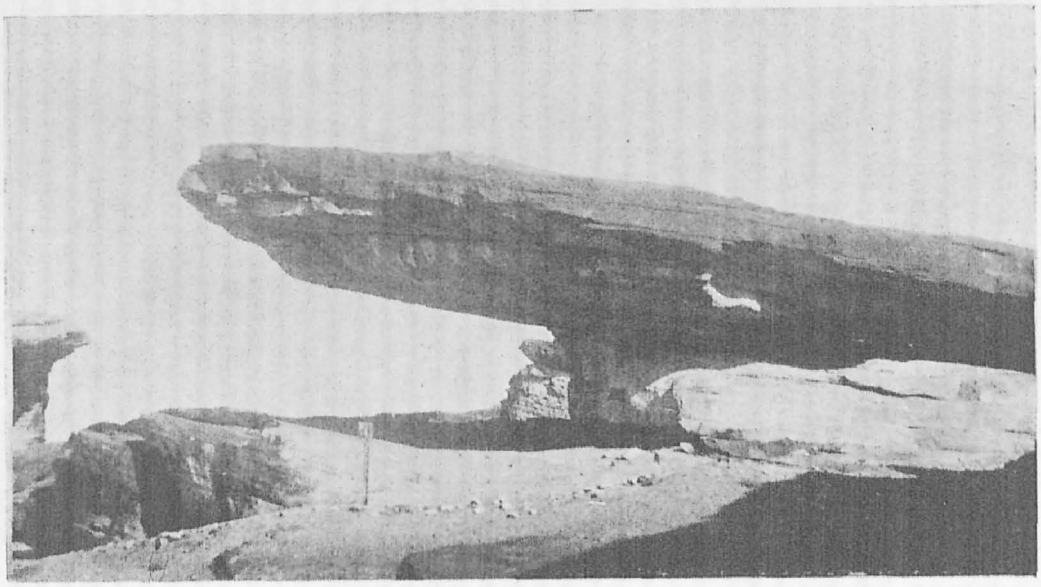


Fig. 33b. Detail of a cave-shelter at Adamgarh. The overhanging rock provided shelter to hunters against inclement weather. The roof is painted with hunting-scenes

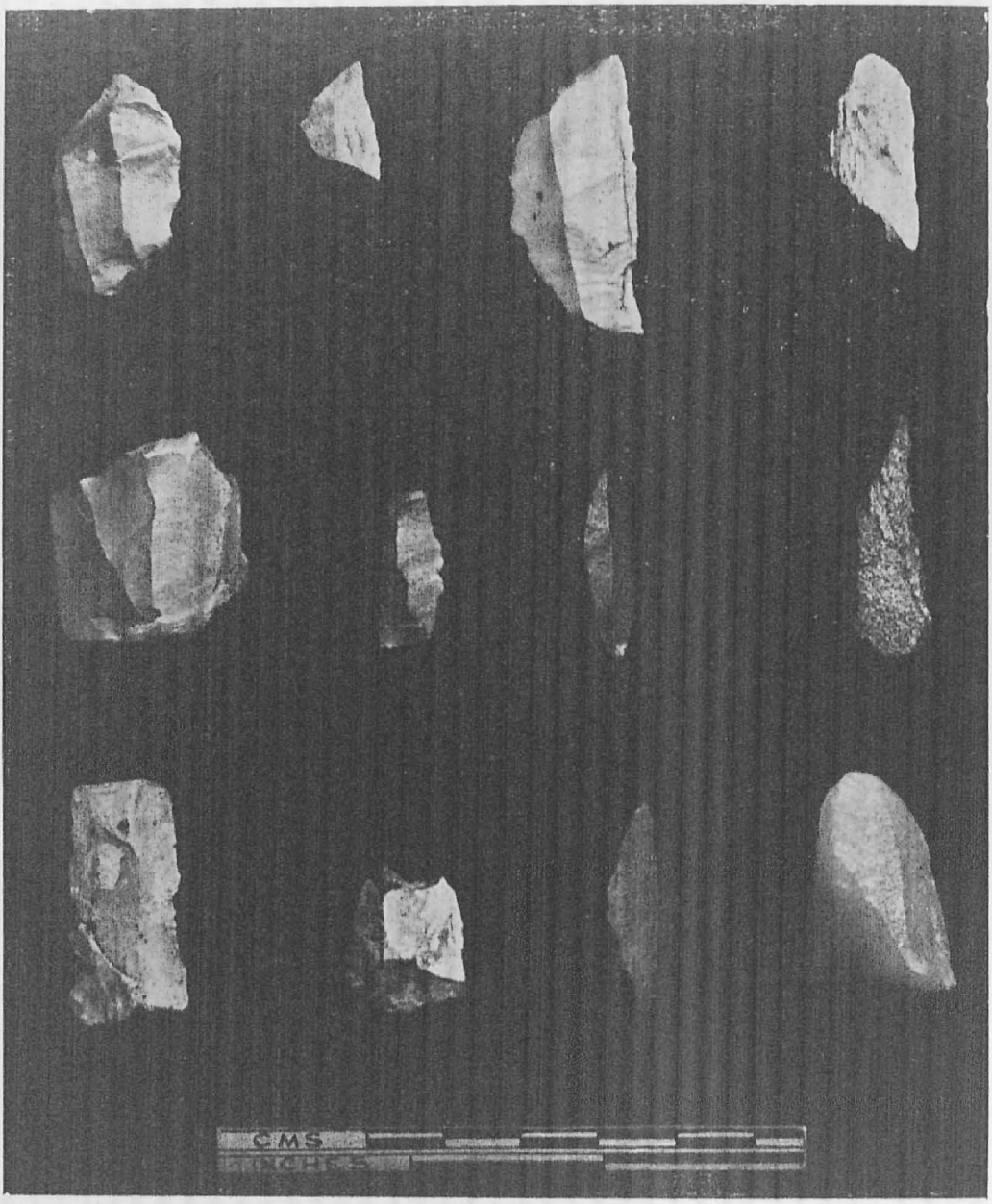


Fig. 34. Microliths from Birbhanpur, District Burdwan, near the Damodar Valley, West Bengal, 4000 B.C. They include blades, lunates, points and borers and burins
(Courtesy : Archaeological Survey of India)

Fig. 35. A mesolithic scene. A man is shooting an arrow tipped with a sharp microlith at an antelope. The other is throwing on a deer a spear tipped with a sharpened stone (Reconstruction from the Museum of Evolution of Life, Chandigarh)

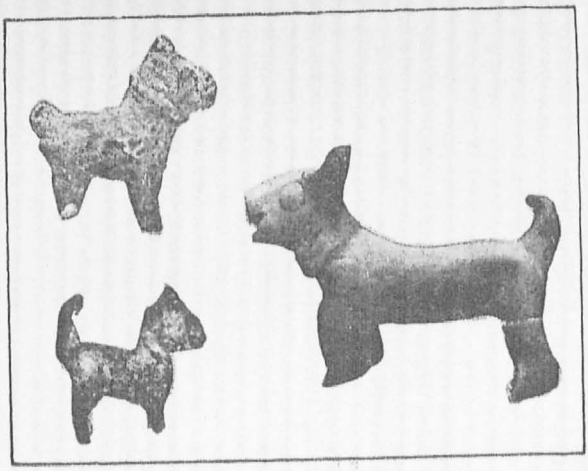


Fig. 36. Toys from Mohenjo-daro, depicting a variety of dogs
(After Mackay)

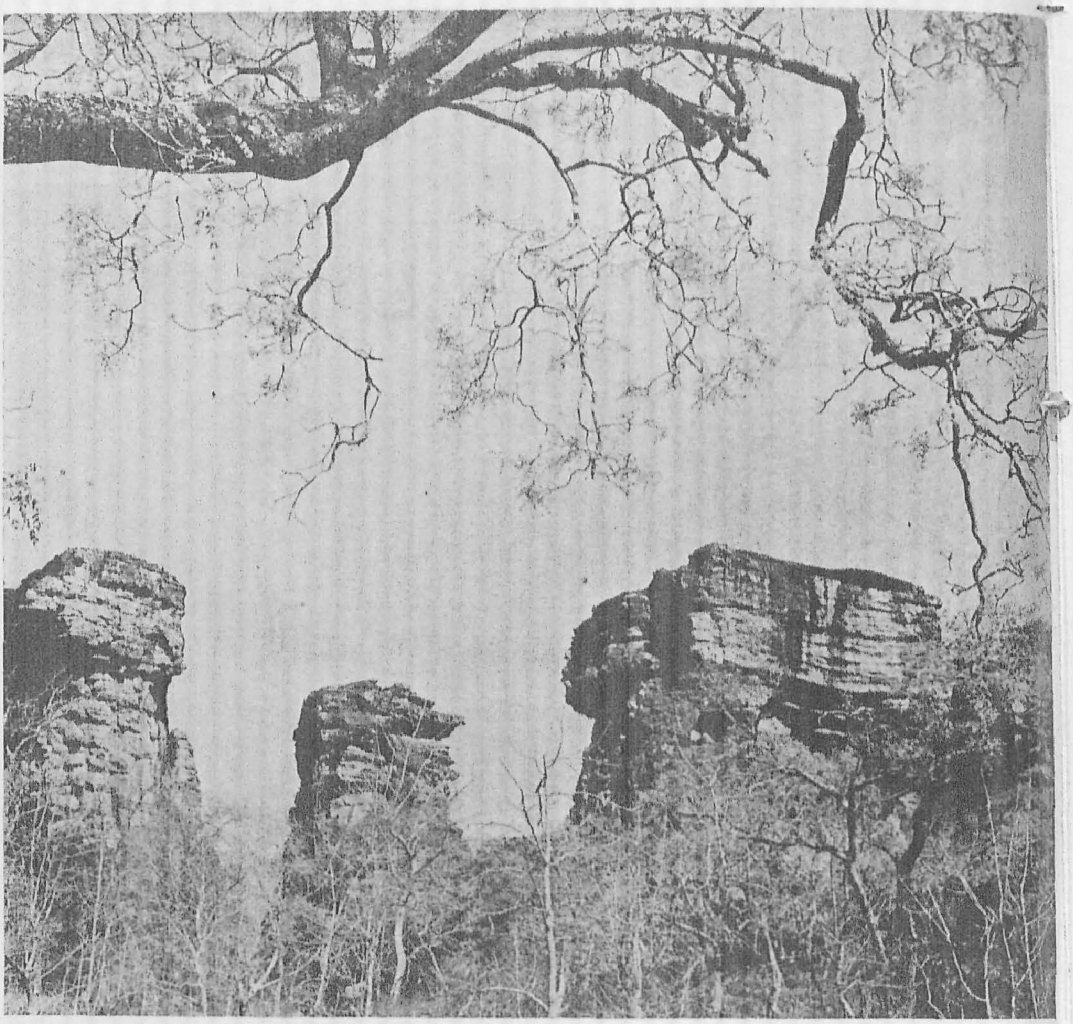


Fig. 37. Cave-shelters at Bhimbetaka, near Bhopal, Raisen District, Madhya Pradesh. The walls and roofs of cave-shelters have paintings dating from the Mesolithic to the early historic period

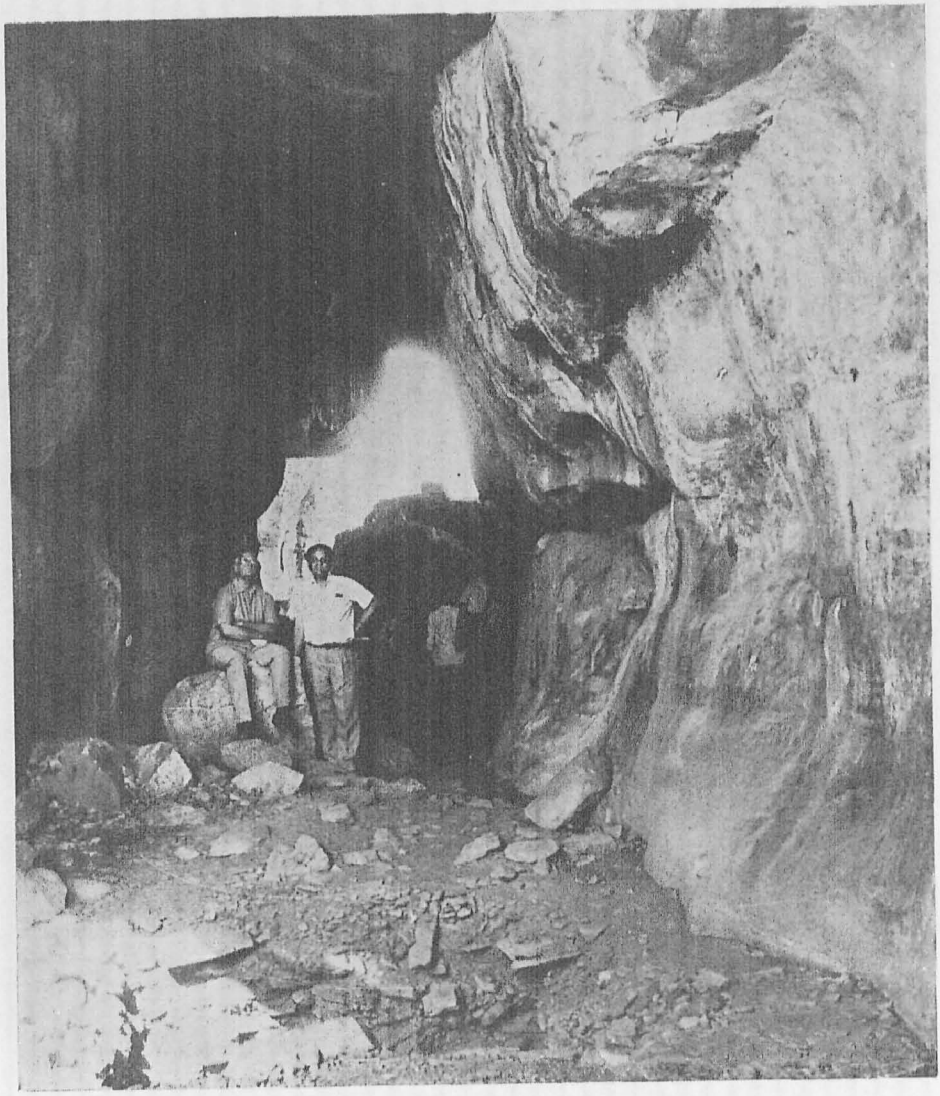


Fig. 38. Interior of the cave at Bhimbetaka. This cave has been in occupation since Palaeolithic times, as is evidenced by the discovery of Acheulian tools from the lowermost layer

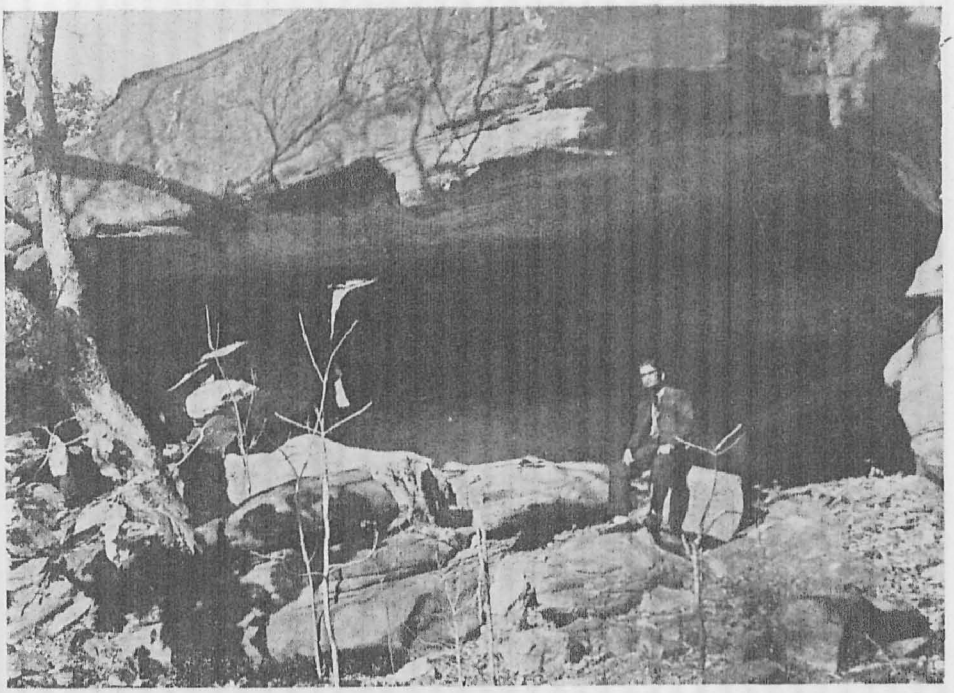
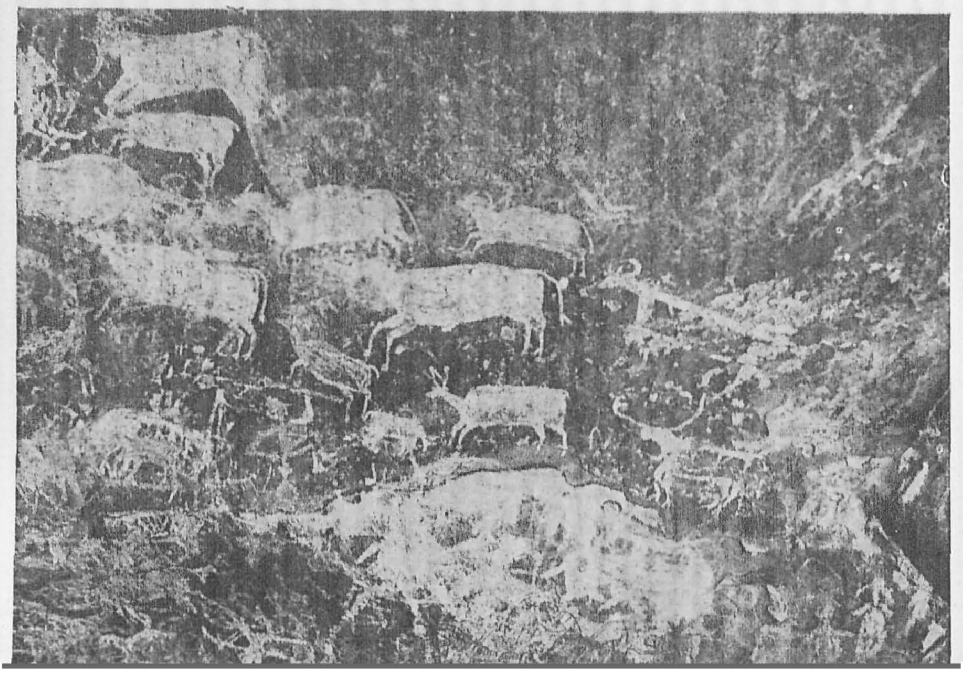


Fig. 40. A rock-shelter at Bhimbetaka. The roof is painted with figures of gaur, deer, sambhar, etc.
(Courtesy: A.P. Khatri)

Fig. 41. Mesolithic painting from a cave-shelter at Bhimbetaka. Herds of *cheetal*, wild buffaloes and cattle are shown



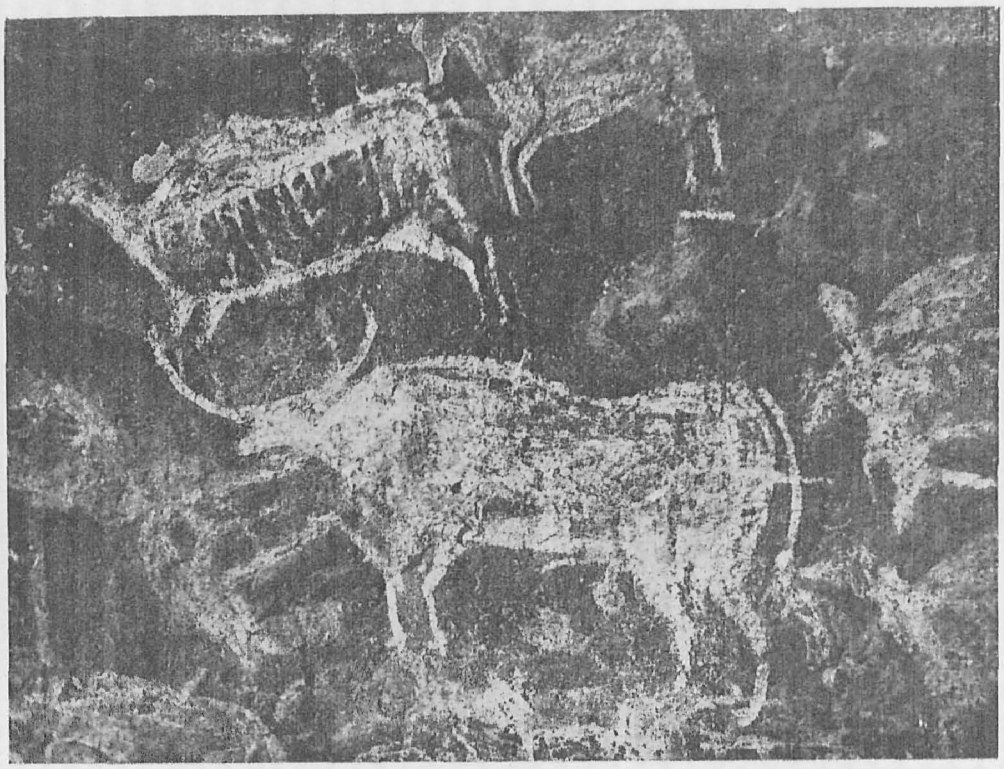
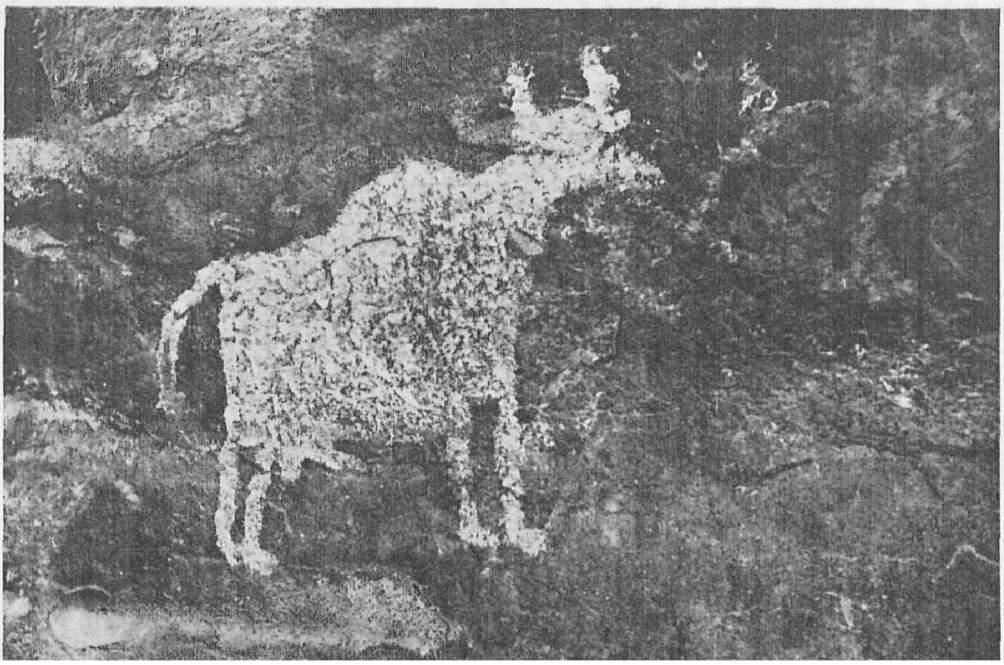
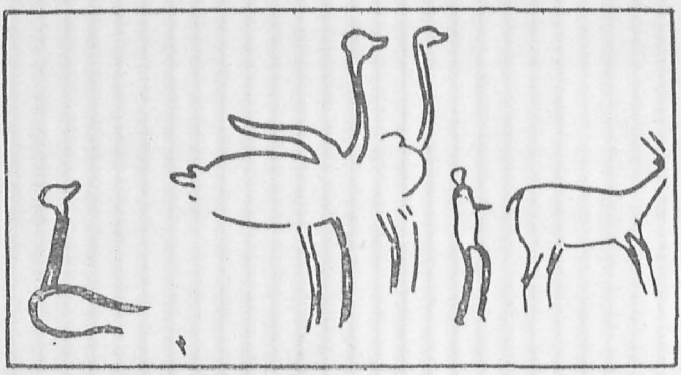


Fig. 42a. A gaur from a cave painting at Bhimbetaka

Fig. 42b. A buffalo-bull—a Mesolithic painting from a cave-shelter at Bhimbetaka





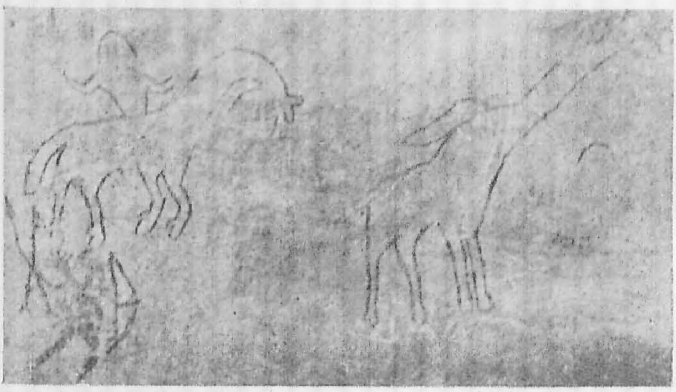


Fig. 47. African birds and animals in Mesolithic cave-paintings from Madhya Pradesh: *top*, a giraffe Bhimbetaka; *middle;* ostriches, Bazar Cave, Pachmarhi; *bottom*, giraffes, Adamgarh cave-shelter, near Hoshangabad

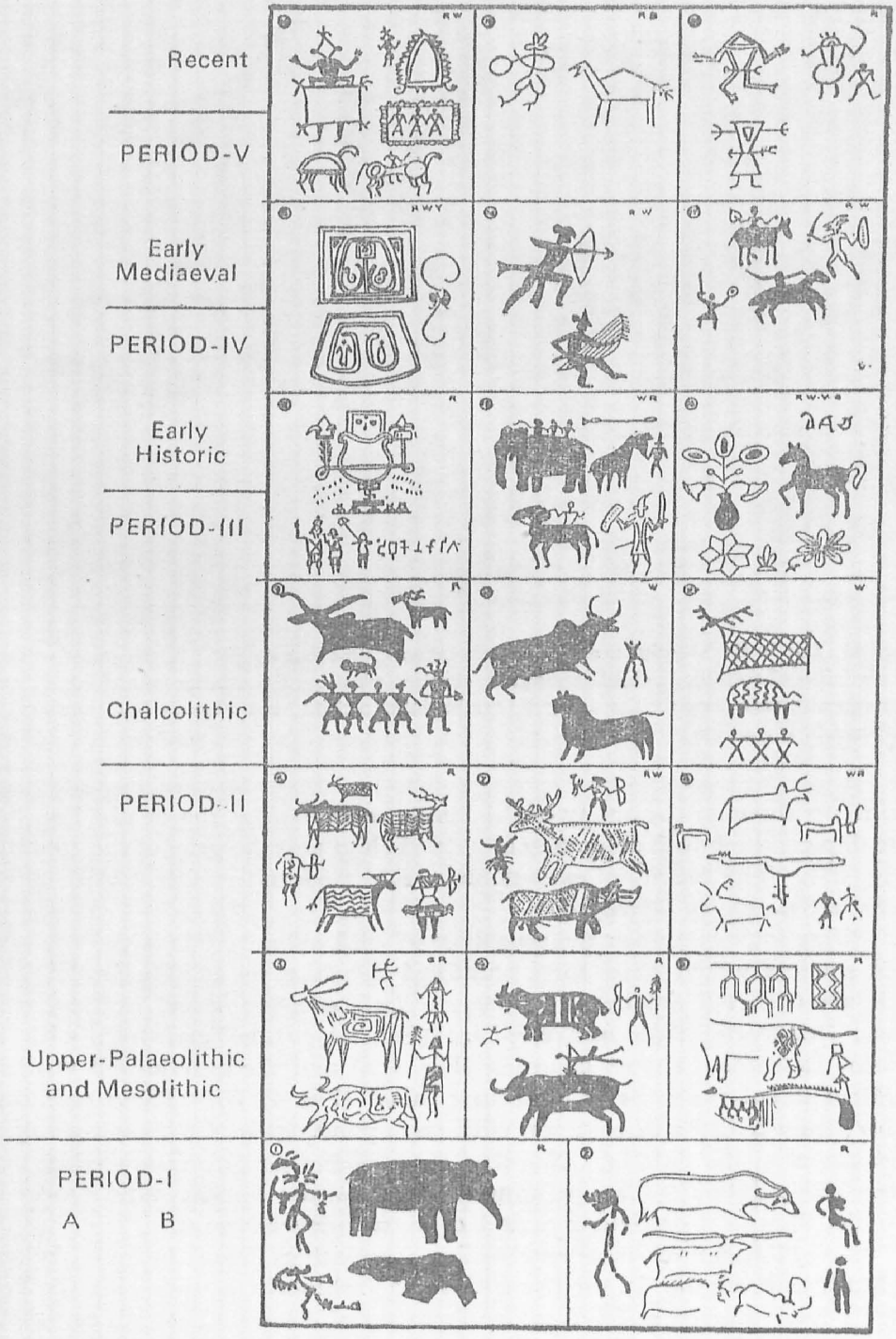


Fig. 43. Chronological and stylistic development of rock-painting in India (After V.S. Wakankar)

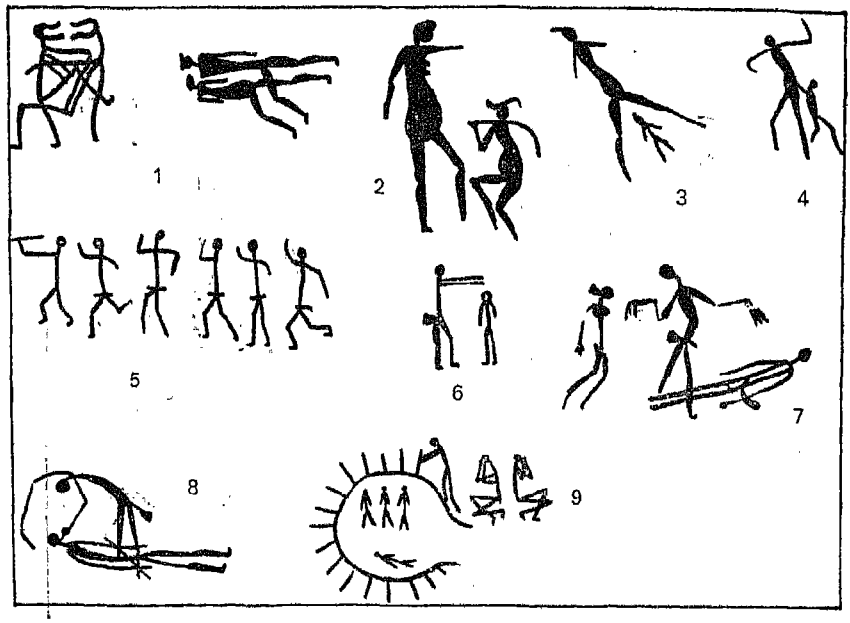


Fig. 44. Life in the Mesolithic age at Bhimbetaka : 1, amorous couples; 2, pregnant women; 3, the birth of a child; 4, child-rearing; 5, children playing; 6, initiation of a child; 7, cure by magic; 8, ceremony for the dead; 9, the burial of a child, and a family in mourning (After V.S. Wakankar)

paintings showing the agony of the family members for the dead. The last one depicts the burial ceremony of a dead child and the grief of the parents (Fig. 44). The brevity of expression is truly modern in spirit. With a few lines, so much is conveyed.

Most interesting are the paintings of wild animals. It is the roofs of rock-shelters which have such paintings in white paint (Fig. 40). The animals depicted are herds of deer, *neelgai*, *sambhar*, gaur, buffalo, wild boar, rhinoceros, tiger and elephant (Fig. 41). The gaur-bull with its enormous horns is shown charging (Fig. 42a) and the buffalo-bull with its uplifted tail seems to be in a fighting mood (Fig. 42 b). These paintings show many features in common with rock paintings in the Tassili-n' Ajjer mountains in the Sahara. Not that there is any genetic relationship between the painters. The paintings show how the human mind works in parallel lines in a particular period of human development.

Now I mention some extraordinary paintings from the cave-shelters of Madhya Pradesh. In the Bazar Cave at Pachmarhi, ostriches are depicted. I have already referred to the discovery of decorated ostrich egg-shells from Maharashtra. It is interesting to see these birds, now restricted to

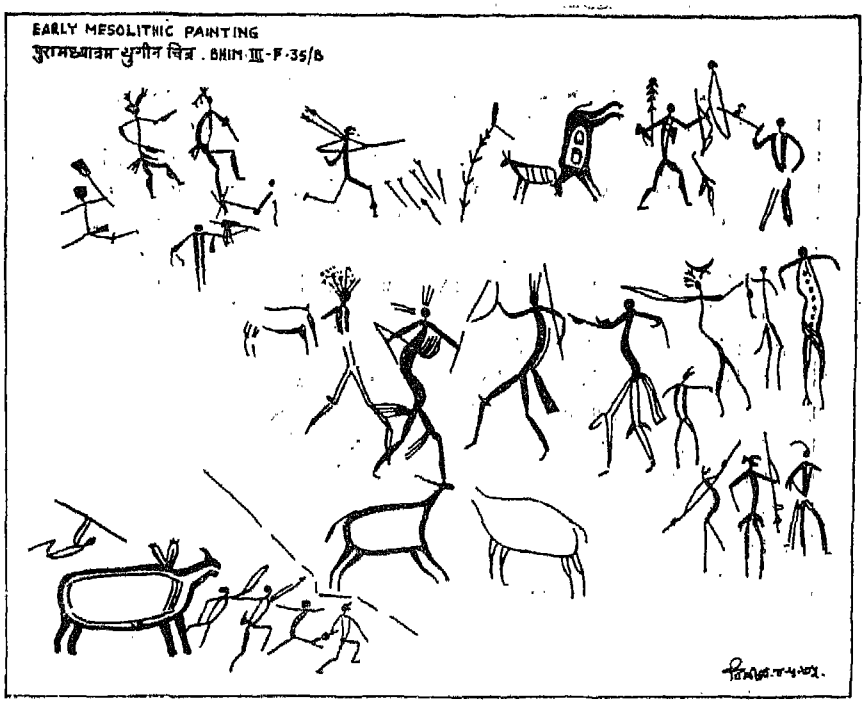


Fig. 45. A Mesolithic painting from Bhimbetaka. Hunters armed with bows, arrows and spears are chasing game. Human figures are elongated to show rhythmic action (After V.S. Wakankar)

Africa, depicted in a cave-shelter in India (Fig. 47, *middle*). Giraffes, whose fossils have been recovered from the Pleistocene deposits in the Siwalik Hills, are also depicted in cave-shelters at Bhimbetaka and Adamgarh. A man with a bow is shooting an arrow at a giraffe (Fig. 47, *bottom*).

A word about the age of the rock paintings. Potteries can be dated by ^{14}carbon method. In some cases, the designs on Chalcolithic-Neolithic pots closely resemble those in some cave paintings. From Modi in the Mandsaur District, a site which had 60 painted rock-shelters, the majority of which have been submerged under the waters of the Gandhi Sagar Dam, Wakankar discovered a painted stone piece and a heap of haematite granules from Mesolithic levels. Thus the date of the painting was established to be that of the Mesolithic period.

There is another significant discovery from Patne in the Ajanta Hill range of Maharashtra. There, S. L. Sali found decorated ostrich egg-shells. The shells were decorated with parallel cross-hatching and concentric circle engravings. At Bhimbetaka, bone engravings of similar designs as well as

of bone tools have been obtained from the upper Palaeolithic and Mesolithic levels.

The rock-paintings at Bhimbetaka, which are green, are earliest on the basis of superimposition and can be attributed to the upper Palaeolithic period. After this period, the green colour has never been used, though there are a few exceptions, such as a group of flower-vase paintings in one cave, which belong to the Gupta period. The green in these later-period drawings is quite different from the earliest group in which it is much darker and tallies with the green nodules found in the upper Palaeolithic levels at Bhimbetaka.

Apart from the colour of the paints, it is the style which is the surest guide to the age of paintings. In the case of cave paintings, some difficulty arises, as the paintings of the living tribals also resemble them. However, this resemblance is only superficial. An expert eye can easily distinguish the recent from the ancient. The Palaeolithic and the Mesolithic paintings have a vigour and verve which is not matched by the present-day tribal painting.

SURVIVING PRIMITIVE TRIBES IN THE MESOLITHIC STAGE

Apart from the stone tools, and cave paintings, some of the surviving primitive tribes provide us with an idea of the mode of life of the Mesolithic people and their food. Of these, the Onge of the Andamans, a Negrite pygmy tribe, are the most primitive. Only about 150 of them survive in the Little Andaman.

Although they have now started using iron tips for their arrows and spears, their economy is essentially of the type of the Mesolithic Age, based on hunting, fishing and gathering. Cultivation in any form is unknown to them.

"Within the limits of their pre-agricultural technology, the Onge optimally utilise the natural resources of the forest and the sea," states Sinha. From the forest, they procure tuberous roots, yams, jackfruits, pandanus fruits and various types of berries, and also pigs, larvae of insects, birds and honey. From the island creeks and their banks, they get freshwater fish, prawns, and turtle eggs. From the sea, they get fish, turtle, dugong, shellfish and crabs, and sea-borne cocoanut.

"The forest provides them not only with the major sources of food but almost all their material requirements. The communal huts and temporary shelters are made from forest products. Other articles of their use—boats, weapons, their scanty body covering, decorative material and medicinal items—are all derived from forest products. Roots, stalks, bark fibres, stems, trunks, branches, leaves, flowers—every part of the tree is used.

"There is a distinct division of labour among them. Hunting pigs, dugong or turtle, fishing with harpoons and bows and arrows are men's

jobs, while women are mainly engaged in the collection of roots and tubers and fishing with nets.[4]

THE FOOD HABITS OF THE TRIBALS OF MADHYA PRADESH

The food habits of the tribals provide us with a clue to the type of food consumed by the Mesolithic food-gatherers and hunters. We will now consider the environment and food articles of the tribals of Madhya Pradesh.

In the Bastar District of Madhya Pradesh, the important tribal and subtribal communities are Maria, Muria, Bhatra, Mahara, Dhakad, and Rawat. In the Betul, Mandla, Sarguja and Chhindwara districts, Gond, Kol and Bharia predominate. The Jhabua District is inhabited by Bhils and Kanjars. These tribes most probably belong to the 'Proto-Australoid' group or the so-called Veddoid type.

Topographically, the regions inhabited by the tribal people are generally hilly and undulating, with high and low plateaus covered with dense and almost inaccessible forests.

Ecologically, the present forest vegetation represents bio-edaphic series, and very little of the primaeval forest is left. However, some relict areas of the mixed deciduous monsoon forests of *Shorea-Tectona-Diospyros* exist. The dominant tree species in the tribal forest areas are *Shorea robusta, Tectona grandis, Diospyros melanoxylon, Terminalia alata (T. tomentosa), Madhuca indica (M. latifolia), Pterocarpus marsupium, Buchanania lanzan (B. latifolia),* and *Anogeissus latifolia.* The sociability of these species is very high and they occur in closed colonies. The herbaceous ground-floor vegetation consists of a large number of species, many of which provide food to tribal races.

In Madhya Pradesh, although rice *(Oryza sativa)* and lesser millets *(Panicum miliaceum, Eleusine coracana,* and *Paspalum scrobiculatum)* form the staple diet of the tribal people, almost all of them supplement it with seeds, grains, roots, rhizomes, leaves and fruits of numerous wild plants which abound in the forests. Grigson (1949) noted that famine has never been a problem in Bastar, as the tribes have always been able to draw half of their food supplies from the innumerable edible products from the vast forests.

Ethnobotanically, the knowledge about the food habits of various tribes is fragmentary and incomplete. Haines (1916), Mooney (1942), Elwin (1947), Grigson (1949), Roy and Rao (1957), Subramanyam *et al.* (1961) and Jain (1963) enlisted some species.

D. K. Tiwari (1977), of the Jawaharlal Nehru Agricultural University, Jabalpur, prepared a detailed list of wild plant species eaten by the tribals in Madhya Pradesh. He has listed 165 trees, shrubs and climbers. Of these, the first category contains a list of 31 plants whose seeds are roasted and eaten. It includes:

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[4]Sinha, S. Primitive Hunters, Shifting Cultivators, *The Times of India Annual,* 1974

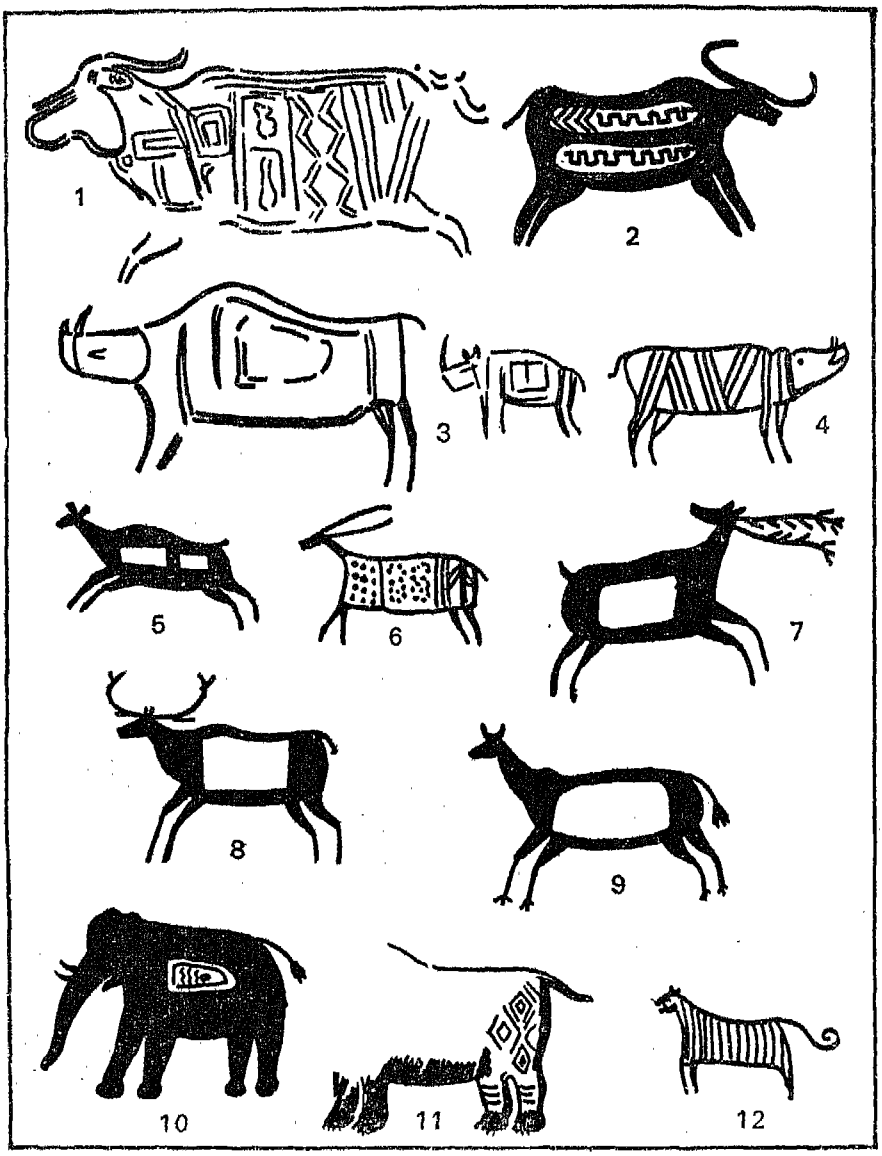

Fig. 46. Animals depicted in Bhimbetaka rock-paintings: 1, a wild buffalo; 2, a gaur; 3, a rhinoceros; 4, a boar; 5, a chinkara; 6, a spotted dear; 7, a sambhar, 8, a deer; 9, a blue bull (*nilgai*); 10, an elephant; 11, a tiger or panther; 12, a tiger
(After V.S. Wakankar)

Avena fatua, Coix lacryma-jobi, Dendrocalamus strictus, Madhuca butyracea, Oryza sativa var. *spontanea, Paspalum scrobiculatum* and *Setaria glauca.*

There are 19 plants whose roots and tubers are eaten after baking, boiling or processing. This category includes: *Asparagus racemosus, Arisaema tortuosum,* and eight species of *Dioscorea.*

There are 17 plants whose juice is taken fresh or after fermenting. This group includes: *Caryota urens, Phoenix sylvestris, Madhuca longifolia, Borassus flabellifer* and *Ampelocissus latifolia (Vitis latifolia).*

There are 25 plants whose leaves are eaten as vegetables. These include *Rotala leptopetala (Ammannia pentandra), Amaranthus spinosus, Bauhinia purpurea, Indigofera glabra (I. pentaphylla), Moringa oleifera (M. pterygosperma), Portulaca quadrifida, Nymphaea nouchali, Nelumbo nucifera* and *Shorea robusta.*

There are 10 plants whose petals are cooked as vegetables. These include species of *Bauhinia, Sesbania grandiflora, Cochlospermum religiosum* and *Holoptelea integrifolia.*

There are 63 plants whose fruits are eaten raw, ripe, or roasted or pickled. The fruits of *Aegle marmelos* provide delicious food for the forest-dwellers. *Buchanania lanzan,* the *chironji,* provides them with delicious nuts. It occurs in many forests in Madhya Pradesh. The fruits of *Emblica officinalis (amla),* rich in vitamin C, are eaten raw or are pickled.

There are five species of *Ficus* which provide figs for the forest-dwellers. The fruits of the thorny shrub *Pithcellobium dulce (Inga dulcis),* also called *jungli jalebi,* are favourites with the tribals. Seedling mangoes *(Mangifera indica)* are common and are also eaten raw or ripe by both man and monkeys.

Tamarindus indica (imli) is a common forest tree whose pods make good pickles. The sepals of *mahua (Madhuca butyracea)* are greedily eaten and are also fermented for liquor. *Morus alba,* the mulberry, provides fruit for both man and birds. Besides, the *ber, Ziziphus mauritiana* and *Z. oenoplia,* provide delicious fruit. It has been eaten by the jungle-dwellers from the Mesolithic period onwards.

So far as sugar is concerned, honey of wild bees, *Apis mellifera,* was its main source for the tribals. Combs of wild bees are found in all the jungles of India. The rocky cliffs of Bhimbetaka are studded with numerous honeycombs of wild bees.

Thus we find that, apart from the flesh of wild animals, the Mesolithic people had a variety of seeds, leaves and fruits which they could collect from the jungles. The selections which they made ultimately provided plant material to their successors for cultivation in fields and gardens.

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CHAPTER 8

THE NEOLITHIC AGRICULTURAL REVOLUTION IN WESTERN ASIA

INVENTION OF POLISHED STONE IMPLEMENTS, DISCOVERY OF AGRICULTURE AND DOMESTICATION OF ANIMALS

7500 B.C. — 6500 B.C.

WHILE people were hunting wild animals and subsisting on leaves and fruits of the jungle trees in India, a remarkable development took place in western Asia, viz. the discovery of agriculture.

The birthplace of the Neolithic agricultural revolution was the hilly region embracing Israel, Jordan, Anatolia, Iraq, the Caspian Basin and the adjoining Iranian plateau. It is in this region that wild ancestors of two major cereals, wheat and barley, and of domesticated animals like goat, sheep, pig, and cattle *(Bos primigenius)*, are found. Thus, apart from the fertile soil, all the requirements of mixed farming, which include agriculture and stock-raising, were present in this region (Fig. 49).

The Natufians, who are so named after a camp-site in the Wadi-el-Natuf, in Jordan, used sickles of small flint blades set with gum into the grooved shafts of bone. The blades were finely notched and set in a line to make a continuous saw-edge. The silica in the grass or corn stalks had polished the edges of the flints into a bright lustre from constant use. On the flat rock floor at the cave mouth were hollows made by pounding the grain into flour, and stone mortars were found for the same purpose.

In Fig. 48, a reconstruction of a harvesting scene from the Fertile Crescent, two men and a woman are shown harvesting wheat with stone sickles. In the background is a cluster of huts.

It is the animals that live in herds that are more amenable to domestication. The herd is ususally led by a leader whom the herd follows. If the leader is captured, the rest of the herd can easily be caught. Sheep, goats, cattle and pigs, which are the main domestic animals, come under this category and no wonder that they were the first to be domesticated. Similarly, among plants it is the grasses which tend to grow densely, and are most amenable to control by man. Most of our cereals, e.g. wheat, barley, oats and rice, are grasses.

The oldest Neolithic settlement sites known are Ali Kosh, Bus Mordeh phase (7500 B.C.) in Iran, Jericho in Jordan (7000 B.C.), Jarmo in Iraq (6750 B.C.) and Belt Cave below the Caspian (6500 B.C.) in northern Iran. Between them, they more or less embrace the region called the Fertile

Crescent, which saw the rise of Neolithic culture. Ali Kosh, Jericho, Jarmo and other ecologically similar localities witnessed the first attempts at agriculture. These are mountainous areas where adequate rainfall for non-irrigation agriculture exists. The Ali Kosh villagers harvested their cereals with flint sickles, which were set into hafts by means of asphalt. They ground up wheat, barley, and crop weeds on saddle-shaped or shallow-basin grinding-slabs, using simple discoidal handstones of pitted limestone. An innovation was the use of the stone mortar and pestle.

Braidwood states, "Jarmo was a permanent, year-round settlement with about two dozen mud-walled houses that were repaired and rebuilt frequently, creating about a dozen distinct levels of occupancy. We have identified there the remains of two-row barley (cultivated barley today has mostly six rows of grains on a spike) and two forms of domesticated wheat. Goats and dogs, and possibly sheep, were domesticated. The bones of wild animals, quantities of snail shells and acorns and pistachio-nuts indicate that the people still hunted and collected a substantial amount of food. They enjoyed a varied, adequate and well-balanced diet which was possibly superior to that of the people living in the same area today."[1]

Jarmo and other ecologically similar localities witnessed the first attempts at agriculture. In the region about Jarmo, the present-day botanical evidence strongly substantiates the idea that here are found wild wheat, wild barley, lentil, pea, flax, fig and almond—all of which are potentially domesticable in their present forms, or have potential factors for hybridization. All are found in a definitely wild state, that is, in uncultivable situations, so that they must be considered indigenous and not later introductions. From this region, Neolithic culture diffused in a series of waves to Aegean and Levant, Egypt, southern Russia, the Balkans and the Danube Valley, Italy, France, Spain, the British Isles and India.

POLISHED STONE-AXES

Polished stone-axe or celt, with its edge carefully ground, was an important tool which enabled the Neolithic man to obtain a foothold in the forests. In the forest clearings, these farmers started the cultivation of crops. Very often, fire was used for burning forests, and grains of cereals were dibbled with the aid of pointed sticks, as is still done by some farmers in the hill areas of Assam. Later on, stone-hoes with wooden handles were invented. The sowing of crops was largely the work of women, who are credited with the discovery of agriculture. It was only after the domestication of cattle and the invention of the plough, which came much later, that woman was liberated from the toil of cultivation. In most states in India, even now whereas ploughing is done by man it is the woman who follows the plough and drops the seed in the furrows.

[1]Braidwood, R.J. The Agricultural Revolution, *Scientific American*, Sept. 1960

CULTIVATION OF PLANTS

It is the cereals—wheat, barley, rice, millets and maize—which have contributed most to the building up of the Neolithic culture. They yield nutritious food and the grains can be easily stored for a number of years. All the cereals have arisen from wild grasses, and wild ancestors of a number of them are known. One of the major differences between the cultivated forms and the wild ancestors is that in the latter the seed is shed as soon as it is ripe, whereas in the former the seeds remain enclosed in their husks and can only be separated by threshing. The cultivated forms possibly arose from a lethal mutation as a result of which non-shattering varieties developed, and they could be successfully harvested, threshed and winnowed. A fascinating history of cultivated plants has been built up by the discovery of carbonized seeds and impressions on potsherds from archaeological sites. The study of pollen has provided us with evidence of farming, inferred from the occurrence of cereal pollen or the pollen of weeds associated with cultivation. Sculptures and paintings showing agricultural operations also provide evidence of past agriculture. Other evidences are storage pits, pots, sickles, hoe-blades and saddle-querns.

Wheat. Vavilov recognized 14 species of *Triticum*, which fall into three groups with 7, 14 and 21 chromosomes respectively. Among these, the most ancient are the 7-chromosome wheats comprising *T. aegilopoides*, the wild einkorn, and *T. monococcum*, the einkorn. Carbonized seeds of both these species have been found at Jarmo. Both have fragile stems, loose spikelets, and a single seed in each spikelet. Both easily hybridize. The wild einkorn is found in Armenia and Georgia in the Soviet Union, and in western Iran. There are no records of this wheat in India, Africa or China. Einkorn is still cultivated in the hilly regions of Europe and the Middle East. Its importance lies in the fact that it is the ancestor of all other cultivated wheats, excepting emmer (Fig. 52).

There are seven species of 14-chromosome wheats. They originated through hybridization and chromosome doubling of the 7-chromosome einkorn with a 7-chromosome wild grass which is still unidentified. The only wild species with 14 chromosomes is the wild emmer, *T. dicoccoides*, which is found in Armenia, northern Palestine, Syria, Turkey, and western Iran. The wheat found at Jarmo is of an irregular type with coarse and loose ears comparable with those of *T. dicoccoides*. From its original home, emmer diffused into Egypt, Ethiopia and Europe. It is still grown on a considerable scale in Ethiopia. Emmer was the wheat of Egypt until it was replaced by bread wheat after Alexander the Great conquered Egypt in the fourth century B.C. Outside Ethiopia, emmer lingers on as a relict crop in Yugoslavia and southern India.

The third domesticated wheat was also a tetraploid. It was so trivial that there is no common name for it; scientifically, it is named *Triticum*

timopheevi. It originated in Transcaucasian Georgia and has spread only as a collector's item for genetic studies.

The 14-chromosome wheats have tough stems and seeds which thresh free from their glumes and consist of 4 species: *T. durum* (macaroni), *T. persicum* (Persian), *T. turgidum* (rivet) and *T. polonicum* (Polish).

The wheat we grow today is none of these three early domesticates. All three are known as glume wheats because the spike, or the seed-bearing head, breaks up when it is threshed, leaving each seed enclosed in a hard, shell-like glume, or husk. The seeds must then be processed further, usually by pounding in a mortar, to free them of the husks. Some time after emmer was domesticated a mutation occurred that caused the base of the glume to collapse at maturity, freeing the seed. At the same time, the spike became tough, so that it did not fall apart as the ancestral spikes had done. The mutated, free-threshing emmer is the ancestor of our macaroni wheats.

'The major wheat species of the world, and the one that contributes most to the annual harvest of 360 million tonnes, is still another kind, known generally as bread wheat. It is a hexaploid; that is, it has 21 pairs of chromosomes. It arose long after the initial domestication of the three primitive glume wheats. Its extra set of chromosomes was contributed by a wild goat-grass called *Triticum tauschii*, and the distribution of the wild progenitor suggests that the hybridization may have taken place somewhere near the southern end of the Caspian Sea. *T. tauschii* is the only species of goat-grass with a continental distribution, and it may have contributed to the adaptation that makes it possible for bread wheat to be grown on the dry steppes of the world. As a wild grass *T. tauschii* is essentially worthless, but as a contributor of genetic characteristics it literally made a billion-dollar crop out of a million-dollar one'.[2]

The 21-chromosome wheats comprise five species and are widely cultivated. Of these, *T. aestivum* (common), *T. sphaerococcum* (shot) and *T. compactum* (club) are true bread wheats which comprise 90 per cent of the wheat grown today. Grains of *T. sphaerococcum*, the common wheat of northern and central India, found from Mohenjo-daro are dated about 2300 B.C. This wheat seems to have been grown widely in the Indus Valley.

Barley. There are two species of cultivated barely, the two-rowed *(Hordeum distichum)*, and the six-rowed *(H. hexastichum)*. The wild ancestor of the two-rowed barley is found in Palestine, Arabia, Asia Minor, Transcaucasia, Iran and Afghanistan, and of the six-rowed barley in eastern Tibet. The earliest find of barley is from Jarmo.

DOMESTICATION OF ANIMALS

During the Neolithic times, along with the cultivation of cereals the

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[2]Harlan, J.R. The Plants and Animals that Nourish Man, *Scientific American*, Sept. 1976

Fig. 48. A Neolithic rural scene, depicting the harvesting of wheat and barley with stone sickles, with clusters of huts in the background
(Reconstruction from the Museum of Evolution of Life, Chandigarh)

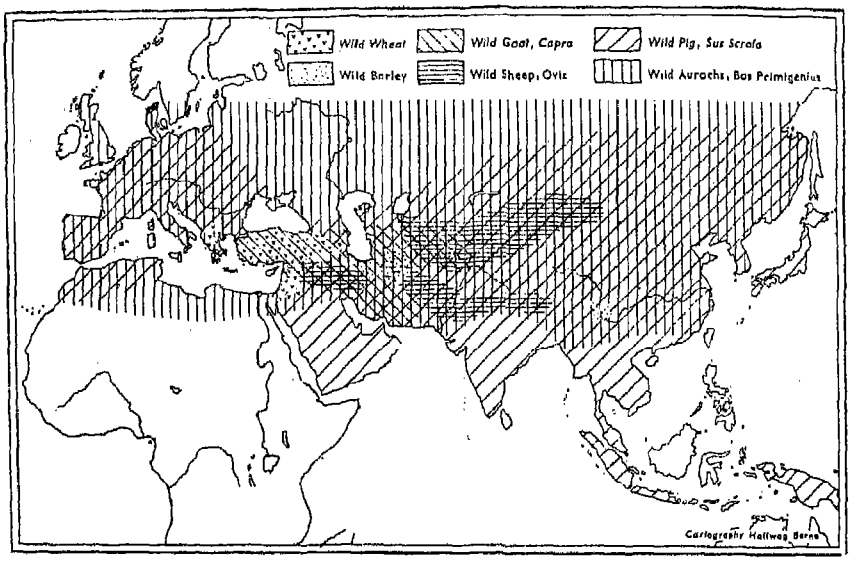
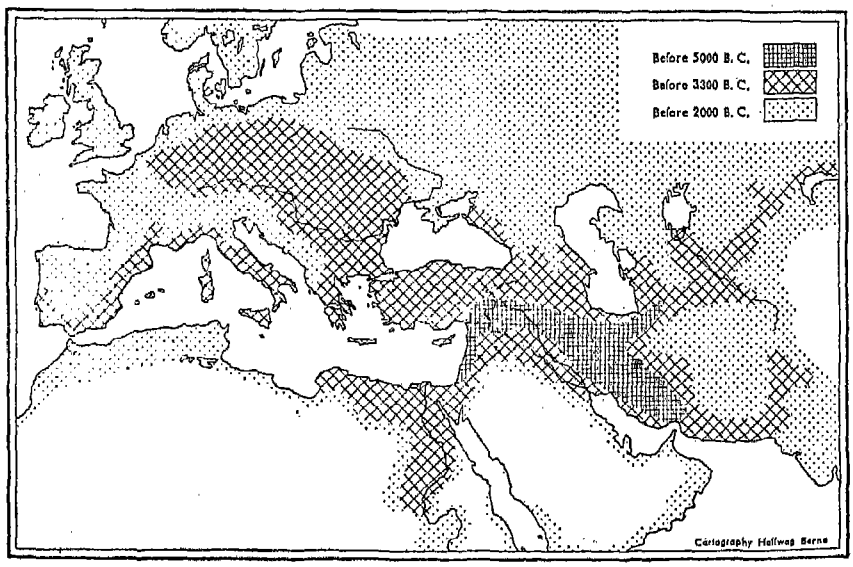


Fig. 49. The distribution of the wild ancestors of domestic plants and animals in the Old World
(Based on a map in Sonia Cole, *The Neolithic Revolution*; by permission of the Trustees of the British Museum, Natural History; courtesy: UNESCO)

Fig. 50. The diffusion of farming into Asia and Europe
(Based on a map in Sonia Cole, *The Neolithic Revolution*; by permission of the Trustees of the British Museum, Natural History; courtesy: UNESCO)



domestication of animals was also carried on. This became possible because the habits and habitats of animals and plants and their reproduction and growth came under keen observation. Domestic animals like sheep, goats and cattle are movable sources of food, and their dung is used as manure. Goats and cattle also supply milk. The hair of sheep and goats can be woven into cloth or beaten into felt. The use of animals to carry loads or draw ploughs and vehicles is a later adaptation.

Changes in climate and the advent of aridity are regarded as important factors favouring the domestication of wild animals. With the decline of food and water supplies, the wild animals herded hungrily round the scattered oases around which human settlements had already been established. The close contact of wild animals with man paved the way for their domestication.

The time sequence in which wild animals were domesticated is as follows: Firstly, goat and sheep; secondly, cattle and pigs; and lastly, draught and transport animals such as the horse and the ass. This sequence is borne out by the excavations carried out in the Belt Cave, where the remains of domesticated sheep and goats are found in the earliest pre-pottery horizon dated to the first half of the sixth millennium, whereas the remains of pigs and cattle are found in the second half of the same millennium.

HOUSING, POTTERY, BASKETRY AND LOOM

A distinctive feature of the Neolithic culture was the development of houses built of locally available materials. Walls made of *pise* or sun-dried bricks were popular in south-western Asia, Africa and China. The oldest-known Neolithic houses are of Jericho and Jarmo, in which both stones and *pise* were used. The walls were lined with lime-plaster, and the floors were plastered and burnished with smooth stones. The wooden door frames were possibly provided with skin curtains.

The development of agriculture and the production of foodgrains in sizeable quantities led to the problem of storage. Pots were required not only for storing foodgrains but also for cooking. Though Jericho was occupied in the eighth millennium, the first pots are dated about the middle of the sixth millennium. The first pots were hand-made from clay, and the use of the wheel in pottery came much later. The baking of pots is of significance for the beginning of science. As Gordon Childe observes, "It is the earliest conscious utilization by man of a chemical change." The use of pottery extended the range of cooking operations and improved the diet of man.

Basketry was first developed in Iraq, Iran, Palestine and Egypt. Coiled basketry was popular in Egypt. Weaving was made possible by abundant supplies of flax and wool. Flax was the material used for textile in the early Neolithic times in Egypt, Asia and Europe. According to Jacquetta

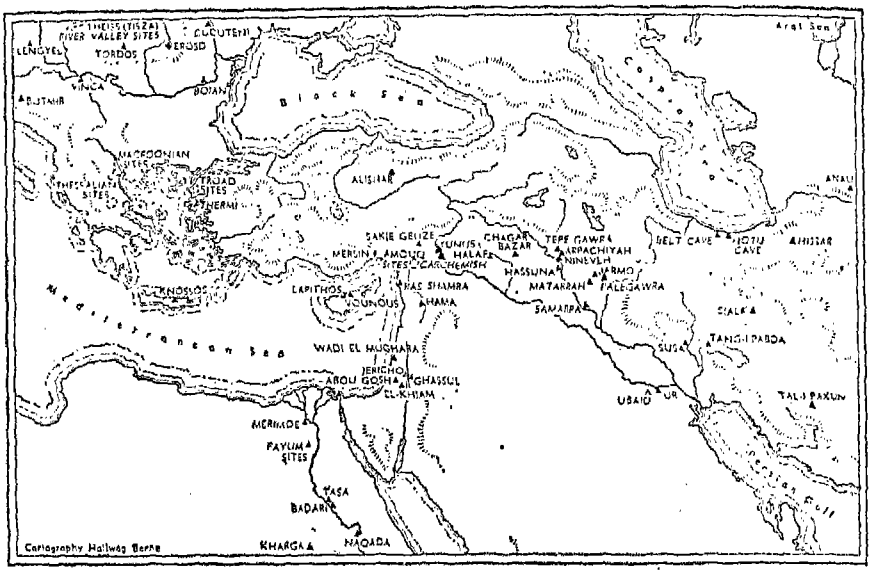


Fig. 51. Neolithic sites in South-West Asia and eastern Europe
(After J. Braidwood, Oriental Institute, University of Chicago; courtesy: UNESCO)

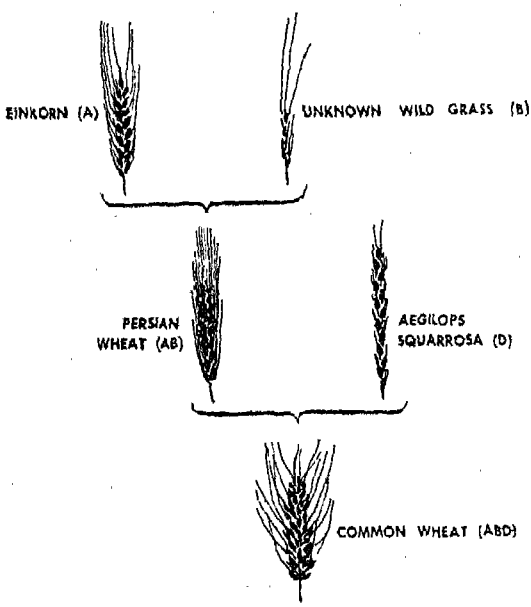


Fig. 52. Ancestry of common wheat
(After P.C. Mangelsdorf)

Hawkes, the Danubians, the windmill people of England, and the first Scandinavian settlers had no textile garments, but relied entirely on skins and furs. Spinning, weaving and making of pots is again credited to women.

The invention of weaving had a deeper implication. As Bernal observes, "Weaving is clearly a further adaptation of basket-making, and both of them involve regularities, first of all actually practised and then thought about, which are at the basis of geometry and arithmetic. The forms of patterns produced in weaving and the number of threads involved in producing them are essentially of a geometrical nature, leading to a deeper understanding of the relations between form and number."

Saddle-querns were used for grinding grain. Possibly, parched grains were used, and the grinding operation may not have been so arduous. Techniques of baking and brewing were also developed.

During the Neolithic or the Polished Stone Age, man acquired the skill of grinding and polishing stone implements like celt, axe or adze, and invented the sickle for harvesting crops. He began to control his food supply by cultivating plants and domesticating animals. Bernal regards the invention of the technique of agriculture, ranking with the utilization of fire and of power, as one of the three most momentous inventions in human history. Like all great transformations, it was not a single act but a process including numerous observations and inventions, all subservient to the essential achievement—the cultivation of seed-giving grasses. Apart from the discovery of agriculture and animal husbandry, other achievements of the Neolithic revolution were wood-working, and manufacture of pottery and textiles. Thus when we speak of the Neolithic revolution, what is implied is not a catastrophe but a major change in the techniques of food production which gave man control over his environment and saved him from the precarious existence of a mere hunter and gatherer of wild berries and roots. For the first time, he lived in settled villages, and apart from security from hunger he had leisure to think and contemplate.

From the Fertile Crescent area, agriculture and animal husbandry slowly diffused into adjoining lands (Fig. 50). It reached the valleys of the Tigris and the Euphrates, Asia Minor, Egypt, Greece, the Danubian area in Europe, Italy, southern France, Iberia and Iran before 3300 B.C., and Sind a little later.

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CHAPTER 9

THE CHALCOLITHIC CULTURE IN MESOPOTAMIA

INVENTION OF THE PLOUGH, WHEEL AND METALLURGY

3000 B.C. — 1700 B.C.

THE term Chalcolithic is applied to communities using stone implements along with copper or bronze ones. In more advanced communities, the proportion of copper and bronze implements is higher than that of stone ones. The Chalcolithic revolution, like the Neolithic, was the climax of a long process. It was the ultimate result of what Gordon Childe calls: "The Second Revolution between 6000 and 3000 B.C. which transformed tiny villages of self-sufficing farmers into populous cities, nourished by secondary industries and foreign trade, and regularly organized as States. The scene of this drama lies in the belt of countries between the Nile and the Ganges. During this period, man has learnt to harness the force of oxen and winds, he invents the plough, the wheeled cart, and the sailing boat, he discovers the chemical processes involved in smelting copper ores and the physical properties of metals, and he begins to work out an accurate solar calendar."[1]

The Chalcolithic revolution began in Mesopotamia in the fourth millennium B.C. From this nuclear zone, it spread to Egypt and subsequently to the Indus Valley. The valleys of Tigris and Euphrates have a fertile soil. The Sumerians who settled in the deltas of these rivers had just emerged from the Neolithic stage of culture. They had splendid pottery and carried on cultivation with flint hoes. Their capital was Ur, which was subsequently destroyed by flood. To the north of Sumer was Akkad, which included the Neolithic sites of Jarmo and Hassuna, which saw the birth of agriculture. By 3000 B.C. Sumerian civilization was fully developed, and about 2385 B.C. king Sargon of Akkad conquered Sumer and unified the country.

Copper is not found in Mesopotamia and it was imported from Oman on the Persian Gulf. Hence it was with imported copper that the Sumerians worked and they became masters of the technique of bronze-manufacture.

One of the major events of the Bronze Age was the shifting of primitive wheat varieties from the mountains to the plains. Helbaek believes that one result of this forced movement of primitive cereals beyond their natural habitat by the human agency may have been the emergence of new plants. With the use of the bullock-drawn wooden plough, the rich alluvial soil started yielding bumper crops of wheat. The plot gave place to the field,

[1]Childe, V. G. *Man Makes Himself*, p. 118

and agriculture really began. In fact, the plough heralded an agricultural revolution, just as the tractor in the present century. Horticulture was concentrated around the urban centres. The priestly hierarchy, with the concentration of surpluses in their hands, started building monumental temples, which dominated the economic life. It was also the beginning of warfare with emphasis on fortification for the urban centres. There was expansion of handicraft production, which led to the development of trade.

Mesopotamia and the adjacent lands are favourably situated among the three of the centres of origin of cultivated plants, viz. the Near Eastern, the Mediterranean and the Central Asiatic. The Central Asiatic is the native home of wheat, peas, beans, lentils, gram and cotton.

Whyte thus sums up the contribution made by the Near Eastern and the Mediterranean centres to cultivated plants of the Old World: "The world's potential sources of western orchard fruits are concentrated in the Near East, the native home of the grape, pear, cherry, pomegranate, walnut, quince, almond, apricot and fig. The first orchards were undoubtedly located in the Near East. In Soviet Georgia and Armenia, one may still observe all phases of the evolution of fruit-growing from wild groves consisting almost wholly of wild fruit trees through transitional methods to those approaching modern fruit-growing, including the grafting of the better wild varieties on the less-valuable wild forms. Here also one may see that primitive man, while clearing away forests to make room for grain fields, has left standing the better specimens of wild apple, pear and cherry. It appears that viticultural methods and all the more important grape varieties have been acquired from the Near East, where one can still find wild forms quite suitable for culture in vineyards. In *Medicago*, *Pyrus* and *Amygdalus*, species formation has been active and is still occurring. Natural polyploidy has been discovered among wheats and numerous species of wild plants, particularly in alpine and subalpine zones. From Turkey, Iran and Soviet Central Asia has come the world's wealth of melons, and the leading forage crops, lucerne, Persian clover, a number of species of *Onobrychis*, *Trigonella* and vetch."[2]

In the cultivated plants of the Mediterranean centre, one can easily trace the important role played by man in selecting the most suitable forms; the Mediterranean forms of flax, barley, beans (*Vicia*) and chickpea are notable for their large seeds and fruits in contrast to the small-seeded forms of central Asia, their basic centre of origin, where most of the dominant genes of these plants are concentrated. "The western dispersal of vine, olive, fig, stone fruits, bread wheat, rice, ornamental and shade trees was apparently partly or wholly due to the spread of Greek and Roman civilizations. To

[2]Whyte, R. O. *Evolution of Land Use in South-Western Asia*, p. 86

this the Arabs added the sugarcane, date palm, cotton, some types of *Citrus*, lucerne and other plants. The grapevine and lucerne also went eastwards into China and are clearly attributed to Change Chi'ien about 140 B.C."

EGYPT

The main elements in the population of Egypt were the Libyans who came from the north, and the Semites who came from Palestine. The Semites brought with them flocks of sheep and techniques of making pottery and stone vases, and elementary knowledge of metals. It is they who ushered in the Chalcolithic phase in the southern countries. It is through them that the civilization of Mesopotamia reached Egypt. In proto-dynastic age, irrigation of fields by canals had been introduced, and towns with temples had been founded. River transport by means of boats, propelled by paddles by batches of men, developed. This was followed by the use of the sail, thus harnessing power of the wind in the service of man. A system of writing had developed and the Egyptian art had acquired its peculiar idiom.

The City. The origin of the city is one of the main achievements of the Mesopotamian and Egyptian civilizations. The rise of the city meant a new social organization, as well as the origin of town-planning and architecture. Apart from food-producers, a city has a preponderance of people who are not directly engaged in agriculture and are administrators, priests, traders, craftsmen and labourers. The rise of a city itself meant improvements in the technique of agricultural production so that non-agriculturists could also be maintained. It also meant the rise of a leisured class, the priests, who could think and study. It is these people who watched the stars, the moon and the sun and thus developed astrology, the mother of the science of astronomy. Already, by about 2700 B.C., observations of the Egyptian priests had led to the compilation of a solar calendar. The Mesopotamians developed the sexagesimal system and mathematical tables from which algebra and arithmetic arose in due course.

Irrigated Farming and the Plough. In the Chalcolithic Period, basic agricultural techniques, which had developed in hilly uplands, shifted to lower river valleys. The system of nomadic shifting cultivation gave way to the cereal-fallow system. Irrigated farming was developed. Flood waters were stored in reservoirs for irrigation in the valleys of the Nile and the Euphrates, and canals were dug. Hence Chalcolithic is also called the age of irrigated farming.

The sowing of seed by dibbling with a pointed stick gave place to hand furrowing. Woolley mentions that the settlements of Al'Ubaid people in the Euphrates Valley are marked by the vast numbers of heavy flint hoes which litter the sites. The invention of the plough, which was at

first only a forked branch of a tree, brought about improvement in cultivation by field tillage. Though it is not possible to credit any particular country with its invention, the plough was in use in Mesopotamia before 3000 B.C. The Sumerian plough had a tube attachment through which seed could be dropped. This is the earliest seed-drill known. Copper was as yet expensive and, hence, denticulated flint sickle blades were in common use up to the middle of the third millennium B.C.

Irrigated agriculture with the use of canals has its own problems. What is considered a boon in early stages becomes a curse in due course. The cause of the decline of Sumerian civilization, according to Whyte, was salinity and water-logging. After 1,000 to 1,500 years of irrigation, serious salinity problems developed. By 1700 B.C. wheat had completely disappeared in the south, and barley, which is more salt-resistant, survived but gave lower yields. It was the loss of command of environment, observes Toynbee, which led to the breakdown of the civilization of the Tigris Basin.

Braidwood thus sums up the achievements of the Bronze Age: 'In 3,000 or 4,000 years the life of man had changed more radically than in all of the preceding 250,000 years. Before the agricultural revolution most men must have spent their waking moments seeking their next meal, except when they could gorge following a great kill. As man learned to produce food, instead of gathering, hunting or collecting it, and to store it in the grain bin and on the hoof, he was compelled as well as enabled to settle in larger communities. With human energy released for a whole spectrum of new activities, there came the development of specialized non-agricultural crafts. It is no accident that such innovations as the discovery of the basic mechanical principles, weaving, the plough, the wheel and metallurgy soon appeared.'

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CHAPTER 10

THE PRE-HARAPPAN PEASANT COMMUNITIES OF BALUCHISTAN AND THE DOMESTICATION OF ANIMALS

THE arid land of Baluchistan with its barren mountains was green and fertile about five thousand years ago. Sir Aurel Stein discovered a large series of stone-built dams and terraces, called *gabarbands* by the Baluchis, which were designed to aid the irrigation of fields. The *gabarbands* indicate climatic conditions with a greater rainfall.

Piggott, on the grounds of techniques employed in pottery-painting, has proposed a broad classification of the pre-Harappan Baluchi cultures as below:

A. Buff-ware Cultures

1. *The Quetta Culture* (from sites in the Bolan Pass)
2. *The Amri-Nal Culture* (from two sites, the first in Sind, and the second at the head of the Nal Valley in Baluchistan)
3. *The Kulli Culture* (from a site in Kolwa in South Baluchistan)

B. Red-ware Cultures

4. *The Zhob Cultures* (from sites in the Zhob Valley of northern Baluchistan)

'The variety in styles and techniques among the products of the Baluchistan communities—the strongly individualized groups of pottery types', states Piggott, 'permits us to visualize the existence of little peasant states, each more or less self-contained, within a natural area such as the Zhob Valley, or those of the Kolwa and Maskai. The similarities we can detect between the localized cultures are the outcome of common necessities among farming peoples working a difficult land.'[1]

A pre-pottery microlithic culture has been discovered from Kili Gul Mohammed which has been dated early fourth millennium B.C. These people lived in houses built of mud bricks. They kept sheep and possibly cultivated crops. Period II yielded hand-made pottery and Period III both hand-made and wheel-turned pottery as well as copper. Damb Sadaat shows three periods, with somewhat continued development, dating from 2528 or 2625 B.C. for Period I and from 2554, 2425 or 2220 B.C. for Period II. The wheel-turned pottery, terracotta figurines and copper objects are among some of the finds. Rana Ghundai yielded a complete sequence through a number of periods. At Rana Ghundai, the inhabitants of the earliest phase used hand-made pottery and flint blades, tended cattle and

[1]Piggott, S. *Prehistoric India*, p. 134

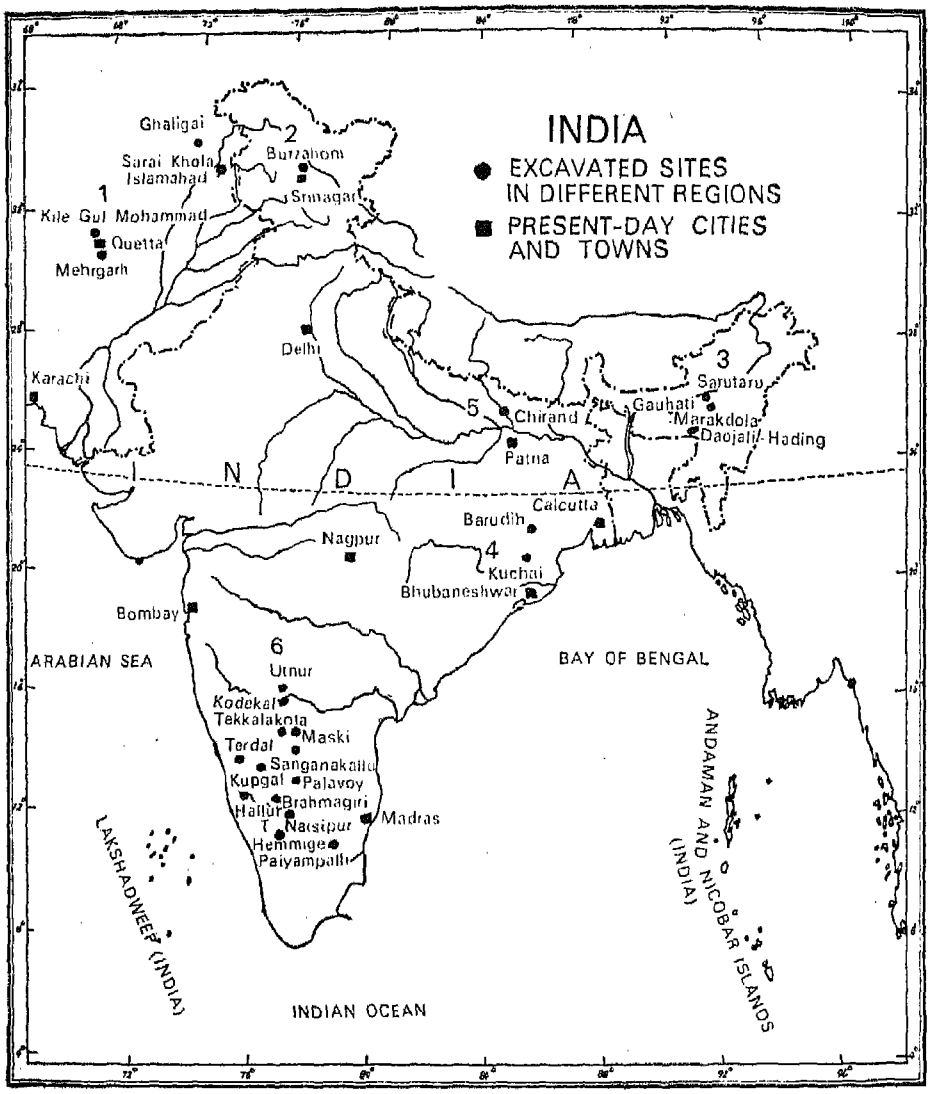

Fig. 53a. Neolithic cultures of Indian subcontinent

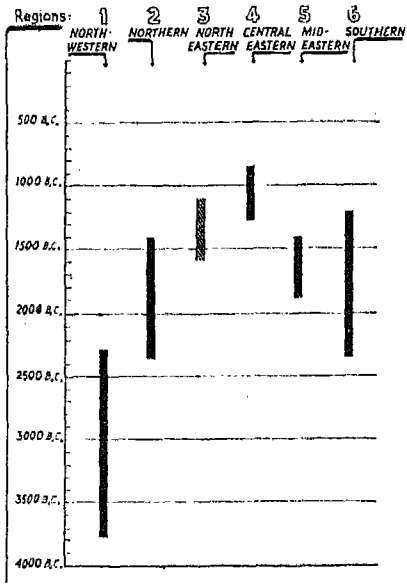

Fig. 53b. Neolithic cultures of Indian subcontinent and relative chronology based on ^{14}C dating
(After B.K. Thapar)

lived in huts. The location of some of these sites and their relative age is given in a map and a bar diagram prepared by B.K. Thapar (Fig. 53). As they lie between the higher inland plateau of central Asia and the low flat plains of Sind, the possibilities of influences from important settlements round the south-east of the Caspian Sea, Tepe Hissar, Anau and Namasga Tepe in Russian Turkestan can hardly be overlooked.

Stone saddle-querns and riders from Kulli attest corn-growing. Chert blades from Shahi-tump and Mazena-damb are comparable with those in the Amri-Nal Culture and, according to Piggott, seem to be archaistic survivals.

Apart from the technique of potteries, it is the representation of domestic animals which provides us with a clue to the life of the people. The typical painted decoration on Kulli ware consists of zones of non-representational motifs between which, in many instances, runs a frieze of naturalistic representations of animals and plants. The frieze represents a standard scene, in which two humped cattle dominate, in grotesquely elongated form, a landscape with formalized trees and rows of diminutive, stylized wild goats (*Capra hircus*). The cattle are usually shown as tethered, either to one of the trees between which they stand or to a peg. In between a bull and cow is a branch of a *pipal*-tree with heart-shaped leaves (Fig. 54). Comparison may be made with the bull in a Mughal painting of the eighteenth century (Fig. 55). The resemblance between the two is remarkable.

The cattle are of the typical humped form (*Bos indicus*). The figures

of goats, which so often accompany those of the cattle on the vase-paintings, are more stylized, and represent the wild goat (*Capra hircus*), with curved, swept-back horns (Fig. 54). Fish are sometimes used to form a continuous band of design on shallow plates, where they follow one another, head-to-tail, in a narrow circular zone.

Cattle figurines were found in very large numbers—66 were found at Kulli, and no less than 85 were found in a restricted area on the lowest occupation-floor at Shahi-tump. The figures are 75 to 100 millimetres long, and the characteristic feature of the zebu cattle, i.e. a well-developed hump, is well enough suggested (Fig. 54 E).

The animal bones recovered comprise the humped ox (*Bos indicus*), domestic sheep (*Ovis orientalis vignei*), and the ass (*Equus asinus*).

The evidence from paintings on pottery and the recovery of bones of animals leads us to the conclusion that the Baluchi farmers had domesticated goats, sheep, zebu cattle and the ass.

There is no doubt that the domestication of goats, sheep and zebu cattle took place in Baluchistan. According to Carl Sauer, the hearths of domestication are to be sought in areas of marked diversity of animals, where there was a large reservoir of genes to be sorted out and recombined. So far as the above-mentioned animals are concerned, Baluchistan was such an area.

How were the wild animals domesticated? Carl Sauer explains: 'Taming of the wild again may be thought of as beginning by infant capture, nursing by a foster mother, and raising the young in close association with man. A plausible reconstruction is thus: man returning from the hills with a kid or lamb, woman rearing it, and children growing up with the young animal and leading it out to browse. In such a gentle captivity, breeding might occur and thus domestication begin.[2] The domestication of goat and sheep took place in the pre-agricultural phase. When the nomadic man with the aid of the dog brought sheep and goat under his control, it was the first step towards food production.

Goat (*Capra hircus*). The wild ancestors of domesticated breeds of goat are known to a large extent. The wild goat (*Capra hircus*) is found in the barren hills of Baluchistan and western Sind (Fig. 56). It is the chief ancestral stock from which the various breeds of domestic goats have been derived. In the north-east of Quetta, it is replaced by markhor (*Capra falconeri*) and is found in Turkestan, Afghanistan, Baluchistan and Kashmir (Fig. 60). The Circassian goat is said to be the descendant of the markhor. By far the most important is the bezoar goat (*Capra hircus aegagrus*), which ranges from Sind in the east through Iran and Asia Minor to Crete and the Cyclades in the west. In many parts of this area, it has disappeared.

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[2]Sauer, C. *Agricultural Origins and Dispersals*, p. 86

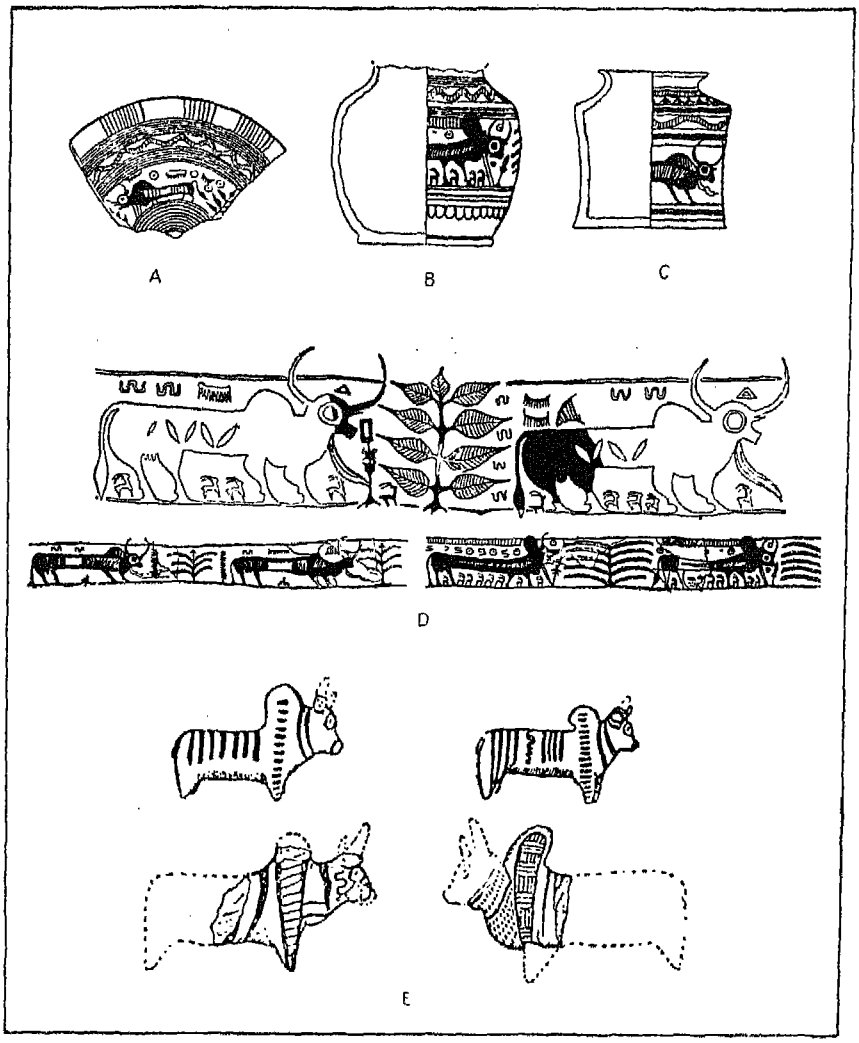

Fig. 54. Zebu bulls painted on pottery, and bull figurines, Kulli Culture, from a site in Kolwa, in southern Baluchistan
(After S. Piggot)

From Iran it extends into Russian Turkestan and the Caucasus, and into the west of Asia Minor.

In the late Pleistocene, the bezoar extended south into Lebanon, where its remains were found in an upper Palaeolithic context in the Antelias Cave, near Beirut. This goat is a true bezoar. In addition, the

bezoar was recorded from the cave called Mugharat-el-Wad on Mount Carmel in Palestine. As the specimen came from a disturbed deposit, its age could not be ascertained; it may have been Palaeolithic or Mesolithic. If Palaeolithic, this find would extend the area of the wild bezoar as far south as the mountains of Palestine. In addition, it was found in the Natufian cave of El Khiam in Israel (Vaufrey, 1951).[3]

The goat was the earliest ruminant to be domesticated. Long before 6700 B.C. the scimitar-horned bezoar goat had been domesticated, and most of the derived breeds lost the characteristic sub-angular and broad cross-section of the male horn. It may well have been first domesticated in Palestine, though Iran is an alternative. The domesticated goat existed in Iran about 6000 B.C. In the fourth millennium, goats with twisted horns appear, and gradually become dominant. This change may have coincided with the Chalcolithic stage. By Bronze Age times the twisted horn had become the fashion. The twisted-horn goats have descended from two stocks, one being the scimitar-horned Neolithic goat. The other, though twisted, is nearer the bezoar and thus betrays closer kinship with the original stock.[4]

The Harappa toys contain representations of a goat. Two seals from Mohenjo-daro show a wild bezoar goat with enormous curled horns, and a bearded domestic male goat with side-spreading horns (Fig. 57).

The Gaddi goat greatly resembles the ancestral wild goat. In the mountains, Gaddi goats were used as beasts of burden. They are still used in the Himalayan districts of India for carrying panniers of salt and food-grains.

Sheep (*Ovis orientalis vignei*). All varieties of domestic sheep have descended from three species of *Ovis* found wild in the mountainous regions of Asia and Europe. The earliest to be domesticated in south-west Asia was *Ovis orientalis vignei*, the urial, found wild from Tibet to Elburz mountains. Descendants of *Ovis musimon*, the mouflon, are found in Sicily, Corsica, Sardinia, Cyprus, Anatolia and northern Iran. *Ovis ammon*, the argali, is found in the mountainous regions of Soviet Central Asia. The argali is a very large sheep, with a shoulder height of up to 120 cm, and occurs farther east and north-east than the urial, ranging from Bokhara through the Altai Mountains and Tibet to northern China. According to Zeuner, it has certainly contributed to the domesticated stock of India and the Far East, but in connection with the origins of sheep-breeding it is of subordinate importance.

Ovis orientalis vignei, which has many wild varieties in mountains from Afghanistan to Armenia, is probably the ancestor of domesticated sheep in India as well as in Arabia. The people of Anau in Soviet Turkestan domesticated a variety of *Ovis orientalis vignei*, and it is generally believed that all

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[3]Zeuner, F.E. *A History of Domesticated Animals*, p. *130*
[4]Zeuner, F.E. *A History of Domesticated Animals*, p. *140*

domesticated sheep have been derived by selective breeding and crossing from the varieties found in Turkestan. The inhabitants of Mohenjo-daro and Harappa had domesticated sheep with them. Toys showing a ram's head have been recovered from Mohenjo-daro (Fig. 57).

Though sheep were most probably domesticated in the mountains of Iran, Turkestan and Baluchistan, we find that they came to the plains rather early in the history of civilization and served a useful purpose in the economy of the Mesopotamian and northern Indian civilizations. They provided milk, meat and clothing for the inhabitants of the cold north.

In the mountain ranges of the Himalayas and in Tibet, breeds occur which betray urial descent, such as the Hunia. It is tall and strong and carries salt over the passes.

Another Himalayan breed is the barwal. The rams, with their massive horns, the bases of which almost touch each other, suggest the presence of argali blood. They are used as fighting sheep. The so-called unicorn sheep of Nepal belong to this breed. The searing of the horn-buds with a hot iron causes the horns to grow upwards in a fused condition.

In the hotter parts of India, breeds of sheep are kept which are closely related to those of western Asia and Africa. The dumba, which occurs from Turkestan to western India and Pakistan, is a fat-tailed breed (Fig. 59). Others belong to the long-legged and lop-eared groups. There is no archaeological evidence for their history.

The complex picture presented by the history of domesticated sheep is summarized as follows by Zeuner. 'The sheep was domesticated with the aid of the dog before agriculture was fully developed. The sheepdog played a vital part in the domestication of ruminants. The original centre of domestication is the Aralo-Caspian steppe and Turkestan. From there, sheep-keeping spread early into Iran, and later into Mesopotamia and Baluchistan. The domesticated race of wild sheep was in the first instance the arkal, which belongs to the species of the urial. The five main breeds which had reached Mesopotamia by about 2000 B.C. were: (1) the screw-horned hair-sheep, (2) the screw-horned wool-sheep, (3) the zackelschaf, (4) the ammon's horn wool-sheep and (5) the ammon's horn fat-tailed wool-sheep. All these were of urial stock, so far as is known. In so far as sheep are kept in India, Tibet and other countries of the east and south Asia, they are of western derivation, and basically of urial stock. Argali blood has, however, been introduced repeatedly, and a few breeds are claimed to be of almost pure argali stock.

'Before domestication began, fat had to be obtained from game animals. With the domestication of the sheep it became available in practically any quantity required. Sheep fat was in due course replaced by vegetable oils in the Neolithic, though for culinary purposes it continued in esteem among eastern peoples. Nevertheless, the numerous technological uses of fats

almost certainly were greatly developed as a result of the domestication of the sheep.

'The use of wool was probably discovered when the peculiar mode of moulting in large coherent patches was observed by the first domesticators. It would have been easy to make sheets of felt from such material, and felt-making has remained an important industry in many parts of central Asia, where it is even today associated with nomadic culture. Spinning and weaving were probably first practised with vegetable materials.

'Woven cloth made of wool was not readily accepted in areas where good plant fibre, mainly flax, was available and where the climate was sufficiently mild. It, therefore, developed mainly in climates with a cold winter, and its subsequent spread to warmer zones was probably due to the development of finer qualities of wool.

'It thus appears that the domestication of the sheep, apart from ensuring a permanent meat supply, also improved greatly the supply of raw materials, of skins, hair, fat and bones. All these became, in due course, available from other sources, namely other domesticated ruminants. But the production of wool has almost entirely remained a monopoly of the sheep'.[5]

Goat and Sheep. 'The chief differences between the goat and the sheep are in their ecological requirements and in the raw materials they supply. The sheep is essentially a grass-feeder, preferring (where available) the protection of open woods. The goat is a browser, preferring foliage of shrubs to grass. In spite of this all goats are well adapted to life beyond the tree-line, both in high mountains and in arid zones, where small shrubs are available in abundance. The goat is probably content with even sparser food than the oriental breeds of sheep. In particular it eats aromatic herbs despised by other ruminants; hence it can penetrate farther into the desert. Apart from the supply of meat, which both species provide, the sheep scores in respect of wool and fat and in the quality of its meat whilst the goat furnishes more milk. It is possible that the use of milk and its derivatives was first established with the goat, before the cattle were domesticated.

'In the course of time, however, the sheep got the upper hand over the goat, especially in temperate countries, presumably because its meat is tastier and less tough and because it produces both fat and wool. Moreover, where cattle are kept without difficulty, the need of keeping goats as milch animals does not arise. Yet, where pasture is scarce, where thorny scrub dominates over grass, where it is difficult on account of lack of good food and water to keep cattle, the goat becomes an important economic factor, for it is able to live under conditions which do not suit sheep, and it provides milk in quantities which are large compared with the size of the animal.

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[5]Zeuner, F.E. *A History of Domesticated Animals*, pp. 197, 198

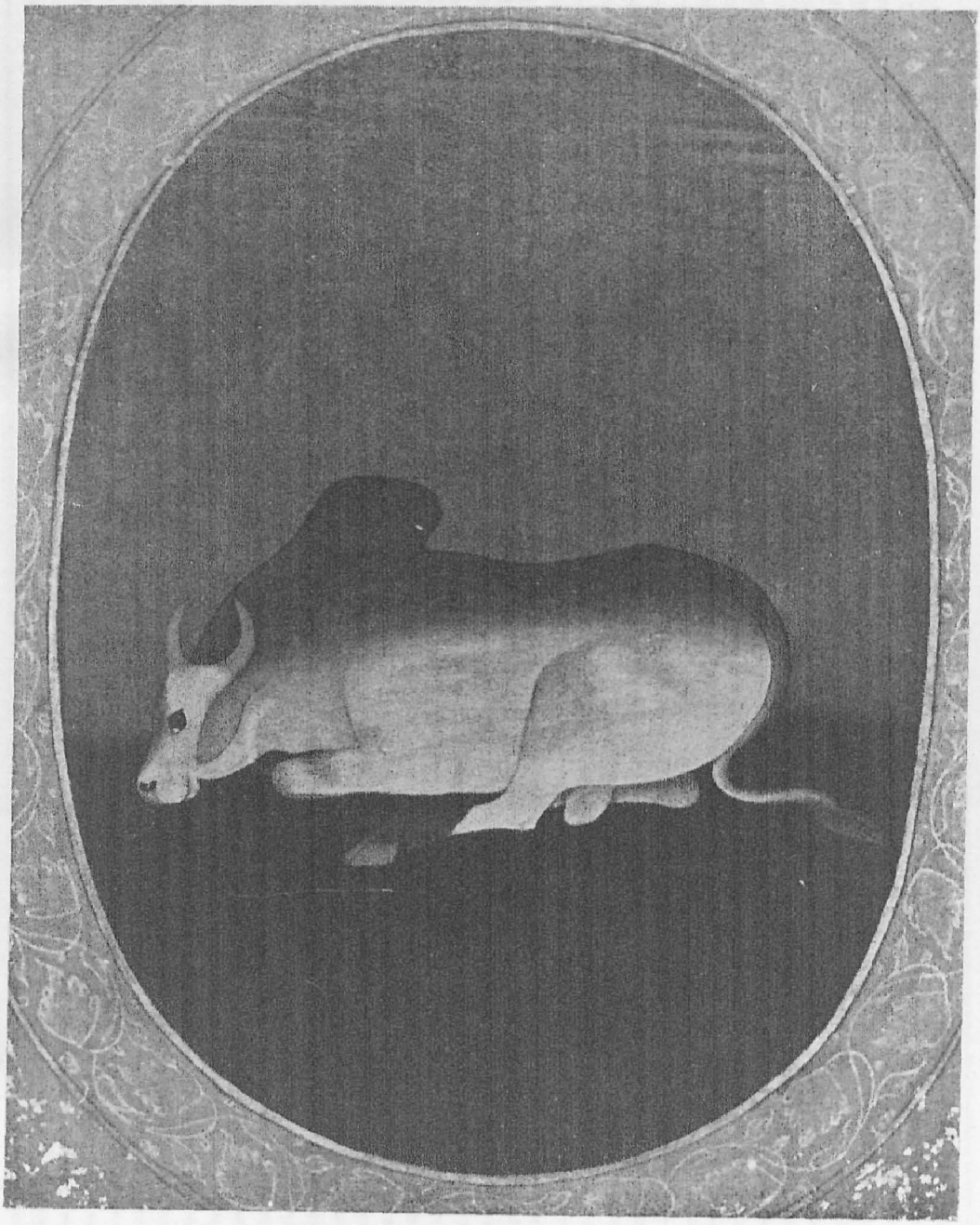

Fig. 55. A Brahmani bull, Mughal, eighteenth century
(Courtesy : National Museum, New Delhi)

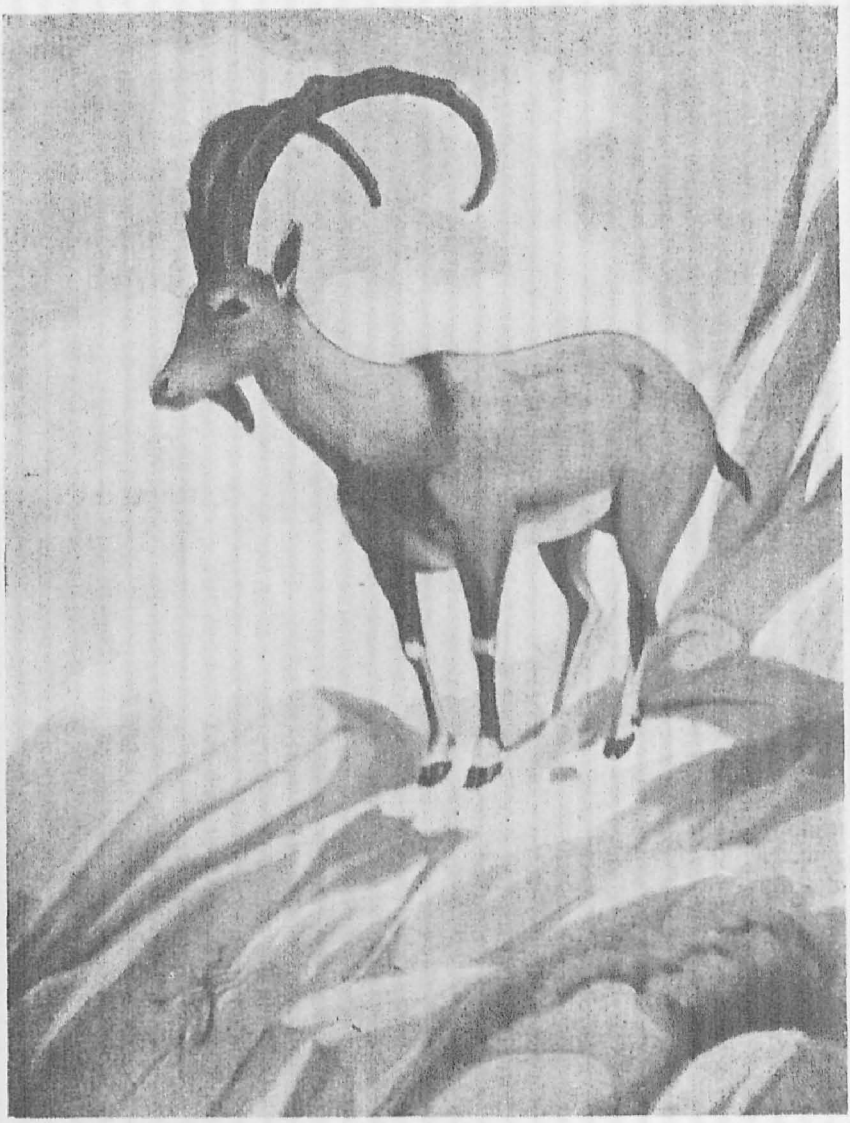

Fig. 56. The wild goat (*Capra hircus*) is still found in the barren hills of Baluchistan and western Sind. It is the chief ancestral stock from which the various breeds of domestic goat have been derived

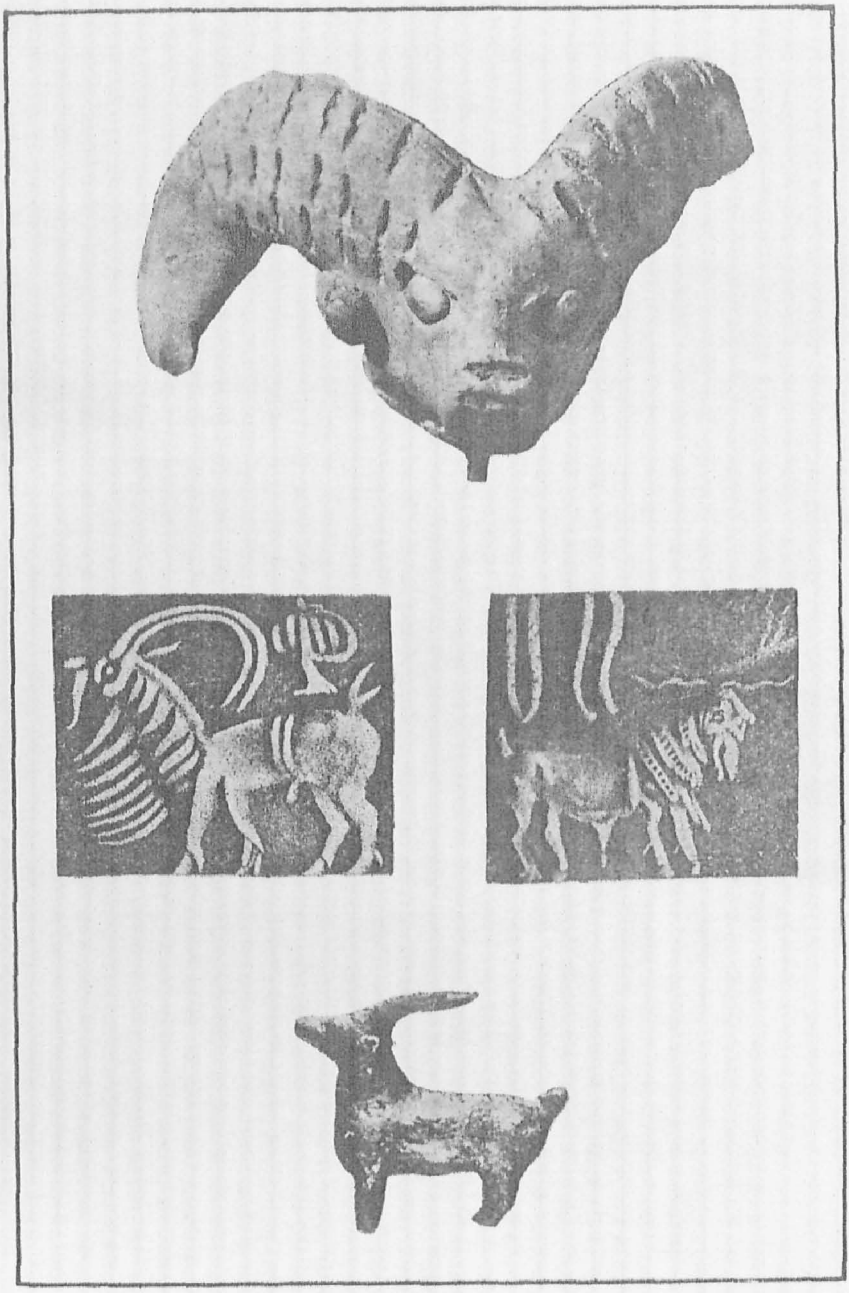

Fig. 57. Domestication of sheep and goats. Toys and seals from Mohen-jo-daro: *top*, a ram; *middle*, *left*, a wild goat (*Capra hircus*) *middle*, *right*, a domesticated goat; *bottom*, a domesticated goat
(After Mackay and Vats)

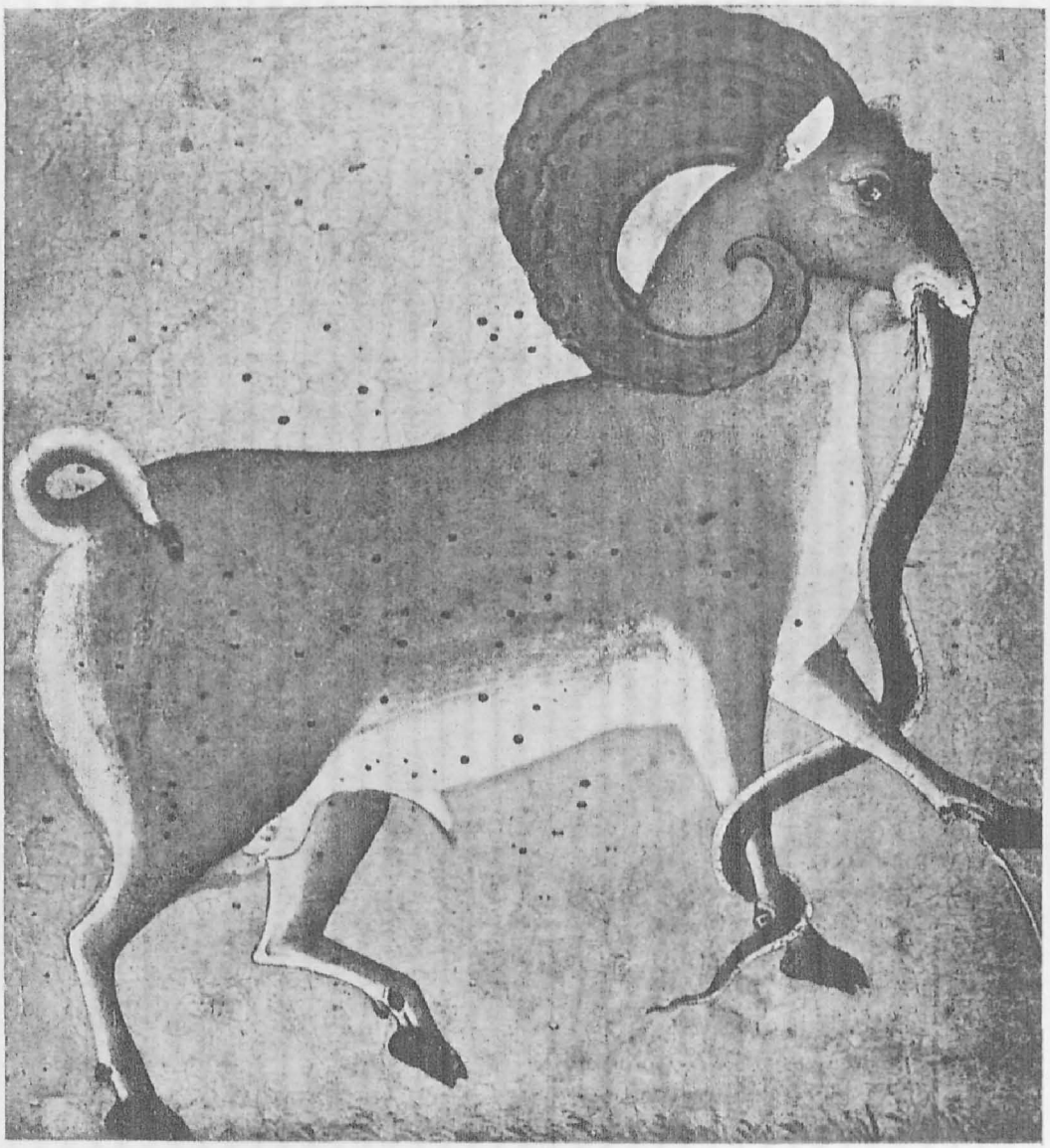

Fig. 58. The *nayan* (*Ovis amon hodgsoni*), the largest wild sheep with curled horns, is found in northern Ladakh, Spiti, Sikkim, Kumaon, Nepal and Tibet. The legend is that it eats snakes. Mughal, early eighteenth century
(Courtesy : Salar Jung Museum, Hyderabad)

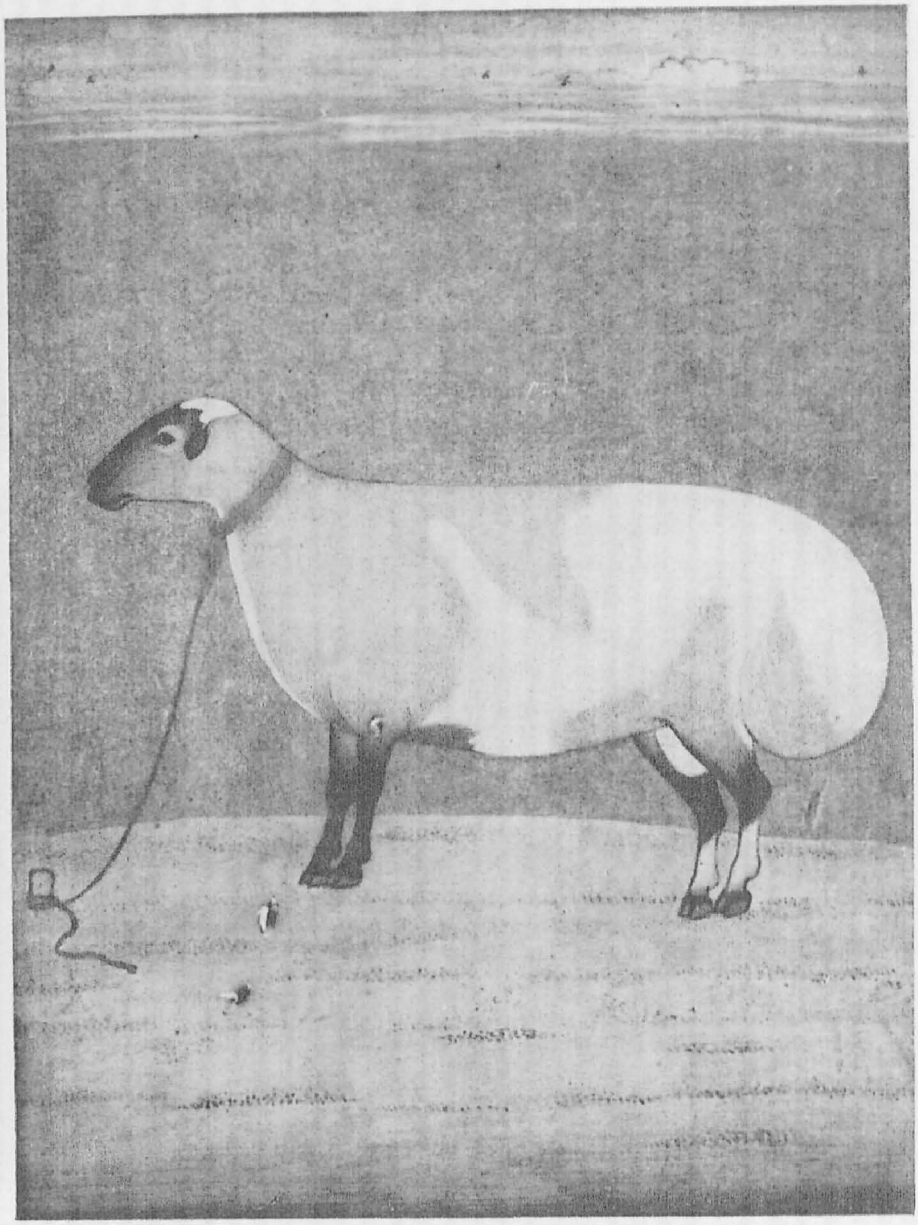

Fig. 59. Dumba, a breed of sheep with a fat tail. Mughal, early eighteenth century
(Courtesy: Prince of Wales Museum of Western India, Bombay)

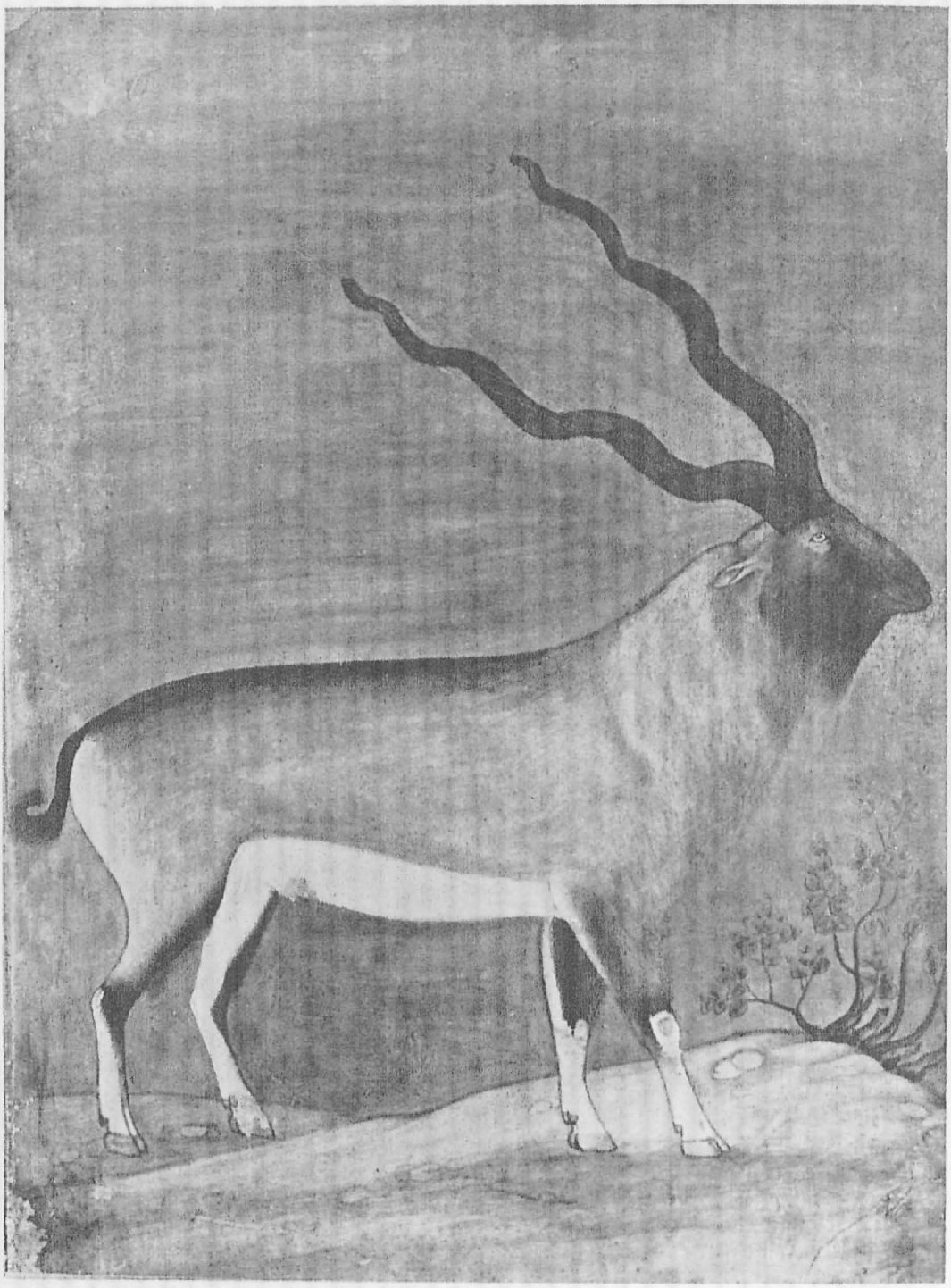

Fig. 60. Markhor (*Capra falconeri*), a wild goat with horns spirally twisted like a cork-screw, is found in Afghanistan and from Hazara to the Pir Panjal mountain range in Kashmir. Mughal, seventeenth century
(Courtesy : Salar Jung Museum, Hyderabad)

Hence the goat has been kept by preference in the mountainous districts and the dry steppes all over the world.

'As a producer of raw materials for technical processes, the goat is less important than the sheep. Its skin has been used since time immemorial for water-containers, but it does not supply fat and its hair is usually coarse, wool in the strict sense of the word being rare. Therefore, though goat's hair is used, and no doubt has always been used, where available, the sheep became the most important producer of spinning material. One wonders why the goat has not been completely replaced by the sheep. The reason appears to be that as a browser it prefers environments different from those liked by sheep. It can thrive on desert scrub and it yields more milk'.

Ass (*Equus asinus asinus*). The true asses are of purely African origin. They are derived from North African wild race, now extinct. According to Zeuner, the ass was first domesticated in the Valley of the Nile or in Libya.

The bones of the ass have been recovered from Rana Ghundai in Baluchistan. The remains of the ass have also been reported from Harappa, Kalibangan (Rajasthan), and Rangpur (Gujarat), Period III (1000-800 B.C.). It is, however, not certain that these bones are not of half-asses, or hemiones.

For patient hard work, no animal can match the donkey. In construction work and in the digging of canals, loads are carried by donkeys. After the day's hard work, they are just let loose to eat whatever they can find. However, the donkey's greatest contribution to animal husbandry is as progenitor of the mule. The hybrid between the male ass and the female horse is the mule, a sure-footed animal, so useful in carrying loads on narrow mountain paths.

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CHAPTER 11

HARAPPAN CHALCOLITHIC CULTURE IN PAKISTAN

SIND AND WEST PUNJAB

2300 B.C. — 1600 B.C.

THE Mohenjo-daro mound in the Larkana District of Sind, capped by a Buddhist stupa, and the ruined city of Harappa, littered with bricks, were known to the people of Sind and the Punjab for a long time. Excavations at Harappa in the Montgomery District of the Punjab Province were started in 1921 by Daya Ram Sahni, and at Mohenjo-daro in 1923 by R.D. Banerjee. The work at the two sites was co-ordinated by Sir John Marshall. The excavation of the town of Chanhu-daro in Sind was undertaken by Mackay in 1935-36. Detailed excavations at Harappa were later on done by M.S. Vats in 1939-40. The Indus civilization is known as the Harappa civilization after Harappa, the site where it was identified for the first time. Lothal in Gujarat was a contemporary of Harappa and Mohenjo-daro. From Sind and the western Punjab, Harappan Chalcolithic culture spread to the eastern Punjab, western Uttar Pradesh, Rajasthan and western Madhya Pradesh. From Lothal this culture diffused to a number of sites in Gujarat (Fig. 61).

From end to end of the territory stretching from Mohenjo-daro to Harappa, from some 40 settlement-sites, come pottery of identical mass-produced types. Harappan Chalcolithic culture is further characterized by the concurrent use of copper or bronze flat axes and stone blades. The mass production of stone blades started in the Neolithic Period in the Fertile Crescent and it continued even after the discovery of copper on account of the cheapness of stone and its easy availability. Other characteristics of Chalcolithic culture are steatite and faience beads, along with those of carnelian, agate and copper, and peculiar terracotta figurines. Houses are built of baked bricks of standard dimensions. Stamp-seals are engraved with figures of domestic animals and a uniform script. A standard system of weights is recognizable. Whereas some sites are villages, others are small towns, and 350 miles [563 kilometres] apart stand two cities, each covering at least a square mile [2.6 square kilometres] of ground, twin capitals of an empire.

CITIES OF HARAPPA AND MOHENJO-DARO

The northern 'capital' Harappa is in the Punjab (Pakistan) about 100 miles [160 kilometres] south-west of Lahore. The southern city, Mohenjo-daro, is on the Indus, in Sind, nearly 200 miles [320 kilometres] north of

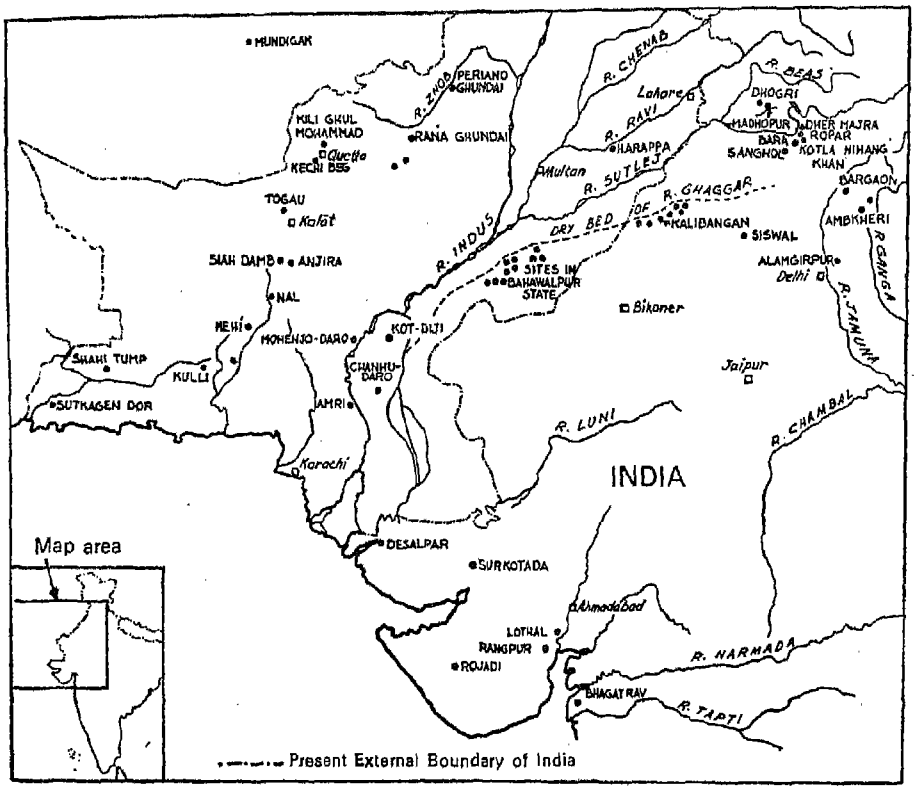

Fig. 61. Harappan and pre-Harappan sites
(After Y.D. Sharma)

Karachi. 'The very existence of these large cities and towns', states Piggott, 'must pre-suppose a considerable agricultural population producing an adequate surplus beyond its immediate needs for sale to the towns. The invariable use of burnt clay bricks throughout the Harappa culture must imply far greater timber resources for firing the kilns than the present vegetation of tamarisk and scrub would afford.

'Though none of the evidence is conclusive, the inference from the fauna, the wood needed to burn so many million bricks, and the implication of a flourishing agricultural background, all suggest a climate different from that of today, when at Mohenjo-daro the range in annual temperature is between 120°F [49°C] in summer to frost in winter, with a rainfall of less than 6 inches (152 millimetres] in the year. The very use of burnt brick as a building material instead of the sun-dried mud brick common to the Ancient East may imply the necessity of finding something more durable under

conditions of frequent or considerable rainfall, and the elaborate sytem of drains in the cities may also be explained in connexion with a greater volume of rain-water'.[1]

The cities of Harappa and Mohenjo-daro were contemporary; laid out according to a common ground-plan, each was with its defence citadel towering above the rest of the town. They seem to have been twin capitals, a northern and a southern, of one united kingdom.

Harappa and Mohenjo-daro were large cities with systematic town-planning. Harappa had a circuit of 4·8 kilometres. Its bricks provided ballast for the railway track of the North-Western Railway for many kilometres. Both the cities were protected by citadels, and were planned in rectangular blocks separated by broad main streets (Fig. 62). The houses were built of kiln-fired bricks, and some were two-storeyed. They had three to four living-rooms and were provided with a bath, a kitchen and a well. The use of the corbelled arch indicated Mesopotamian influence. The drainage system consisted of kiln-fired ring wells, which can also be seen in a section of the Nalagarh mound at Rupar (Fig. 69).

The citadel at Mohenjo-daro had massive towers of burnt bricks. Inside the citadel was a public bath, cloak-rooms, a square-pillared hall for public gatherings, and a large granary.

The Harappans. Evidence of the physical type and personal appearance of the Harappans lies in two sources, viz. sculptures in stone and bronze and the remains of skeletons found on the excavated sites. From the available evidence, it appears that more than one ethnic strain was present in the population. Nearly half the skulls belong to the Mediterranean type, which includes a large number of groups of people from Spain to India. This is the type also found in late Natufian of Palestine, and pre-dynastic Egypt. It is found in Arabia and northern India. Such people are medium to tall, with a complexion ranging from dark to light olive-brown, a long head and face, and a narrow and relatively pronounced nose, black hair, and eyes ranging from black to brown and characteristically large and open. The body is of slender build. An example of this type is seen in the bust of a bearded man from Mohenjo-daro, wearing a cotton shawl, with a trefoil motif. The upper lip is shaved and the beard is trimmed (Fig. 63). This fashion, though pre-Islamic, is still followed by some Moslems in Pakistan and India.

The other type is the Veddoid or Proto-Australoid. Three skulls from Mohenjo-daro belong to this group and these possibly represent the aboriginal inhabitants of the country. Of small stature, with a dark skin, approaching black, wavy or curly black hair, long head, broad flat nose and fleshy protruding lips, these people form the main element in the southern and central

[1]Piggott, S. *Prehistoric India*, pp. 137, 138

Fig. 62. Systematic town-planning with rectangular blocks separated by broad main streets as seen in excavated remains at Mohenjo-daro, Sind, Pakistan, 2300 to 1750 B.C.
(Courtesy: Archaeological Survey of India)

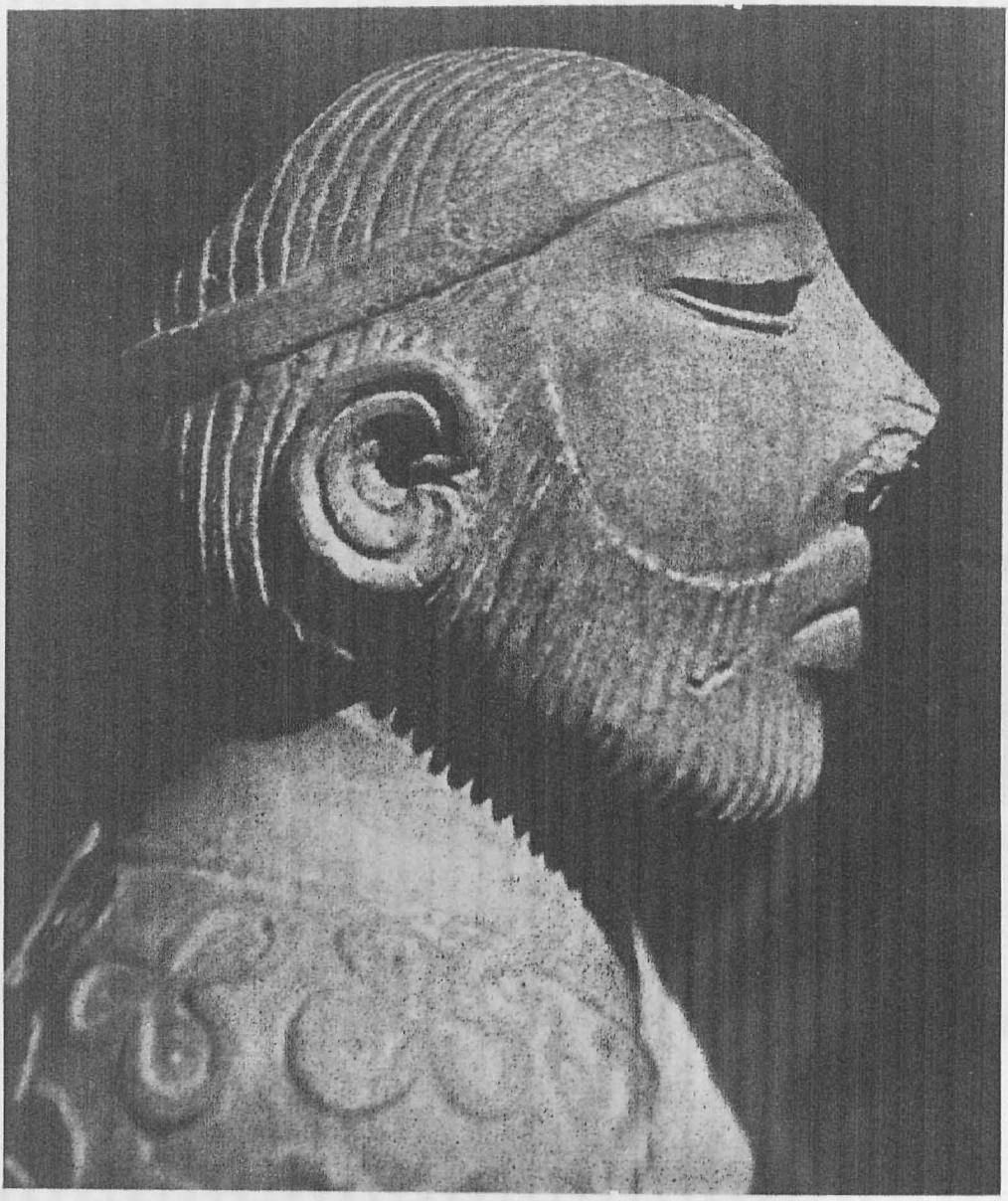

Fig. 63. Head of a bearded man wearing a shawl with trefoil motif. The shawl was possibly of cotton. Mohenjo-daro, 2300 B.C.
(Courtesy: Archaeological Survey of India)

Fig. 64. A bronze figure of a nude dancing-girl wearing bracelets
(Courtesy: National Museum, New Delhi)

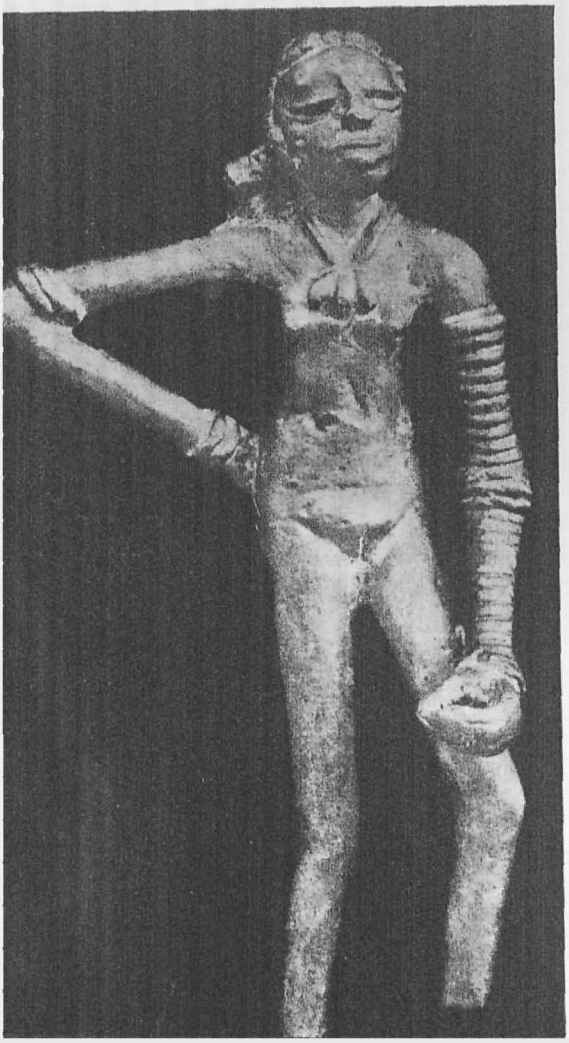

Fig. 65. A painted dish on stand. This type of pottery is typical of Harappan Civilization. Harappa, 2300 B.C.

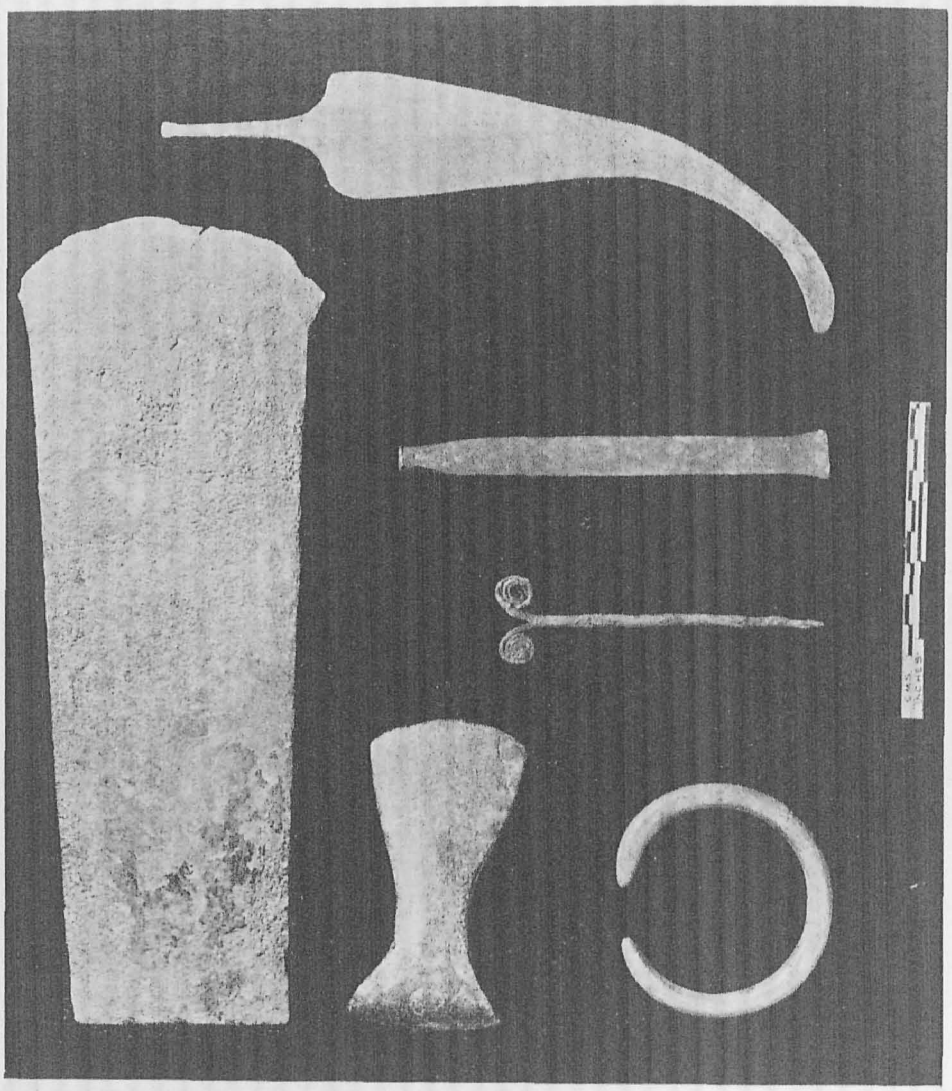

Fig. 66. Bronze objects, axes, knife, a chisel, etc., from Sind and Harappa
(Courtesy : Archaeological Survey of India)

Indian aboriginal tribes of the present day. The bronze sculpture of a dancing-girl in the National Museum, New Delhi, represents the Proto-Australoid type—dark complexion, slender build, and thick lips (Fig. 64).

Burials. The Harappans buried their dead. The bodies were extended from north to south, with the head towards the north. The graves were large enough to contain an average of 15 to 20 pots. The pots recovered from the graves at Rupar contained foodgrains (Fig. 70). Personal ornaments were sometimes worn by the dead, e.g. shell bangles, necklaces and anklets of steatite or paste beads, copper finger-rings, and ear-rings of thin copper wire. Toilet and other objects were occasionally included: handled copper mirrors, mother-of-pearl shells, an antimony stick, a large shell spoon. 'In one grave at Harappa a pottery lamp and bones of a fowl were found at the foot. A grave at Harappa was notable for the fact that the body had been buried in a wooden coffin, 7 feet [2·13 metres] long and 2-2½ feet [61-76 centimetres] wide, widening towards the head. The thickness of the timbering of the coffin, as shown by a clear stain in the sandy soil, was 1½ inches [3·8 centimetres], representing, side-walls of *Dalbergia latifolia*. Traces of the lid on the sandy material immediately overlying the skeleton were identifiable as deodar which grows in the Himalayas and may have been river-borne to Harappa.'[2]

Harappan Culture. The Harappans had reached a high state of culture. They wore cotton garments, and used ivory combs and copper mirrors. Women wore a variety of ornaments of bronze and gold. They used knife blades, saws, sickles, spears, axes, arrow-heads, daggers of bronze and copper fish-hooks. They had weights of chert, steatite and chalcedony. These articles were no doubt produced by skilled craftsmen—copper-smiths, carpenters, jewellers, goldsmiths, stone-cutters and potters. There was a system of writing from right to left, and there must have been a class of clerks. A system of trade with the adjoining countries must have developed, as most of the commodities, including metals, timber and precious stones, were imported. The discovery of Harappan seals at Ur in Mesopotamia indicates trade relations with the Indus Valley during the reign of Sargon of Akkad, *c.* 2380 B.C. There is little doubt that the idea of literate urban civilization reached the Indus Valley through Iran from the earlier civilization of Mesopotamia, a country which had trade links with northern India. This view is further strengthened by the composition of the population of Mohenjo-daro as revealed by the examination of skulls. About 50 per cent of skulls are of dolichocephalic Mediterranean type, similar to those of Al'Ubaid in Sumer.

The occurrence of copper ore in Baluchistan, the western Himalayas and Rajasthan accounts for the rise of Chalcolithic culture in the north-

[2]Wheeler, M. *The Indus Civilization*, pp. 66, 67

west of the Indian subcontinent. Evidence of earliest copper-smelting is found among the makers of painted pottery. In the early phases, copper must have been worked by hammering and cutting only from natural metal or from the metal smelted from ore. The copper or bronze axes are flat, without the shaft-hole (Fig. 66). They were presumably hafted in a split and bound handle. Arrow-heads are of copper or bronze. They are thin and flat, resembling those from northern Iran. Knives are leaf-shaped. Copper and bronze axes, daggers and spears were in use. The use of copper was limited, as the metal was scarce and expensive. Most implements were made of stone. Chert blades, which were provided with handles, continued to be used by the Harappans on account of their cheapness and abundance. The concurrent use of copper and stone implements gave the name—Chalcolithic — to this culture. On account of the scarcity of copper, the use of this metal was restricted to weapons, tools for city craftsmen, and for ornaments for women. The major technological advance of the Harappan culture was the use of metals, particularly that of copper and its alloy, bronze.

The general characteristics of this civilization, as enumerated by Wheeler, include a thick red-slipped ware in cylindrical and goblet shapes, intersecting circles, *pipal* leaves, rosettes and peacocks as motifs, Indus seals and script, triangular terracotta cakes, kidney-shaped inlays of shell or faience, metal tool types, and town-planning according to a grid-iron scheme of streets and houses. A cultural uniformity, unquestionable technical competence, though dull, and a flare for standardization are noticeable in all areas of activity—in the making of bricks, in sanitary arrangements, in pottery, in the wide range of copper and bronze tools, vessels and human and animal figurines, and seal-cutting from steatite blocks. In this effortless competence, of which evidence has survived in archaeological remains of all descriptions, one can see the picture of city-centred prosperous agricultural communities thriving on wheat, barley, sesamum and mustard, animal husbandry, an industry of woven cotton, various arts and crafts and an extensive trade, all rendered possible by an efficient central government with capitals, defensive city outposts, docks and harbours.

The buildings and articles found in the excavations of Harappan towns were produced by specialized craftsmen—brickmakers, carpenters, potters, coppersmiths, stone-cutters, goldsmiths, and jewellers. The regularity of the streets implies a civic authority with officials to enforce its decisions. Sweepers must have been employed for cleaning the drains. There must have been a class of clerks, since a system of writing and numeral notation was in use, as well as standardized weights and measures.

All these classes, evidently very numerous, must have been supported by the surplus food-stuffs produced by peasants living in the city or in the suburban villages. In Chapter 13 is described the agriculture of the Harappans, which supported the urban civilization.

CHAPTER 12

HARAPPAN CHALCOLITHIC CULTURE IN INDIA

PUNJAB, HARYANA, JAMMU, UTTAR PRADESH, RAJASTHAN, GUJARAT AND MADHYA PRADESH

c. 2200 B.C. — 1600 B.C.

FROM the nuclear area in Harappa in the western Punjab, the Harappan Chalcolithic Culture slowly diffused to Bahawalpur, eastern Punjab, Haryana and Jammu in about a century. From Haryana it reached the border districts of western Uttar Pradesh. From Mohenjo-daro in Sind it reached Lothal in Gujarat. Most of the Harappan settlements in Gujarat are situated on the coast of Kutch and Kathiawar. From Gujarat the Harappan culture diffused to eastern Madhya Pradesh and Maharashtra. A brief account of these sites is given below.

PUNJAB (INDIA)

(i) KOTLA NIHANG KHAN, DISTRICT RUPAR

In the Punjab (India), a number of Harappan sites have been discovered. M.S. Vats excavated Kotla Nihang Khan near Rupar in 1939, and demonstrated the parity of its antiquities with those of Harappa. A row of furnaces was discovered. They might have been used for manufacturing implements or ornaments. The date of Kotla Nihang Khan is about 2200 B.C.

(ii) RUPAR AND OTHER SITES

The Nalagarh mound at Rupar on the Satluj was excavated by Y.D. Sharma in 1953–56. In the lowest stratum, Harappan potteries, bronze implements and inscribed steatite seals were discovered (Fig. 67). The details of these objects are shown in Fig. 68. The mound also contained a number of ringed soak-wells (Fig. 69). The burials were typically Harappan, with lots of pots accompanying the corpse (Fig. 70). In the proto-historic Punjab, Rupar could claim the status of a town. Round about Rupar are a number of sites, viz. Dher Majra and Bara, north of Rupar, Kotli, south-west of Rupar, Chamkaur, west of Rupar, and Hawara, south-west of Chamkaur. At Bara, Y.D. Sharma found a distinct culture with its antecedents traceable to a pre-Harappan tradition. Dher Majra is a Bara culture site. The same is the case with Sanghol. The Bara culture is rich in pottery, terracotta cakes and faience. Bronze is known and Barans seem to have subsisted on agriculture and fishing. At Rupar and

Chandigarh, both the Bara and Harappa cultures overlap. Bara is dated to 2350 B.C. to 1950 B.C. by Y.D. Sharma, and hence it was a contemporary of Harappa.

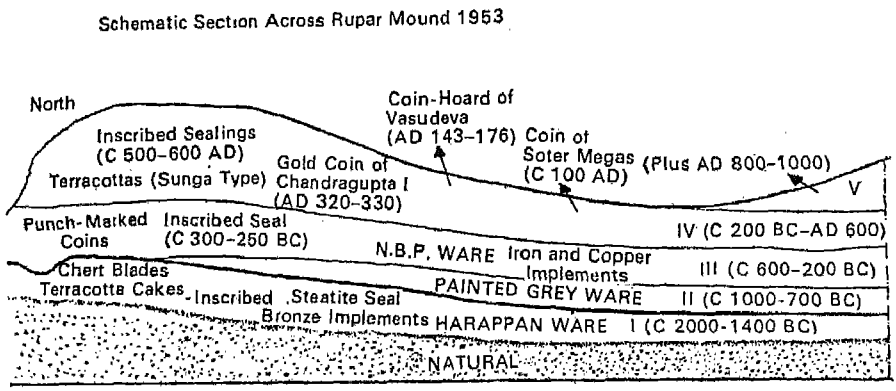

Fig. 67. A schematic section across the Nalagarh mound at Rupar, 1953, showing strata, 2000 B.C. to A.D. 600. In the lowest stratum, Harappan wares with bronze implements were discovered. These were overlain by Painted Grey Ware

The Harappan and late Harappan sites have also been located at Kurrara-Kurrari and Manikpur-Sharif in Tehsil Kharar, and Arnauli, Bara-Samana and Kainor in Tehsil Rupar.

(iii) SECTOR 17 OF CHANDIGARH

In Sector 17 of Chandigarh, while the foundations of a shop were being dug, the remains of a Harappan cemetery were found. Several types of pottery were excavated, viz. pre-Harappan, Harappan and Bara wares. On the one hand, there were unmistakable Harappan forms, such as dishes-on-stand, pointed goblets, beakers, lids, basins, ring-stands, troughs, including a funnel-shaped vase with an inscription in Harappan characters. And on the other hand, there were certain decorative designs, both painted and incised, resembling Kalibangan pre-Harappan pottery. Other finds include a humped terracotta bull with forward-pointing horns. This bull combines the hump of the zebu with the horns of the urus. Toy cart-frames and wheels, stone querns and pestles are evidence of agriculture. Bangles of faience, terracotta and copper, and beads of agate, paste and terracotta were also found. A reconstruction of the Harappan town of Chandigarh shows flat-roofed houses below the Siwaliks (Fig. 71).

Sarangpur near Chandigarh had pottery resembling the pre-Harappan

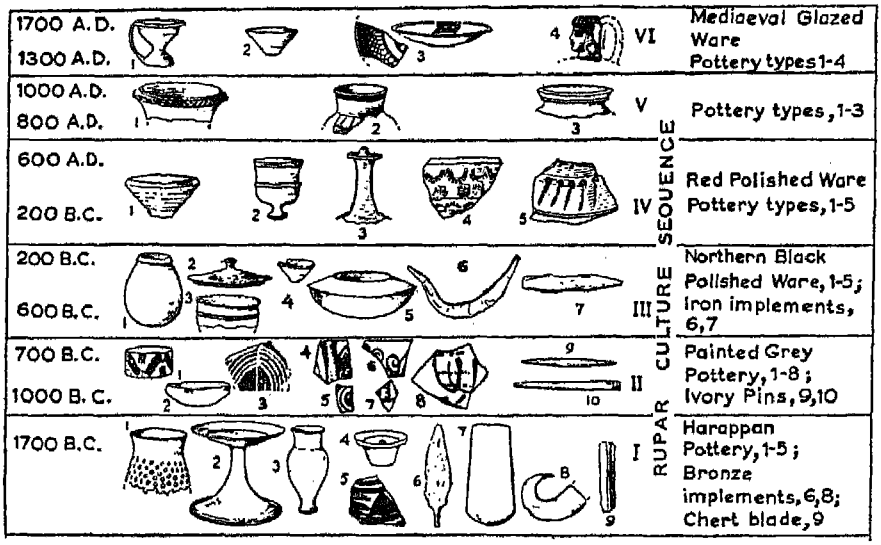

Fig. 68. Sequence of Rupar culture from sections of the Nalagarh mound, Rupar, Punjab (After Y.D. Sharma)

ware of Kalibangan.

District Ludhiana

Sanghol. Period I revealed some Harappan material, viz. a chert weight, and pottery. Houses were made of packed clay, had mud flooring, *chulahs*, and circular pits for storage.

Dadheri had a late Harappan horizon in period IA.

Mandiala Kalan is known for a red ware painted in black-hatched triangles, and an externally incised ware which indicates affinities with the incised ware of Bara. Sharma observes, "The arrival of the Harappans on the Satluj was a continuous process; they came in wave after wave bringing in new ideas and ceramic traditions." He cites three Harappan sites, namely Deheru, Manupur and Kheri-Nodh-Singh along the course of the Budhanala, a dried-up bed of the Satluj near Ludhiana. It indicates the route followed by the Harappans to Rupar.

District Gurdaspur

The sites in District Gurdaspur contain only Grey Ware associated with Painted Grey Ware and late Harappan Red Ware. The main sites are Kanwa, Dodwan, Haripur, Lohagarh, Hardo Rawal Khurd, and Gurdas Nangal da Theh.

District Amritsar

At Gharinda, west of Amritsar towards the border, at a distance of six kilometres before Attari, Painted Grey Ware, Grey Ware and a few late Harappan sherds were discovered.

District Ferozepur

In the District of Ferozepur at the site in Sosan, Painted Grey Ware, Grey Ware, and late Harappan Ware were discovered.

District Jullundur

In the District of Jullundur Painted Grey Ware, Grey Ware and late Harappan Ware were found at Apara, Haripur and Chini Kanjri Ka Theh. On the north-western side of the district, Grey Ware and Black Slipped Ware were discovered at Malsian, Karalan and Kartarpur. On the eastern side of the district, Nagar and Kathpalon yielded the evidence of Painted Grey Ware, Grey Ware and late Harappan Ware.[1]

HARYANA

A recent survey has brought to light 391 protohistoric occupations in Haryana. They are in the valleys of the Sarasvati, the Drishdavati, the Sabi and the Yamuna.

Siswal in the Hissar District represents a pre-Harappan phase in Haryana.

Excavations at Mithathal, in the Bhiwani District by Suraj Bhan revealed three cultural levels, dating from *c.* 2000 B.C. to 1500 B.C. About 145 late Harappan settlements have been located in the Karnal, Kurukshetra, Ambala and Gurgaon districts.[2]

Bhagwanpura

Bhagwanpura is situated on the right bank of the Sarasvati in the Kurukshetra District. Here, the late Harappan culture was found interlocked with the Painted Grey Ware culture. The excavations revealed different house types also. The earliest were semi-circular thatched huts supported on posts fixed in post holes. In one house, four saddle querns and different types of pestles were found. In the second structural phase, a mud-walled house complex was discovered. It had 13 rooms, with a corridor in between the two sets of rooms, and a courtyard on the eastern side. The size of the

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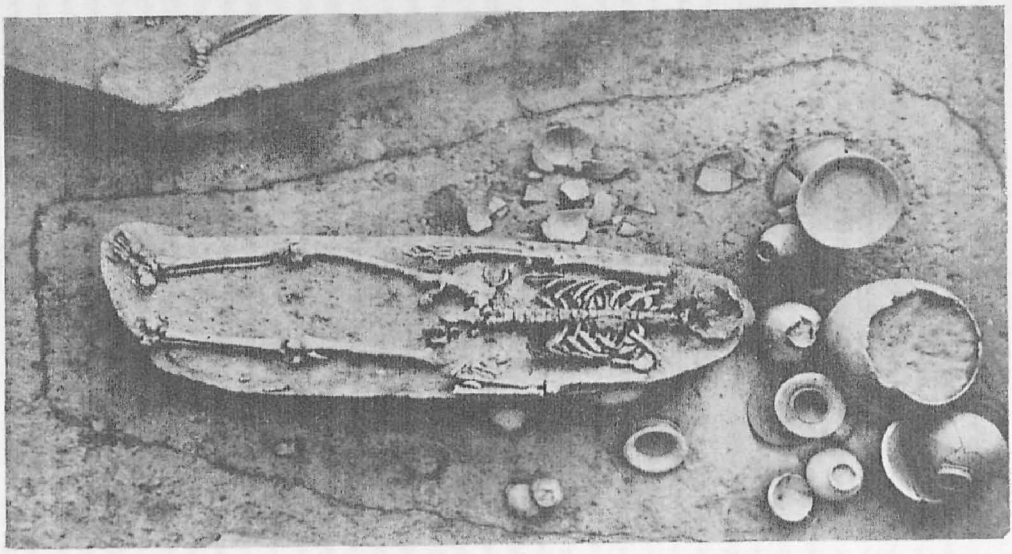
[1]Joshi, J.P. 'Overlap of late Harappan Culture and Painted Grey Ware Culture in the Light of Recent Excavations in Haryana, Punjab and Jammu', *Indian Inst. Adv. Studies, Seminar*, Simla, Nov. 1977

[2]Suraj Bhan, 'The Protohistoric Settlement Patterns in Haryana', *Indian Inst. Adv. Studies, Seminar*, Simla, Nov. 1977

Fig. 69. Ringed soak-wells for draining waste water from houses in the Nalagarh mound (Courtesy: Archaeological Survey of India)

Fig. 70. A burial from Rupar. A number of pots, some containing foodgrains, were buried along with the corpse
(Courtesy: Archaeological Survey of India)



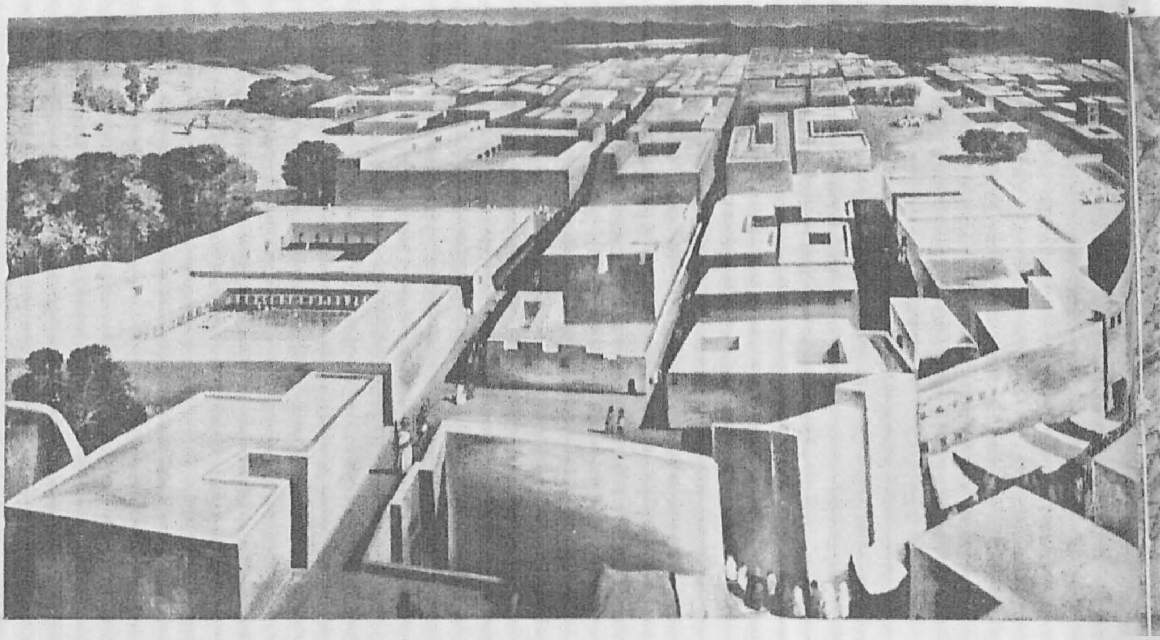
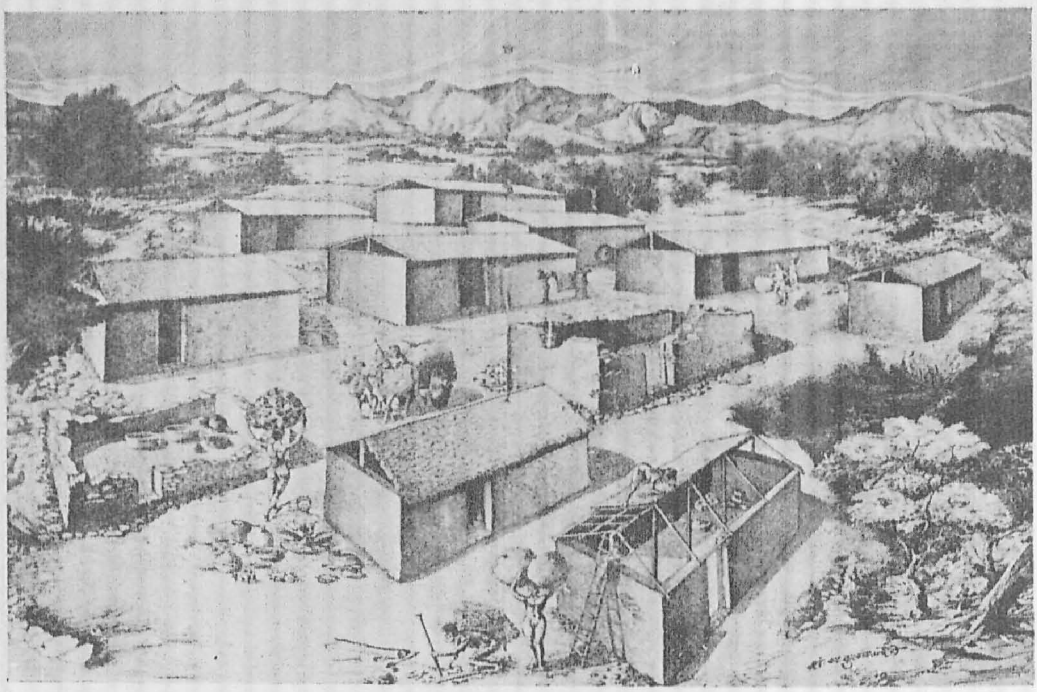


Fig. 71. A reconstruction of the Harappan town near Chandigarh, c. 2000 B.C.
(Courtesy: Museum of Evolution of Life, Chandigarh)

Fig. 72. A reconstruction of the proto-historic village of Ahar
(After H.D. Sankalia)



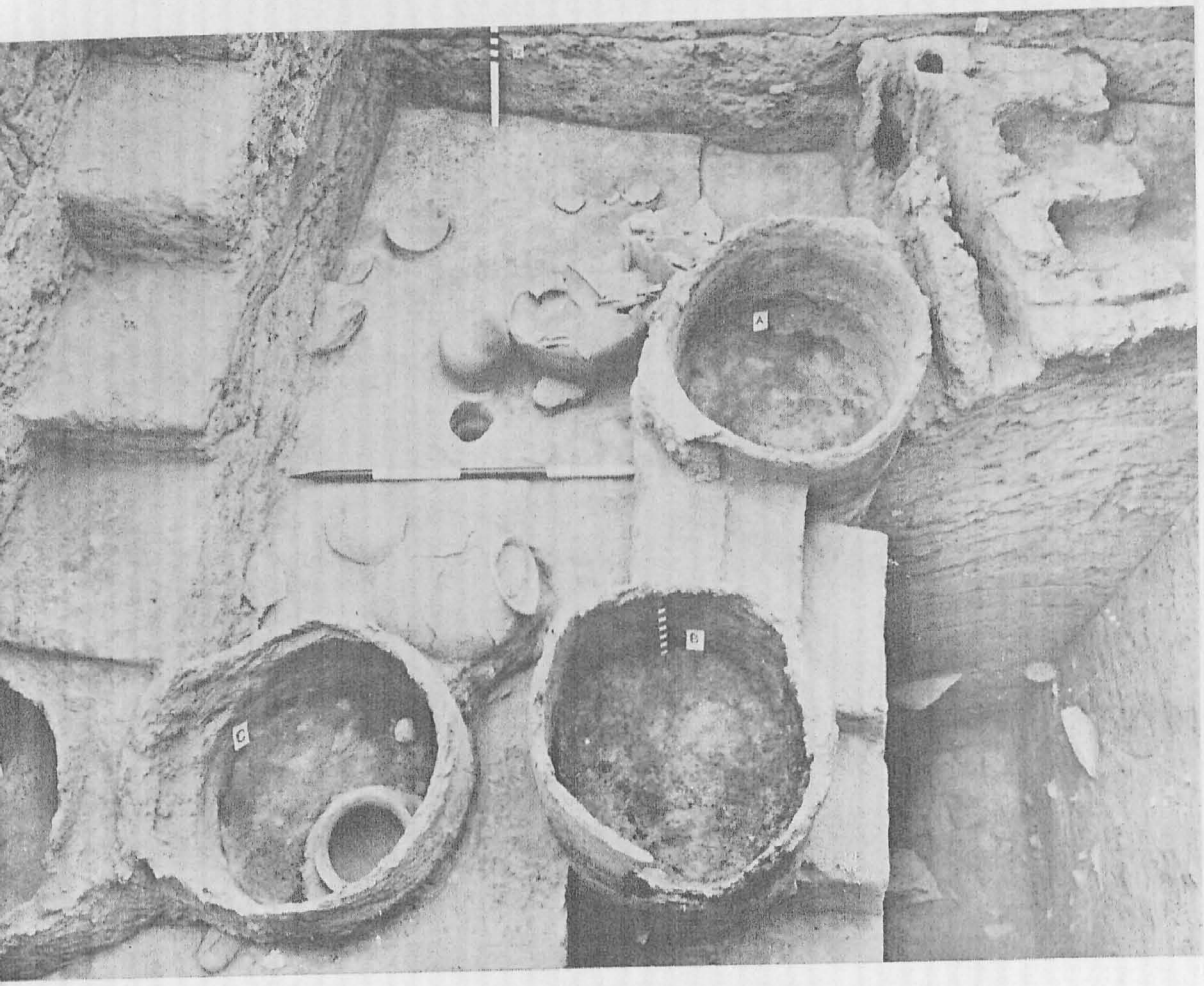


Fig. 73. Excavation at Ahar near Udaipur, in Rajasthan. Corn bins and *chulahs* are shown. Rice grains were found along with pottery, 1800 B.C.
(Courtesy: Archaeological Survey of India)

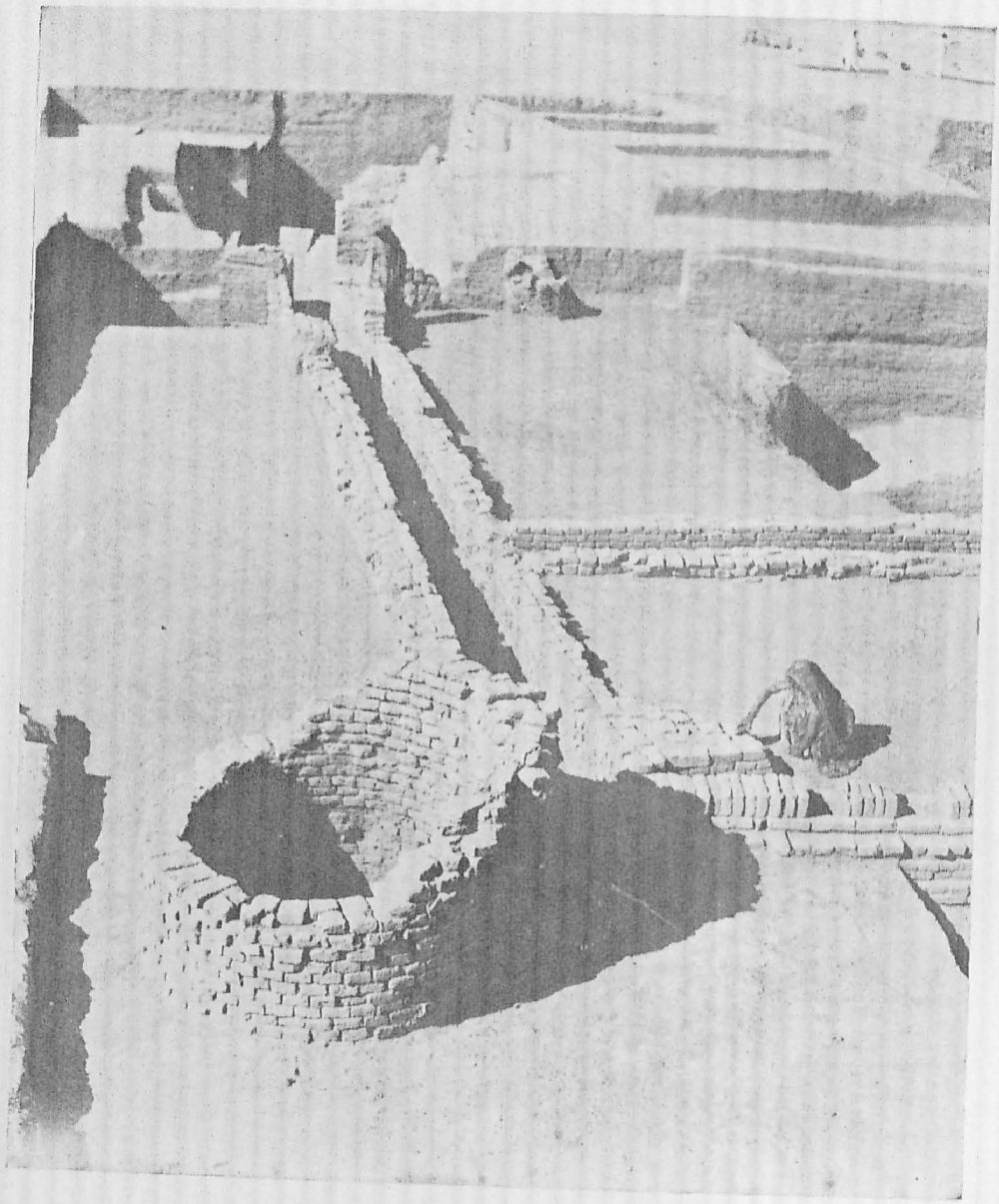


Fig. 74. A well and a public drain at Lothal, a Harappan site in Saurashtra, 2300 B.C. (Courtesy: Archaeological Survey of India)

rooms varied from 1·60 × 1·60 metres to 3·35 × 4·20 metres. From these rooms, besides copper objects, faience bangles and beads, terracotta *ghata*-shaped beads, bone styli, terracotta figures, Painted Grey Ware vessels and plain Grey Ware vessels and late Harappan pottery were discovered. A statistical analysis of the pottery revealed 2 to 5 per cent of the late Harappan element.

In the third structural phase, the houses were built of baked bricks. Two skeletons discovered from this place were oriented north-south, conforming to the Harappan tradition, but there were no grave-goods.[3]

Banawali lies in the dried-up course of the Sarasvati. It has revealed three culture sequences, viz. pre-Harappan— *c.* 2500 to 2200 B.C.; Harappan —*c.* 2200 to 1700 B.C.; and Bara Ware culture — *c.* 1700 to 1450 B.C.[4]

JAMMU

Manda

The ancient site at Manda, Akhnoor, lies on the right bank of the Chenab River at the foothills of the Pirpanjal Range. It is 28 kilometres north-west of Jammu and about 1 kilometre from Akhnoor. Excavations at this site have revealed three sequences of cultures. The oldest consists of the pre-Harappan Red Ware and the Harappan Red Ware. The Harappan pottery consists of red ware, jars, dishes, dish-on-stand, beakers and goblets. The antiquities ascribable to this period include a copper double-spiral-headed pin, bone arrow-heads with a tang, terracotta bangles, cakes, chert blades, saddle querns, pestles and potsherds with Harappan graffiti.

The next period shows the Harappan Red Ware and Grey Ware associated with Painted Grey Ware.

WESTERN UTTAR PRADESH

District Saharanpur

The chief concentration of the Harappan sites occurs in the Saharanpur District. The settlements are not more than 200 metres in length, suggesting that they were small villages. Most of the sites are on the Yamuna River or on its tributaries. These sites are at Bahupur, Pilakhni, Chilhera, Krishni, Kalahetti, Tatarpur Kalan, Nirpalpur, Hulas, Piki, Redi Malakpur, Nayavans alias Nayagaon, Fatehpur Gujar, Chhaparheri, Salarpur, Khatauli, Kaulakheri, Sarkari Sheikh and Ratna Kheri.

District Muzaffarnagar

Bhura: Situated at a distance of about 8 kilometres north of Kairana,

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[3]Joshi, J.P. 'Overlap of Late Harappan Culture and P.G.W. Culture in Haryana, Punjab and Jammu', *Indian Inst. Adv. Studies, Seminar*, Simla, Nov. 1977

[4]Bisht, R.S. 'Harappa Culture in Punjab: A Study in Perspective', *Indian Inst. Adv. Studies, Seminar*, Simla, Nov. 1977

the ancient site at Bhura is located along the dried bed of the Katha Nala, a tributary of the Yamuna.

DISTRICT MEERUT

Alamgirpur: An Indus site has been discovered at Alamgirpur, 27 kilometres west of Meerut. Alamgirpur is located on the left bank of the Hindon, a tributary of the Yamuna. The excavations revealed a succession of four cultural periods. The earliest yielded kiln-burnt bricks, the Harappan pottery, terracotta objects comprising animal figurines, cakes, carts, cubical dice, beads and bangles. Beads of steatite and semi-precious stones, bangles of faience and a broken blade of bronze were also found. The use of cloth with a plain weave is a significant feature of objects recovered from Alamgirpur. Polished stone querns and pestles were also found.

Singauli Taga: A Harappan site was discovered at Singauli Taga on the left bank of the Hindon River in 1966.

DISTRICT ALLAHABAD

Indus sherds as well as dishes-on-stand have been reported from Kausambi in the Allahabad District.

RAJASTHAN

(i) KALIBANGAN

An important discovery of a pre-Harappan township in Rajasthan was made by B.B. Lal and B.K. Thapar in 1971. The mound is known as Kalibangan or black bangles, as fragments of black bangles were found strewn over it by the local inhabitants. Another site which is close by is called Pilibangan, or yellow bangles.

Kalibangan is on the left bank of the dry bed of the Ghaggar (the ancient Sarasvati) in the Ganganagar District in the erstwhile Bikaner State. The settlement is in two parts, following the Harappan pattern, viz. a citadel on the west, and the town on the east. Both the citadel and the town were protected by a fortified wall. The site has yielded evidence of two periods of occupation, of which the lower is pre-Harappan, and the upper belonged to the Indus civilization. Below the Harappan citadel are the remains of a pre-Harappan small township which represents a different culture. [14]Carbon determinations show a date between 2450 and 2300 B.C. for the pre-Harappan levels. The pre-Harappans were in a chalcolithic stage like the Harappans. Proto-Harappan seems to be a more appropriate term for their culture.

The pre-Harappan settlement was fortified, and within the walled area

[14]Deshpande, M.N. 'The Harappan Settlements in Ganga-Yamuna Doab', *Indian Inst. Adv. Studies, Seminar*, Simla, Nov. 1977

there were houses made of mud-bricks of the same size as that of the fortification wall. An ordinary house consisted of a courtyard, around which were located the living-rooms. Adjoining the walls of the houses were small platforms or *chabutaras*. Some of the houses had ovens resembling *tandoors*, and cylindrical pits lined with lime-mortar, used possibly for the storage of foodgrains. This is the pattern which prevails in the villages in Rajasthan even now.

The citadel consisted of two almost equal but separately patterned parts. Both these parts were surrounded on all sides by a fortification wall, reinforced at intervals with rectangular bastions. The southern half contained half a dozen massive platforms of mud and mud-bricks, each separated from the other by a passage, and the northern half contained the residences of the elite.

Because of the depredations of brick-robbers, no plans are available of the buildings which stood upon the platforms. But the available remains indicate that some of these might have been used for religious purposes. On one of the platforms were located a well, a fire altar and a rectangular pit lined with baked bricks containing bovine bones and antlers, representing perhaps sacrifices. On yet another there was a row of fire altars, a well and a series of bathing-floors. The presence of these features in the citadel is noteworthy. In the city, there were no street-drains or bathing-platforms. These amenities suggest that the inhabitants washed and bathed and performed their rituals in the citadel area.

The city had a grid of streets which divided the area into blocks. Four arterial streets running north-south and three running east-west have been uncovered, and it is surmised that the unexcavated northern portion of the city may contain more.

To avoid damage to the houses from vehicular traffic, wooden fender-posts were provided on some of the street-corners. There has so far been no evidence of regular street-drains. House-drains, which were either of wood or of baked bricks, discharged their contents into storage-jars buried in the floor of the street.[6]

According to Raikes, the desertion of Kalibangan and other sites in the Sarasvati Valley took place owing to a change in the course of the river about 1800 B.C. to 1700 B.C. Owing to the tectonic changes, the Yamuna, which used to flow in the present bed of the Sarasvati, turned westwards.

Faulted strata and ruptured walls were revealed in the excavated trenches in the pre-Harappan settlement. It seems that the pre-Harappan settlement was destroyed by an earthquake. It was rehabilitated, and subsequently flourished for about six hundred years.

The past never disappears. It survives in the present in some shape.

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[6]Thapar, B.K. 'Digging up the Past', *Times of India Annual*, 1977

B.B. Lal[1] points out that the Marwari women cover their entire arms with silver bangles like the nude dancing-girl from Mohenjo-daro. *Tandoor* is still in use in the villages of the Punjab for baking *chapaties*. In Rajasthan, villagers have platforms in front of their homes where they sit to gossip or to enjoy the warmth of the sun in winter. Sets of copper instruments, viz. tweezers (*mochna*), tooth-pick, and a small spoon-like device for removing wax from the ears, are still sold in the towns of Himachal Pradesh. The Harappans had a similar kit of tools.

(ii) AHAR—BANASIAN CULTURE

The village of Ahar, about 3 furlongs [605 metres] from the Udaipur Railway Station, is known in medieval inscriptions as Aghatapura. It was the capital of Guhila kings, the ancestors of the Ranas of Mewar, before they migrated to Chittor. Close to it, on the bank of a rivulet, also called Ahar, lies a mound locally known as Dhulkot. There are other sites on the banks of the Banas and its tributaries, and hence the culture is called Banasian.

For security, a hill-girt valley was chosen by the people of Ahar. There is a fairly good amount of rainfall, so that water for drinking and irrigation is available. This region provided excellent hunting. Deer and wild boars are still plentiful.

For building houses, schist was available and it could be easily broken into the required size of slabs. Quartz nodules were available in abundance to strengthen and beautify the walls of mud houses.

The plinth of houses was built with roughly dressed slabs of schist. The walls were made with mud or mud-bricks. Timber was used, but sparingly. The roof was sloping and was thatched with bamboos, and additionally covered with grass and leaves.

These stone-and-mud-walled houses, with sloping roofs, were fairly large. The largest one so far exposed has a length of 33 feet [10 metres]. Other houses have a range between 22 × 17 feet and 10 × 9 feet [6·7 × 5.2 metres and 3 × 2·75 metres]. A reconstruction of the village of Ahar by H.D. Sankalia (Fig. 72) shows that even now there are villages in Rajasthan which are not distinguishable from it.

Saddle querns were found in the kitchen, near the *chulah*. Though grains—charred or not charred—have not been discovered from Phases Ia and Ib, some cereal, e.g. wheat, must have been ground into flour, made into dough and converted into *chapaties* by baking on pans of clay, numerous fragments of which were found. Initially, it appeared that *jwari* (a kind of millet) was used in Phase Ic, the grains of which were found mixed with

[1]Lal, B.B. 'The Indus Civilization: Problems and Issues', *Indian Inst. Adv. Studies, Seminar*, Simla, Nov. 1977

clay in making pottery. There is some doubt about this find, as it was from a disturbed layer.

The prehistoric Aharians certainly ate rice. According to Vishnu-Mittre, rice was of the long-seeded strain, perhaps the ancestor of the fragrant *Basmati* rice. Abundant impressions of rice husks on potsherds have been found from Phase a, Period I.

Fish, turtles, fowl, cattle, buffalo, goat, sheep, deer and pig were also eaten by the people of Ahar. The bones of the domesticated cattle, *Bos indicus*, predominate among those of other animals.

Three terracotta toy wheels indicate the use of cart by the people of Ahar. The Aharians possessed seven kinds of pottery. Of these, the Black-and-Red was used as a table ware. Red Ware and Grey Ware were also used.

Copper tools and weapons were made from the copper ore smelted from deposits in the Aravallis. Five copper axes, one knife blade, a copper sheet, a bangle and two rings were found. The occurrence of copper slag indicates that the Aharians smelted copper.

The Ahar axes, though thinner and with a more flaring edge, are not otherwise different from the flat socketless axes discovered from other sites in India.

Ahar is the only site where during this period lithic blades were not used for household purposes, along with copper, and stone axes. Hence the Ahar Culture has been called the Copper Age Culture.[8]

The Banasian culture is distinctive in its absence of a stone industry of any kind in its earlier phases and in the presence of numerous copper objects, particularly axes made of locally available copper. Black and Red Wares are predominant, with lustrous Red Wares appearing in later phases. Radiocarbon datings carried out at the University of Victoria, Australia, indicate the beginning of the Ahar culture around *c.* 1990 to 2144 B.C. Some late dates, 1727, 1552, 1273 B.C., are indicated by samples analysed at the Tata Institute of Fundamental Research. According to Allchin, the Banasian phase might have extended from 1800 to 1400 B.C.

GUJARAT

Rangpur, a Harappan site in Gujarat, south-west of Ahmedabad, was discovered in 1934. Subsequently, Lothal was discovered. Five mounds were discovered at Somnath in the Sorath District. They are marked by a chalcolithic blade industry, Harappan segmented faience beads, and dishes-on-stand pottery. A Harappan mound was discovered at Rojdi on the Bhadar River, 34 miles [55 kilometres] south of Rajkot.

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[8]Sankalia, H.D. *The Prehistory and Protohistory of India and Pakistan*

value can be judged from the fact that it is one of the three ingredients of *triphala*, an Ayurvedic medicine and tonic.

Irrigation

The farmers of Inamgaon cultivated wheat, barley, *kulth*, *mung* and peas. A large mud embankment on a stone foundation for diverting flood water in the Ghod River through a channel dug for the purpose was also discovered at Inamgaon. According to Dhavalkar[6], this is the earliest evidence of irrigation in India.

THE LATE HARAPPANS IN THE GODAVARI VALLEY

S.A. Sali[7] has drawn attention to some late Harappans in the Godavari Valley in Maharashtra. From an ancient site at Kalivada on a bank of a small feeder stream of the River Pravara near the village of Ambhore, in the Sangamner Taluka of the Ahmadnagar District, potteries were found which closely resemble the late Harappan red ware. Sali believes that this is the first evidence indicating the southward extension of the Harappans into the Godavari Valley.

DAIMABAD

The Chalcolithic site at Daimabad on the Pravara River in the Ahmadnagar District was excavated by Deshpande in 1958-59. It yielded evidence of four phases, viz. Neolithic, Late Harappa, Buff and Cream Ware, Malwa and Jorwe cultures. Apart from potteries, charred grain of barley, a fragment of a copper celt, and microliths of chert and chalcedony were discovered from the Late Harappan phase.

In 1974, a hoard of bronzes was discovered by a Bhil from the roots of shrubs which he was uprooting for fuel. Sali ascribes them to the Late Harappan phase. These comprise a chariot with a pair of humped bullocks yoked to it. This must be the breed present in Maharashtra in 1300 B.C. It was used for ploughing, pulling carts and chariots (Fig. 140). The chariot is driven by a naked man. Attached to his penis is a four-hooded cobra. In front of him is a dog standing on the central pole. Other animals in the hoard are a rhino, a buffalo and an elephant. Obviously, it is a cult image. According to Sali, the man represents the Pasupati, Shiva, the Lord of Beasts.

A pot recovered from Inamgaon has a painting showing two zebus yoked to a bullock-cart (Fig. 141).

The Harappan Daimabad was a sizeable town covering more than 20

[6]Dhavalkar, M.K. "First Farmers of Maharashtra," in *Dawn of Civilization in Maharashtra* (Ed. K. Khandalavala)

[7]Sali, S.A. The Harappan Contacts in the Deccan, *Indian Inst. Advanced Study, Seminar*, Simla, Nov. 1977

a *thali* combined with a stool.

Utensils of quartz, copper, ivory and bone, terracotta toys, and seals and beads of sundry materials have been discovered. The toys include terracotta animal figurines and carts. The weights of quartz or agate are identical with those of the Indus Valley. Spearheads, arrowheads, axes and fish-hooks of copper or bronze were also recovered.

According to S.R. Rao, 'Lothal as well as the Indus Valley cities received gold from the Kolar and Hatti gold mines in Karnataka. The occurrence of typical Harappan products such as disc-beads of white steatite at Maski, Piklihal, Tekkalakota, Utnur (2300 B.C.), and flat copper celts at Tekkalakota (1700 B.C.) and Hallur, all situated within the gold-producing region of Deccan, assumes great significance in the present context. Recently some neolithic sites have been discovered in the ancient gold-working region around Kolar in Karnataka and Hosur in Tamil Nadu. It is not improbable that the gold from Kolar and Hatti mines was carried over land and sea routes through one of the ancient ports situated on the west coast mentioned by later Greek writers. [14]Carbon date or the Indus culture of Lothal is 2300 B.C.

(ii) RANGPUR

Rangpur is 30 miles [48 kilometres] to the south-west of Lothal. In the second millennium B.C., a part of the population of Lothal apparently set out for the interior of Kathiawar, settling at Rangpur. Rangpur was undoubtedy inhabited earlier, since agate and jasper microliths, not associated with pottery, have been found there. The traces of Indus culture at Rangpur are the same as those at Lothal. They represent a later phase and include utensils of poorer quality. This deterioration is accentuated towards the end of the second millennium, when the pottery became decadent and the weights and knives of quartz disappeared. In the first millennium, two types of pottery were in use: the bright red and the red-and-black.

'Rangpur excavations have thus not only confirmed the Harappan penetration into Gujarat-Saurashtra, but have also shown that there was a pre-Harappan settlement, and a continuation after the destruction of Harappan.

'With these changes we should note the presence of the horse and *bajra*, besides the absence of so many typical Harappan objects of daily use and the presence of newer ones. Except in the climate and vegetation and to a great extent in the fauna—cattle, buffalo, sheep, goat, pig and deer—there was a great change in the lifeways of the inhabitants of Period III at Rangpur'.[10]

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[10]Sankalia, H.D. *The Prehistory and Protohistory of India and Pakistan*, pp. 380, 381

(iii) SURKOTDA, DISTRICT KUTCH

The site at Surkotda in the Kutch District was discovered in 1965, and has provided us with evidence regarding the diffusion of the Harappan culture from Sind via the land route. The excavation brought to light a sequence of three cultural periods. In the earliest period, the objects found were largely Harappan. They included long chert blades, beads of steatite, carnelian, lapis lazuli, faience and terracotta; copper rings, bangles and a spearhead; terracotta toy cart-frames, bangles and cakes; bone objects; and a large number of clay *lingas*. The pottery showed typical Harappan forms, the Indus goblet, dish-on-stand, perforated jar, handled cup, as also characteristic Harappan painted designs, such as the fish scale, *pipal* leaf, cranes, deer, and plantains.

In Period II, the Harappan elements were less pronounced. Among the finds were a copper flat celt and a chisel, indicating some metallurgical sophistication. The upper levels yielded sherds of the white-painted black-and-red ware of the Ahar fabric which indicated that a new group of settlers had arrived.

MADHYA PRADESH

KAYATHA, DISTRICT UJJAIN

The Kayatha culture was discovered by V.S. Wakankar in 1964. Kayatha is the ancient Kāpiṭṭhaka situated on the right bank of the River Choti Kali Sindh, a tributary of the Chambal, about 25 kilometres to the east of Ujjain.

The Kayathans had distinctive pottery, copper tools and ornaments, and also lithic blades. Their houses were round or rectangular and had wooden posts, placed at intervals, supporting a split bamboo screen, plastered with mud inside as well as outside. The roofs were conical or flat.

The Kayathans were the earliest settlers of Malwa who lived in houses, possessed wheel-made pottery, used tools and weapons of stone and copper or bronze and probably cultivated wheat. The period when the first settlement took place would be around 2000 B.C., as suggested by a few ^{14}C dates. About 1800 B.C. the Kayathans disappeared from the scene.

The people of Kayatha believed in the cult of the stylized bull. Kayatha has yielded a large number of these bulls in terracotta. A clay figure of a horse has also been discovered from Kayatha. It is a powerful piece of sculpture which conveys the restless energy of a horse.

NAGDA

Nagda on the Chambal was another important settlement. Like Kayatha it has thick debris of the Chalcolithic Period.

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CHAPTER 13

HARAPPAN AGRICULTURE

CULTIVATION OF WHEAT, BARLEY AND COTTON

EVIDENCE of agriculture in the Indus Valley and other areas which came under the influence of the Harappan chalcolithic culture is in the finds of foodgrains and fibres recovered in excavations, and in potteries, granaries, terracotta toys and ornaments. The size of the Harappan towns itself indicates that it was a plough agriculture, with dependence on bullocks for draught.

THE PLOUGH

The Sumerians developed the plough about 2900 B.C. Possibly, the Harappans learnt the use of the plough from the Sumerians. All primitive ploughs were made of wood, and wood is a perishable material. Hence there is no possibility of finding an actual wooden plough from a Harappan site. However, a terracotta model of a plough, 7×19.7 centimetres has been discovered from Mohenjo-daro (Fig. 78). This toy plough is kept in the Prince of Wales Museum, Bombay. Its shape is rather peculiar. There is a longish beam and the plough breast terminates in a rectangular manner. There is no indication that it had a handle (*munna*) for the ploughman to hold.

Apart from the terracotta plough toy, there is indirect evidence of the existence of the plough in the Harappan times. In an earlier chapter, I have referred to the site of Kalibangan in western Rajasthan. Its pre-Harappan levels have been dated 2450 to 2300 B.C. The people of Kalibangan had domesticated cattle, and carried on agriculture. To the south-east of the pre-Harappan settlement a ploughed field was discovered by B. B. Lal and B. K. Thapar. This is the earliest ploughed field so far excavated anywhere in the world. It showed a grid of furrows, with one set more closely spaced (about 30 centimetres apart) running east-west, and the other widely spaced (about 1.90 metres apart), running north-south (Fig. 80). This pattern bears a remarkable resemblance to ploughing as is now carried on in the neighbourhood, where mustard and gram are grown in two sets of furrows in the same field. Compare, on the other hand, the state of agriculture in Europe. In Germany, the cultivation of small plots with hoes was still the sole economy down to about 2000 B.C.

Allchins, relying on Lambrick, who, according to them, had personal knowledge of Sind, describe as follows how crops were grown in the river-rain tract of the Indus. "The principal foodgrains, that is wheat and

barley, would have been grown as spring (*rabi*) crops: that is to say, sown at the end of the inundation upon land which had been submerged by spill from the river or one of its natural flood channels, and reaped in March or April. In modern practice such land is neither ploughed nor manured, nor does it require additional water. Lambrick remarks that 'the whole operation involves an absolute minimum of skill, labour and aid of implements.' Other crops, including cotton and sesamum, would be sown as autumnal (*kharif*) : that means they would be sown at the beginning of the inundation and harvested at its close, in autumn. For this fields surrounded by earth embankments would be required, most probably along the banks of natural flood channels. Although this method is more precarious than the former, both exploit the natural fertility of the alluvium, and the annual inundation. Both systems are still in use."[1] According to my experience of cultivation in the riverain areas of the Punjab, when the land has appropriate moisture or *wattar*, as it is called, land is ploughed, seed is sown and the soil is smoothened with a plank. The practice followed by the Harappans could not have been different. For the proper sowing of crops, soil has to be stirred and seed has to be covered.

Seed-drill

S.R. Rao in his monograph, *Lothal and the Indus Civilization*, has reproduced a photograph of a seal from Lothal which he feels depicts a seed-drill (Fig. 79). But its shape is rather unusual for a seed-drill.

The Wheeled Cart

Ox-drawn sledges were still being used about 3000 B.C. at Ur to convey royal corpses to their final resting-place. But long before that date, the sledge had been transformed by an invention that revolutionized locomotion on land. The wheel was the crowning achievement of prehistoric carpentry; it is the pre-condition of modern machinery, and, applied to transport, it converted the sledge into a cart or wagon.

Wheeled vehicles are represented in the Sumerian art as early as 3500 B.C., and in northern Syria perhaps even earlier. By 3000 B.C., carts, wagons, and even chariots were in general use in Elam, Mesopotamia and Syria.

In the Indus Valley, wheeled carts were in use when the archaeologic record begins about 2300 B.C. and at about the same date in Turkestan too. Children's toys from Mohenjo-daro, Harappa, Lothal and Chandigarh include some wheeled carts, which indicates that they were in use in ordinary life (Fig. 81). Bronze models of carts have also been found at Harappa and

[1]Allchins, B. and R. *The Birth of Indian Civilisation—India and Pakistan before 500 B.C.*, p. 261

Chanhu-daro. These bullock carts had solid wheels. They very much resemble small carts, called *lahiru*, which are used for carting farmyard manure in the villages of Oudh. In Orissa the bullock-carts have solid wheels. A toy-cart from Mohenjo-daro had a basket-like body, which indicates that it was possibly used for carting farmyard manure (Fig. 83). Excavations at Harappa have revealed cart-ruts, 3 feet 6 inches (1 metre) in width. The present-day bullock-carts in Sind have the same width (Fig. 82, *right*).

Bullock-carts from Lothal

A solid wheel of a toy-chariot in alabaster carved with geometric and other designs, and terracotta toy-carts furnish evidence of the means of communication in Lothal. Probably, male buffaloes and bullocks were yoked to the carts. Three main types of bullock-carts were reconstructed by Rao with the help of the toy-wheels and cart frames found in the excavation at Lothal. The first type has a solid chassis, which is concave or flat. The second and third types have a perforated chassis. The third type has, in addition, a detachable cross-bar. On such a chassis, wooden posts were fixed to form a box-like frame (Fig. 81, *top*). Even now, the carts in Gujarat carry such frames formed by interlacing ropes (Fig. 81, *bottom*). Cotton is carried in this manner in these carts. The wheels of the Lothal carts were attached to the free projecting ends of the axle which was secured with leather straps to the main frame. Lynchpins seem to have held the wheels in position. The carts with a detachable cross-bar and those with a chassis made up of two curved bars were confined to Saurashtra. Rao believes that the latter were meant for carrying light loads, whereas the other two types were used for carrying heavy loads.[2]

Bernal states that the bullock-cart combined two critically important ideas—the use of animal power and the wheel. "These inventions were to have enormous material and scientific consequences. The cart and the plough between them enabled agriculture to be spread over all open plains and so far beyond the limits of the old civilizations. The increased possibilities and speed of transport by cart and even more by ship, together with the need to know the sources of valuable materials, led to deliberate exploration and to the beginnings of geography."[3]

Protection of Crops from Wild Animals and Birds

Here I may as well refer to the wildlife of the Harappan period, as represented in seals and toys. In some cases, bones of wild animals have also been recovered. The wildlife consisted of the elephant, rhinoceros,

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[2]Rao, S.R. *Lothal and the Indus Civilization*, p. 123
[3]Bernal, J.D. *Science in History*, p. 77

wolf, jackal, *nilgai*, gaur (Indian bison), wild buffalo and species of deer, such as the *hangul* or Kashmir stag, *chital*, *sambhar*, *barasingha*, four-horned antelope, black buck and hog deer. The *sambhar*, *barasingha* and *chital* were fairly widespread.

The Harappa toys contain representations of the rhinoceros, the tiger, and the elephant. There are toys shaped as monkeys, squirrels, mongooses, snakes, pangolins, wild boar and crocodiles (Fig. 84). From among the birds, the duck, peacock, hen, kite, pigeon, dove and parakeet are represented in the toy art.

Out of these wild animals and birds, *nilgai*, deer of different varieties, wild boars, and parakeets must be the cause of damage to the crops of Harappans, as they do even now wherever they are found. How did the Harappans protect their crops? Terracotta sling-balls are found in all Harappan excavations. Possibly, the farmers used these sling-balls for scaring away pests. The sling is the earliest device by which force and range were given to the arm of a thrower of missiles. Slings and sling-balls are even now used by the farmers for protecting the maize crop in the submontane areas of northern India. A boy armed with a sling standing on a *machan* in the midst of a field of maize is not an uncommon sight.

Granaries

The best evidence of agriculture in the Harappan areas is in granaries, which have been discovered at Harappa and Mohenjo-daro. Mortimer Wheeler thus describes the granary at Harappa. "To the north of these 'lines' the ground is littered with a medley of broken walls and floors which have not been intelligibly planned. Amongst these *disjecta*, however, not less than seventeen circular brick platforms emerge as a unit. It was built of four concentric rings of bricks-on-edge, with fragments of a fifth (or possibly of packing) round a central hole which had apparently held a wooden mortar. Fragments of straw or husk were found about the centre, and burnt wheat and husked barley were noticed in the central hollow of one of the other specimens. There can be little doubt therefore that the platforms surrounded mortars for the pounding of grain with long wooden pestles, as in some parts of India today." In Fig. 85 we see two women pounding barley with wooden pestles in a village home in Haryana. The importance of the Harappa platforms is their indication that this process was there concentrated and possibly regimented.

"A hundred yards [91 metres] north of the 'platform' area, and itself within a hundred yards of the river-bed, lay the remarkable group of granaries which supplies a key to the whole layout. These granaries, each 50 × 20 feet [15.2 × 6.1 metres] overall, are ranged symmetrically in two rows of six, with a central passage, 23 feet [7 metres] wide. They are built upon a podium of rammed mud, some 4 feet [over 1 metre] high, rivetted along

parts of the eastern and western sides and the whole of the southern and with baked bricks stepped back to form a battered face, like the rivetment of the citadel defences. Incidentally, the continuous rivetment along the southern end and the absence of space at the sides prove that the approach was on the north, i.e. from the river-bank, suggesting the use of water-transport for incoming or outgoing supplies of grain.

"The floors of the individual granaries were carried clear of the ground on sleeper-walls, three to each unit. In at least two instances, the central sleeper had rectangular thickenings as though to carry posts or piers for additional roof-support. The purpose of the sleepers, as in the closely similar granaries of Roman forts, was to provide intervening air-ducts to keep the overlying building dry and so to prevent sweating and mildew. The structures were entered from the central passage by short flights of brick steps, and the systematic use of the passage itself for something more than transit is indicated by the presence in it of a number of carefully laid brick floors. As the general level rose outside the area, the air-ducts beneath the floors tended to become choked, and accordingly small projecting air-vents, conducting from the higher level, were added at their outer ends. The combined floor-space of the 12 granaries was something over 9,000 square feet [836 square metres], and approximates closely to that of the Mohenjo-daro Granary as originally planned.

"We may glance at the layout of the area as a whole. Its units consist of (i)ranges of a barrack-like quarters within a walled compound, (ii) serried lines of platforms apparently for pounding grain, and (iii) a marshalled array of uniform granaries within easy reach of the (former) river."[4]

The isometric projection of the granary at Harappa can be seen in Fig. 86. There is a structural similarity between the Indus granaries and an Akkadian structure at Susa.

It seems that trade in the Harappan times was by barter. The seals were not money, but were stamp seals, used for stamping packages. They were carved on steatite, a soft stone. It seems that families of merchants had adopted certain domestic animals as totems. That is why they engraved their likeness on the seals. From the ruins of a warehouse at Lothal 71 sealings were recovered, most of which bear impressions of cloth used for packing the cargo which was consumed by the fire. Circular plano- convex pieces of clay, according to B. B. Lal, may be regarded as tokens carried by merchants or their messengers.

The granaries also indicate that payment to labourers was in kind. As in the Indus Valley, all important cities in the Tigris-Euphrates Valley had granaries. A text from Ur implies that one of the granaries stored enough barley to provide wages for 4,020 days; another text refers to the

[4]Wheeler, M. *The Indus Civilization*, pp. 32, 33

commandant of the granary who was responsible for seeing that 10,930 man-days' payment was made out of his store, presumably in barley, to meet the wages of the workers from the town; the workers included scribes, overseers, shepherds and irrigators. Another text refers to royal barley, to be returned with interest, received by Lulamu from the granary of the canal-bank. All these documents are of *c.* 2130-2000 B.C. Another tablet of the same period records a harvest gathered from certain fields belonging to the temple of Nan-she in Lagash.[5]

From the size of the granaries it can also be concluded that the peasants paid their dues to the Government in kind, who, in turn, used it for payments to employees of various kinds. The artisans, carpenters and others received their wages in kind from the farmers.

Granary at Lothal: A structure standing on a platform and consisting of 12 blocks of brick forming channels about 26 inches [66 centimetres] broad and separated by air-ducts was identified by Mortimer Wheeler as a granary. It seems that agriculture, fishing and trade were the main occupations of the inhabitants of Lothal. The size of copper fish-hooks indicates that fish of large size were caught by the fishermen of Lothal in the rivers.

FOOD CROPS

The Harappans cultivated bread wheat (*Triticum aestivum*), *T. sphaerococcum*, barley (*Hordeum vulgare* and *H. hexastichum*), sesame, peas (*Pisum sativum* var. *arvense*), melons, date-palm, and species of *Brassica.* Cotton was an important crop and the centre of origin of *Gossypium arboreum* lies in the Indus Valley. These crops are dealt with in the following account.

Wheat. Among the cereals wheat and barley were recorded from Harappa and Mohenjo-daro. The association of these two cereals in the archaeological remains of Mesopotamia, along with other evidence, has led to the belief that there was some contact between the Indus Valley and Mesopotamian civilizations. Helbaek has pointed out that wheat and barley have been cultivated together from the very beginning of village-farming in western Asia.

Luthra has shown that the wheat recovered from Mohenjo-daro belongs to *Triticum vulgare* (*T. aestivum*), *T. compactum* and *T. sphaerococcum.*

Triticum aestivum, the common bread wheat, *T. durum*, the macaroni wheat, and *T. dicoccum*, the emmer wheat, are the three important species grown in India. *T. sphaerococcum*, which was cultivated in the past in the Punjab, Uttar Pradesh and Madhya Pradesh, has now gone out of cultivation and has been replaced by the more high-yielding bread and macaroni

[5]Wheeler, M. *The Indus Civilization*, p. 35

wheats. *T. compactum* was reported to have been cultivated in India (Howard, 1916).

T. sphaerococcum is a wheat of great antiquity and has been found in the excavations at Mohenjo-daro dating back to 2300 B.C. (Fig. 90). It is supposed to have originated in the north-western area of the Indian subcontinent. It appears that in ancient India the cultivation of *T. sphaerococcum* was widespread. It has high resistance to drought and this factor has contributed to its success. *T. sphaerococcum* appears to be a derivative of *T. aestivum.*

Percival states, 'Like its ally *T. compactum*, this race *T. sphaerococcum* probably arose as a mutant among the progeny of an early hybrid. Its peculiarly small round grains very closely agree in form and size with Buschan's *T. compactum globiforme*, the naked-grained wheat, most commonly grown in various parts of Europe in Neolithic times, and it is possible that the race now confined to India is a remnant of an ancient stock.'

Percival again states, 'This race, which I received from India and parts of Persia, is referred to by Howard to *T. compactum* Host, but the latter so far as I am aware does not occur in India.'[6]

According to Ram Dhan Singh, Vavilov concurred with Percival's view. Ram Dhan Singh referred to the later extensive work of Ellerton, who made a world-wide collection of wheat species and cultivars, and says that though Ellerton's collection did include a specimen of *T. sphaerococcum* derived from the Euphrates region of Iraq and Percival's earlier collection included a sample from Iran, both are considered to be importations from India. It appears that Wimshurst (1920), who wrote a paper on wheats and barleys of Mesopotamia, held a similar view.[7]

Barley. All barleys, wild and cultivated, belong to the same potentially interfertile population and are grouped under one species, *Hordeum vulgare.* There is now overwhelming evidence to show that barley was domesticated from a two-row progenitor resembling *H. vulgare* subsp. *spontaneum* in the Near East region around 8000 B.C. (Harlan, 1968, 1969). The barley culture in India appears to have come from western Asia (the Near East in European terms), and can be followed with fair certainty across northern India and then southwards (Raikes and Dyson, 1961; Sankalia, Subharao and Deo, 1953; and Vishnu-Mittre, 1974). The series of archaeological finds from Ur and Mohenjo-daro have now pushed back the antiquity of India's relations with western Asia to the third millennium B.C. At that time the ancient Indus cities were in regular and intimate contact with the Sumerian cities of Iraq (Sen, 1963).[8]

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[6]Percival, J. *The Wheat Plant*, G. Duckworth & Co. Ltd, London, p. 463, 1921

[7]Singh, R.D. *Triticum sphaerococcum* Perc. (Indian Dwarf Wheat), *Indian J. Genet. Pl. Br.* 6: 34-47, 1946

[8]Bakshi, J.S. and Rana, R.S. *Barley in Evolutionary Studies in World Crops—Diversity and Change in the Indian Subcontinent* (Ed. Sir Joseph Hutchinson), p. 47

A few grains of barley have been found mixed with wheat at Mohenjo-daro and identified by Luthra (1936) as *Hordeum vulgare* var. *nudum*. In low frequency they are also found mixed with wheat at Chanhu-daro (Vishnu-Mittre, unpublished). The material from Harappa is referred to as *H. vulgare* var. *hexastichum* (Vats, 1940). In contrast to the low frequency of barley found at the above sites, a sizeable quantity was found at Kalibangan (Fig, 87, *bottom right*). Mohenjo-daro material, as mentioned above, is dated 1750 B.C. from the late levels, whereas Kalibangan material is dated to 2090-2075 B.C. (Agrawal and Kusumgar, 1968 a, b). There is reason to believe that barley was cultivated throughout the Harappan period from 2300 B.C. to 1750 B.C.

The Kalibangan material consists of small and large grains and some of them are twisted, indicating that they were produced in two lateral rows and suggesting that they belonged to the six-rowed barley. The collection includes both naked and hulled forms.

More or less contemporary with the Harappan civilization, records of barley have recently been discovered from the Gangetic plain, from Atranjikhera in Uttar Pradesh dated to 2000-1500 B.C. (Chowdhury, Saraswat, Hasan and Gaur, 1971) and from the Neolithic of Chirand, Bihar, estimated to date from 2500-1800 B.C.[9]

Thus, although the Indo-Aryans appear to have brought with them their staple foodgrain (*yava*), the wheat and barley material of the Indus people was also adopted by them, generating new variability required for more intensive cultivation. It may well be that barley came to India not once but on several prehistoric occasions, either through the trade routes or along with immigrating people.

In the plains and at low altitudes in the hills, only six-rowed hulled barleys are grown commercially. At higher altitudes, however, where barley replaces wheat as a staple crop, hull-less six-rowed types are grown.[10]

An indirect evidence of the cultivation of foodgrains, such as wheat and barley, by the Harappans is provided by terracottas and saddle querns. In a terracotta from Mohenjo-daro, we see a woman kneading flour (Fig. 89). This is how wheat-flour is kneaded even at present in India. In Fig. 88 is shown saddle-quern recovered from the Harappan settlement, Sector 17, Chandigarh. *Sil* and *vatta* are the descendants of the saddle-quern and are used for grinding spices in Indian homes. Saddle-querns were possibly used for grinding roasted barley. Roasted barley-flour mixed with sugar is the *sattu*, so much relished by the people in the

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[9]Vishnu-Mittre, Palaeobotanical evidence in India, in *Evolutionary Studies in World Crops—Diversity and Change in the Indian Subcontinent* (Ed. Sir Joseph Hutchinson), pp. 18, 19

[10]Bakshi, J.S. and Rana, R.S. Barley, in *Evolutionary Studies in World Crops—Diversity and Change in the Indian Subcontinent* (Ed. Sir Joseph Hutchinson), pp. 47, 48

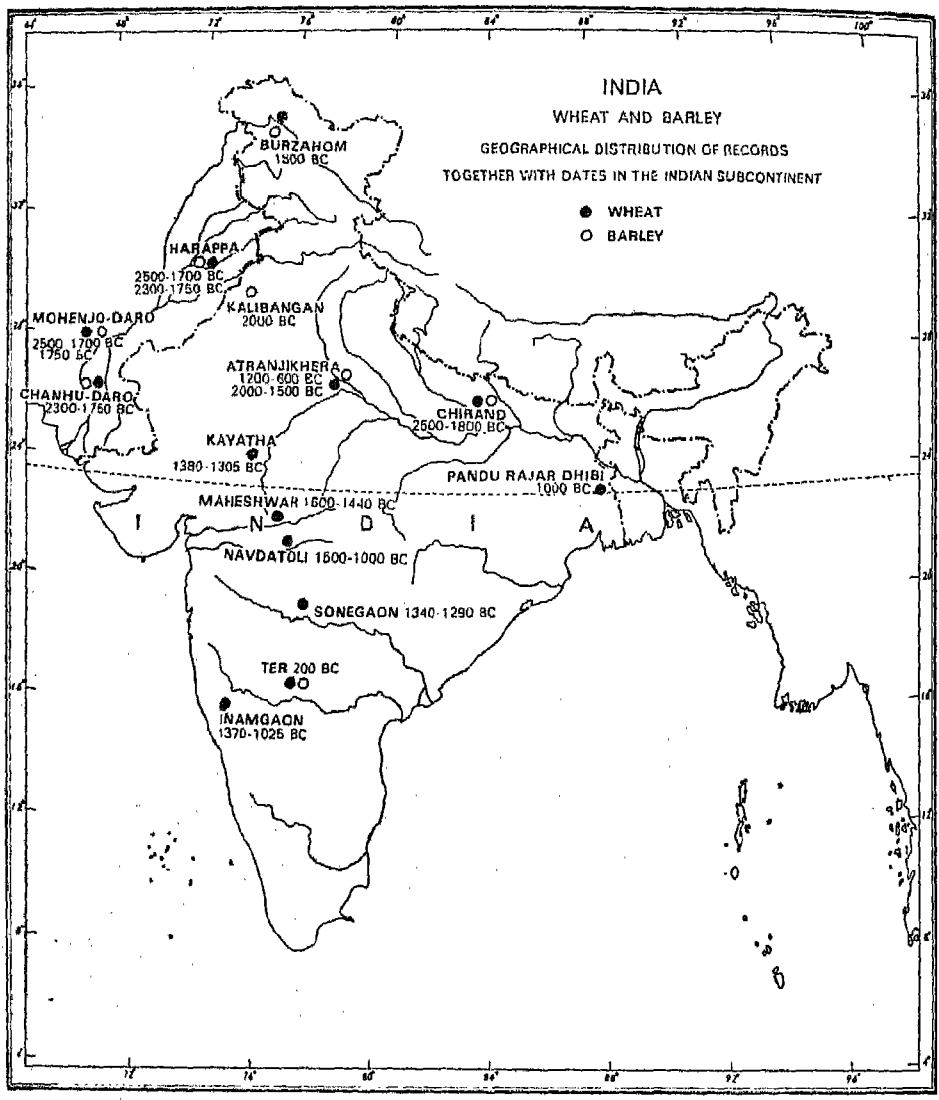

Fig. 75. Geographical distribution of wheat and barley, together with dates, in the Indian subcontinent
(After Vishnu-Mittre)

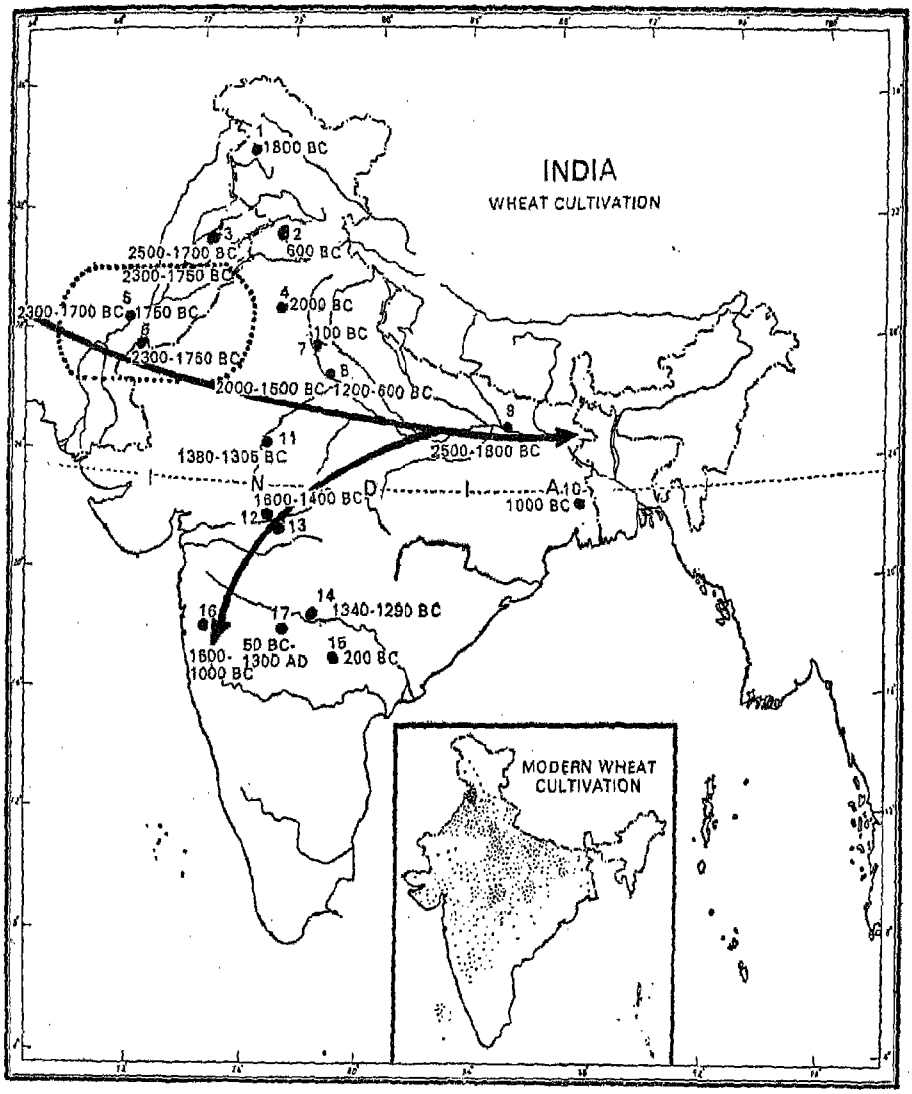

Fig. 76. Wheat cultivation in the Neolithic period and in the present age (After Vishnu-Mittre)

Himalayas.

Gram (*Cicer arietinum*). Gram (or *chana*, as it is called in Hindi) is the most important of Indian pulses. It is grown in the arid areas of the Punjab, Haryana, Rajasthan, Bihar, Uttar Pradesh, Gujarat, and Madhya Pradesh.

Carbonized grains of gram have been recovered from Kalibangan, a Harappan site in Rajasthan (Fig. 87, *top*)

Thus we find that all the three major food crops of north-western India, viz. wheat, barley and gram, were cultivated by the Harappans. It is in this very area that they achieved dominance in the cropping system in due course (Fig. 75).

According to van der Maesen[11], there are 35 wild species of *Cicer* in central and western Asia, one species being endemic in Greece, one in Ethiopia and one in Morocco. *Cicer arietinum* (*chana*) is widely cultivated in the Indian subcontinent, Iran, central Asia, the Mediterranean countries and Ethiopia (Fig. 77). It has also been introduced into Mexico, Peru and Chile.

The chickpea (*chana*) is one of the oldest and most widely used grains in the Middle and Far East. In the immediate vicinity of cultivated chickpea, especially in Turkey and Syria, wild relatives occur, although not in abundance. In Iran and Afghanistan, the wild relatives are distinguished from the cultivated species by differences in morphological characteristics and the altitude at which they grow.

The earliest-known occurrence of chickpea and a specimen, probably belonging to a wild species of *Cicer*, were reported from the Hacilar site near Burdur in Turkey. The deposits in these layers were dated by using the ^{14}C method to about 5450 years B.C. (Helbaek, 1970). For later millennia (*c.* 3300 B.C. onwards during the Bronze Age) the proof of its cultivation was found in Iraq and at Jericho. The late Bronze Age specimens of chickpea were discovered stored in large vessels in Crete. In India the introduction of chickpea may be attributed to the Harappans, who were the earliest to cultivate it.

Peas (*Pisum sativum* var. *arvense*). Vats (1940) discovered seeds of peas (*Pisum sativum* var. *arvense*) from Harappa.

Sesame (*til*). Historical, philological, botanical and ethnographical evidences suggest the possibility of an independent origin of agriculture in Africa in the area near the headwaters of the Niger River. Murdock believes that the Mande people who inhabited this area were the first to domesticate sesame.[12] Botanical evidence also suggests that sesame origi-

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[11]van der Maesen, L.J.G. Cicer *L., A Monograph of the Genus, with special reference to the Chickpea* (Cicer arietinum *L.*), *its Ecology and Cultivation*, pp. 1, 2 and 11

[12]Murdock, G.P. *Africa : Its People and their Culture History*, Edgar Anderson, in *Evolution after Darwin*

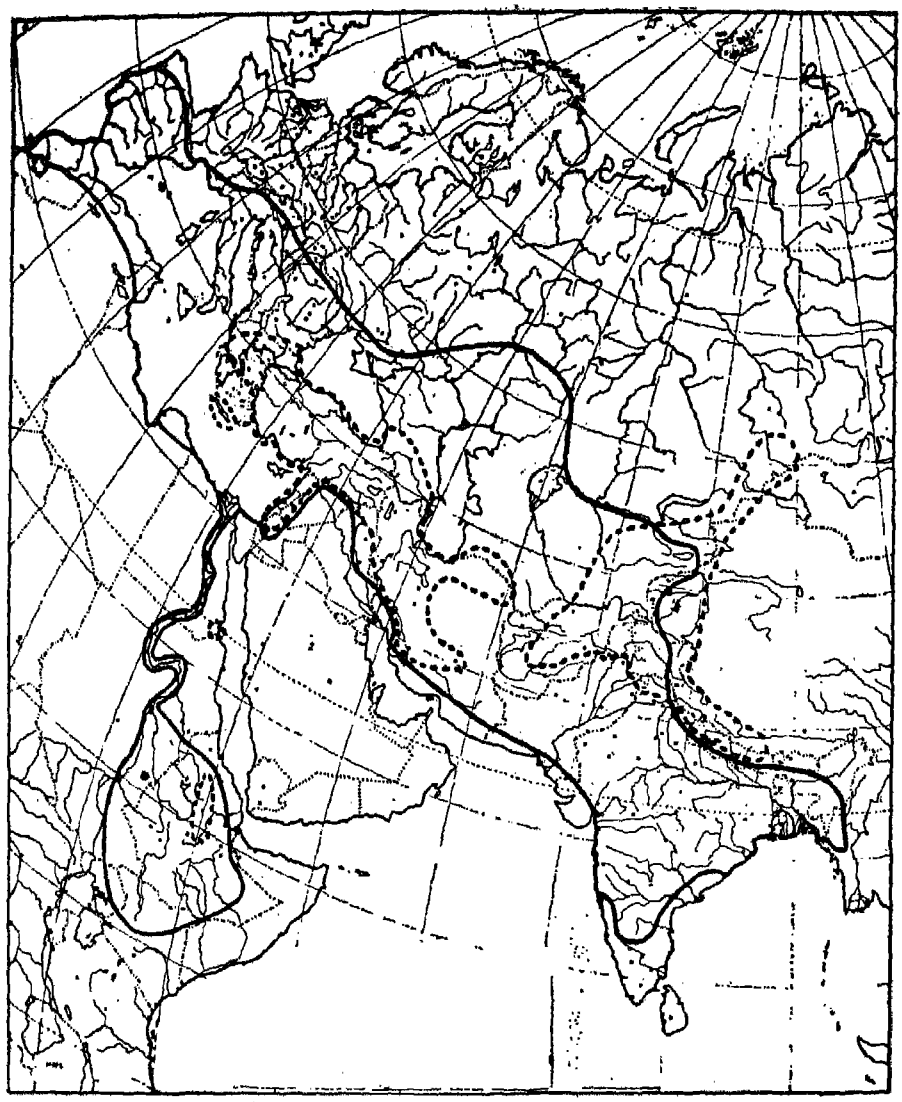

Fig. 77. Distribution of the genus *Cicer* and the main areas of cultivation of *C. arietinum* in the Old World. The dotted line encloses the areas where the species of genus *Cicer* are found. The continuous line encloses the areas where *C. arietinum* is cultivated
(After L.J.G. van der Maesen)

nated in Africa.[13]

The recovery of a lump of charred sesame by Vats at Harappa suggests that it was cultivated by the Indus Valley people. They are likely to have received it from Africa direct or via Mesopotamia. Botanical evidence shows an early spread of sesame from Africa to India via the Sabaean Lane.[14]

In Sumer, sesame was frequently mentioned as Se-gis-mi in the clay tablets, beginning from the third dynasty of Ur. It was perhaps introduced there directly from Africa. Both Lothal and Mohenjo-daro people had trade relations with the Sumerians and this might have led to the introduction of sesame. Once grown in India, sesame entered the Indian diet and cookery to such an extent that we hardly feel that it came from Africa. From India it spread to China.

Rape. The Brassicas cultivated in India are of the oleiferous types, belonging to two species, *Brassica campestris* and *B. juncea*. *B. campestris* has given rise in India to three distinct cultivars: brown *sarson*, yellow *sarson* and *toria*. They are cultivated in rather distinct ecogeographical areas, and may be regarded as ecotypes. Collectively, they are known in India as rape, and they constitute an important oilseed crop. *B. juncea* is more vigorous, and is an important oilseed crop. It is known in India as mustard.

B. campestris occurs wild as a weed from western Europe to eastern China. The Indian rapes fall geographically midway in the vast geographical distribution of the species. The wild, unspecialized primitive rape became a weed of cultivation, and gave rise to a range of cultivars as a result of three different types of selection in the three main regions of its habitat. In the West, selection for root development gave rise to the turnip. In the Far East, selection for leafy vegetables yielded the great diversity of Chinese cabbages that are classified as *B. pekinensis* and *B. chinensis* (Herklots, 1972). In the mid-region, in India, selection for oil content gave the three oleiferous races, brown and yellow *sarson* and *toria*. All these types are cross-compatible and they belong, in Harberd's terms, to the same cytodeme. The Indian oleiferous group appears to have been developed by the differentiation of the brown *sarson* stock. According to Russian workers, and also according to Singh (1958), eastern Afghanistan and the adjoining areas of Pakistan and north-western India may be regarded as its centre of origin. From this centre, yellow *sarson* arose through the selection of the yellow-seeded types that were considered to be of superior quality. *Toria* arose in response to selection for adaptability to the

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[13]Joshi, A.B. *Sesamum*, ICAR

[14]Mehra, K.L. 'History of Sesame in India and its Cultural Significance', in *Vishveshvaranand Indological Journal*, Vol. V, Pt i

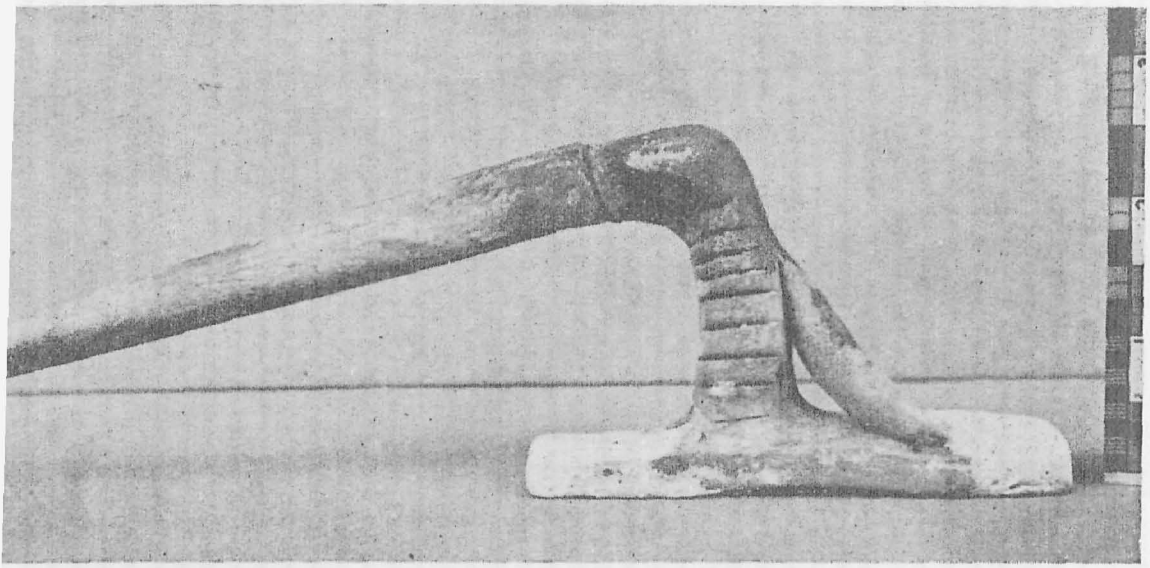


Fig. 78. Plough, terracotta, 7 × 19.7 cm. Mohenjo-daro, *c.* 2300 B.C.
(Courtesy : Prince of Wales Museum, Bombay)

Fig. 79. A seal from Lothal with a picture of a seed-drill
(After S.R. Rao)

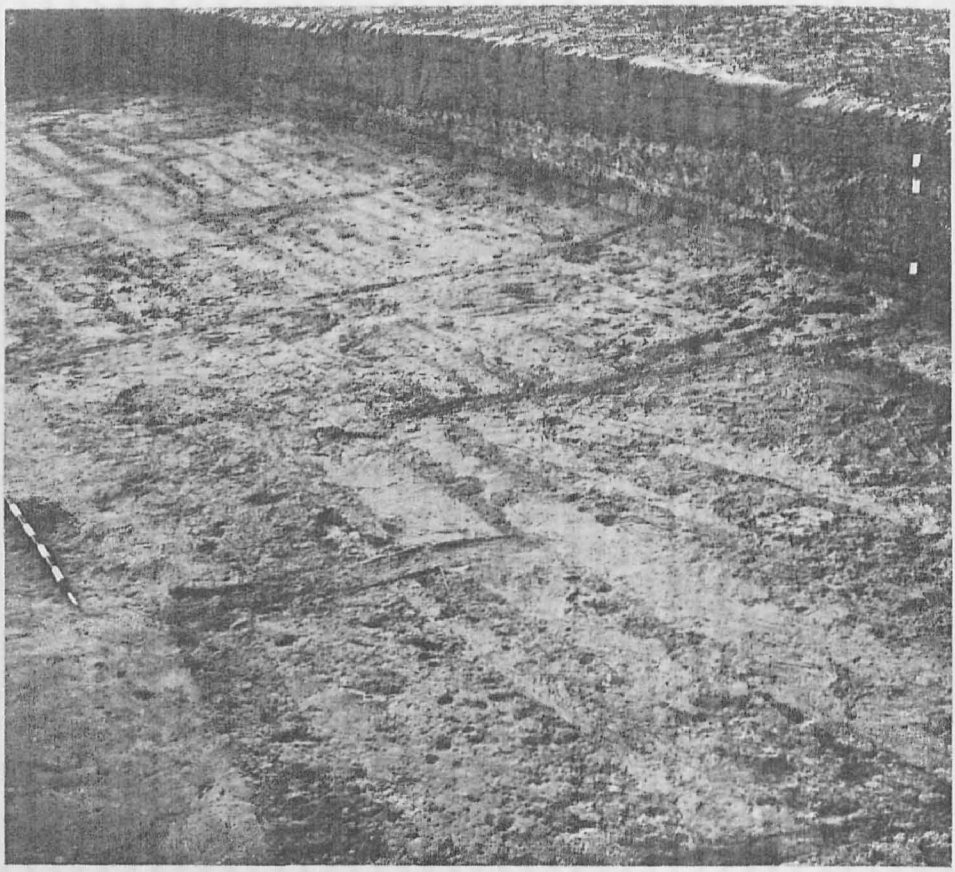


Fig. 80. Furrow marks of ploughed land on the southern side of KLB 2, Kalibangan, Rajasthan (*top*)
(Courtesy : Archaeological Survey of India)

The present-day method of ploughing (*bottom*) very much resembles the ancient one

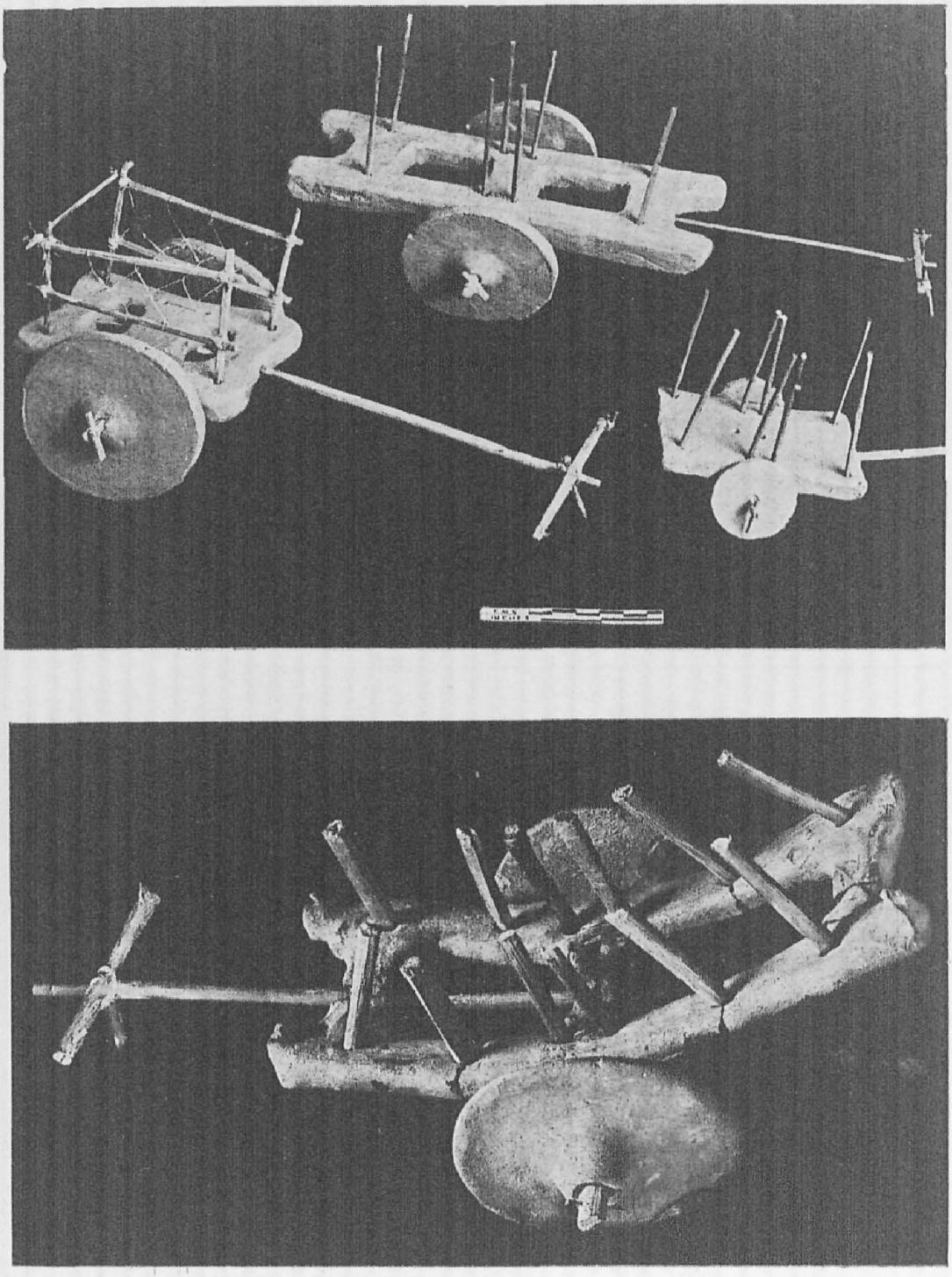
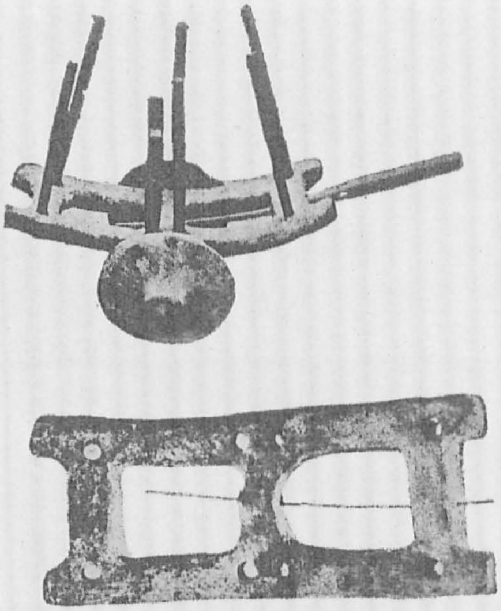


Fig. 81. Terracotta toy-carts from Lothal
(After S.R. Rao)



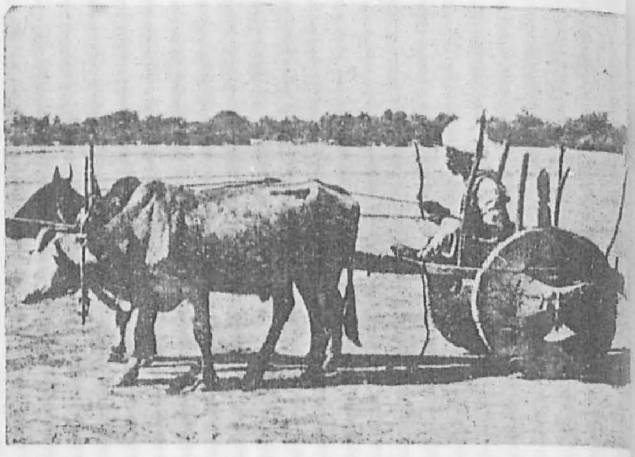


Fig. 82. A toy-cart from Harappa, with solid wheels (*left, top*), and frame of the toy-cart (*left, bottom*)
(Courtesy: Archaeological Survey of India)
The bullock-cart in the present-day Sind (*right*) is not far removed from the Harappan cart

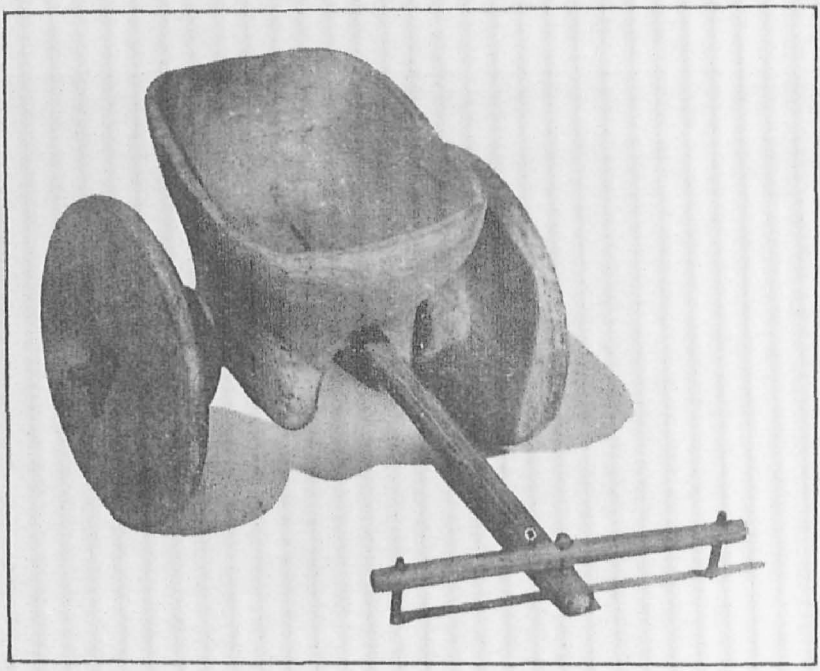


Fig. 83. A toy-cart from Mohenjo-daro. It was possibly used for carting manure
(Courtesy: National Museum, New Delhi)

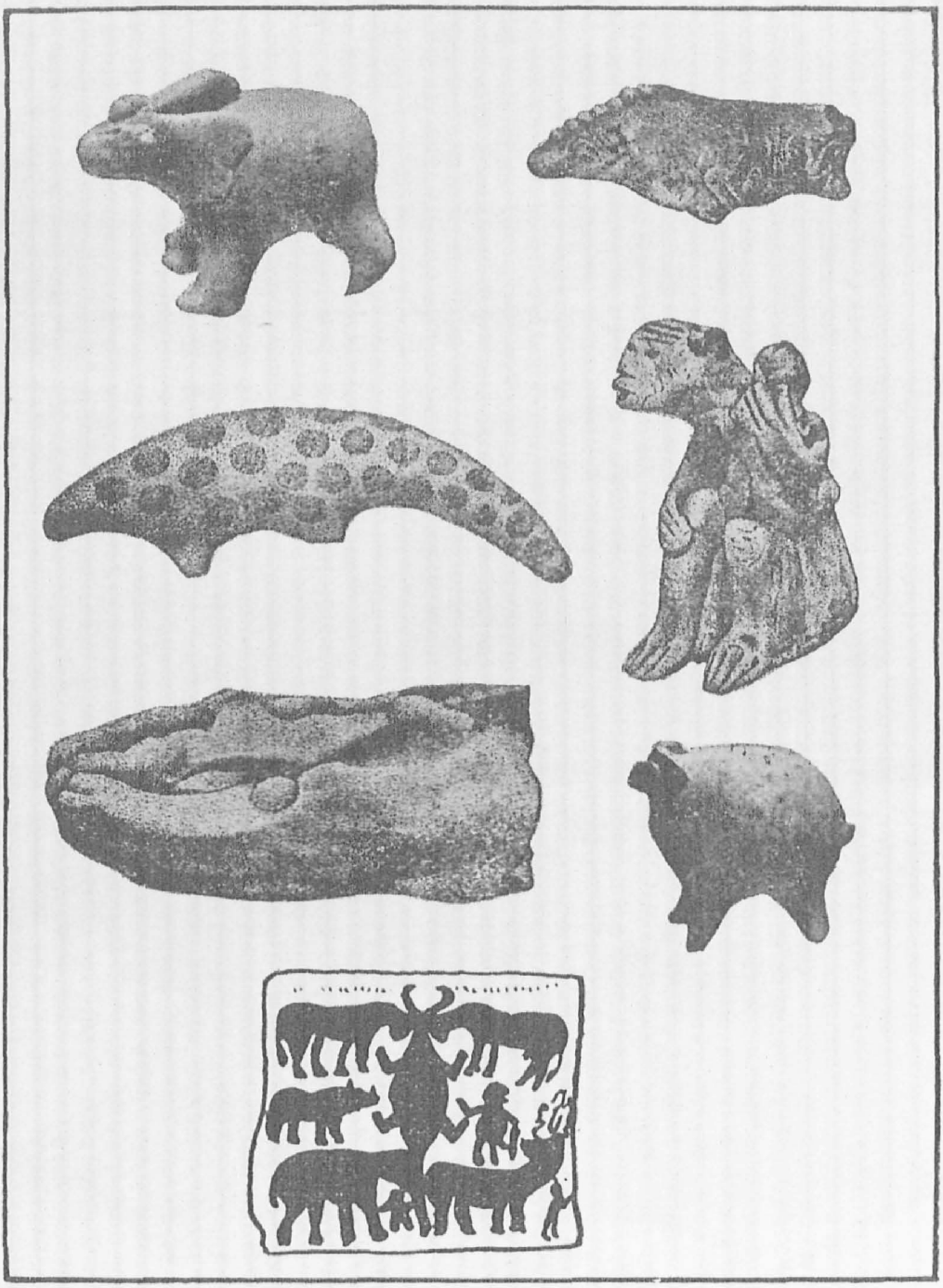


Fig. 84. Toys modelled on wild animals, depicting hare, tiger, pangolin, monkey, crocodile and wild boar
(After Mackay)

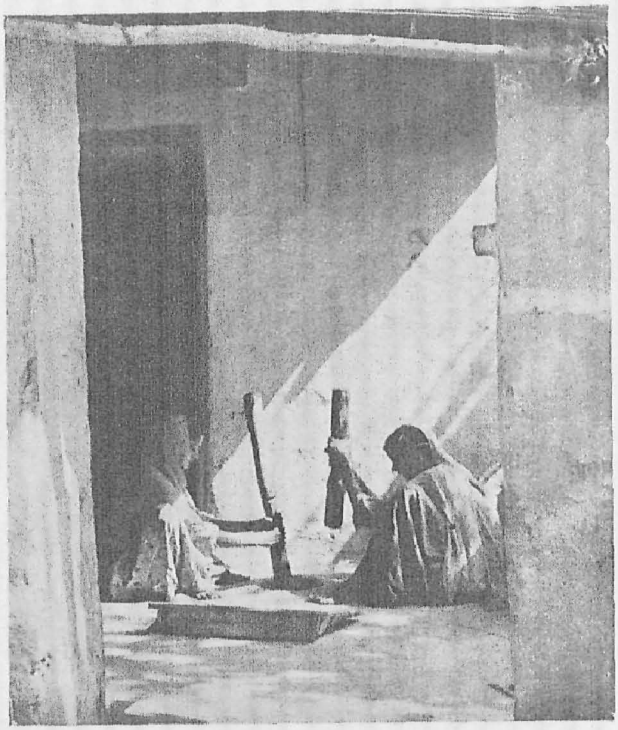
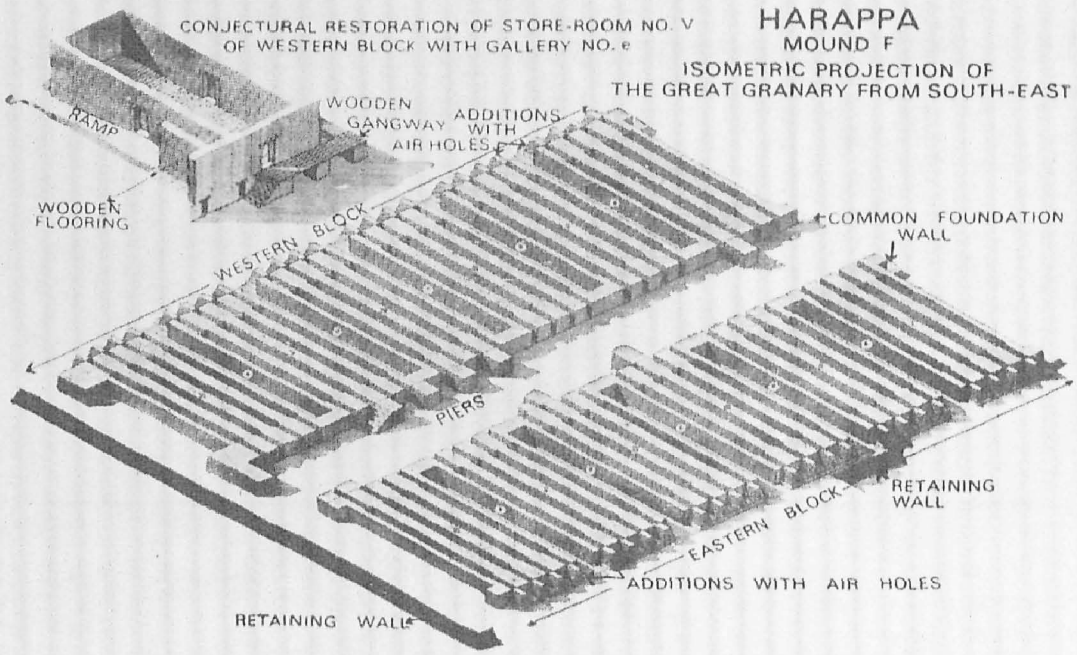


Fig. 85. Women pounding barley with wooden pestles in a village home in Haryana. The stone mortar is embedded in the floor. In the foreground is a *chhaj* for winnowing husk. (Courtesy: H. K. Gorkha, Indian Agricultural Research Institute)

Fig. 86. Isometric projections of the great granary, Harappa (Courtesy: Archaeological Survey of India)



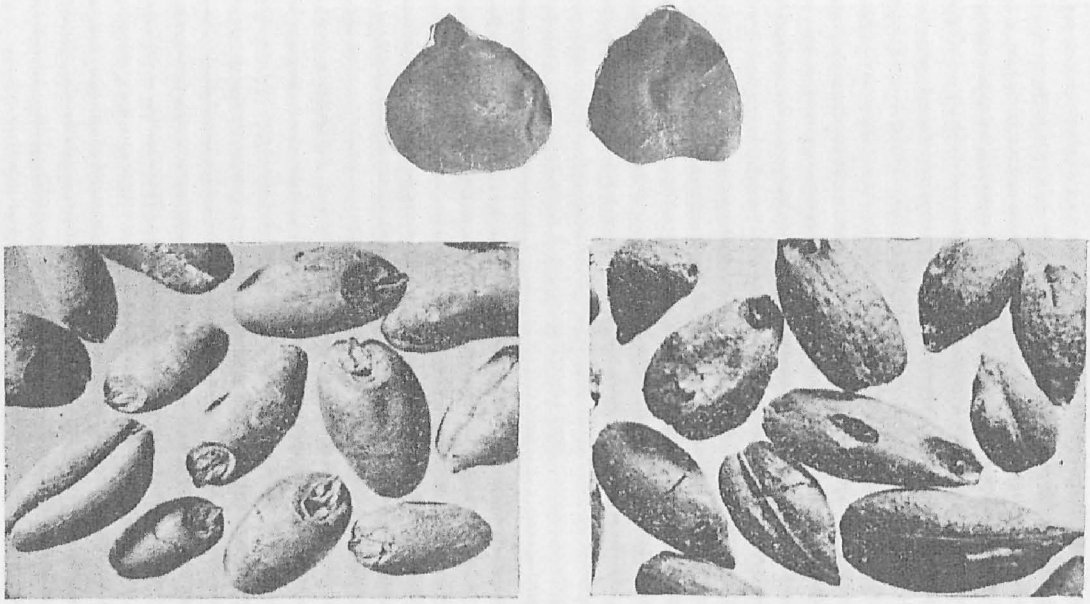


Fig. 87. Carbonized grains of *Cicer arietinum* from a Harappan site, Kalibangan, Rajasthan (*top*). Carbonized grains of *Triticum sphaerococcum* from a Harappan site, Mohenjo-daro, Sind (*bottom, left*). Carbonized grains of *Hordeum* sp., from a Harappan site, Kalibangan, Rajasthan (*bottom, right*)
(After Vishnu-Mittre)

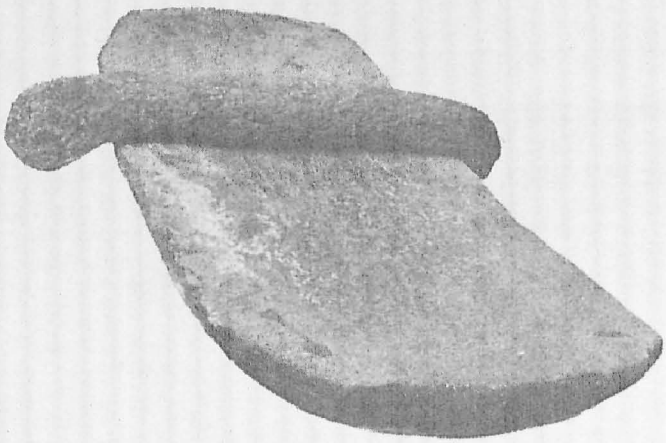


Fig. 88. A saddle-quern recovered from a Harappan settlement, Sector 17, Chandigarh, *c.* 2200 B.C.
(Courtesy : Museum of Rural Life of the Punjab, Punjab Agricultural University, Ludhiana)

Fig. 89. A terracotta from Mohenjo-daro, showing a woman kneading flour
(Courtesy : National Museum, New Delhi)

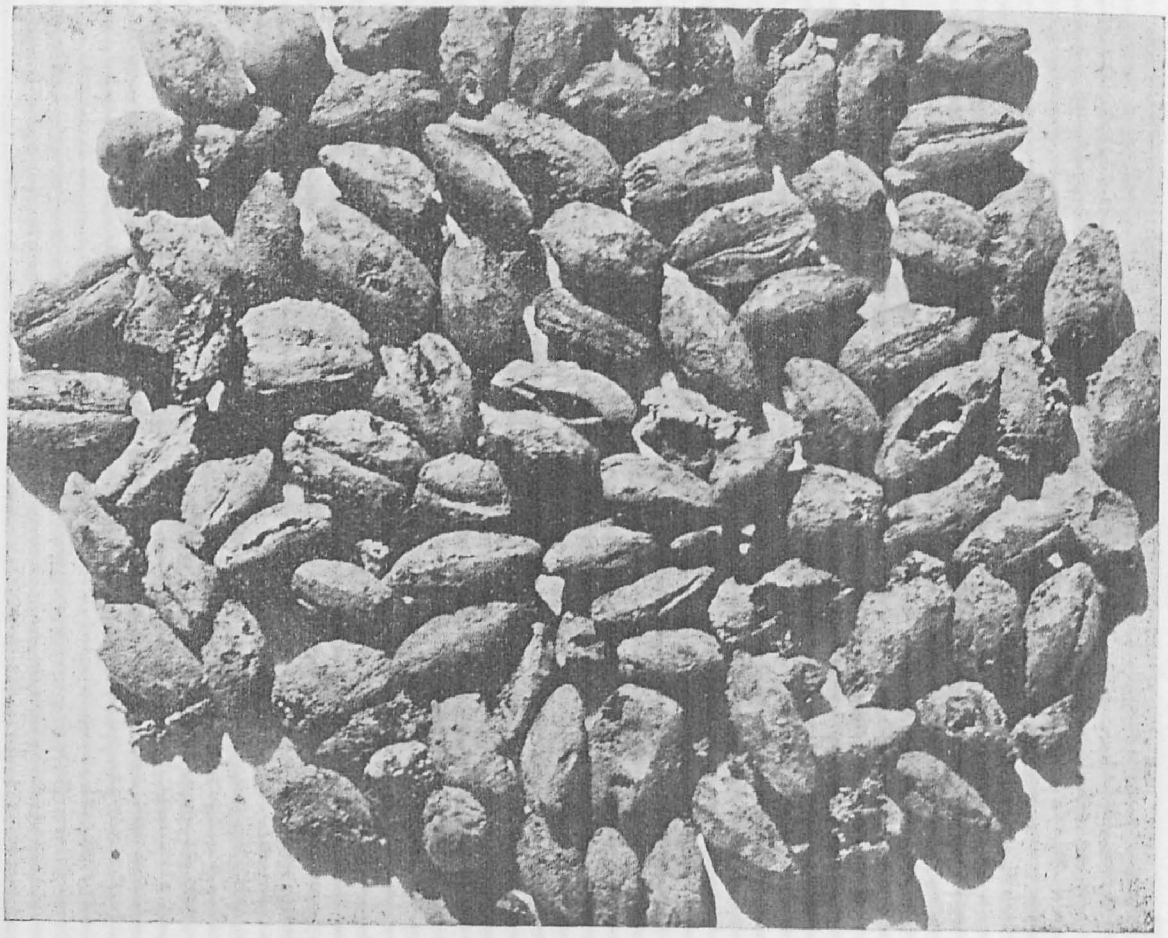


Fig. 90. Carbonized wheat grains from Mohenjo-daro dated to 1755 B.C. by ^{14}C method. They compare with those of *Triticum sphaerococcum*
(Courtesy: Genetics Museum, Indian Agricultural Research Institute, New Delhi)

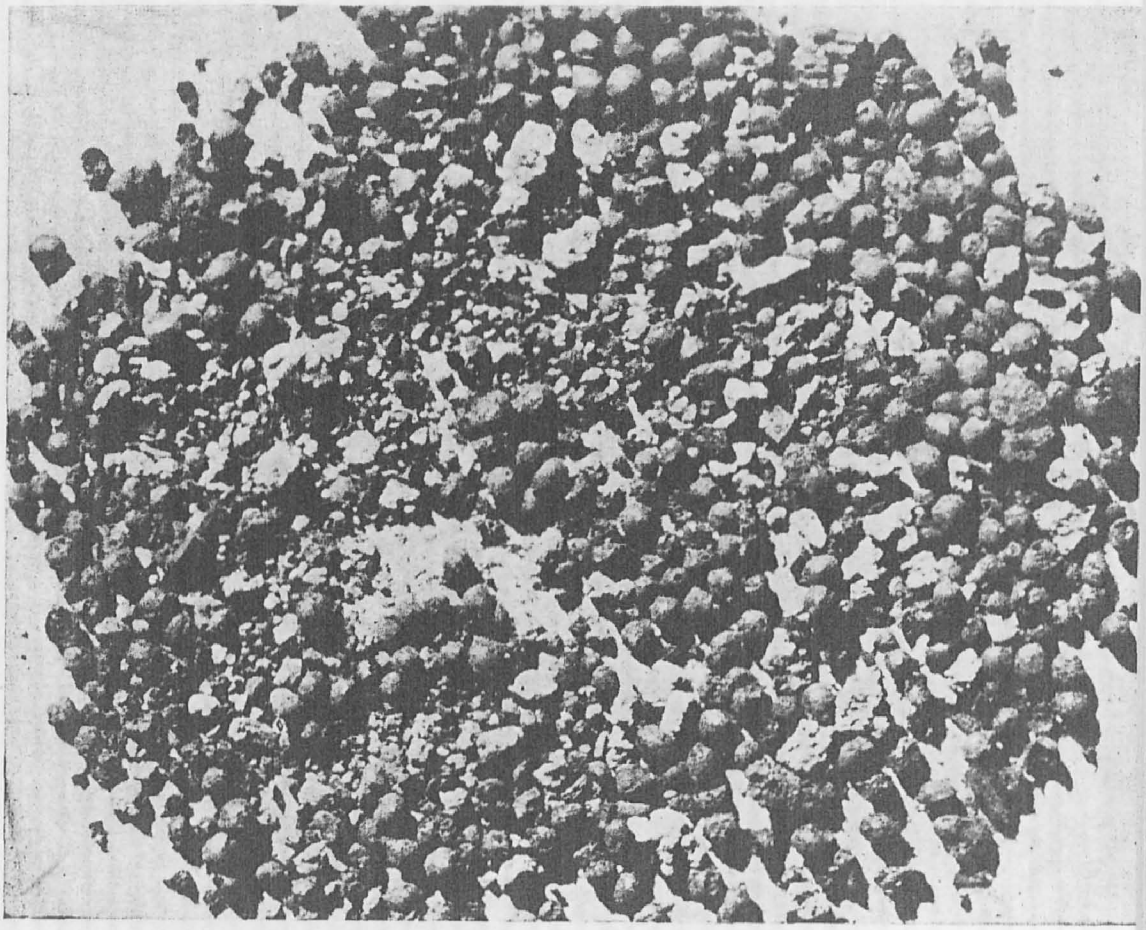


Fig. 91. Seeds of mustard from Chanhu-daro, Sind
(Courtesy: Genetics Museum, Indian Agricultural Research Institute, New Delhi)

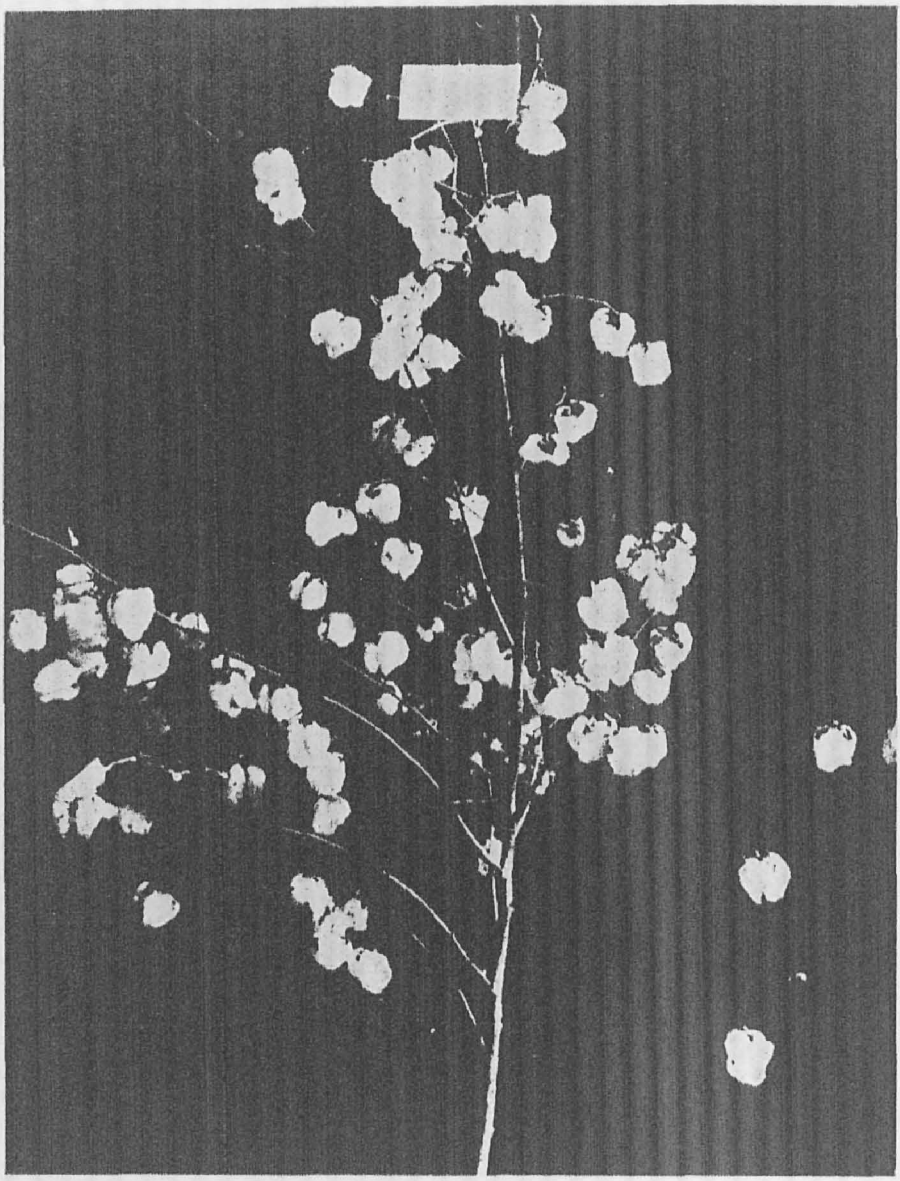


Fig. 92. A plant of *Gossypium arboreum* with open bolls. This cotton plant was known to the Harappans
(Courtesy: Indian Agricultural Research Institute, New Delhi)

ecological situations of Bengal, Bihar, Orissa, Uttar Pradesh and the Punjab.[15]

Sarson oil is used in India for cooking. It is also used for massage, and it is believed to strengthen the skin and to keep it cool and healthy. With camphor it forms an efficacious embrocation in cases of muscular rheumatism, stiff neck, etc. The oil is used for lighting, and the oilcake is a favourite cattle feed. The seeds mixed with hot water form an efficient counter-irritant poultice. The tender leaves and shoots are relished as *sāg*, a favourite food of the Punjabis.

The seeds of *Brassica juncea* have been recovered from Chanhu-daro, a Harappan site in Sind. A sample of it is preserved in the Genetics Museum of the Indian Agricultural Research Institure, New Delhi (Fig. 91).

The Harappans at Surkotada in Kutch had found diverse uses of the seeds of several kinds of grasses, sedges, cheno-amaranths, portulacas, and polygonums, perhaps for medicinal purposes or to feed the birds (Vishnu-Mittre and Savithri, 1973-74; Savithri, 1976).

COTTON

The Indus Valley civilization is the earliest to have spun and woven cottons. The Babylonian and Greek names for cotton, *Sindhu* and *Sindon*, respectively, point to the Indus Valley as the home of cotton. A statuette of a man from Mohenjo-daro shows him wearing textiles (Fig. 63). The first sample of cotton material was a small fragment of cloth found by D.R. Sahni from Mohenjo-daro. It was found clinging to the side of a silver vase, and was dyed red with madder. Its preservation was due to a fortunate accident, viz. the formation of silver salts from the silver of the vase. Turner and Gulati, of the Technological Laboratory of the Indian Central Cotton Committee, who examined the sample, concluded that it was undoubtedly made of cotton fibre, the typical convoluted structure of cotton being plainly visible. Another sample was received from Mohenjo-daro, viz. small pieces of string found attached to some pottery. The string was found to be 24-fold cotton yarn. The fibre-weight, the number of convolutions, the ribbon-width and the fibre-rigidity of the sample were strikingly similar to those of the coarse Indian cottons of the *arboreum*, *herbaceum* and *indicum* types. Turner and Gulati concluded that this early coarse cotton had been produced from a plant closely related to one of Watt's *arboreum* types.

In *Gossypium arboreum*, commonly known as the *desi* cotton, wild and weedy types have been recorded from Kathiawar, Gujarat, Khandesh and the Deccan. They are perennial, and are hence known as tree-cottons. In

[15]Narain, A. Rape and mustard, in *Evolutionary Studies in World Crops—Diversity and Change in the Indian Subcontinent* (Ed. Sir Joseph Hutchinson), pp. 67, 68

G. herbaceum, wild and weedy types are known from the coastal strip to the north-west of Karachi, through northern Baluchistan to south Yemen, Ethiopia and the Sudan, and even to western Africa to the south of the Sahara.

The perennial forms of *Gossypium herbaceum* race *accrifolium* and the perennial forms of *Gossypium herbaceum* race *indicum* are morphologically very much alike, except for differences in their fruiting parts. Genetically also, *Gossypium herbaceum* and *Gossypium arboreum* are very close.

In *Gossypium arboreum*, two types of perennial cotton were collected by Watt (1907). One of these groups of perennial cotton belonged to the race *indicum* of peninsular India. They were considered to be one of the primitive perennial forms. The so-called Rozi cottons are the cultivated forms of this perennial cotton. All the annual forms of *Gossypium arboreum* cultivated at present are the derivatives of these *indicum* perennials.

The other perennial forms of this species belonged to the race *burmanicum* distributed in Assam and Burma.

The Harappans not only grew cotton, but also devised methods of ginning, spinning and weaving it into cloth. Considering the age when it was achieved, it was a great technological advance.

Cotton cloth seems to be the Harappans' main export to Mesopotamia. From the Mesopotamians they got woollen garments and silver in exchange. The Indus civilization had boats with sails. A terracotta amulet from Mohenjo-daro shows a boat with two birds known as *Dishakaka*. Sailors in those days slowly sailed, hugging the coast-line, and they usually carried shore-sighting birds, e.g. crows, doves and swallows. 'When the ship was out of sight of land, they would set the shore-sighting bird free and it would go to the East, to the South, to the West and to the North and to the intermediate points and rise aloft. If on the horizon it caught sight of land, thither it would go. But if not, it would return to the ship.'[16]

FRUITS

Date-palm (*Phoenix sylvestris*). Two faience sealings, shaped like a date seed, suggest the familiarity of the people of Harappa with the date-palm (Vats, 1940).

Lotus, Pomegranate, Lemon and Coconut. There is a representation of lotus fruit in toys from Harappa. Earthenware vases shaped like a pomegranate and a coconut suggest that these fruits were known to the people of Harappa. A pendant shaped like a lemon leaf suggests its presence at Harappa (Vats, 1940).

Melon. A few vestiges of seeds comparable with those of melon are

[16]Srivastava, B. *Dishakaka* on a terracotta amulet from Mohenjo-daro, *Indian Inst. Adv. Studies, Seminar*, Simla, Nov. 1977

known from Harappa. The seeds were too brittle to be lifted up (Vats, 1940).

INCREASE IN POPULATION

Technological innovations which lead to an increase in food production and its secure supply also result in an increase in population. More people are required for agriculture than for hunting and fishing. Kosambi estimates that the most efficient hunting and food-gathering can hardly support one person per square kilometre, pastoral life can support three, but agriculture about a hundred.

Grahame Clark estimates the population of England and Wales at 250 human beings in upper Palaeolithic, 4,500 in Mesolithic, 20,000 in the Neolithic, and about 40,000 in the second millennium B.C. during the Bronze Age. No estimates are available for India, but there is no doubt that in the Harappan area the new techniques of plough cultivation and irrigated farming led to a substantial increase in population.

USE OF WOOD AND DEFORESTATION

Here, a reference may be made to the use of wood by the Harappans. The oldest record of the use of wood, in the Indian region, is from Harappa proper and from the sites of Harappan culture in Gujarat. At Harappa, deodar (*Cedrus deodara*) and rosewood (*Dalbergia latifolia*) were used for coffins. Other wood remains found at Harappa were of a wooden mortar (*Ziziphus mauritiana*; syn. *Z. jujuba*) for pounding grains. The Harappans in Kutch used timber of *Tamarix*, *Albizzia*, teak, *Pterocarpus santalinus*, *Soymida febrifuga* and *Adina cordifolia*, possibly for agricultural implements, carts, axles, axe handles, oil presses, grain-pounders, turnery, tanning and dyeing and for fuel (Savithri, 1976). The choice of these woods for specific purposes shows not only the knowledge of where the trees grow but also of the characteristic qualities of the woods used. The charred timbers recovered from Lothal in Gujarat were *Acacia* sp., *Albizzia* sp., *Tectona grandis*, *Adina cordifolia* and *Soymida febrifuga*.

According to Wheeler, one of the major factors of the decline and fall of the Harappan culture was the widespread deforestation of the surrounding region to meet the demands of firewood for baking millions of bricks used for the building of the city of Mohenjo-daro. Large-scale use of wood for baking pottery, smelting metals, and as domestic fuel further depleted the forests. The building of houses and ships also made demands on the forest reserves. The clearing of land for cultivation and grazing by domestic animals were other biotic factors which led to the destruction of vegetation. This is how man pays the price of cultural advance and civilization. Eastward shifts of the edge of the south-western monsoon has been suggested by Piggott as the cause of increasing aridity. The final

blow was, in all likelihood, delivered by the energetic Aryan nomads who massacred the inhabitants. On the topmost level of the city, skeletons of men, women and children, bearing axe or sword cuts, have been discovered. Though the Harappan cities were destroyed by the invaders, the achievements of the Harappan culture, viz. the use of copper and bronze, pottery, the plough, the bullock-cart and irrigated farming were adopted by the Aryans.

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CHAPTER 14

DOMESTIC ANIMALS OF THE HARAPPANS AND POULTRY AND FISH

On the seals from Harappan sites are depicted contemporary wild and domesticated animals whose actual remains in the form of bones have also been recovered from the excavations. The inference from the fauna is that the climate was more humid. It provided an environment for the rhinoceros, the tiger, the water-buffalo, the *sambhar*, and the elephant to thrive, none of which now exists in wild form in the region. Domestic animals included humped bull (*Bos indicus*), Indian buffalo (*Bubalus bubalis*), goat (*Capra hircus*), sheep (*Ovis orientalis*), pig (*Sus scrofa cristatus*), one-humped Indian camel (*Camelus dromedarius*), ass (*Equus asinus*), and at least two types of dog, one referable to the modern pariah-dog, *Canis tenggeranus harappenis*, and the other to a mastiff type. The cat from Harappa (*Felis ocreata* r. *domestica*) resembled the common European domestic cat in appearance.

The domestication of animals is closely linked with agriculture. The development of animal husbandry without crop-raising is impossible. This fact is proved from archaeological excavations which show that animal husbandry and agriculture occur together. The large ruminants, such as cattle and buffalo, possibly came as crop-robbers to the fields of the farmers of the river-civilization of Sind and the Punjab in the pre-Harappan phase. They were captured by the farmers and ended up as domesticated beasts in their pens. The pig is also a crop-robber, and even now it is a pest in sugarcane fields in northern India.

There is a close link of vegetation, animals, and man. Domesticated animals provide man with food in the shape of meat and milk and power. Their power value was probably more important than their food value, and the degree of development of an ancient civilization is closely related to the relative efficiency of the domesticated animals available in the country concerned. The Red Indians of North America and the aborigines of Australia had no other animal available to them than the dog, and hence they remained in a primitive hunting stage for centuries when others had gone far ahead. The Indians of Mexico, Central America, Peru and Bolivia domesticated the llama and alpaca for transport and developed a much higher type of civilization, the Maya culture, as compared with their kinsmen in North America. However, there were no draught animals in the Americas, and their agriculture was ploughless. They depended upon the use of spades and digging sticks for the cultivation of crops. Bullocks, asses, elephants, horses and camels are more efficient than llamas and alpacas and hence the Mesopotamian, Egyptian, and Indian civilizations were

far ahead of the Meso-American civilization. Bullocks, baffaloes, asses, elephants, horses, goats, sheep, and camels have played a great role in the development of civilization in early stages. They provided animal power which supplemented the human muscle power, thus relieving man of drudgery, and providing him with surplus food, on account of which a leisure class arose which could think of higher things.

Mammals domesticated for draught, milk and meat are cattle, gaur, and the buffalo.

DOMESTIC ANIMALS

Seals and clay toys from Mohenjo-daro depict a variety of domesticated cattle. It is noteworthy that only bulls are depicted on the seals and not cows. Out of these, the most prominent is a zebu, with an enormous dewlap with folds (Fig. 94, *middle row, left*). Out of the present-day breeds, it resembles the Kankrej, which is found in the Tharparkar District in Sind, and also in Gujarat (Fig. 95, *bottom*). Kankrej is the heaviest of Indian breeds, with a powerful body, a broad chest, and a well-developed hump. The skin of the males is silver grey, iron grey or even black. The dewlap is well developed and the sheath is pendulous. The forehead is broad, and horns are curved and covered with skin to a comparatively higher point. Bullocks are powerful draught animals, and cows are fairly good milkers. A silver grey Kankrej bull and a cow from Kathiawar are shown in Fig. 96. The animals are grey and their horns are enormous. It is interesting to note the survival of an ancient breed from Mohenjo-daro down to the present in India and Pakistan.

There is a toy depicting a humped bull, with short thick horns (Fig. 94, *bottom row, middle*). It resembles the Red Sindhi bull (Fig. 99, *top*).

There is a humpless bull with moderately curved horns and a strong neck with folds (Fig. 94, *top row, left*). It greatly resembles the gaur (*Bos gaurus*), which is even now found in the jungles of Madhya Pradesh, north of the Narmada River (Fig. 97, *bottom*). It has no dewlap. The bull shown in the seal also resembles the Maithon (Mithun) found in Assam, which does not have a hump or a dewlap.

There is another variety of a humpless bull, usually represented with a single horn which has been unfortunately nicknamed unicorn (Fig. 94, *middle row, centre right*). There are many seals which show this breed. In fact, 312 seals out of 387 excavated from Mohenjo-daro in the first exploration depict this animal. The largest number of seals from Lothal have the image of the urus bull. Only a few have the figure of the Kankrej zebu bull. Rao states, "Whereas no figure of cow was found at Harappa and Mohenjo-daro two specimens were recovered from Lothal. One of them has short forward-projecting horns and a low hump. The udders and genital organs are

clearly indicated."[1] Seals from Surkotada in Gujarat and Kalibangan in Rajasthan also bear the image of this animal. This indicates that it was a favourite animal of the Harappans and was found in Sind, Gujarat and Rajasthan. The head is drawn in a profile; that is why only one horn is shown. In some of the composite figures, two horns are shown. This animal has cloth-covering or a *jhul* on its back, and in front of it is an elaborate type of manger. These are some indications of domestication. It resembles *Bos primigenius*, or aurochs, as depicted in the caves of Lascaux, south-western France. The horns are forward-pointing, with tips slightly turned upwards. The aurochs from Pleistocene onwards was found in Europe, North Africa, Egypt, Palestine, Mesopotamia, Iran and Baluchistan. The European domesticated cattle are the descendants of *Bos primigenius*. Its domestication was undertaken before 4000 B.C. 'In the Siwaliks a *Bos acutifrons* occurs, which Pilgrim regards as the possible ancestor of the Pleistocene wild cattle, i.e. of both *Bos namadicus* of India and of *Bos primigenius* of Europe. An Asiatic origin of the group, according to Zeuner, is altogether likely since the aurochs is either very rare or altogether absent in the lower Pleistocene of Europe. It became fairly frequent in the Great Interglacial, but not abundant until after the end of the Ice Age. With no ancestral forms known from anywhere in Europe, this increase in the frequency of wild cattle looks very much like an invasion from elsewhere, attempted repeatedly and succeeding finally in the Holocene. By this time the species had spread as far west as Spain and Morocco and eastwards to China and Siberia'.[2]

The aurochs became extinct in Europe in the middle of the nineteenth century. Zeuner has reproduced a picture of an auroch published in1827 (Fig. 98, *bottom*). When we compare the aurochs from the caves of Lascaux, the seal of the so-called unicorn from Mohenjo-daro and the picture of the last surviving aurochs, no doubt is left that the bull shown in seals from Mohenjo-daro and other Harappan sites also represents aurochs (*Bos primigenius*).

The zebu is a characteristically Indian breed characterized by a prominent hump on the shoulder, a long face, upright horns, drooping ears, small brow-ridges, a dewlap and slender legs. Its colour varies from white to grey and black. The hump of the zebu is an enlarged muscle and not just a store of fat. The hump is a genetically fixed character already well developed in the calf at birth. Apart from the hump, in colour, voice and habits the zebu differs greatly from European cattle. Possibly, the zebu is a direct descendant of *Bos namadicus*, which was found wild in India throughout the Pleistocene.

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[1]Rao, S.R. *Lothal and the Indus Civilization*, p. 50
[2]Zeuner, F.E. *A History of Domesticated Animals*, p. 203

The earliest representation of zebu is in a rough figurine from the earlier Halafian period at Arpachiyah in northern Mesopotamia which dates back to 4500 B.C. Zeuner remarks, "That the oldest find should be Mesopotamian may be regarded as an archaeological accident, for subsequent ones point to India, and indeed have been regarded as evidence for Indian contacts with the Mesopotamian civilization."[3]

At Mundigak, in Afghanistan, humped bull figurines occur from period I onwards. Allchins remark that these figurines provide the earliest evidence so far of the domestication of *Bos indicus*.[4]

This also indicates that the domestication of zebu in Afghanistan, Sind and Baluchistan must have taken place as early as 4000 B.C.

Apart from seals, bones of cattle have been found in Mohenjo-daro. The presence of the bones of calves indicates that their flesh was eaten by the people of Mohenjo-daro.

"The very considerable frequency with which the remains of *Bos indicus* have been met with during the excavations indicates that the inhabitants of Mohenjo-daro at one stage or other of their history maintained large herds of this animal," observes Marshall. "In quite a large number of cases the teeth indicate that the animal from which they were derived was young; for instance, in the case of the third molars there has, in many cases, been but little wearing down of the tooth surface, while in a few instances this tooth has only just been erupted. This would appear to indicate that the inhabitants slaughtered these animals for food, and it is possible that this may also provide the explanation of the total absence in the collection of any complete long bone belonging to this species; probably such bones were split in order to obtain the marrow."[5]

It seems that the zebu cattle were originally domesticated in the mountainous regions of the Baluchistan and Afghanistan. Zebu cattle have aversion for water and never bathe in ponds, whereas the buffalo takes delight in wallowing in mud and swimming in ponds. The preference of the zebu for dry land and its aversion for water indicates its origin in a dry mountainous environment.

The domestication of zebu cattle in Afghanistan, Baluchistan and Sind was a most important step taken by man in the development of agriculture. The zebus can withstand high temperature, and are resistant to many tropical diseases. They have played a useful role in the development of the cattle population in the tropical areas of China, Indonesia, the Philippines, Africa, and recently in southern United States of America, Australia and Brazil (Fig. 93). In India alone there are 178.3 million zebu cattle. They

[3]Zeuner, F.E. *A History of Domesticated Animals*, p. 239
[4]Allchin, R. and B. *The Birth of Indian Civilization*, p. 258
[5]Marshall, J. *Mohenjo-daro and the Indus Civilization*, Vol. II, p. 669

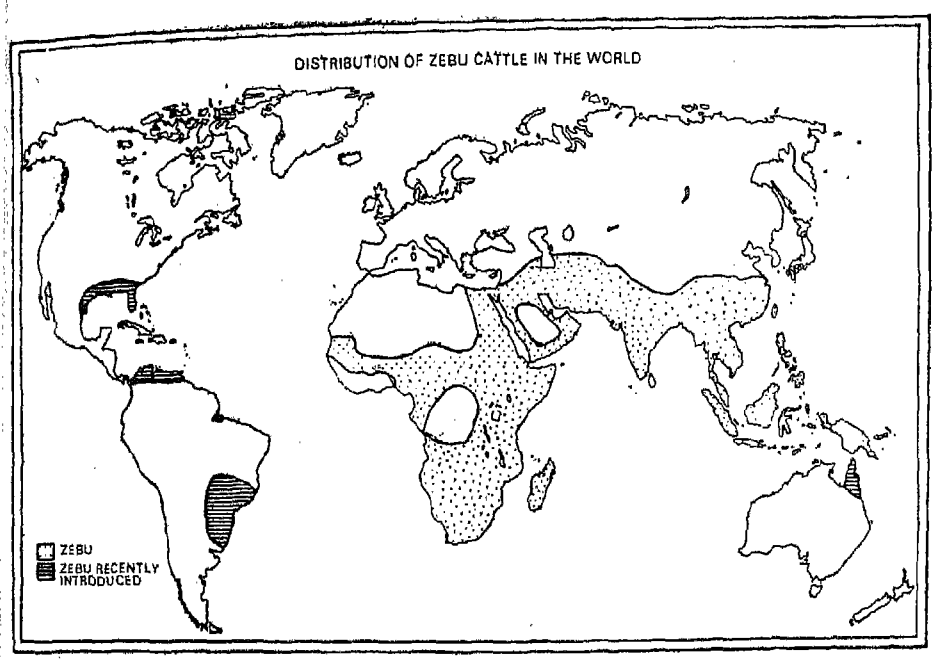

Fig. 93. Distribution of zebu cattle in the world. The home of the zebu cattle is the Indian subcontinent. It has been recently introduced into Brazil and the southern USA

provide draught for ploughing land, and for carting produce. They provide milk and meat for consumption of human beings. Their hides were used in the past for manufacturing shields as well as shoes. Their dung and urine are used as manure to fertilize the crops. As beasts of burden and of traction, they still play an important role in the agriculture of Asia. In the pre-agricultural phase, and in early agriculture, reliance was entirely on human muscle-power. The cattle relieved human beings of a great drudgery.

The Buffalo (*Bubalus bubalis*). Buffaloes belong to the order Artiodactyla, suborder Ruminantia, family Bovidae, tribe Bovini. Within the Bovini, Bohlken (1958) distinguishes three groups—Bovina (cattle), Bubalina (Asian buffalo) and Syncerina (African buffalo)—among which no interbreeding appears to be possible. The domestic buffalo was given the specific name *bubalis* by Linnaeus. According to Bohlken's terminology, it should be called *Bubalus arnee* forma *bubalis*.

The Indian buffalo is thinly haired; it is dark ashy grey, almost black. The legs are thick and short. It is of heavy build, and has large hoofs, a short tail, a large wide muzzle, and a long head, which is carried low. The neck

is short and thick, with the head set at the same level as the back and at a peculiar angle, indicating its water-dwelling habit. The forehead is flat, and the large and angulated horns are black. Two distinct types of horns—the one sharply and regularly curved, and the other extending straight outwards for a considerable distance—exist, these representing either distinct local races or dimorphic phases of the species. Horns are angular in section. A pale-brown variety occurs in Assam.

The buffalo generally reaches maturity at about three years, calves for the first time at about four years, and breeds up to 16 or 20 years of age, usually at intervals of about 16 to 18 months. The gestation period is 10½ months. The body temperature of the buffalo is normally lower than that of cattle and this lower temperature may account for its heat-tolerance coefficient.

According to Baini Prashad, the Indian buffalo is the lineal descendant of the gigantic *Bubalus palaeindicus* of the Pliocene, fossils of which have been recovered from the gravels of the Narmada and the topmost beds of the Siwaliks. With the remains of the extinct buffalo, *Bubalus palaeindicus*, stone implements were also found in the valleys of the Godavari and the Narmada by Rutimeyer, which shows that it was a contemporary of man.

In the Pleistocene Period, the genus *Bubalus* was widely distributed in Europe and southern Asia, as is evident from skeletal remains from some parts of Europe. When the climate became drier, it was restricted to India, Indochina and some of the south-east Asian islands. The European buffalo of today was reintroduced from the East in its domesticated form.

According to Duerst, *Bubalus palaeindicus* was hunted by ancient inhabitants of Iran and Mesopotamia about 3800 B.C., when Sargon ruled over Accad.

There are now three wild buffalo species in Asia which have appeared sufficiently distinct to attract individual names. These are the anoa of Celebes, the tamarao of Mindoro and the *arni* or Indian wild buffalo. Only the last has been domesticated. Duerst regards the anoa buffalo of Celebes, *Bos depressicornis*, as the most primitive buffalo which is connected with the Indian buffalo through the Mindoro buffalo, *Bos mindorensis*, of the Philippines. It is probable that the local varieties of buffalo were domesticated in different places where they were found. The present restriction of the Indian buffalo to the Oriental region is probably due to desiccation of north-western Asia.

The Indian wild buffalo, *Bubalus arnee*, receives its specific name from the Hindi *arni*, of which the masculine is *arna*. Its present distribution is northern India, and possibly also Sri Lanka and the region of Indochina. The *arni* lives in large herds in thick reeds, rushes or grass jungles; they are

closely bound to water (Fig.101) and spend much of the day in wallows[6].

As late as the beginning of the nineteenth century, wild buffaloes were common in the marshes and jungles of the Indian subcontinent, east of longitude 80° E, and north of the Godavari River, but excluding the Ganges plain itself. Their number has now been reduced by the spread of cultivation and consequent habitat destruction, together with hunting and disease, to some 1,400 in six isolated areas, chiefly reserves in Assam, a few herds in the Kosi River area of Nepal, and 400-500 in the Bastar District of southern Madhya Pradesh and the Koraput District of Orissa (Daniel and Grubh, 1966).

The wild buffalo is a very large animal, standing 150-170 cm at the shoulders, and it can reach 200 cm and a weight of nearly 1,000 kg. It is grey black, dark grey or dark brown; usually the muzzle and the legs below the knee are light grey, and there are distinctive white or grey chevron markings on the neck and above the brisket. The horns are very large and widely separated from each other at the base. They leave the skull sideways, forming an angle of about 130° with each other, and curve round in the shape of a sickle or in a crescent, with the tips pointing inwards (Fig. 101). There used to be a variety in Assam with long straight horns curved only at the tip (Fig. 104). The horns diverge little from the plane of the face; those of the female are more slender and often longer than those of the male. They average over 60 cm in length.[7]

The wild buffalo is found in Assam, Sunderbans, the Himalayan Tarai, Orissa and the Raipur District of Madhya Pradesh and in Sri Lanka. Blanford suspects that those from Sri Lanka are not truly wild, and are descendants of escaped animals. However, the long horns of the wild buffaloes of Assam indicate their authenticity as truly wild animals (Figs 101, 104). In a bronze toy showing a buffalo on wheels, from Daimabad, Ahmednagar District, Maharashtra, *c.* 1300 B.C., the horns retain their primitive character (Fig. 103). Long horns are still found in some of the inferior breeds, e.g. the Nagpuri buffalo (Fig. 102). The Surti buffalo also has long, spreading, thick horns which is, indeed, a primitive character (Fig. 100, *top*). The best breed of buffalo is the Murrah of the Punjab and Haryana, with curled horns and a capacious udder (Fig.100, *bottom*).

There are two well-defined ecological types of buffalo, namely swamp buffalo and the river buffalo. The swamp buffalo is the denizen of marshland, where it wallows in the mud and feeds on coarse marsh grass and reeds. These buffaloes sink up to their bellies in muddy water and

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[6]Mason, I.L. Species, Types and Breeds, in *The Husbandry and Health of the Domestic Buffalo* (Ed. W.R. Cockrill), pp. 1, 3, 5

[7]Mason, I.L. Species Types and Breeds, in *The Husbandry and Health of the Domestic Buffalo* (Ed. W.R. Cockrill) pp. 4, 5

cover their bodies with mud as a protection against sun and flies. They are also nocturnal. The river-type buffalo is the one found throughout India and Pakistan and prefers clean water—rivers, irrigation canals and ponds—in which to wallow. This type has been specially developed for milk production and is docile and easily managed. All the best milch breeds of India and Pakistan, e.g. Murrah and Nili, are river type.

Baini Prashad is of the opinion that one of the centres, if not the sole centre, of domestication of the buffalo in India was the Sind Valley. He has described a horn and some jaw-bones of the Indian buffalo from Harappa. The bones of the buffalo are less common than those of cattle, and at Mohenjo-daro appeared only in the upper levels. There are eight seals on which the buffalo is depicted. Out of these, a typical seal is shown in Fig. 94 (*top row, right*). The animal has long horns, as in the wild buffalo from Assam. From this evidence it seems that the Punjab and Sind are the home of the early domesticated buffalo.

Even at present the buffalo is more common than the cow in the Punjab and is valued more on account of its higher milk yield and its greater fat content which is more suitable for the preparation of *ghee*. It is a more efficient user of rough forage than cattle. Not being sacred, a certain amount of culling is possible. Its love for water betrays its original home in the swampy jungles of the Punjab and Sind. Even now in its wild form it is never found in the mountains. The buffalo has played an important role in the economy of ancient India, as the female gives plenty of milk and the male is ideal for transport and for ploughing muddy rice fields.

The Indian buffalo reached Indo-china, China and Japan quite early. In muddy rice fields of these countries, it found an ideal environment. Its westward spread was, however, slow. From Sind it reached Iran and Mesopotamia. The first record of it in the Jordan Valley was A.D. 723. From Iran, the buffalo reached southern Russia and the Balkan countries. It seems likely that the buffaloes were brought back to their European homes by the Crusaders. About A.D. 1200, Bulgaria and Macedonia had buffaloes in plenty. From Bulgaria they spread to Italy, and Hungary, which marks their northernmost outpost. At the end of the thirteenth century, buffaloes were present in the Pontine marshes of Italy. Buffalo population is steadily increasing. Recently, it has found a new home in northern Australia, southern USA, and the Amazon Valley of South America.

Out of the total world population of buffaloes (1971), which has been estimated at 140 million, India has 57.4 million, China 30 million and Pakistan 12.1 million . Out of the Indian breeds, the best is the Murrah (Fig. 100, *bottom*). Its breeding area is Haryana. The skin and the hair are black in Murrah, and the horns are curled into a spiral. The ears are small,

thin and pendulous; the legs are short and straight, with black hoofs. The barrel is massive and well developed. The udder is well developed with a prominent zigzag milk vein. The teats are long and well spaced. The females weigh up to 900 kg.

Another good breed is Nili-Ravi found in the Montgomery and Multan districts of the Punjab (Pakistan), and in the Fazilka Tehsil of the Ferozepur District of the Punjab (India). It resembles the Murrah in the colour of its skin and hair. It has white markings on the forehead, muzzle, legs and tail switch.

The Surti buffalo is found in the Charottar tract of Gujarat, which embraces the Kaira District and the adjoining territory of Baroda. Its horns are of medium length and are sickle-shaped. They are flat with transverse corrugations. They are directed downwards and backwards and then turn upwards (Fig. 100, *top*). The females weigh on the average 540 kg. The buffalo is still the more popular milch animal in India. With selective breeding, better nutrition and improved health control, it has the potential of meeting the protein requirements of India. In India both the buffaloes and cattle coexist. While discussing the possibility of introducing the Indian buffalo into potential areas, Cockrill states, 'There are many harsh areas where the only possibility of getting a fair return from the land lies with the water buffalo; such environments include substantial parts of Australia's Top End, the marshes of southern Iraq, and wide expanses of Latin America.'[8]

The Elephant (*Elephas maximus indicus*). The mammals domesticated primarily for transport and labour are the elephant, the camel, the horse and the ass.

The earliest evidence in support of the use of elephants is to be found on 15 seals from Mohenjo-daro. The elephants shown clearly belong to the Indian species. Similar seals bearing the image of the elephant have been recovered from Harappa.

Six out of the 15 Mohenjo-daro elephants distinctly show a line extending down from the back behind the foreleg (Fig. 105). The line indicates a covering cloth or wrapping on the back. It proves that the Indian elephant was domesticated by the time of the Indus Valley civilization (2300-1600 B.C.).

The elephant is a five-toed ungulate, ideal for transporting and soldiering in swampy jungles where horses and mules are rendered ineffective. It eats the leaves of bamboos, plantains, *pipal (Ficus religiosa)*, banyan (*Ficus benghalensis*), and of various species of reeds (e.g. *Typha*) which flourish in swamps. Its principal food is leaves of rushes and reeds. As there are few swamps in northern India and Pakistan, reeds, rushes and

[8]Cockrill, W.R. *The Husbandry and Health of the Domestic Buffalo*

bamboos have vanished, and with them has vanished the elephant. It may be noted that whereas even a petty land-owner can keep an elephant in Bihar and Bengal, as its natural food is so abundant around *jheels* in these moist regions, it is difficult even for a raja to keep one in the Punjab. The elephant served for transport of goods in civil life, and as a tank in battles. It continued to hold its sway for long in northern India and slowly made way for the more active horse, which is less expensive to keep and is more manoeuvrable. The decline of the elephant must have started from 1600 B.C. when the Aryan horsemen warriors invaded India. The elephant as a weapon of war suffered a major defeat in 326 B.C., when the elephants of Poros fled in confusion before the cavalry charges of the Greeks under Alexander. Since then, its utility in warfare has gradually declined. Its present distribution is restricted to the wet areas of India, namely Kerala, Assam, Bihar, and the *tarai* zone of the sub-Himalayas.

Even now the elephant is used for hauling heavy logs in the forests of Assam and Burma. It is also ridden on ceremonial occasions when pomp and pageantry are necessary for beguiling the crowds.

The Camel (*Camelus dromedarius*). Like the horses, the camels as a group are of American origin. North America was the centre of camel evolution throughout the Tertiary. The earliest-known ancestral camels are called *Protylopus*. They lived in the upper Eocene and were no larger than hares. The Oligocene camel, *Poebrotherium*, had the size of a sheep. *Protomeryx* of the lower Miocene, *Protolabis* of the middle Miocene, *Procamelus* of the upper Miocene, and *Pliauchenia* of the Pliocene are further stages, and some of the later American camels were very large. In the Pleistocene of North America, including Alaska, the genus *Camelus* occurred. It is from such a late source that the present-day camels of the Old World appear to have been derived by way of migration to Asia across the Bering Straits, when these were dry land in the late Pliocene or in the early Glaciation times. Only one invasion of camels appears to have succeeded prior to this date; it brought to the Siwaliks of northern India *Camelus sivalensis*, a species which is believed to be not closely related to the living camels, and another smaller species (*C. antiquus*), which Falconer thought was perhaps related to the llama.

The Pleistocene wave of true camels spread rapidly to the west along the dry belt of the Northern Hemisphere. It reached eastern Europe, with *C. knoblochi* in Sarepta, southern Russia, and *C. alutensis* in Rumania. They were not able to thrive farther west in Europe because of the unsuitable climate. Whereas these forms are supposed to have been closely related to the two-humped Bactrian camel, the dromedary became separated from the northern branch somewhere in western Asia and spread across Arabia (present in the late Pleistocene of Azraq Oasis, according to Clutton-Brock, 1961) and Palestine (where it was the contemporary of Levelloisian

man at Sabha) into northern Africa, reaching even Mauritania in the extreme west. The dromedary had arrived in northern Africa in Acheulian times."[9]

The remains of the camel have been discovered from Mohenjo-daro and Harappa. Baini Prashad is of the opinion that the one-humped camel was domesticated by the people of the Indus Valley. Another centre of domestication of the one-humped camel is in northern Africa. The two-humped Bactrian camel is a native of Central Asia, and has been found wild near Lop Nor, and was probably domesticated in that region. A few camel bones of the Indian one-humped race (*Camelus dromedarius*) were found at Anau in Turkestan and in the neolithic Tripolye culture of southern Russia, where they are likely to be approximately contemporary with the Harappan civilization. One of the rare representations of a camel in the prehistoric Asia, states Piggott, comes from a site probably of the second millennium B.C., just over the border of Baluchistan in Persian Makran, at Khurab, where it is modelled in relief on a bronze object.[10]

The camel was not known to the Aryan invaders, though Herodotus mentions that the camels used by Indians were as swift as horses. This statement suggests that dromedaries, not Bactrians, were in use in the Indus Valley in the fifth century B.C. The country is indeed well suited for this animal.

In north-western India and Pakistan, the dromedary is an important beast of burden at present. It is popular in the desert areas of Rajasthan, Gujarat and Haryana, where it is used for carrying loads. In Haryana it is used for working Persian wheels and also for threshing of sorghum (Fig. 107,*bottom*). With the eyes covered with leather goggles, it would go round and round, turning the wheel with great patience (Fig. 107, *top*).

Ass (*Equus asinus asinus*). The ass is the proverbial beast of burden, found all over India. Even in this mechanical age, it is playing a vital role in construction work and in the carrying of earth where canals are dug. It is economical to keep, and the owners after day's work let it loose to fend for itself. Apart from grass, it eats street wastes and weeds. The upkeep of no other animal is so cheap.

There was considerable building activity in the Harappan towns, and one can presume that the ass was used by the Harappans for transporting bricks and other building materials. It may also have been used for riding. In Arab countries, apart from riding, asses are used for the treading of corn and for pulling the plough.

Zeuner believes that the ass was first domesticated in the Valley of the Nile. A herd of asses is depicted on a panel in the tomb of Sahure, fifth

[9]Zeuner, F.E. *A History of Domesticated Animals*, p. 346
[10]Piggott, S. *Prehistoric India*, p. 159

dynasty, 2650 B.C. The wild asses of northern Africa must have contributed to the domestic stock.

In India, the wild ass (*Equus hemionus*) is found in the Rann of Kutch, and in the desert of Bikaner and Jaisalmer (Fig. 106). It also occurs in Sind, Baluchistan, Afghanistan, Iran and Kurdistan in Iraq. According to Lydekker, 'This species, of which there are several local races, has moderately large ears, an erect mane, and a tail covered at the base with short hair which grows longer towards the tip. It is fawn or chestnut-brown above, and white below, the back being marked with a dark-brown, partly white-edged, stripe, running down the middle. Sometimes there is a shoulder-stripe, and sometimes the legs are barred with reddish brown. The shoulder-height is about 48 inches [1.2 metres] and the total length about 80 inches [2 metres], whereas the tail measures about 23 inches [58 centimetres]. The animal is darker at the ear-tips and round the hoofs, and the tip of its tail is blackish. It inhabits desert and semi-desert plains. It is generally found in herds very difficult of approach, and subsists on such vegetation as is to be found in those arid districts. An exceedingly swift animal, it is rarely overtaken by a single horseman, and is generally caught when young by being tired out by a number of horsemen taking up its pursuit one after another.'[11] Prater[12] states that wild asses are readily tamed when young.

The greatest contribution that the ass has made to animal husbandry, according to Zeuner, is as the progenitor of the mule, a sure-footed animal, which can carry heavy loads on narrow mountain paths. It is known that in earlier times crosses were attempted between hemiones and asses, as well as between horses and asses, but of the several possibilities only one proved really successful, the hybrid between the male ass and the mare, called the mule. The product of the union of a horse with a female ass is called hinny; it is, on the whole, rare. Pohlig found that hinnies were valued as good for riding in Persia, and Pallas mentioned them from China.[13]

The bones of asses have been found in the excavations at Harappa, along with those of other domestic animals. It was possibly tamed from the stock of wild asses which are still found in Sind and Baluchistan. The remains of the ass have also been reported from Kalibangan (Rajasthan) and at Rangpur (Gujarat) Period III (1000-800 B.C.). They may be the remains of onagers.

The Pig (*Sus scrofa cristatus*). The Indian wild pig (*Sus scrofa cristatus*) is found in the Siwaliks and the *tarai* area throughout northern India. It lives in tall grass or scanty bush jungle. It is omnivorous and lives on roots, tubers,

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[11]Lydekker, R. *Wild Life of the World*, Vol. II, pp. 95, 96
[12]Prater, S.H. *The Book of Indian Animals*, p. 190
[13]Zeuner, F.E. *A History of Domesticated Animals*, pp. 382, 383

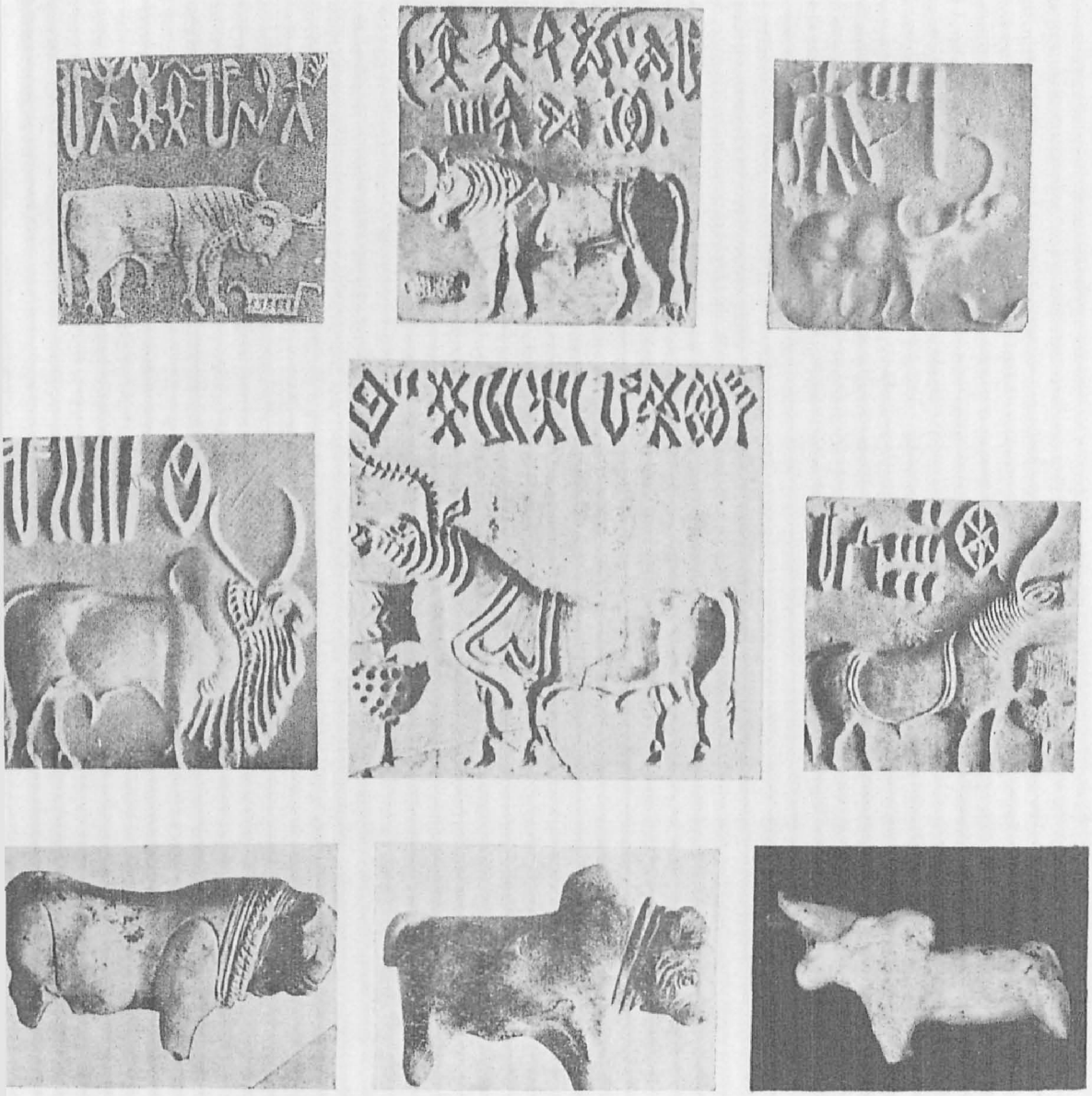


Fig. 94. Seals and toys depicting domesticated animals. *Top row, left and centre*, humpless bulls; *right*, a buffalo. *Middle row, left*, a humped bull of a breed close to Kankrej of Gujarat; *centre and right*, bulls with forward-projecting horns, resembling urus (*Bos primigenius*) of Europe. *Bottom row, left*, a humpless bull; *middle*, a humped bull (all from Mohenjo-daro; after Mackay and Vats). *Bottom row, right*, a humped bull from Sector 17, Chandigarh

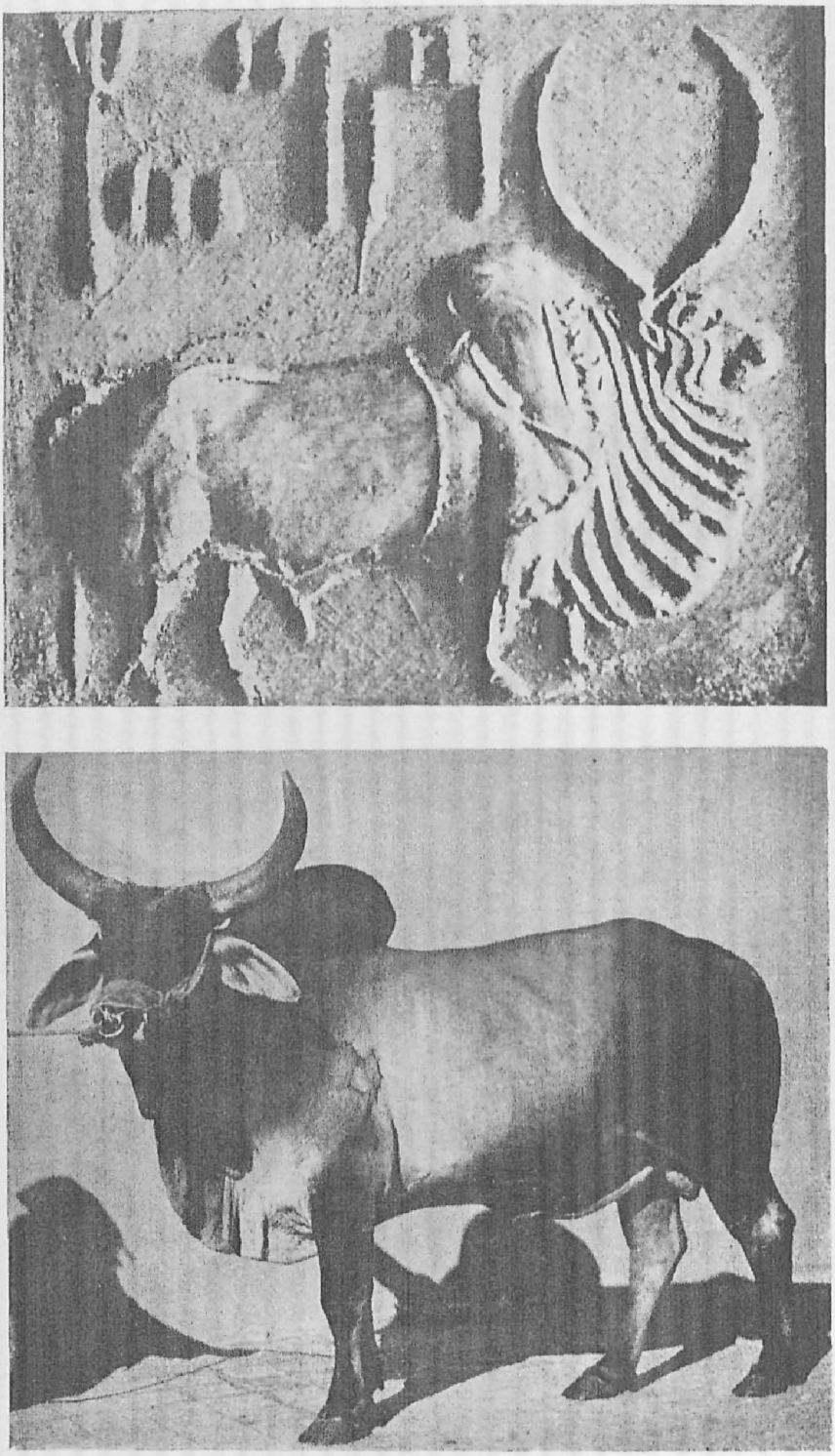


Fig. 95. *Top*, a humped bull depicted in seals from Mohenjo-daro. *Bottom*, a Kankrej bull from Kutch, which resembles the bull depicted on the seal above. This breed is also common in the Tharparkar District of Sind (Pakistan). It is the heaviest breed with curved horns and well-developed dewlap

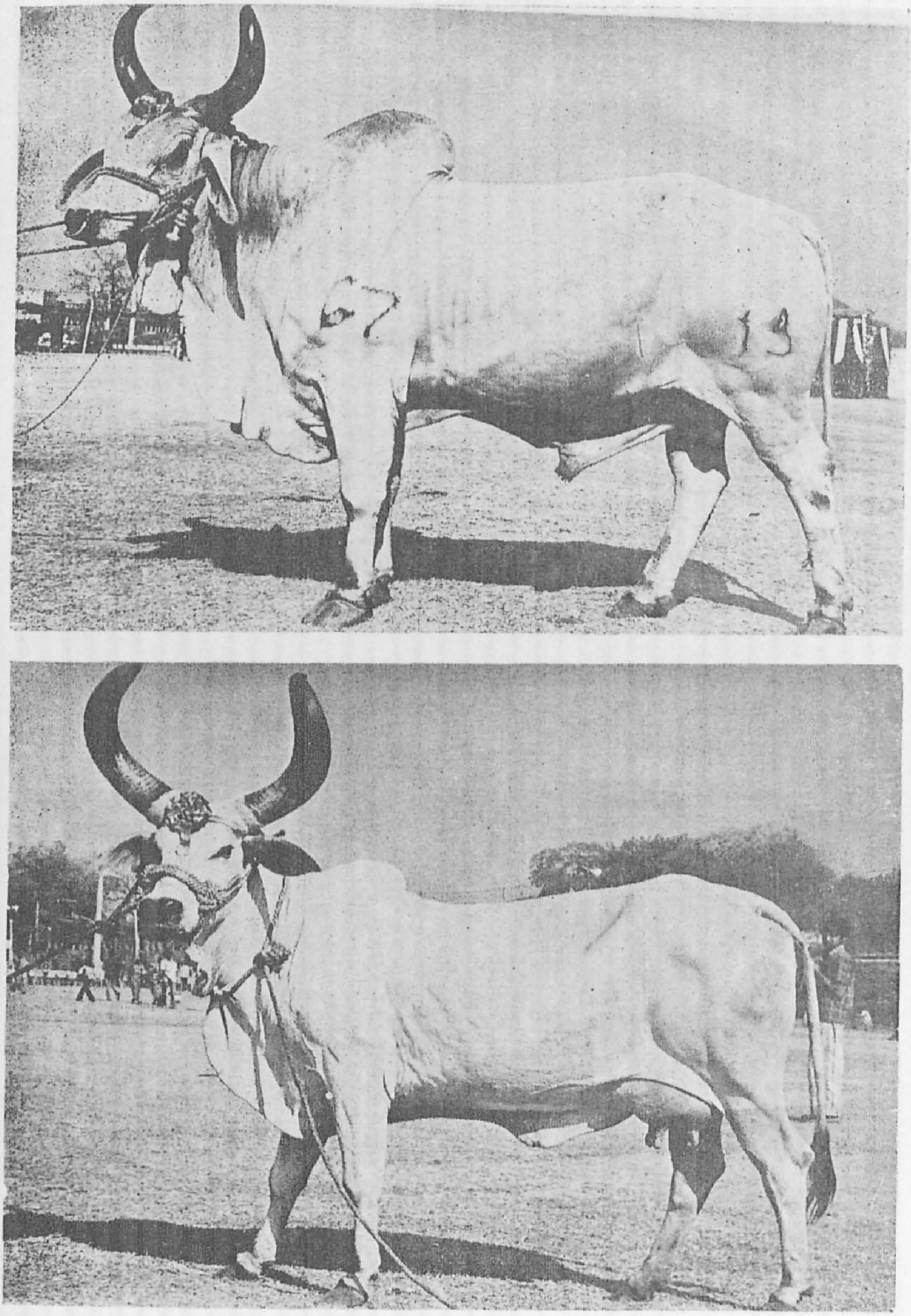


Fig. 96. A Kankrej bull and cow from Kathiawar

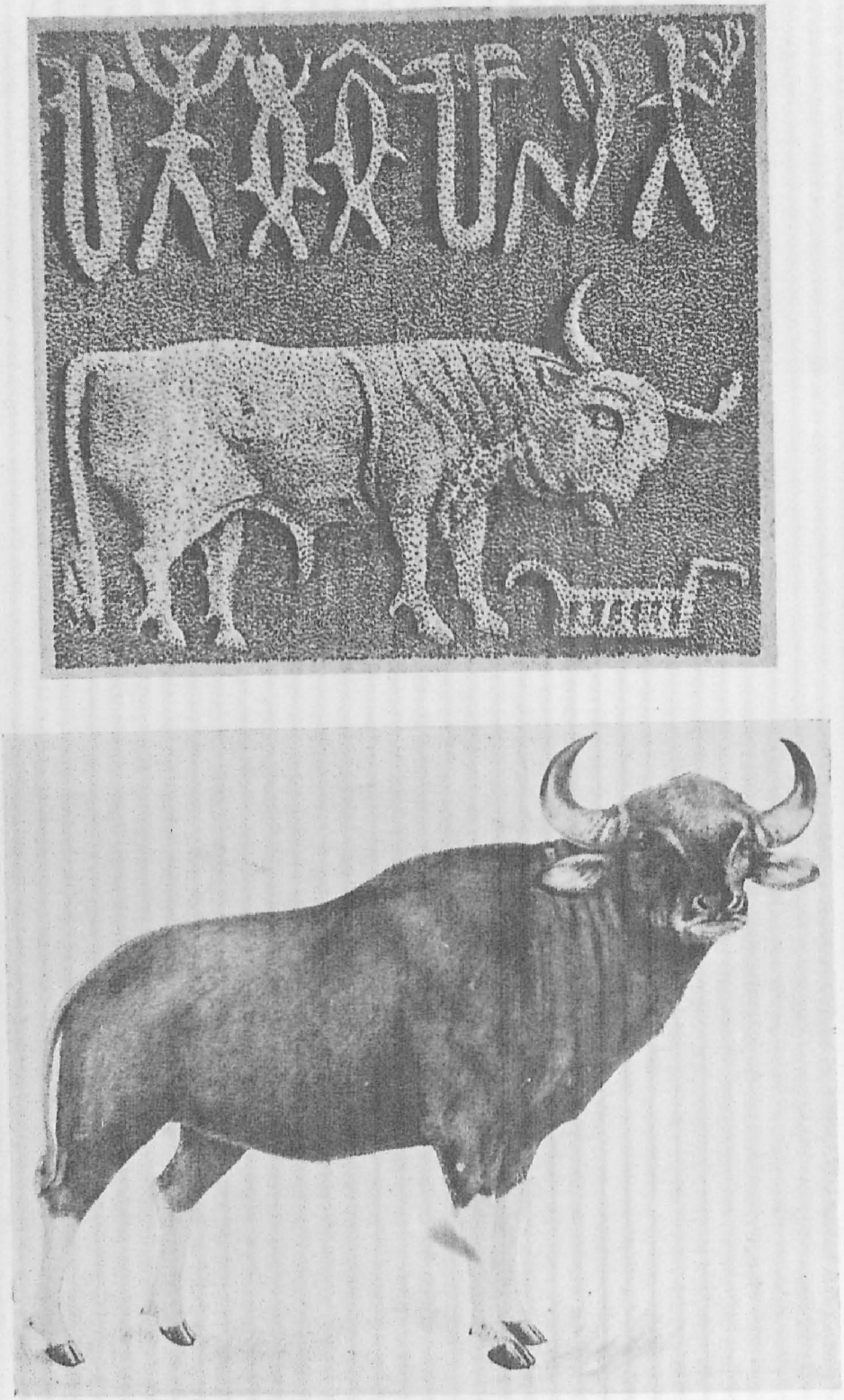


Fig. 97. The horned humpless bull depicted on a seal from Mohenjo-daro (*top*) resembles the gaur, *Bos gaurus* (*below*)

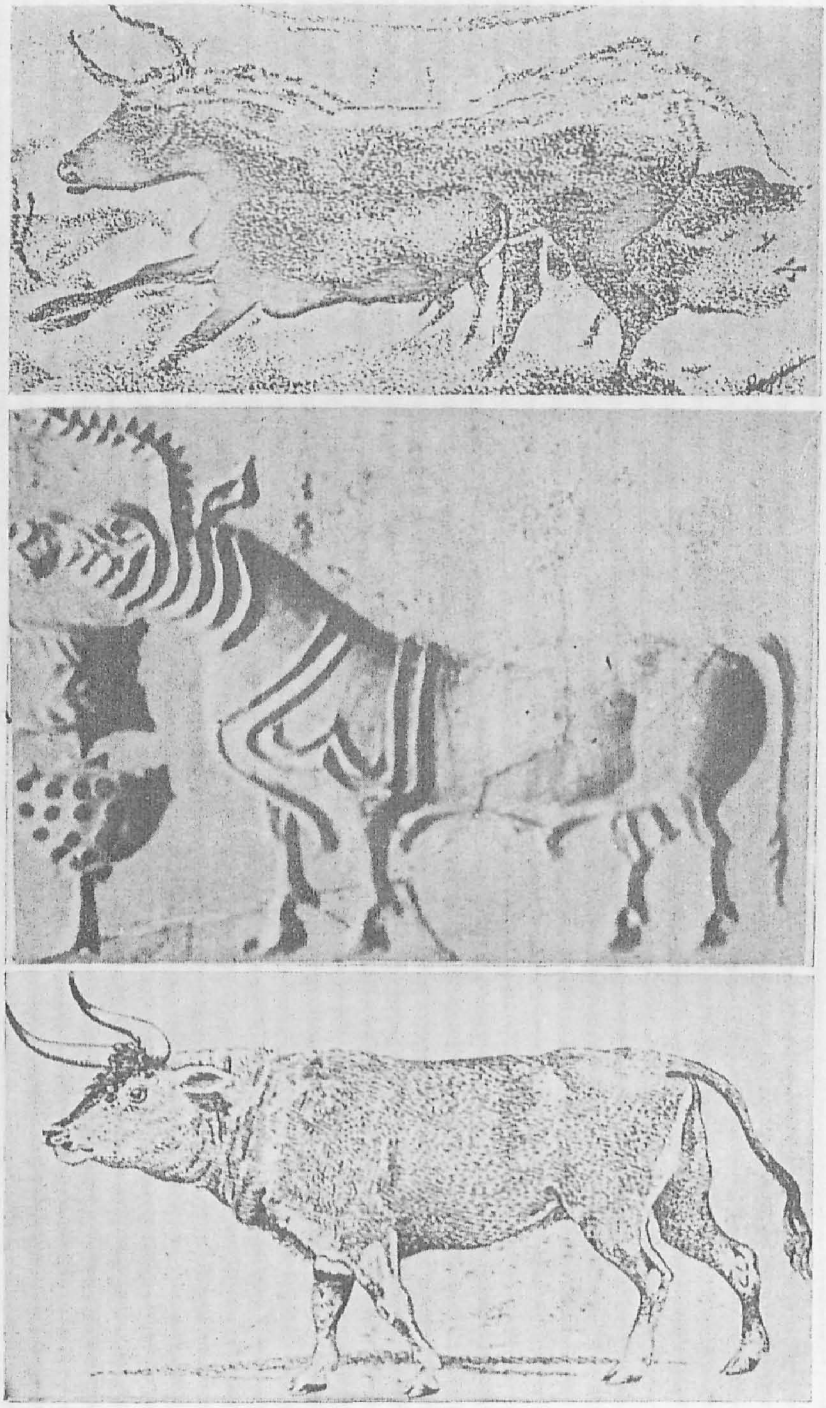


Fig. 98. *Top*, a bull of *Bos primigenius* or aurochs of the late Pleistocene, depicted in the cave of Lascaux, south-west France. *Middle*, the so-called unicorn from Mohenjo-daro also depicts a bull of *Bos primigenius*. It has a manger in front of it, indicating domestication. *Bottom*, the last surviving specimen of aurochs depicted in a picture published in 1827. The aurochs became extinct in Europe in the middle of the nineteenth century
(After Zeuner)

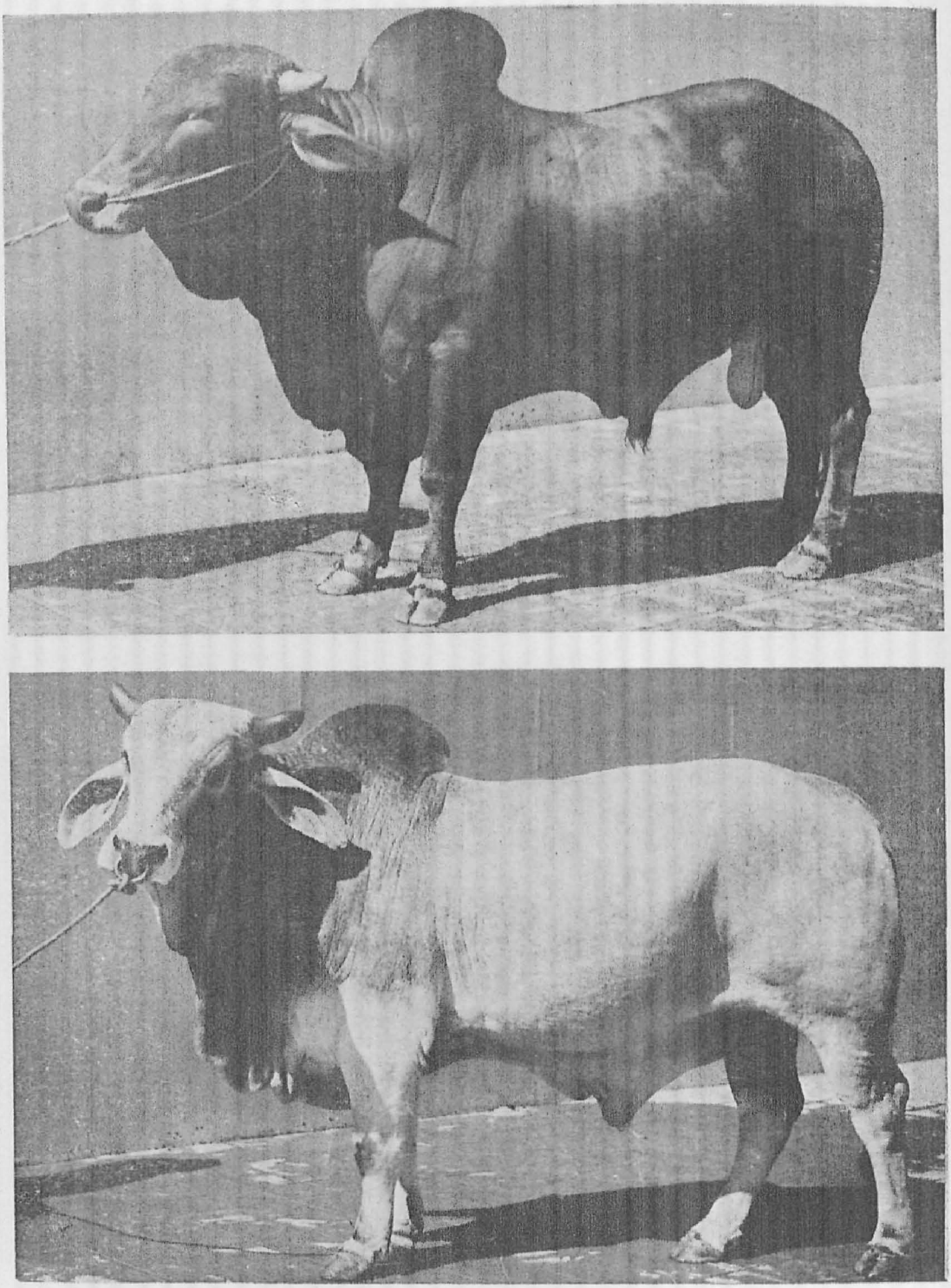


Fig. 99. Breeds of cattle from Sind. *Top*, a Red Sindhi bull; *bottom*, a Tharparkar bull

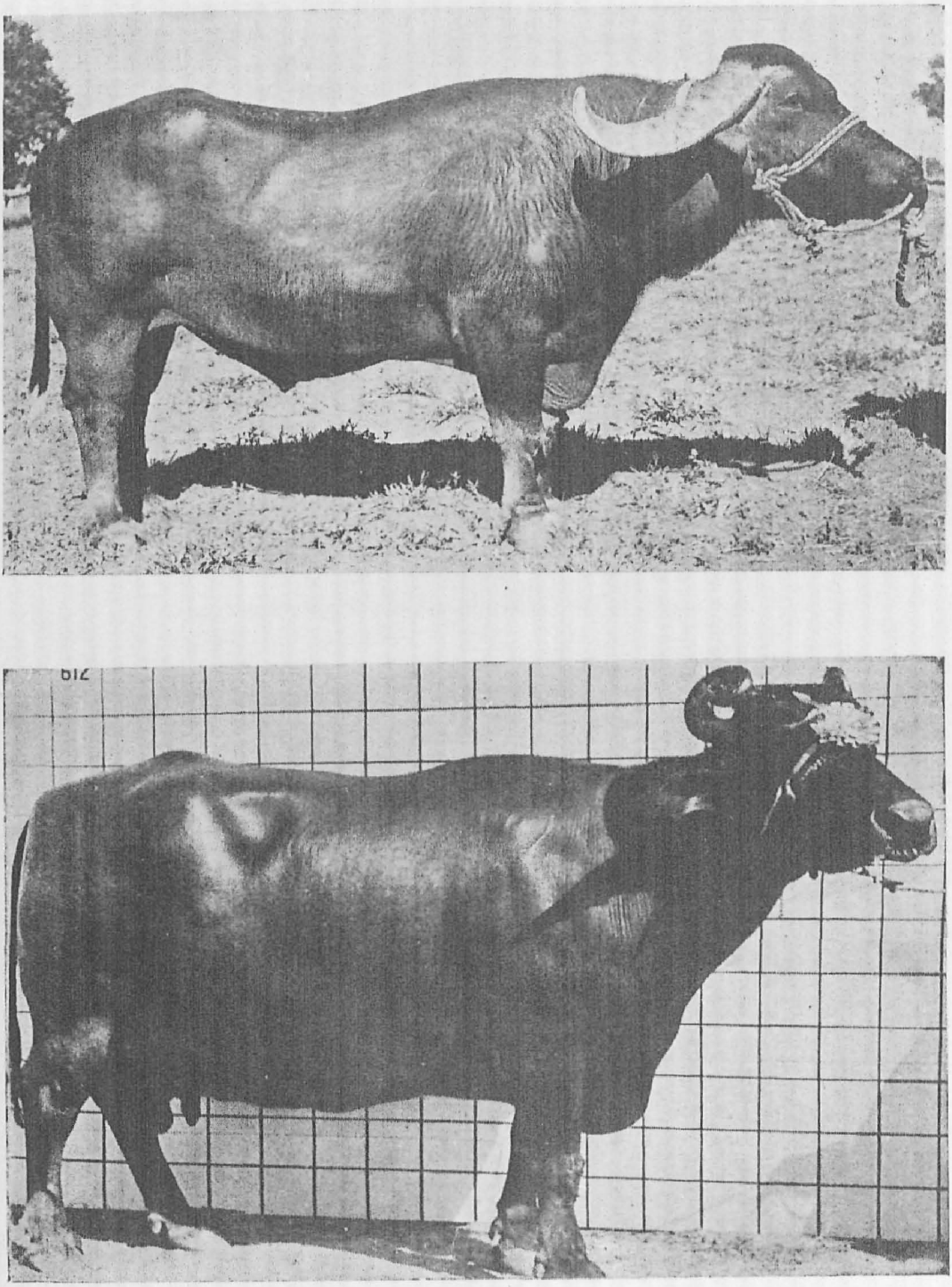


Fig. 100. *Top*, the Surti buffalo has long and thick horns. *Bottom*, the Murrah buffalo has curled horns and has a high milk yield

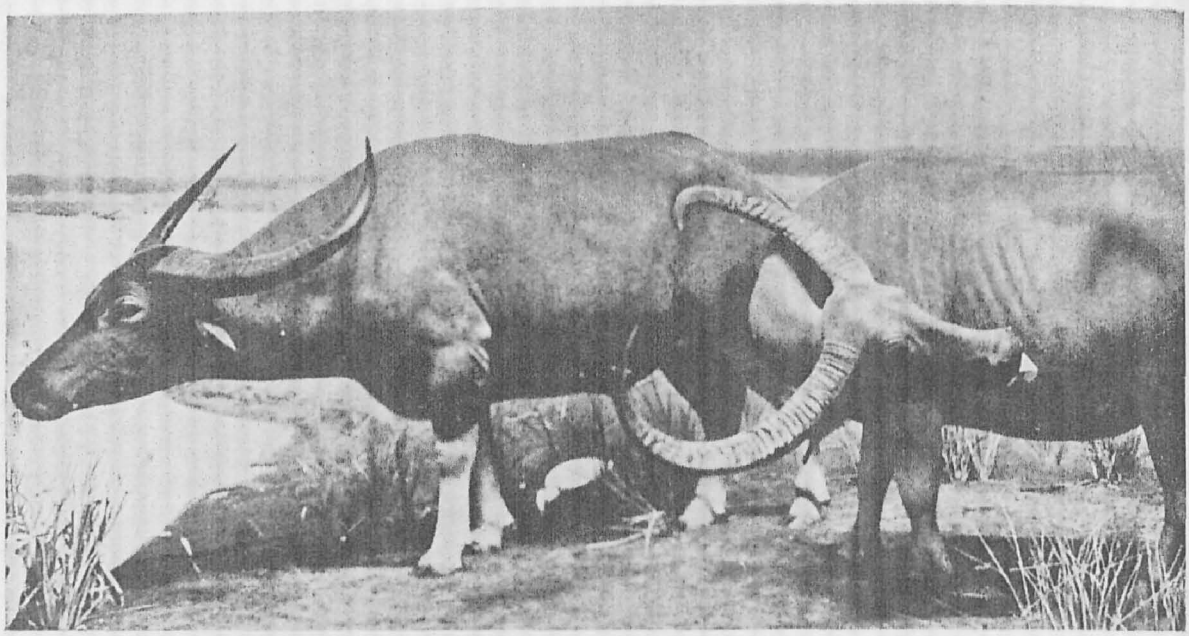
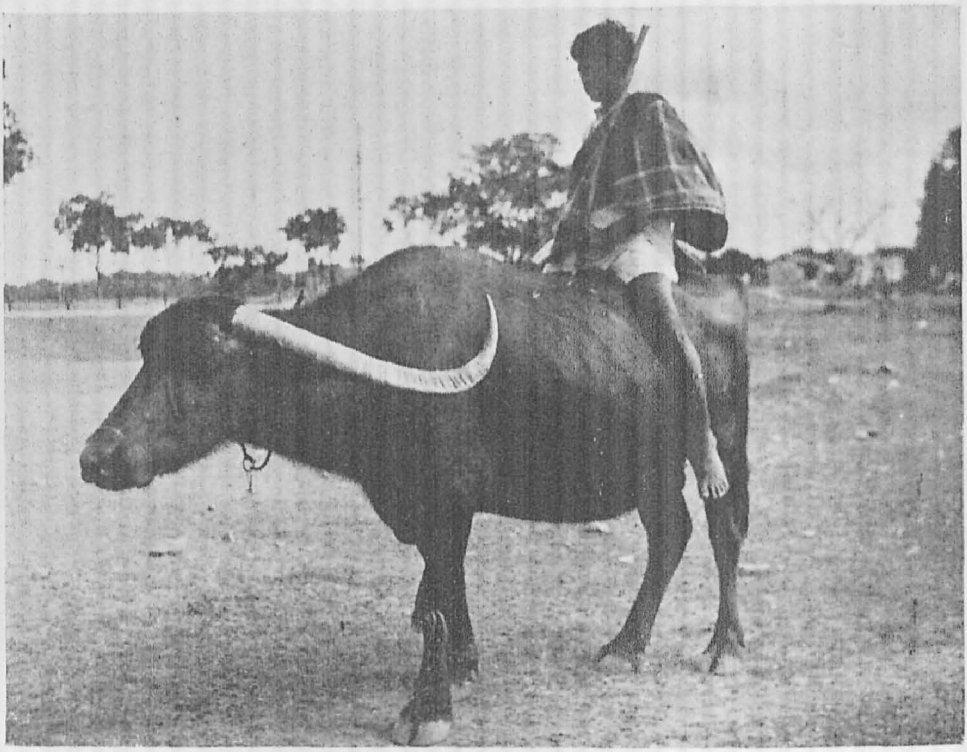


Fig. 101. The wild buffalo from the Brahmaputra Valley in Assam

Fig. 102. Nagpuri buffalo, with its long horns, is very close to the ancestral buffalo



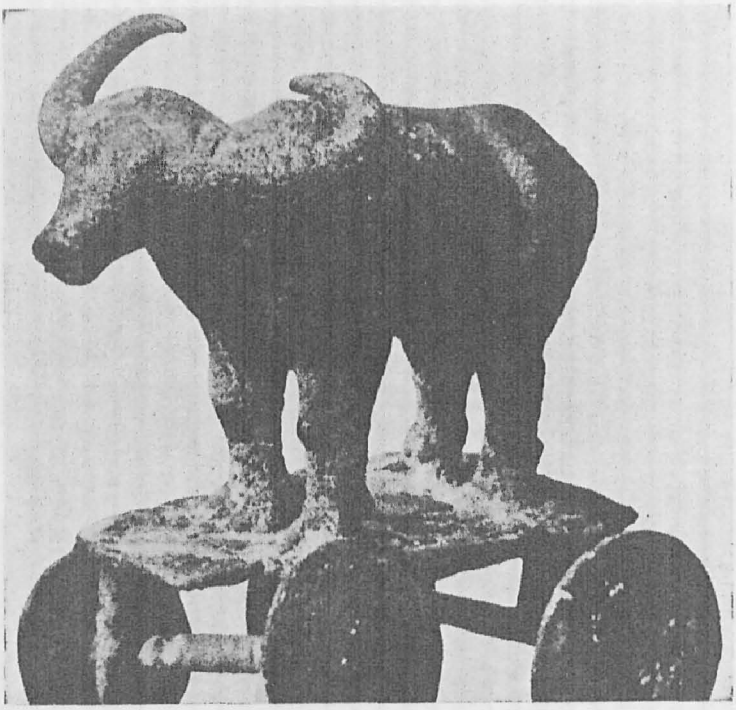
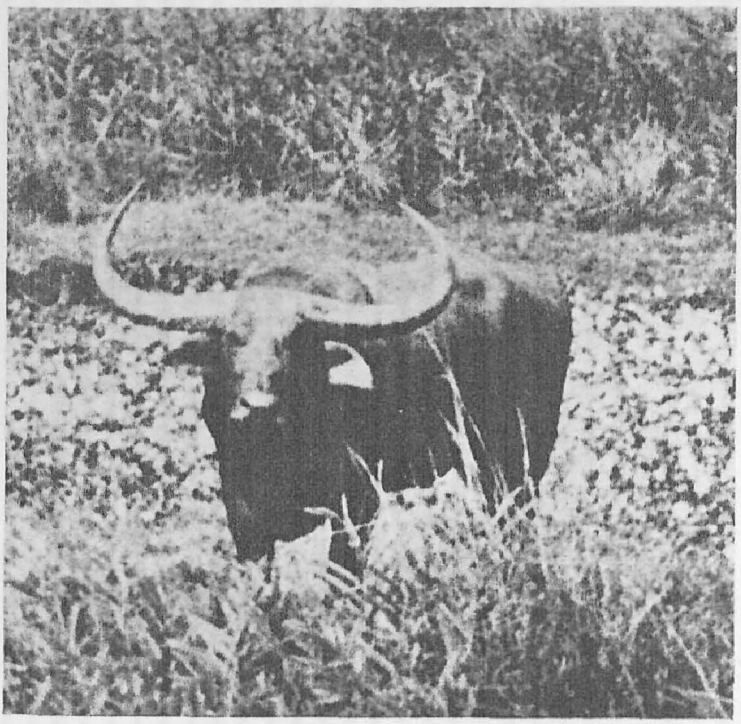


Fig. 103. A buffalo, bronze, Chalcolithic period, *c.* 1300 B.C., Diamabad, Ahmadnagar District, Maharashtra. In the shape of its horns it resembles the wild buffalo below

Fig. 104. The Indian wild buffalo is found in Assam. It lives in reeds and rushes close to ponds



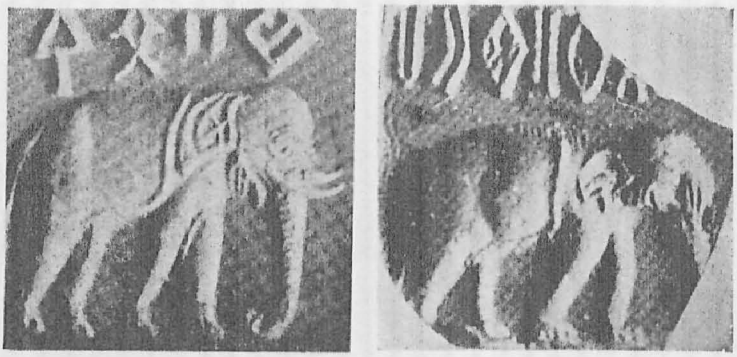


Fig. 105. Seals from Mohenjo-daro showing elephants. They have a covering of cloth on the back, indicating domestication (Courtesy : Archaeological Survey of India)

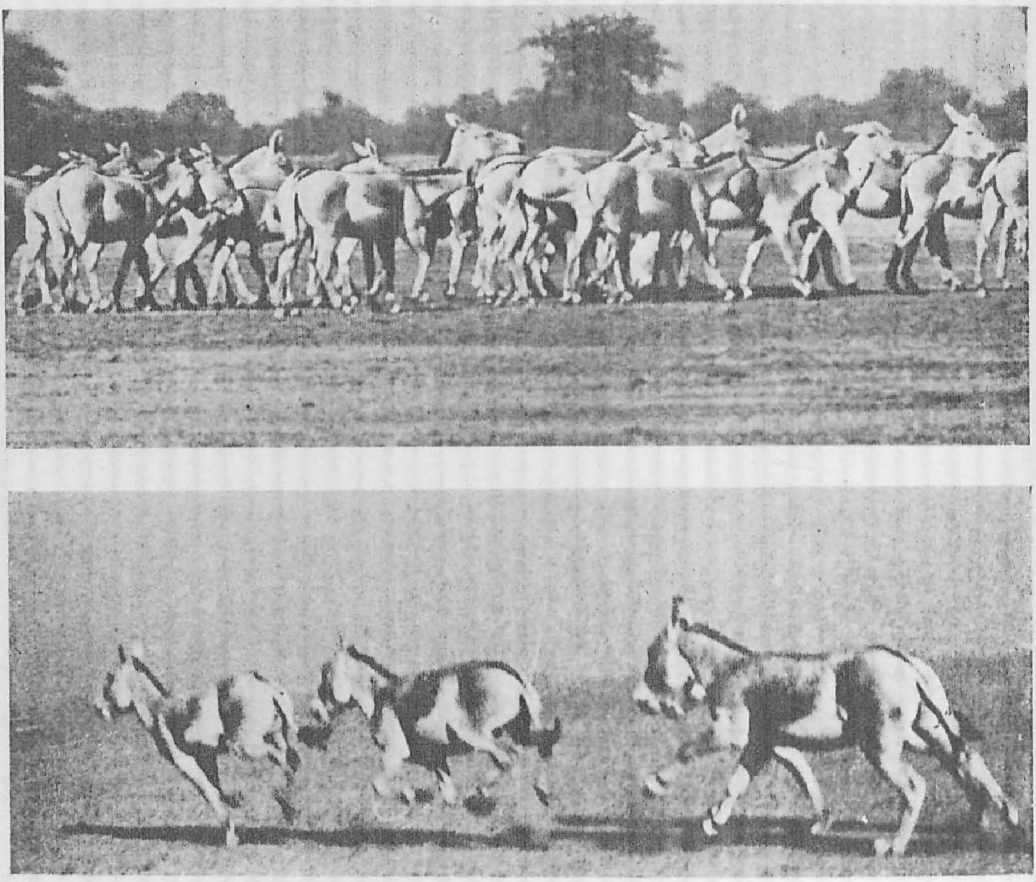


Fig. 106. A herd of hemiones (wild asses) in the Rann of Kutch in Gujarat. In the photo below they are galloping to escape human intruders
(Courtesy : Chief Conservator of Forests, Gujarat)

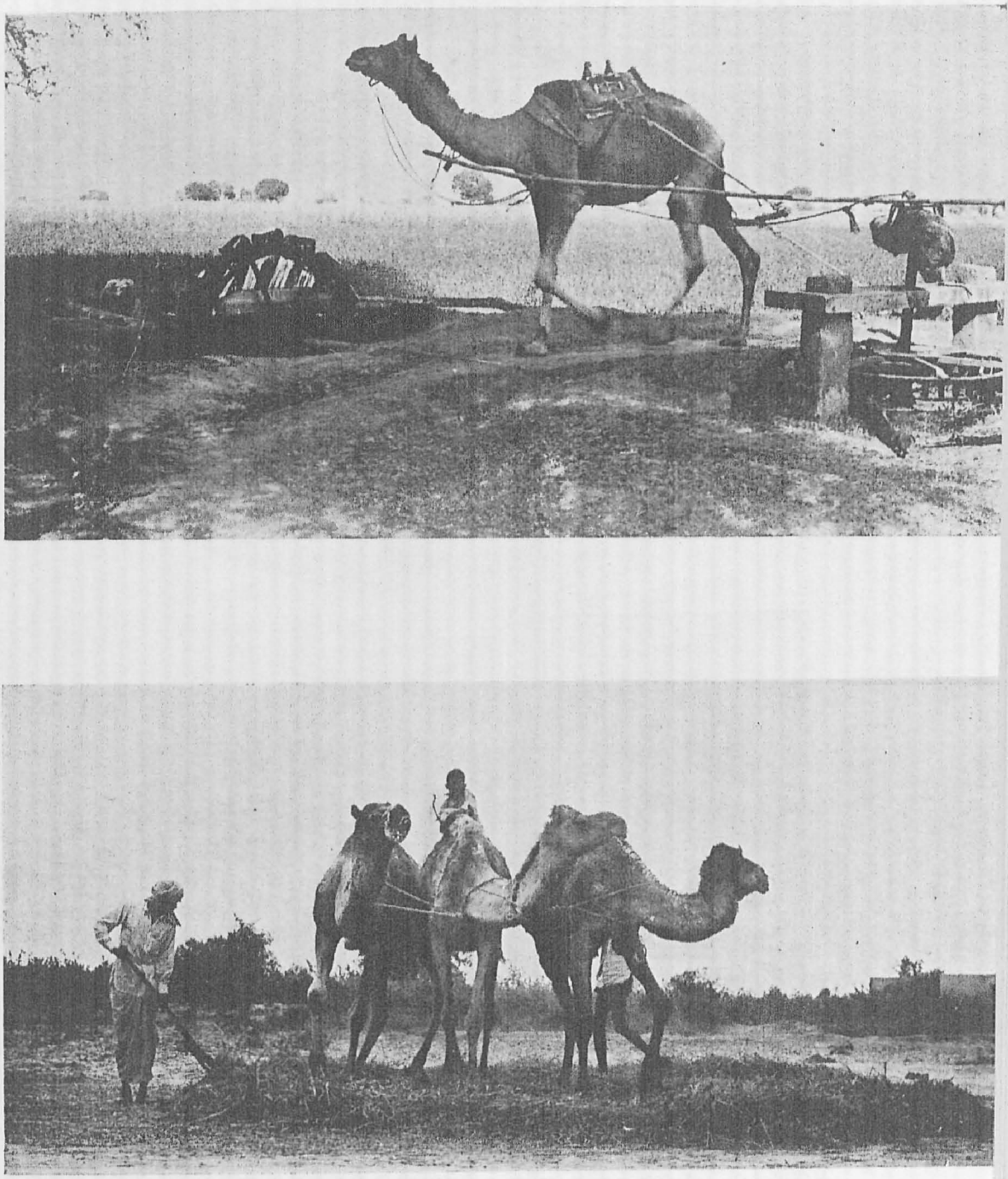


Fig. 107. *Top*, a camel working a Persian wheel. Blindfolded camels work tirelessly for hours. *Bottom*, camels are also used for threshing sorghum in the desert areas of the Hissar District, Haryana
(Courtesy: Indian Agricultural Research Institute, New Delhi)

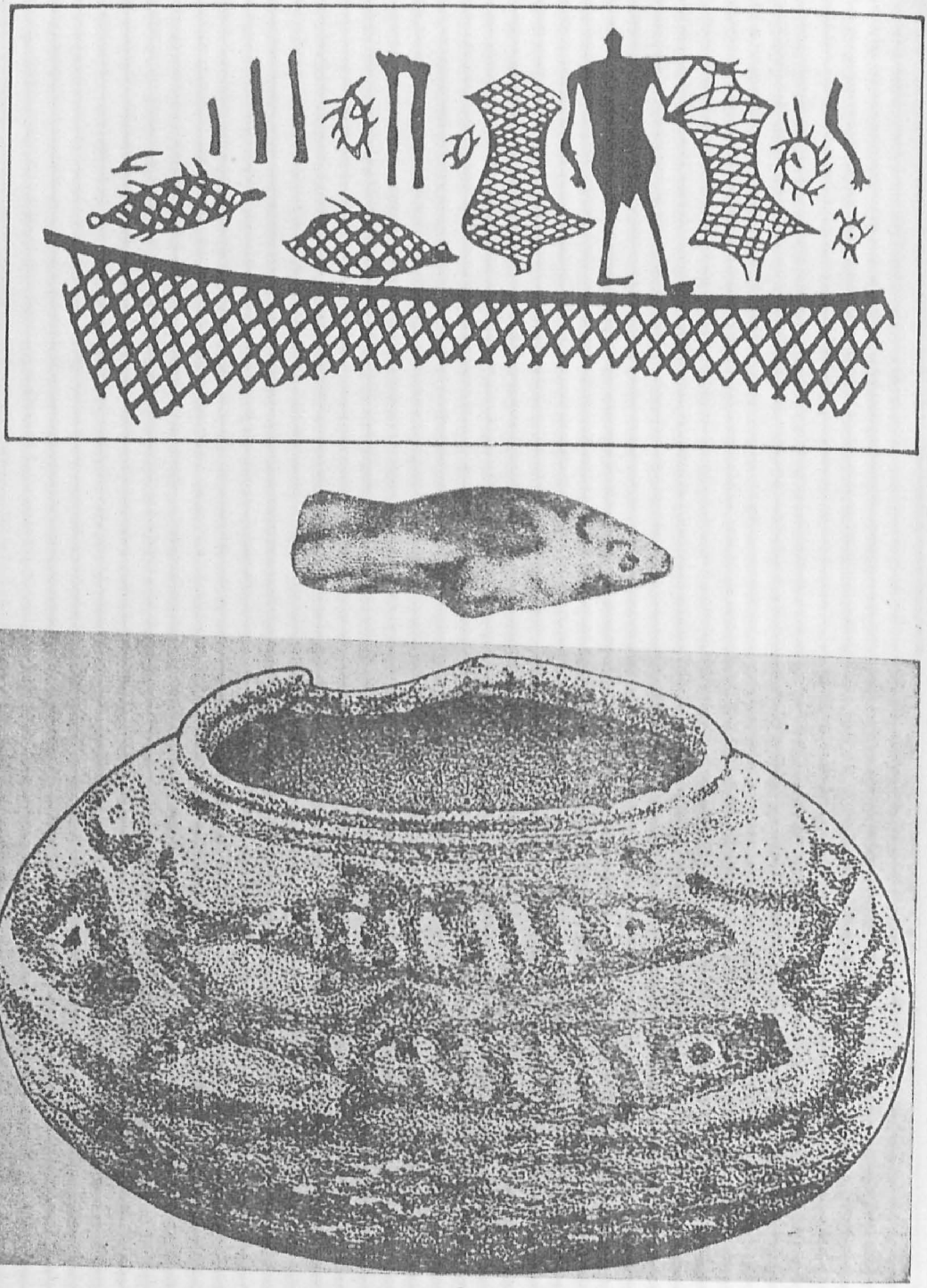


Fig. 108. Fish and fishing in the Harappan period. *Top*, a fisherman with net. *Middle*, a fish-toy from Harappa (both after Vats). *Bottom*, a painting on a pot from Nal, showing *Nemachilus*-like fish.
(After Hora)

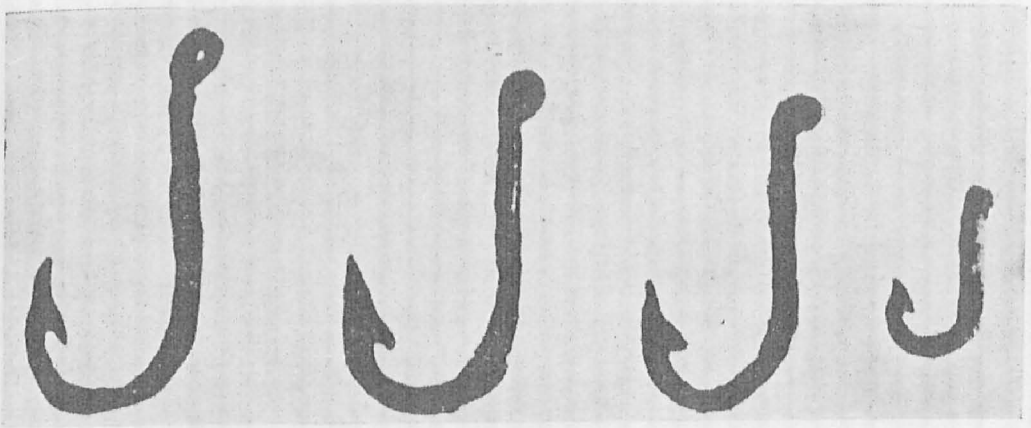


Fig. 109. Copper fish-hooks from Mohenjo-daro
(Courtesy: Archaeological Survey of India)

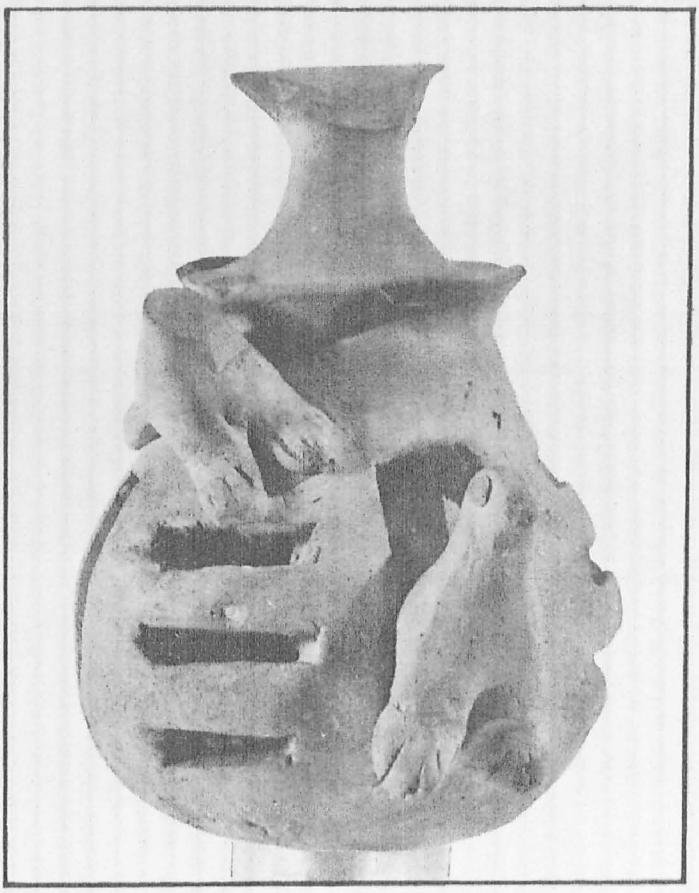


Fig. 110. Birds on a cage—a terracotta from Mohenjo-daro
(Courtesy: National Museum, New Delhi)

Fig. 111. Domesticated birds from the Harappan period, showing a flying pigeon, a parakeet, a domestic fowl and a chick, a duck, a pigeon, and a woman holding a duck

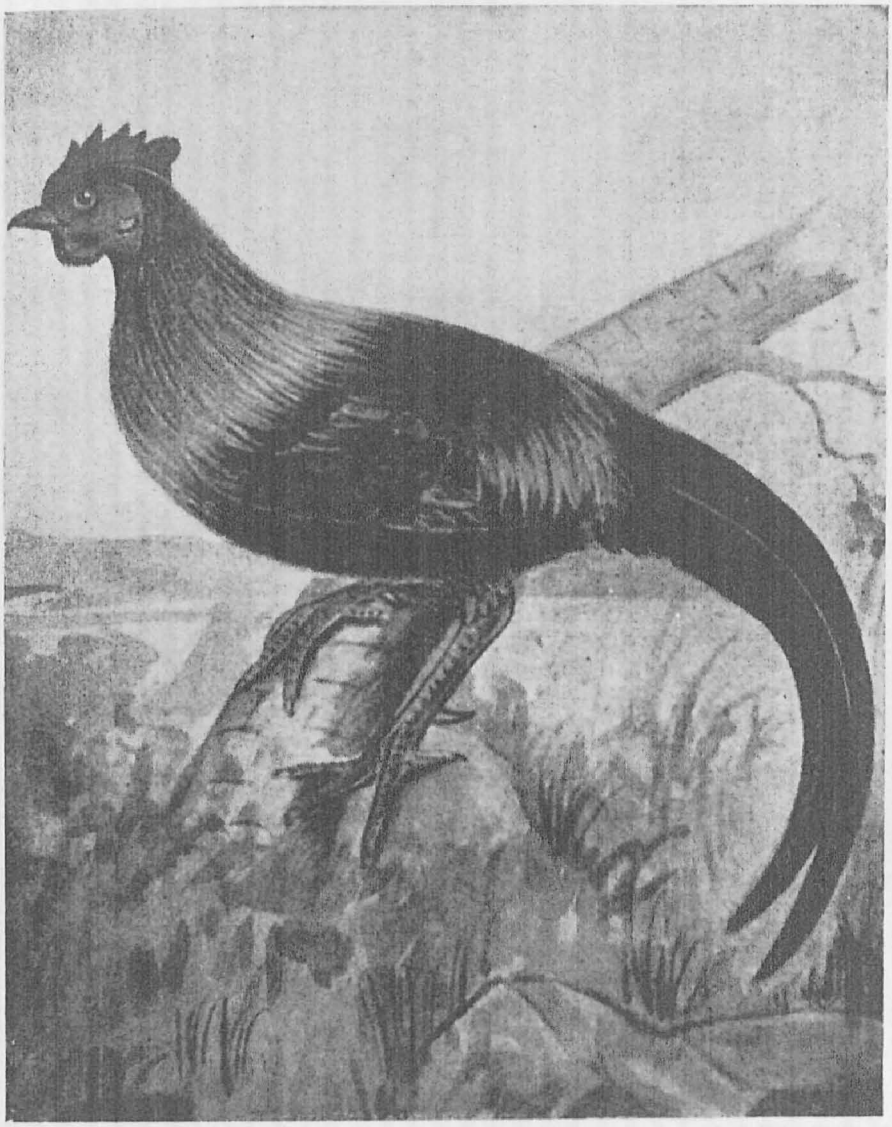


Fig. 112. The red jungle fowl (*Gallus gallus*) is the ancestor of modern poultry

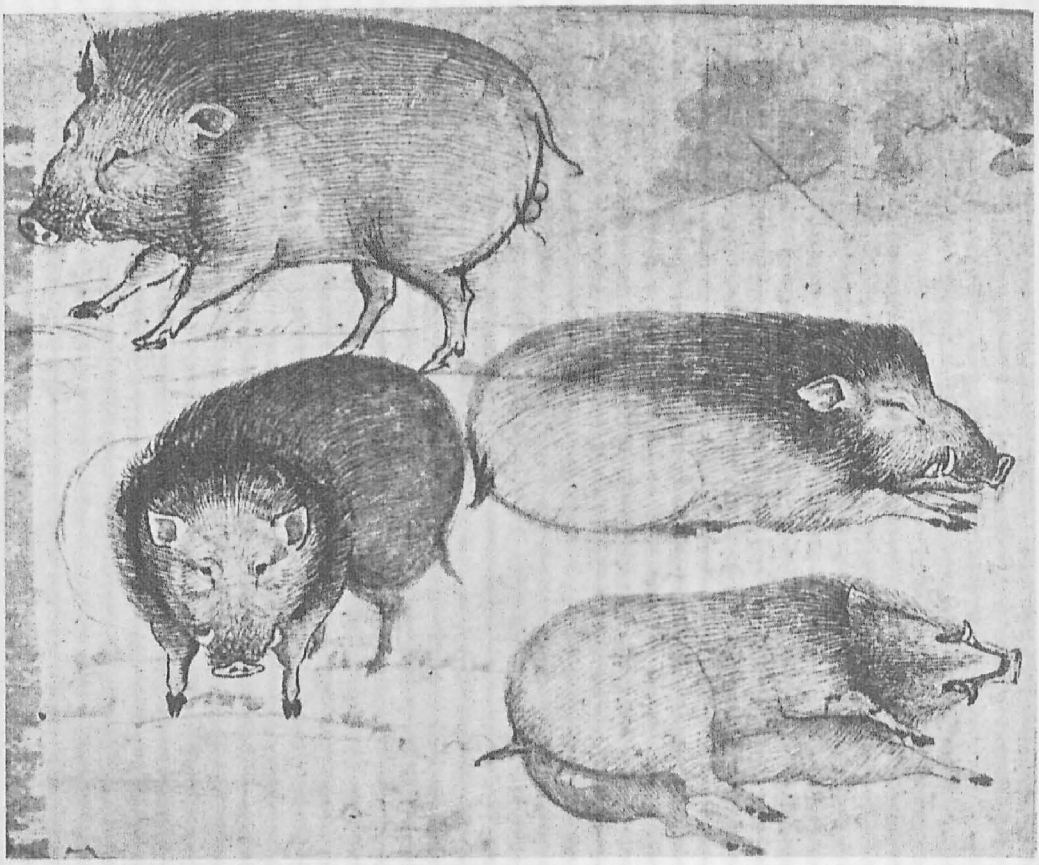


Fig. 113. The Indian wild boar (*Sus scrofa cristatus*) in different moods. Kangra drawing, early eighteenth century
(Courtesy : Museum of Evolution of Life, Chandigarh)

insects and offal. The male is aggressive and even attacks human-beings. Fig. 113 reproduces a painting in which the wild boar is shown in different moods.

All domestic varieties, except the Chinese variety, are the descendants of the Indian wild pig. Pig-breeding originated in India and east Turkestan and spread through the Mediterranean region to Europe. The Chinese variety is the descendant of *Sus vittatus*, found wild in south-east Asia. The European representative is the wild pig (*Sus scrofa*). *Sus scrofa* and *Sus vittatus* are connected by transitional races found in the geographically intermediate areas. The Mediterranean races are intermediate between the European and the eastern Asiatic groups in several respects. It seems that the domesticated pig was repeatedly raised independently from the wild stock all over, wherever it is found.

A toy modelled on a wild boar has been recovered from Mohenjo-daro. The remains of pigs were also found at Mohenjo-daro. "The pig was present in large numbers in this area from the very earliest time when Mohenjo-daro was a flourishing city," states Marshall. "But it is impossible to determine whether or not this animal was actually domesticated or even whether it was used as a source of food by the inhabitants in those far-off times. At the present time, pigs are of common occurrence throughout these parts, and it is possible that in the old days they existed in large herds that roamed the countryside searching for food."[14]

The Cat (*Felis ocreata r. domestica*). The cat identified as *Felis ocreata* race *domestica* is known from the bones recovered from Harappa and is believed to be a descendant of African *F. ocreata*. It was possibly domesticated in Sind and the Punjab. There is very interesting evidence of domesticated cats from Chanhu-daro, a brick over which, when soft and unbaked, a dog had chased a cat, both leaving their characteristic footprints: 'the deep impress of the pads and their spread indicate the speed of both animals...the dog's imprint slightly over-lapping the cat's shows that he came second'. This brick is in the Prince of Wales Museum, Bombay. The cat from Harappa seems to have closely resembled the ordinary European domestic cat.

The main use of cats in an agricultural economy is in rodent control. To save the fooodgrains from rodents, cats are kept as pets in granaries as well as in grain stores in rural homes in India. Its usefulness as a protector of foodgrains gave a special status to the cat. In India it is a sin to kill a cat. To atone for such a sin, the sinner has to present a golden cat to Brahmins.

Fish. With the exception of the carp, all the remains of fish from Mohenjo-daro are from examples of the family Siluridae; of the three genera rep-

[14]Marshall, J. *Mohenjo-daro and the Indus Civilization*, Vol. II, p. 669

resented, two, viz. *Rita* and *Wallago*, are the common inhabitants of the large rivers of India, and *Arius* of sea and estuaries. All the three species are excellent food-fish, and it is probable that they were used for food at Mohenjo-daro. *Rita* and *Wallago* were probably caught locally, but it is not likely that a fish such as *Arius*, which is normally confined to estuarine or tidal regions, would penetrate so far upstream as this, and it seems more likely that these fish were caught further down the river in the neighbourhood of Karachi and were dried and brought up to Mohenjo-daro. At present, large quantities of this species are caught, dried, and salted on the west coast of India. The methods employed for catching fish were by means of nets, traps, or hook and line. Where fish are caught by means of nets or traps in such a river as the Indus, turtles (*Trionyx gangeticus, Chitra indica, Batagur baska*, and *Emyda granosa*) and the *gharial* (*Gavialis gangeticus*) were also captured in the same manner.

A pot from Nal in Baluchistan shows a frieze of *Nemachilus*-like fish (Fig. 108, *bottom*). Hora identified seven genera of fish from Nal ware, viz. *Garra, Crossochilus, Cyprinon, Tor, Nemachilus, Botia* and *Glyptothorax*.

A painted sherd from Harappa shows scenes with human figures. One shows a fisherman carrying two nets suspended from a pole across his shoulders, with a fish and what is probably a turtle near his feet, which rest on a cross-hatched band, presumably the river by which he is walking (Fig. 108, *top*). Apart from evidence from paintings on pottery regarding the methods of fish-catching, fish hooks have also been discovered from Mohenjo-daro (Fig. 109).

DOMESTICATION OF BIRDS

A number of terracottas have been discovered from Mohenjo-daro and Harappa, which indicate that the Harappans had domesticated a number of birds. There is a terracotta from Mohenjo-daro in the National Museum, New Delhi, in which a woman is holding a duck in a tender manner (Fig. 111). A terracotta toy depicts a duck. Parrots and parakeets are favourite birds in Indian folk-lore and painting. There are numerous paintings of the Mughal and Rajput schools depicting a lady with a parrot. These are representations of Padmini, with her favourite parrot Hiraman.

A terracotta from Mohenjo-daro in the National Museum depicts parakeets clinging to a cage (Fig. 110). Parakeets are also depicted in toys (Fig. 111).

The blue rock-pigeon (*Columba livia*) is widely distributed in Asia and Europe. It has become a commensal of man, like the dog, and takes shelter in niches and holes in buildings of all types. A terracotta toy from Harappa depicts a pigeon (Fig. 111).

Domestic fowl (*Gallus gallus murghi*). The domestic fowl (*Gallus gallus murghi*) originated in India. Its ancestor, the red jungle fowl

(*Gallus gallus*), is still found in northern India from Kashmir to Assam and in Madhya Pradesh, Bengal, Orissa, Visakhapatnam and parts of the Godavari District of Andhra Pradesh. It is also found in Burma, Thailand, Malaya, the extreme south of China, Sumatra and Java. It is commonly found in *sal* forests of the Himalayan *tarai*. The cock has beautiful plumage, tinged with bright red near the throat and the tail (Fig. 112). The hen is brown, shy and silent.

The domestic fowl mates freely with *G. gallus* and the progeny is fertile. This free mating indicates its link with the wild jungle fowl.

The birds which man succeeded in domesticating have certain common traits. The first is a tendency to gregariousness. Wild and solitary birds can be domesticated with great difficulty. On the other hand, the gallinaceous birds are pre-adapted for domestication by their gregarious temperament, the social structure of flocks, their poor powers of flight, and the nature of diet.

The earliest evidence of domestication of the fowl is from Mohenjo-daro. There are clay figures in which a hen and a chick are shown figuratively (Fig. 111). A number of avian bones were excavated and they are considerably larger than those of the present-day race of fowls.

Among the seals from Mohenjo-daro, Mackay (1938) recognized one with two birds in the position of fighting. He thought that they were Sonnerat cocks, whereas Gandert (1953) regards them as red jungle fowl. There are clay figurines from the same site and they are intended for the fowl. Most of them are fragmentary, but the evidence is cumulative. There is a cock in a position of display, a fragment with a comb and one which Mackay interprets as a hen with a food dish. This would point to breeding in captivity. This is confirmed by Sewell's study of the bones which are larger than those of the wild bird. A femur from Mohenjo-daro measures 103 mm compared with 69 mm in the case of the wild bird. The femur of a modern table fowl (coll. Institute of Archaeology) measures 115 mm, which shows that the Indus Valley birds had been bred for size. Full domestication had, therefore, taken place, say, by 2000 B.C.

At Harappa the fowl is not absent, but there are only two clay figurines that appear to represent a cock and a hen. From Chanhu-daro, clay whistles are known of a shape suggesting small gallinaceous birds.

It is conceivable that the Indus Valley people kept the fowl only for sport, and that its breeding for flesh occurred later. When the Aryans invaded India, about the middle of the second millennium, the newcomers learnt to admire the cock. The Rig-Veda does not mention it, but the Atharva-Veda and Yajur-Veda do. He is praised for his courage and pride, and as an indicator of time. By about 1000 B.C., it was forbidden to eat the fowl. Evidently, the bird had assumed a religious significance.[15]

[15]Zeuner, F.E. *A History of Domesticated Animals*, p. 448

From north-western India, the fowl was taken eastwards and appeared in China towards the fourteenth century B.C.

The period of the rapid expansion of fowl-keeping was the first millennium B.C. From north-western India, it evidently reached Iran at an early date. Whereas this possibility is implied in the coin evidence from north-western India and its appearance on the Assyrian seals around the eighth century B.C., there is substantial literary evidence in addition. In the religion of Zoroaster, it plays an important part as the guardian of the good against the evil. With his crowing at waking time, the cock became the symbol of the waking day and thus of the light, in general. Hahn believes that the use of the cock as a 'time-piece' arose in Indo-Bactria.

From Iran the domestic fowl spread westwards to Mesopotamia and Asia Minor. It is possible that the Medes, who were subject to the Assyrians from the latter part of the ninth century onwards, brought it into the Euphrates-Tigris Basin. A few seals from the eighth century B.C. show the bird. One found at Nimrud dates from 740 to 710 B.C., according to Mallowan.[16]

Its first introduction into Greece was from Iran in the eighth century B.C. In the sixth century B.C., it spread over the rest of the Greek world.

In the second century B.C. the fowl had become an economically important bird with the Romans. In Britain it appeared in the first century of the Christian Era.

The storage of grain and the conservation of live meat in the form of domesticated birds and animals is the major achievement of man in the Neolithic agricultural revolution. 'Plants capture the radiant energy of the sun and reorganize and store it in the production of seeds and vegetable matter. Animals can utilize the stored energy of plants by eating them and their seeds. By domesticating plants, man gains control over the primary food source for animals. By domesticating animals, he gains control over living organisms that eat plants and greatly concentrate the energy they derive in the form of animal protein. Thus man taps the primary source of food energy by controlling plants, and he assures himself high-protein food by controlling animals.'[17] This led to security in food requirements of man and hence to an increase in his population. Thus, domestication of plants and animals is the foundation of civilization. Only when man is freed from worry of getting food that he starts thinking, and this leads to higher things in life, and the development of science and art and of culture.

[16]Zeuner, F.E. *A History of Domesticated Animals*, p. 445

[17]Watson, R.A. and Watson, P.J. The Domesticator of Plants and Animals, in *Prehistoric Agriculture* (Ed. S. Struever), p. 10

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CHAPTER 15

BURZAHOM—A NEOLITHIC RELICT CULTURE IN A REFUGE AREA

c. 2375 B.C.

NEOLITHIC culture is characterized by polished stone axes, crude hand-made pottery with evidence of cultivars of primitive kinds or their wild progenitors.

In the Indo-Pakistan subcontinent, the existence of Neolithic cultures has been established in six different geographical regions: (i) Northern, covering Kashmir, the Kangra Valley in Himachal Pradesh (excavated site, Burzahom); (ii) North-western, covering Baluchistan, Swat and the contiguous areas of the Upper Sind Valley in West Pakistan (excavated sites, Kile Gul Mohammad, Ghaligal and Saraikhola); (iii) Central-eastern, covering Chota Nagpur plateau with its peneplains in various districts of Uttar Pradesh, Bihar, Orissa and West Bengal (excavated sites, Barudih and Kuchai); (iv) North-eastern, covering Assam, Chittagong and the sub-Himalayan regions including Darjeeling (excavated site, Daojali Hading); (v) North Bihar, covering the District of Saran (excavated site, Chirand); and (vi) Southern, covering peninsular India (excavated sites, Brahmagiri, Sanganakallu, Maski, Piklihal, Utnur, Nagarjunakonda, T. Narsipur, Hemmige, Paiyampalli, Tekkalakota, Terdal, Hallur, Palavoy, Kupgal and Kodekal).

BURZAHOM

Burzahom in Kashmiri means the place of birch. In the past this place was possibly covered with a forest of birch (*Betula utilis*).

The megalithic site of Burzahom situated on the Yendrahom Karewa below the Mahadev peak, about 16 kilometres north-northeast of Srinagar, was discovered by De Terra and Paterson in 1936. It was excavated by T.N. Khazanchi, Raghbir Singh and K.M. Srivastava of the Archaeological Survey of India in 1960 and onwards. About nine other sites of Burzahom culture have been discovered in the terraces of the Jhelum River. Allchins are of the view that the finds of ground stone axes in the Kangra Valley in Himachal Pradesh also probably belong to this group.

Excavations at Burzahom up to 3.6 metres, reaching the virgin soil, disclosed three cultural layers. The earliest settlers were 'pit-dwellers' (*c.* 2375 B.C.). Cut into the upper Karewa bed, the pits were circular or oval and varied from $1\frac{1}{2}$ to $2\frac{1}{2}$ metres in depth. The mouth of pit was narrow. The bottom was usually flat, over which ashy deposits were noticed, signifying human occupation. A landing-step was provided in a

deep pit. In one case, two nearby pits were interconnected by means of a small arched corridor plastered with mud. There were niches in the walls. The occurrence of charred reeds and post-holes in one of the pits suggests that a roof of reeds was provided. The pit-deposits yielded polished stone axes, bone tools, and hand-made, mat-impressed steel-grey pottery, which included a deep bowl with pedestal base and a jar with a flaring rim. A few wheel-made burnished sherds of red ware were also noticed.

In a wide and deep pit, with a charred lining, were found a large number of animal bones, especially of the deer, indicating that the pit was used as a communal hearth.

In the succeeding phase, pit-dwellings were abandoned and the inhabitants began living in mud houses built over the ground. The floors of these houses were often plastered and occasionally painted in red ochre. The potter's craft further improved with the introduction of the wheel. Towards the close of the phase, copper came to be used, although sparingly. The people depended largely on hunting and fishing, as is evident from the scenes depicted on carved stone slabs. An engraved stone slab was discovered by Khazanchi fixed in a tank-like rectangular structure, which could be dated 1200-1300 B.C. It depicts a hunting scene. A man holding a spear is throwing it at the hind quarters of the stag. Another in front is shooting an arrow at him. A dog with an uplifted tail is depicted chasing the stag (Fig. 116).

The tools of the people of Burzahom, especially the stone pounders, querns and lunar knives, suggest that there was also some agriculture.

Period III was marked by intrusion of new ideas. Deep and wide pits were cut into the underlying floor-levels of Period II for erecting megalithic structures. In one case, a rubble wall was built over a dwelling-pit. Though no clear plan was discernible, the complex formed a rough semicircle, opening on the south-eastern side. For keeping the stones in position, a dry-rubble packing was provided. About 1.50 metres below the surface was exposed a huge stone of the megalithic complex. One of the megaliths is still standing (Fig. 115).

Burials. Thirteen burials, eight human and five animal ones, were recorded within the habitation-area. They were buried in circular or oval pits, coated with lime from inside. A noteworthy feature of the human burials of Phase II was the use of red ochre on the bones. Four human skeletons were buried in a crouching position. The burials showed both primary and secondary interments. The former showed extended articulated skeletons, and the latter only selected bones. No grave-furniture was noticed. Pet animals or their bones were sometimes deposited with the human remains.

Pottery. The pottery of the Neolithic Periods I and II was characterized by a grey hand-made ware with shades of dull-red, brown, buff

and burnished black surfaces. In the earlier period, the pottery was coarse both in fabric and finish, and was represented by the bowl, vase and stem. In Period II a burnished black ware of medium fabric made its appearance. It included such shapes as the dish, sometimes with provision for a stand, bowl, globular pot, jar, stem with triangular perforations and a funnel-shaped vase. A distinctive type in the grey or black burnished ware was a high-necked jar with a flaring rim, globular body and flat base. On the lower part of the neck were incised oblique notches. Mat-impressions formed exclusive designs on this ware (Fig. 114).

In Period III, the pottery, predominantly of red ware, was generally wheel-made, though the fabric was coarse.

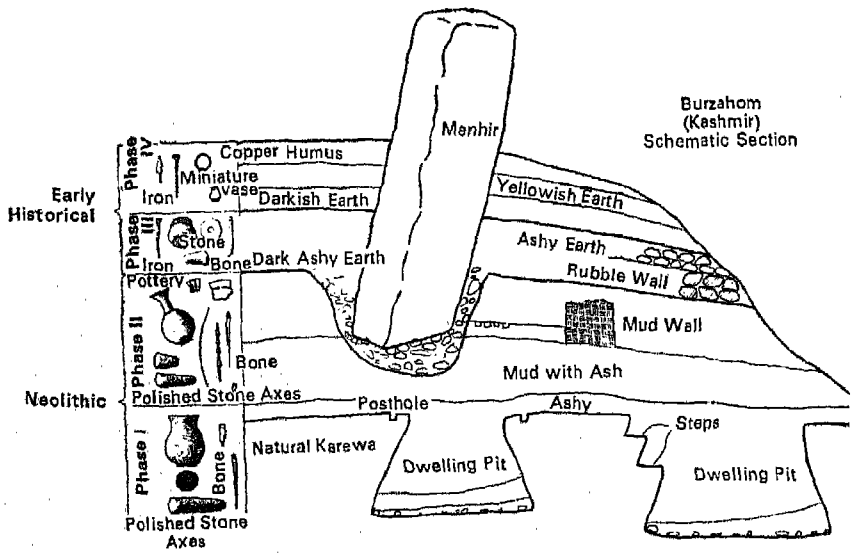

Fig. 114. Schematic section of Burzahom, Kashmir Valley. The lowermost layer has pit dwellings, *c.* 1800 B.C. The menhir marks a burial spot
(Courtesy: Archaeological Survey of India)

Period IV, roughly belonging to an age earlier than the Buddhist site of Harwan, ascribable to the third or fourth century of the Christian Era, yielded a red ware of fine-to-medium fabric, often slipped and mostly wheel-made.

Tools. About 2,000 bone tools were recovered from the excavation. The main types are harpoons for fishing, needles with or without eyes and awls for stitching skins, spear points, arrowheads and daggers for hunting,

scrapers for treating skins, borers, chisels and polishers for working on tools, and perforated knives for agricultural operations. Sankalia observes that the clothing of the people of Burzahom must have been largely of leather, and was cut with flake-knives and stitched with needles and bodkins. Tools were also fashioned out of antlers. The greatest frequency of bone tools was observed in Period II (Fig. 117).

About 1,500 stone objects consisted of polished axes, harvesters, polishers, pounders, chisels and mace-heads (Fig. 118). The larger axes were for heavy work, and the smaller ones for lighter work. The hoes were also of two types; the larger ones were over 10 inches [25 cm] long and 3 inches [7.5 cm] broad. The flake knives were double-edged and one-edged. Double-edged picks, querns and grinders were also found. These are typologically different from their southern counterparts.[1]

Dog Burials. The ritual burial of animals is another feature of Burzahom. Like human beings, animals were buried in oval pits, with their inner sides plastered with lime. The animals found in the burials were wolf, wild dog and ibex. Pet animals, particularly dogs, were sacrificed and buried along with the corpses of the owners, who probably desired their company in the next world. Allchins are of the view that the dog burials, pit dwellings and bone tools suggest the influence of Neolithic culture of northern China. Sankalia believes that it had contact with the pre-Harappan culture of Kot Diji and with the Hissar III culture of Iran.

AGRICULTURE

A crop-cutting instrument with two holes, the like of which has been known from China, indicates that cultivation was practised here (Fig. 118). No direct evidence of cereals grown by the Neolithic Kashmiris has come forth, but seeds of weeds, like *Lithospermum arvense*, species of *Trifolium*, *Lotus corniculatus* and other species of *Lotus*, *Medicago denticulata* and *M. falcata*, and species of *Ipomoea* and *Euphorbia* have been recovered (Fig. 120). Most of these are weeds occurring in cultivated fields, dry pastures and wastelands, and are usually associated with the cultivation of wheat and barley.

Recent pollen analyses carried out in the Haigam Lake, not far away from this site, reveal that the origin of cultivation in the valley started within the blue pine forests which were cleared by the Neolithic man. The climate was much cooler than at present. Subsequent clearances were confined to the broad-leaved forests of oaks and alders which had replaced the conifers. Tree pollen rapidly declines after cutting of the forest-trees, and in its place there is a sharp rise in the pollen of herbaceous plants and the emergence of new weeds which are associated with the cultivation of crops. The cultivation was of a shifting type.

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[1] *Indian Archaeology 1961-62—A Review*, Archaeological Survey of India

Shifting Cultivation. *Jhuming*, or shifting cultivation, is still practised by the tribals in the hilly areas of Assam, Manipur, Tripura, Arunachal Pradesh, Nagaland and Orissa. It is estimated that 338,502 hectares of land was subjected to shifting cultivation in Orissa and 27,287 hectares in Assam (1966).

Sinha thus describes *penda*, or shifting cultivation, practised by the Maria Gonds of the Abujhmar Hills: "The cultural pattern of the Hill Maria centres around the principal subsistence economy of *penda*, shifting cultivation. The technology of shifting cultivation is intimately adjusted to the ecology of Abujhmar Hills."

The *penda* cultivation begins with the felling of trees at a site decided upon by the village elders at a ceremony after the harvest festival, *kaqsar*. The villagers start felling trees after a communal ceremony at the *penda* plot. There is no formal allotment of land, but villagers divide the land by mutual discussion, the size of each plot depending on the number of persons in the household to be fed and capable of doing a full day's work with axe and hoe.

Disputes are practically unknown even today in the Abujhmar Hills, as there is ample land for all. Each *penda* is cultivated for two years, and each year the villagers cultivate a new *penda* and an old *penda*. The conventional cycle of forest regeneration of the Hill Maria is about 18 years.

After the initial operations of clearing, the Hill Marias get ready to set fire to their dried plots. They have the practical knowledge of the local climate, and schedule their firing operations in such a way that the fields receive the monsoon showers within a week.

The village leader goes to the field to start the forest fire and immediately after that each villager sets fire to his respective field. Sowing starts by the third week of June immediately after the break of the monsoon and the date of the first sowing is decided by the headman in consultation with the elders.

Immediately after the completion of sowing, and sometimes in between sowing, the whole *penda* is fenced by wooden logs and bamboos. This is the communal work of all the able-bodied members of the village. The crops cultivated in the *penda* include millets, pulses, small-sized maize, chilli, oilseeds, sweet-potato, arum, pulses and beans. Rice is grown only in semi-permanent or permanent plots near the streams.

Every phase of *penda* cultivation is marked by some rituals. There are rituals for the choice of the *penda* site, the first felling of trees, the first sowing, the harvesting and the eating of the first crops. The *penda* land is considered to be the land of the clan god. When the new grains of the crop concerned have been garnered, the village headman of each village sends word to the *pen-waddai*, or clan-priest, who worships the clan god at his shrine, *pen-rawar*.

Apart from the fact that there is adequate land on the Abujhmar Hills for *penda* cultivation, the collecting and hunting of forest products and animals are an important source of food. Among the forest plants and products, nuts of the *siari*, green mango, *sulphi*-juice, *mahua* flower and seeds, young bamboo shoots and seeds, and various kinds of roots and tubers, and mushrooms are important.

Hunting, an exclusively male occupation, is more popular at the foothills than on the hilltops. Community hunting is generally organized between the harvesting and sowing seasons, the principal game being various types of deer. They also hunt peafowl, jungle fowl and hare. They show a remarkable knowledge of the habits and habitats of the various game animals and birds.

Fishing, on a small scale, is done quite extensively in the hill streams throughout the region. Fishing-rods, various types of bamboo and cane cages and traps are the main fishing-tools.

While the purely hunting-fishing-gathering economy of the Onge of Little Andaman sustains a total tribal population of about 150 today with a density of 0.56 per square mile (1.45 per square kilometre) and an average family size of 3.06 only, the shifting cultivator Hill Maria Gonds of the Abujhmar Hills have a density of about 9.3 per square mile (24 per square kilometre).[2]

POLISHED STONE AXES—THEIR USE

The polished stone axe, prima facie, does not seem to be an efficient tool for cutting trees. How was it used by the Neolithic man? It seems that the Neolithic man had discovered the secret that the life of the tree is in the bark and not in the dead wood in the centre. The bark contains the living cells of the phloem, through which food materials are transported from the leaves to the stem and the roots, and the xylem whose cells pump water from the roots to the leaves. If the bark is removed, the tree dies. It is easy to cut the bark of a tree with the aid of a polished stone axe. The practice of killing trees in this manner is called ring-barking. After the bark is removed in this manner, the tree is left to dry thoroughly and after that it is burnt.

It was estimated by experiment that one man can clear a hectare of forest in five weeks if he uses a stone axe.[3]

During the Neolithic Age, it seems that men cleared large areas of primeval forest with polished stone axes, burnt the clearings and planted small fields of cereals near their huts and used the rest for pasturing animals. An experiment was carried out by two Danish archaeologists, Jorgen Troels-

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[2]Surajit Sinha, Primitive Hunters, Shifting Cultivators, *The Times of India Annual*, 1974

[3]Coles, J.M. 'Experimental Archaeology', *Proc. Soc. Ant. Scot.*, 1966-67, p. 7

Smith and Svend Jorgensen, with Neolithic polished stone axes. They obtained a number of Neolithic flint axe blades from the National Museum in Copenhagen. The axe blades were inserted in a rectangular hole in the haft of ash wood (Fig. 121). It was found that if the haft was not to be split, it must not hold the blade too tightly but must leave room for a little side-wise play of the blade when it struck. They discovered that the proper way to use the flint axe was to chip at the tree with short, quick strokes, using mainly the elbow and the wrist. They concluded that the Neolithic men could have cut large clearings in the forest with their flint axes without great difficulty. After the felled trees had more than a year to dry, brush-wood and branches cut from the trees were spread over the area to be burnt. Then it was ignited along a 30-foot-wide [9-metre-wide] belt by means of torches of burning birch bark attached to stakes. As soon as the ashes cooled down, part of the area was sown with primitive varieties of wheat (einkorn and emmer) and naked barley. The seeds were spread on the ground and raked with a forked branch (Fig. 122). For comparison, two sets of plots were sown—one burned and one unburned but hoed and weeded. The contrast in results was remarkable. On the unburned ground, the grain scarcely grew at all, but the burned ground produced luxuriant crop which was harvested with a flint knife and a flint sickle. In the second year, the burned plots yielded a much smaller crop.[4] This is what happens in *jhum* areas of India. After 2-4 years, the yields decline, and the fields are invaded by tall grasses and weeds, followed by bush and forest. The land is again subjected to *jhuming*. At each turn of the cycle, the soil becomes more and more depleted of plant nutrients and productivity becomes less and less. When *jhuming* is done on hillsides, there is enormous loss of top soil due to erosion.

The polished stone axe is a tool which led to major advancement in the life of the people. It enabled man to cut jungle trees and clear the land for cultivation. It led to the development of carpentry. Thus ploughs, wheels and boats could be manufactured, and wooden houses could be constructed.

A RELICT CULTURE

When one compares Burzahom with Chalcolithic sites of Sind, the Punjab, Rajasthan and Gujarat, one cannot help remarking that it was situated in a refuge area which continued to preserve techniques which had long been superseded in the area which came under the influence of the Harappan Chalcolithic culture. This is not surprising, as even in the present age there are widely different patterns of farming in India. Whereas the Punjab has modern agriculture with the use of tractors, tube-wells, electric

[4]Iversen, Johannes, Forest Clearance in the Stone Age, *Agricultural Beginnings*, 1956

Fig. 115. The megalith at Burzahom, Kashmir Valley

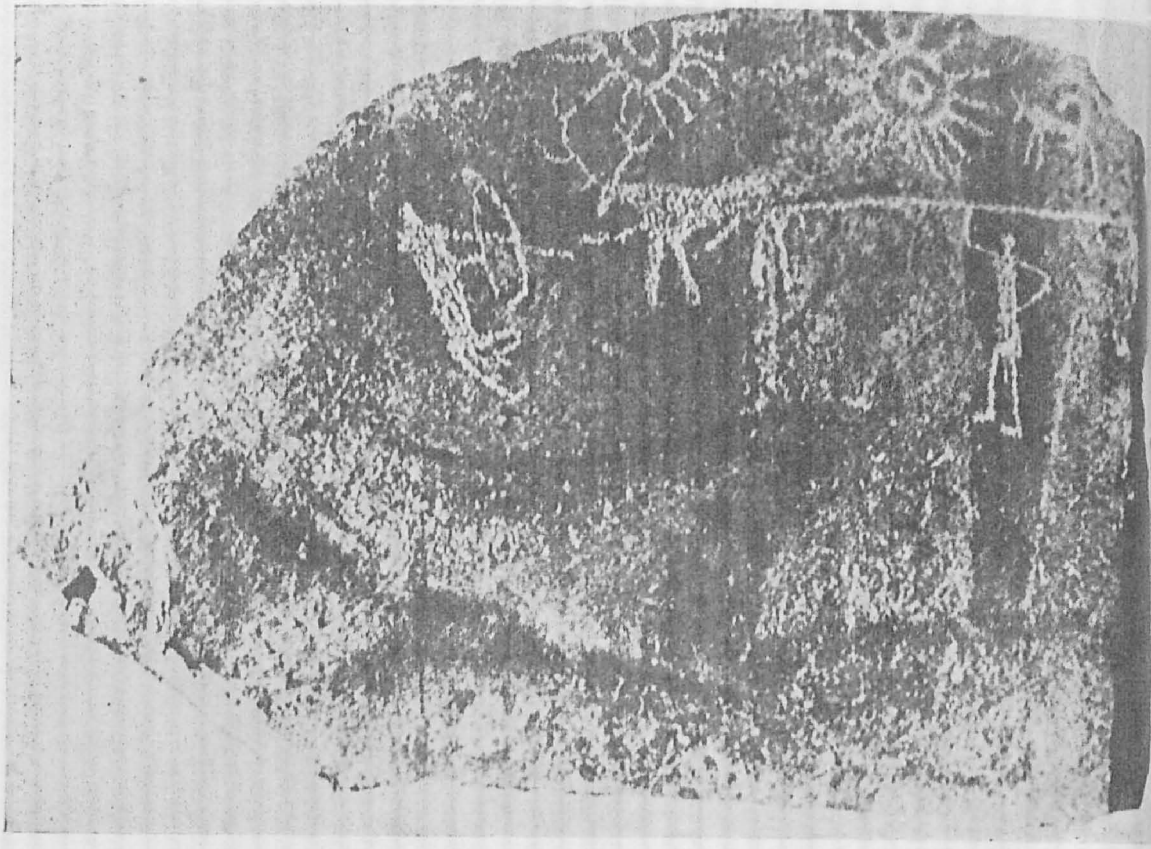

Fig. 116. Hunters of Burzahom holding a stag at bay. The man with a bow is shooting an arrow, and the one behind is flinging a spear. A dog with tail uplifted is chasing the stag
(Courtesy: Archaeological Survey of India)

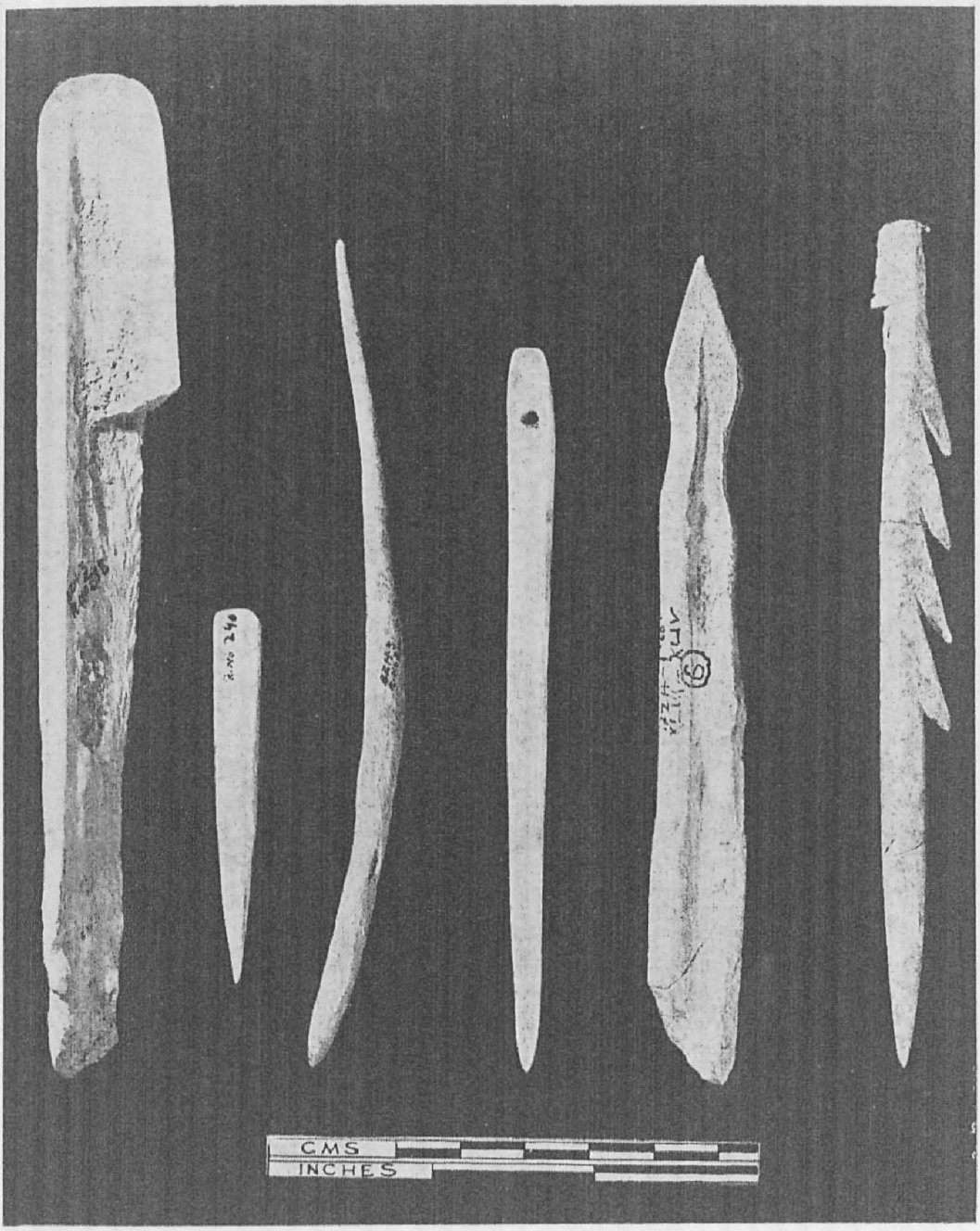

Fig. 117. Bone-tools discovered from Burzahom. The second and fourth from left are needles, and the sixth is a harpoon
(Courtesy: Archaeological Survey of India)

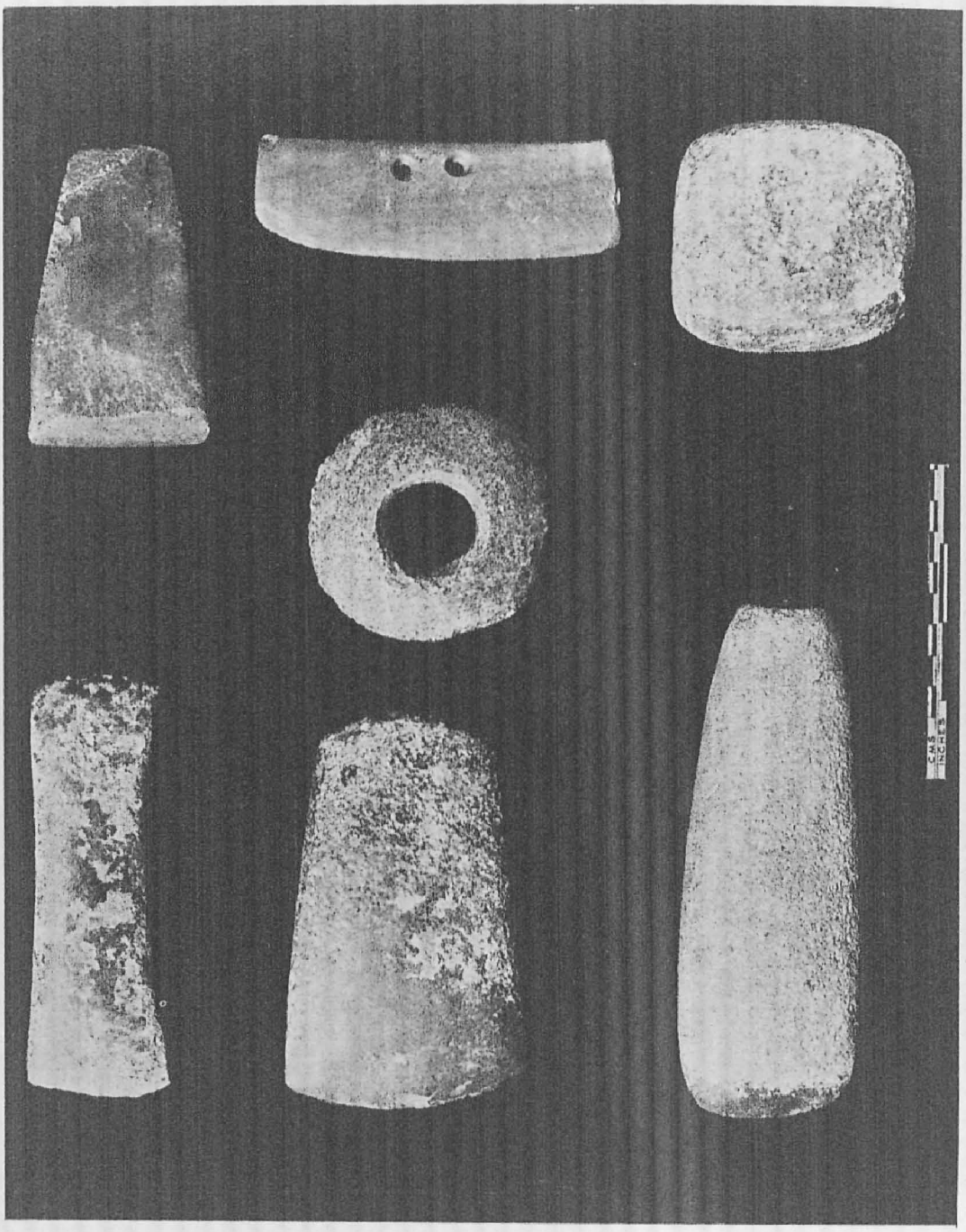

Fig. 118. Polished stone-tools (neoliths) from Burzahom, Kashmir Valley, 1800 B.C. On the top are stone-axes. In the centre is a ring stone and below are a stone-axe and a chopper (Courtesy: Archaeological Survey of India)

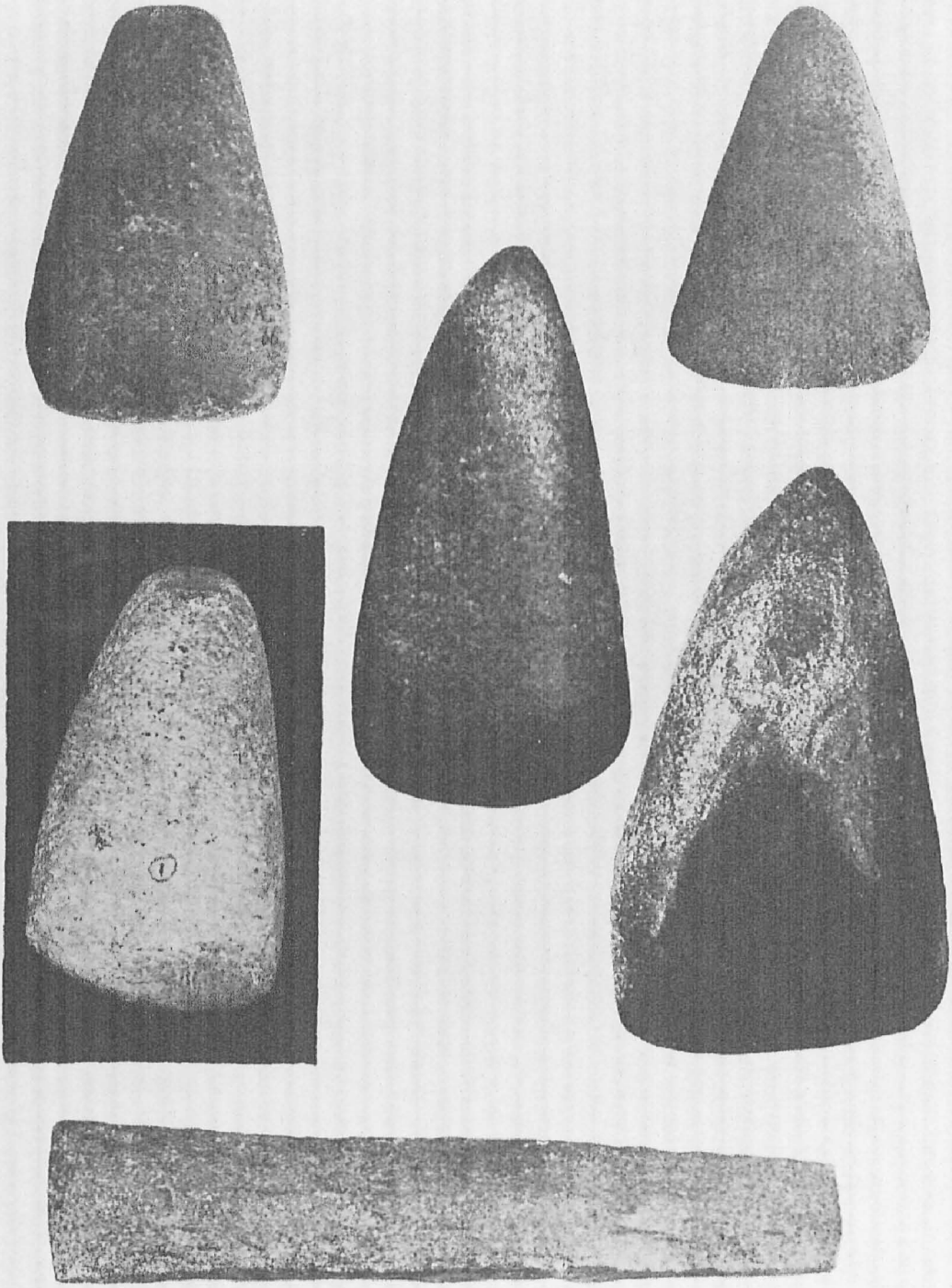

Fig. 119. The Neolithic axe (also called celt or adze), made by the combined techniques of chipping, grinding and polishing, has a sharp convex cutting edge, and the butt end is pointed. These neolithic axes are from different parts of India. The top two are from the villages of Lodhwara, Chakla and Bankat, Karwai Tehsil, Banda District, Uttar Pradesh, collected by A.P. Khatri; the left one in the second row is from a village near Pinjore, Himachal Pradesh; the central axe and the right one on the second row are surface finds from the Raichur District, Karnataka; at the bottom is a chisel from the Raichur District

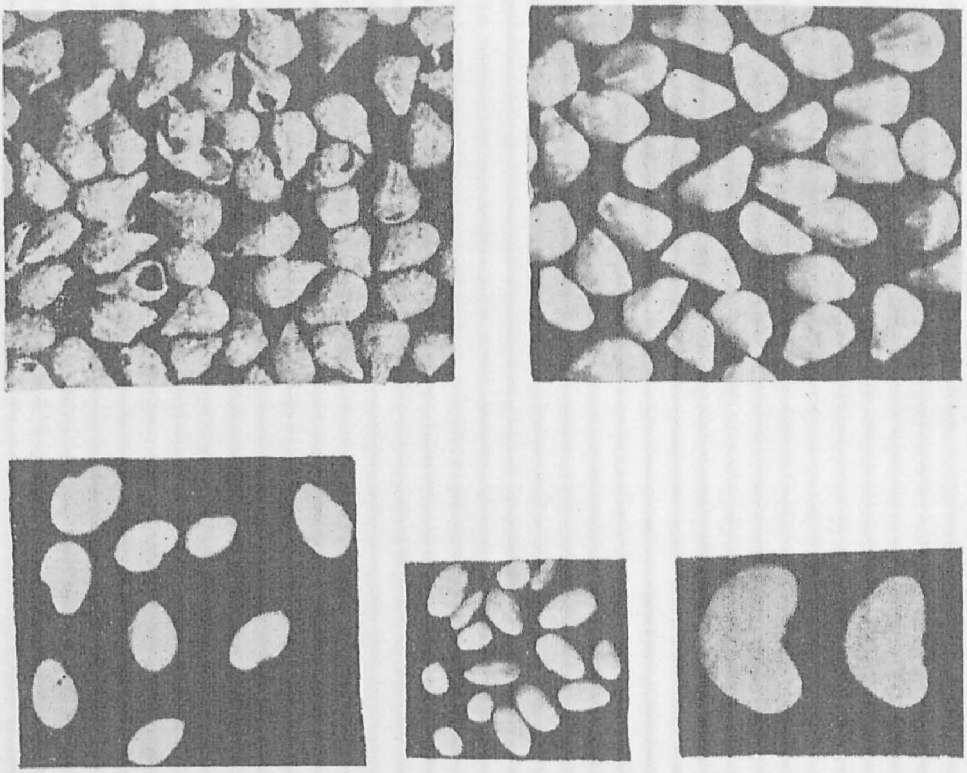

Fig. 120. Seeds of weeds associated with cultivation, from Neolithic of Burzahom, Kashmir. *Left to right: top row, Lithospermum arvense* and *Ipomoea* sp.; *bottom row, Trifolium* sp., *Lotus corniculatus* and *Medicago* sp.
(After Vishnu-Mittre)

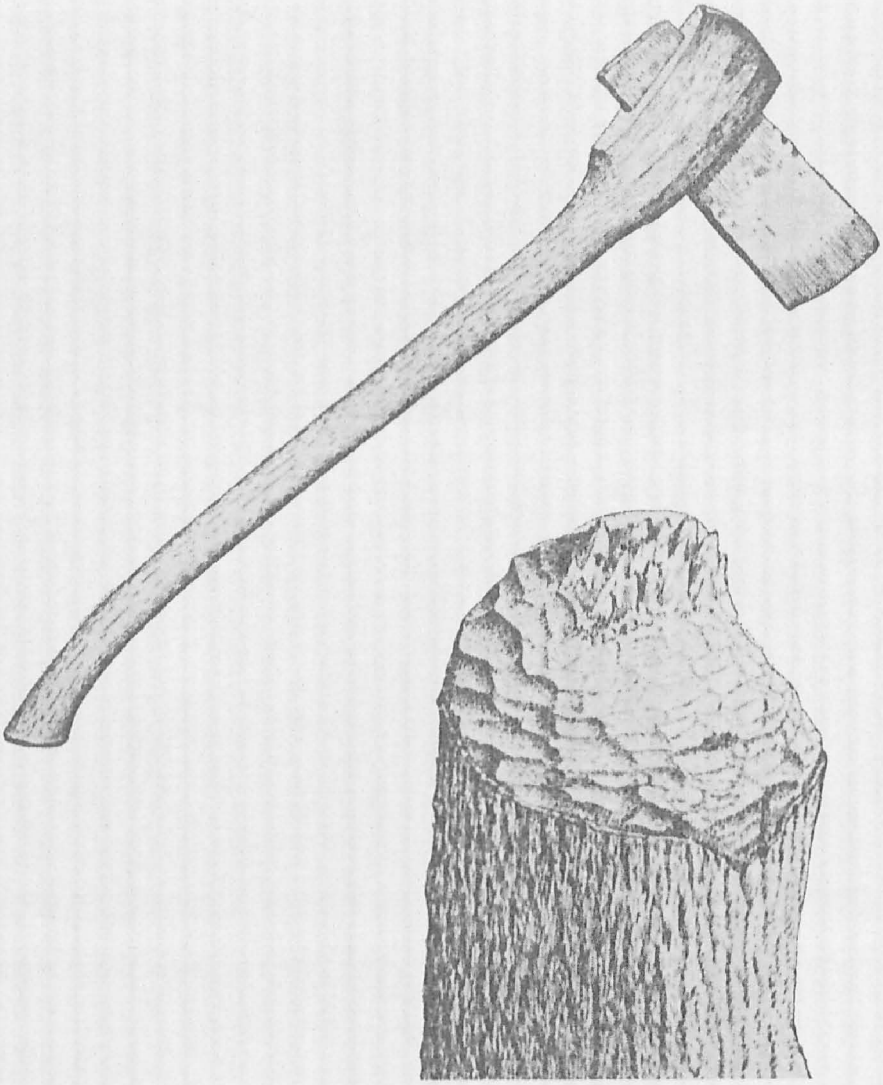

Fig. 121. A stone-axe was reconstructed by mounting the Neolithic flint head on a copy of a Neolithic haft preserved at the bottom of a bog in Denmark. It was found that the full swing of the modern woodsman often chipped or broke the head. Using short, rapid strokes, the experimenters learnt to fell trees having a diameter of more than 30 cm in 30 minutes. To fell small trees, they chopped all the way round the trunk
(After Johannes Iversen)

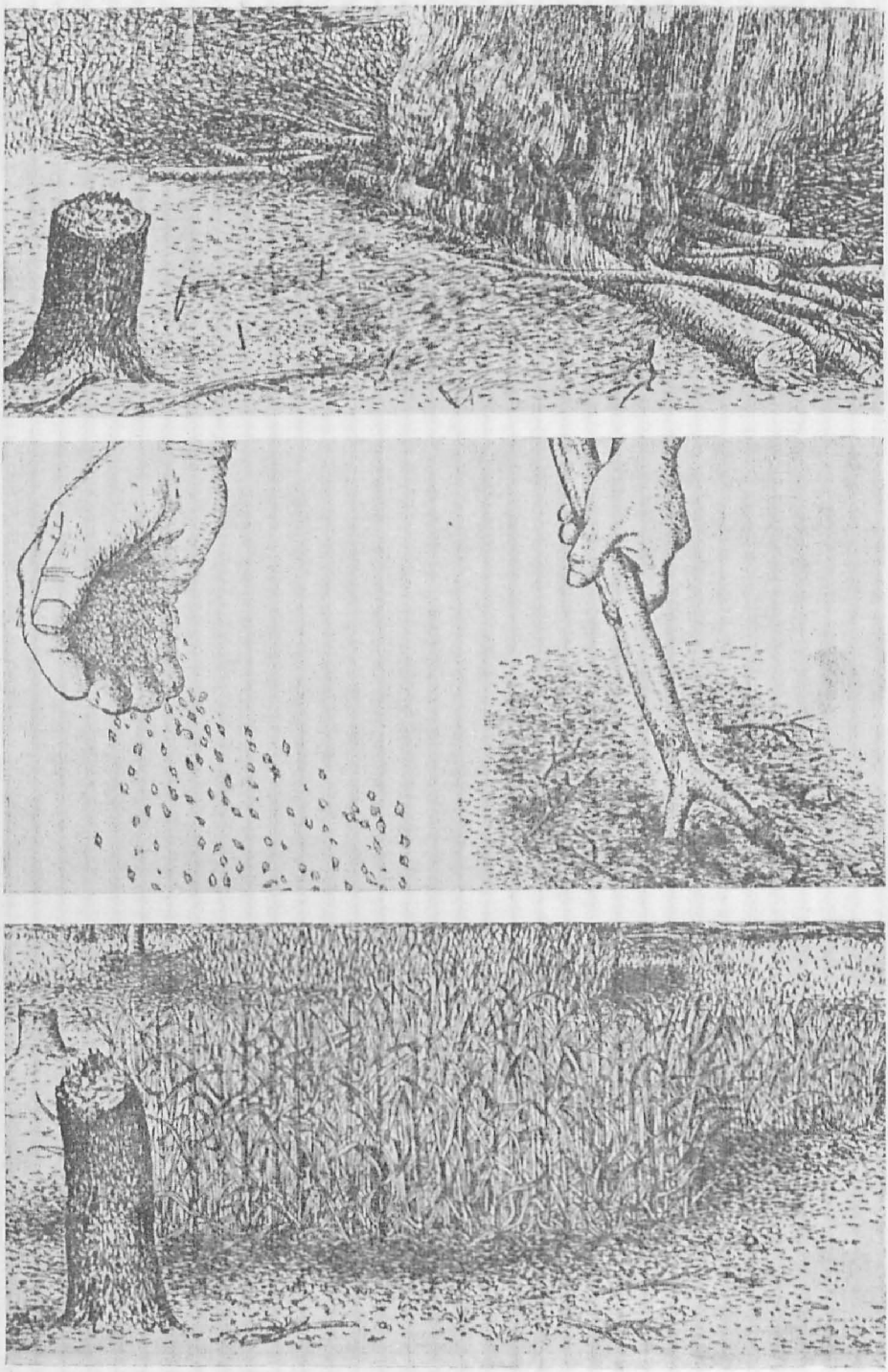

Fig. 122. *Top:* Trees were burnt by covering them with brushwood and igniting a 9-metre strip. When the strip was almost burnt out, the larger logs were used to light the next one. *Middle:* The seed was sown (*left*) by hand in the warm ash, and the seedbed was raked with a forked stick (*right*). The plants sown were barley and two primitive varieties of wheat. *Bottom:* Barley had grown to this height six weeks after it had been sown in the ash of the burnt brushwood and trees. Barley sown in plots not covered with ash grew very poorly

motors, diesel engines, and chemical fertilizers, Orissa, Assam, and large areas in Madhya Pradesh still pursue primitive agriculture. There are jungle tribes in Kerala who still hunt with bows and arrows.

Burzahom also explains the anomalous position of Neolithic cultures in India which, unlike those of other countries, are younger or contemporary with the Bronze Age cultures. Surely, it could be expected that neolithic sites as old as the fifth or sixth millenium B.C. would be discovered in Baluchistan and Himachal Pradesh, which would enlighten us about the beginning of agriculture in the Indo-Pakistan subcontinent. A preliminary report of the French archaeologists about the excavations at the site of Merchrag, about 150 kilometres to the south-east of Quetta on the banks of the Bolan River, points in this direction.

Polished stone axes have been discovered as surface finds from many parts of India. Stone axes in the top row of Fig. 119 were discovered by A.P. Khatri from the Kurwai Tehsil in the Banda District in Uttar Pradesh. They were worshipped as Shiva *lingams* in way-side temples. Stone axes at the centre and right of the second row in Fig. 119, now in the Museum of Evolution of Life, Chandigarh, were discovered as surface finds in the Raichur District, Karnataka. At the bottom is a chisel from the same area.

Recently a neolithic settlement has been discovered by Devendra Handa, about 25 km to the north of Hoshiarpur on the banks of a small river at Dhol Baha. It has yielded pointed butt variety of celts. Polished stone axes have been discovered as surface finds in villages near Pinjore on the Sirsa River, and are kept in the Museum of Evolution of Life, Chandigarh (Fig. 120, *second row, left*). These are indications of Neolithic settlements in the Siwaliks in northern Punjab and Himachal Pradesh. This is a region in which Palaeolithic tools have been discovered at a number of places (Fig. 31). It seems that this area, which has numerous freshwater rivulets, has been inhabited by man from about half a million years onwards.

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CHAPTER 16

NEOLITHIC AND CHALCOLITHIC SETTLEMENTS IN SOUTH INDIA

CULTIVATION OF MILLETS AND PULSES AND DISCOVERY OF SILK

2295 B.C. — 1300 B.C.

ALL over India, ground and polished stone implements of the Neolithic Age have been found, their characteristic material being trap in place of the quartzite used in the Palaeolithic Age. The earliest archaeolithic finds in India were in the Valley of the Tons River in the United Provinces by Le Mesurier in 1860, and they were polished celts of this Age. In 1872, William Fraser located Bellary as the real focus of the Neolithic culture in south India.

Southern Neolithic culture is characterized by burnished grey pottery, polished stone axes and urn-burials. Subsequent to the discovery of a neolithic settlement at Brahmagiri, a number of such settlements were discovered in south India. These are Sanganakallu by Subbarao, Piklihal by Allchin, Maski by Thapar, Utnur and Tekkalakota by Nagaraja Rao. Neolithic settlements in the Andhra-Karnataka region have been discovered at Hallur, T. Narsipur, Hemmige and Nagarjunakonda. In Tamil Nadu, neolithic settlements have been discovered at Paiyamapalli, Gaurimedu and Mangalam. The location of these settlements is shown in Fig. 53a.

How old are these settlements? One of the samples from Utnur gave as early a date as *c.* 2295 B.C. The date for Narsipur is 1805 B.C. and for Tekkalakota 1780 B.C., Paiyamapalli, Sanganakallu, and later phases of Narsipur and Tekkalakota are between 1485 B.C. and 1615 B.C. Sequential changes from core and flake tradition and simple hand-made pottery to more developed wheel-turned pottery and the adoption of copper and bronze tools in the late phase are clearly noticeable. Sankalia thought that Raichur and Bellary were probably the original focus of neolithic cultures in south-eastern India and stimulated the development of similar cultures in Andhra-Karnataka and Tamil Nadu regions. Allchin favours Daimabad in Maharashtra as a focal point which, in its turn, received inspiration from the Harappan cultures and even from Burzahom as far as early pottery is concerned.[1]

NEOLITHIC CULTURES OF ANDHRA-KARNATAKA (PIKLIHAL, UTNUR, NEVASA)

The region in which these cultures flourished is now shared by Andhra Pradesh and Karnataka. The remains of these cultures are found in areas

[1]Sen, S.N. A Survey of Source Material in *A Concise History of Science in India*, p. 9

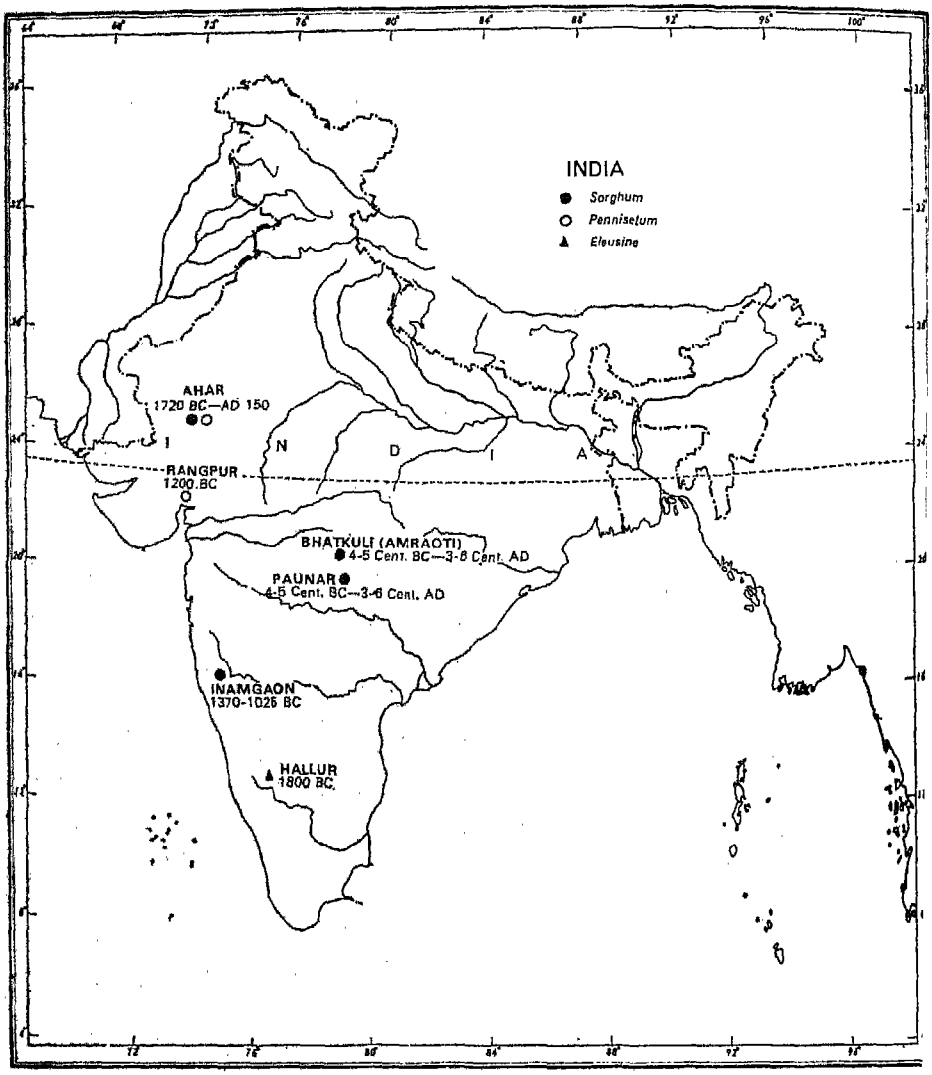

Fig. 123. Geographical distribution of records of millets together with dates in the Indian subcontinent. The earliest record of sorghum is from Inamgaon (Maharashtra), 1370 B.C., that of fingermillet (*ragi*) from Hallur (Karnataka), 1800 B.C., and of pearl-millet (*bajra*) from Ahar, 1720 B.C.
(After Vishnu-Mittre)

with granitoid hills, with dykes, of fine-grained basalt, which is most suitable for manufacturing polished axes. These people lived under overhanging rocks and carried on a primitive type of agriculture in the plains below. They were pastoral people and hunters. This is proved from cinerary mounds, which were large heaps of cattle-dung. Short-horned cattle and long-horned buffaloes, besides sheep and goats, were domesticated. Terracotta figurines from Piklihal depict the zebu cattle. Those shown in rock paintings at Maski are zebu with long, forward-pointing horns, as seen in a terracotta from Chandigarh (Fig. 94). The buffalo is not common. The flesh of cattle seems to have been eaten, as is evidenced by the common occurrence of split and cut bones. Allchin discovered hoof impressions from the floor of a cattle-pen in an ash mound at Utnur. According to him, the size of the larger pens has been inferred to represent herds of 600 to 1,000 animals.

The principal tools of these people were pointed-butt polished stone axes, adzes, chisels, hammerstones, fabricators and microliths. ^{14}Carbon dates from two sites, Piklihal and Utnur, would place their culture around 2100 B.C.

Millets

Millets is a group name for a number of cereals known as coarse grains. Whereas these are grown primarily for their grain, their straw makes valuable cattle fodder. They are annual warm-weather grasses. They are grown under conditions where other crops do not thrive and in regions of low rainfall. Most of the millets are of short duration, i.e. of three to four months' span from seeding to harvest. Their nutritional requirements are low, but they respond well to irrigation and manuring. Some of the millets, particularly *jowar, bajra* and *ragi*, are also grown as irrigated crops in well-manured soils. But they are mostly grown on dry lands as rain-fed crops.

The millets comprise plants belonging to different genera and species, with widely varying habits and characters. The commoner millets cultivated in India are *jowar* (*Sorghum bicolor*), *bajra* (*Pennisetum typhoides*) and *ragi* (*Eleusine coracana*).

Ragi (*Eleusine coracana*). Carbonized grains of *ragi* (*Eleusine coracana*) have been reported from the Neolithic finds of Hallur, about 1800 B.C. in Karnataka (Vishnu-Mittre, 1971). The charred mass, which contains spikelets of *E. coracana*, also contained those of *E. indica*, the wild progenitor of *ragi*. *Ragi* is also called finger-millet on account of resemblance of its stalks with fingers (Fig. 130). It is one of the hardiest crops suited for dryfarming. Its grain is of great nutritive value, and can be stored for many years—even up to 50 years. Its straw is a valuable fodder for cattle. Grains of *ragi* recovered from Hallur are shown in Fig. 129, *top left*. It is noteworthy that Kanataka has the largest area under *ragi*. From Karnataka,

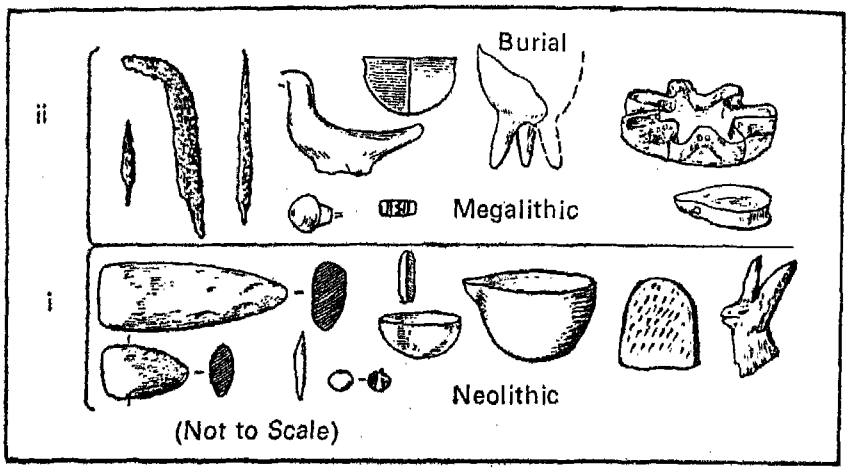

Fig. 124. Two cultural periods at Paiyampalli, District North Arcot (Tamil Nadu)
(i) The Neolithic ground stone-axes, short blades of jasper, agate and chert
(ii) Megalithic iron objects, black and red pottery, tripod burial urn and terracotta lamp with light wicks
(Courtesy: Archaeological Survey of India)

ragi spread to the adjoining Andhra Pradesh, Tamil Nadu and Maharashtra. In these states, *ragi* covers more than two-thirds of the area under it in the country.

Eleusine coracana is a tetraploid, and is regarded as of African provenance. Its presence in India so early as 1800 B.C. is interesting as well as intriguing.

Minor Millets. Minor millets are *korra* or *kangni* (*Setaria italica*), *kodon* (*Paspalum scrobiculatum*), *kutki* (*Panicum miliare*), *cheena* (*Panicum miliaceum*) and *sanwak* (*Echinochloa frumentacea*). Besides, many other allied species, the grains of which are used as food, are reported to be grown to a limited extent, or occur wild near the hilly regions. They are *Setaria glauca*, *S. verticillata*, *Echinochloa colonum*, *E. crus-galli* and *Paspalidium flavidum*. Of these, *kodon* (*Paspalum scrobiculatum*) has been recovered from the early historical site of Ter in the Osmanabad District of Maharashtra (Fig. 131).

Pulses. Carbonized seeds of *kulthi* (*Dolichos biflorus*) have been recovered from neolithic site Tekkalakota, in Karnataka, dated to 1780 B.C. to 1500 B.C. (Fig. 129, *middle row, right*).

PAIYAMPALLI, DISTRICT NORTH ARCOT (TAMIL NADU)
1390 ± 200 B.C.

Phase A contained bone tools and short blades of jasper, agate and chert, besides ground stone axes.

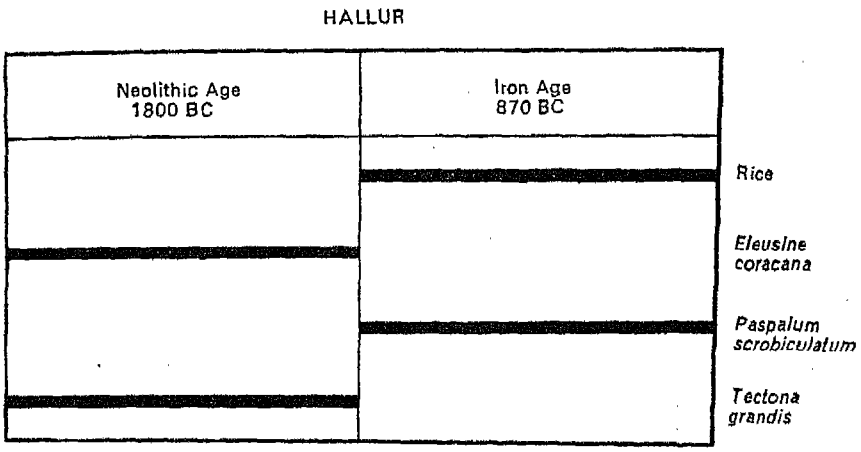

Fig. 125. Foodgrains and timber discovered from Hallur (Karnataka), 1800 B.C. to 870 B.C. (After Vishnu-Mittre)

At Site 1, dwelling-pits of varying depths, cut into the natural soil, oval, circular and oblong, were uncovered. The larger pits had a landing or ramp-like approach on one side. A dwelling-pit lined with stones along the edges showed two phases of occupation. Post-holes along the periphery of some pits suggested the existence of a thatched superstructure over them. Bone tools exemplified by awls, points and scrapers were found in one of the dwelling-pits, besides fragmentary ground axes and short blades of chert and quartz. The ground stone axes revealed all the stages of manufacture, namely flaking, pecking and grinding. Generally, the axes with a pointed butt formed the majority. The mace-heads and perforated stones used as weights for digging-sticks were of particular interest. For domestic use and agricultural operations, short blades of chalcedony, chert and quartz were used as composite tools. The wasteflakes and fluted cores indicated that the blades were made locally.

The Neolithic settlers of Paiyampalli cultivated cereals and pulses. Charred grains of pulses identified as *kulthi* (*Dolichos biflorus*) and *mung* (*Vigna radiata*) have been found in those levels where a few sherds of megalithic pottery occurred in an essentially neolithic habitation-deposit. These may be dated 315 B.C. The skeletal remains from the neolithic levels represented animals of the bovid group, sheep, spotted deer, fowl, pig, jungle cat and rhinoceros. Swamps and thick jungle in the neighbourhood of the Paiyampalli are suggested by the presence of bones of rhinoceros.

CHALCOLITHIC SITES IN THE DECCAN

In the north-western part of the Deccan plateau, traversed by the Narmada and the Tapti flowing westwards and the upper reaches of the Godavari and the Krishna flowing eastwards, a series of chalcolithic sites have been unearthed. These sites are Prakash, Bahal and Tekwada in the Tapti Valley, Daimabad and Nevasa in the upper reaches of the Godavari, Sonegao near the Krishna, Nasik, Jorwe and Chandoli on the plateau itself. An integrated study of this group of Maharashtrian sites has brought to light a number of phases. Daimabad I presents the earliest phase having cultural affinities with Saurashtra and Malwa as also with the upper neolithic phase of Karnataka. Stone axes, perforated ring-stone, a stone-blade industry and a coarse grey pottery form the cultural complex of the first phase. In the second phase, represented by Daimabad II and Prakash IA, copper knife blades, a fine reddish-brown ware and Malwa-type spouted wares appear. Jorwe, Nevasa, Chandoli and Sonegao, which represent the third phase, yield a variety of both stone and copper implements, painted red Jorwe wares with spouts, some lustrous red wares, and fibres of cotton, flax and silk. ^{14}C datings on samples from Sonegao put the Jorwe phase between 1375 and 1290 B.C.; the second phase (Daimabad II, Prakash IA) may be placed between *c.* 1700 and 1400 B.C. by comparison with Navdatoli IIIB and IIIC, and the first Daimabad phase before 1800 B.C.[2]

NEVASA (AHMADNAGAR DISTRICT, MAHARASHTRA), 1500 B.C.

Nevasa is the headquarters of a *taluka* of the same name in the Ahmadnagar District in Maharashtra. It is situated on both the banks of the River Pravara, a tributary of the Godavari, and is about 177 kilometres northeast of Pune. It is an important chalcolithic site in Maharashtra.

A large mound overlooks the river. The portion lying on the left bank is nearly 300 metres long and 100 metres wide. It is called "Lādmod", and is cut up into three smaller mounds. From the water-level it is nearly 21·5 metres high, the top 9 metres or so containing the debris of four cultural periods from 1500 B.C. to A.D. 1500.

The earliest occupants settled on a thick layer of black soil. They cut the jungle with the help of copper and polished stone axes. For the rest of the cutting and clearing, they used short parallel-sided and Gravette-like blades and points of a limpid chalcedony. True saws also occur in this assemblage. The technique by which blades were removed has been described as a "Crested Ridge and Fluted Core" technique, and is a common feature of all the Chalcolithic cultures. Among the heavier tools, we have occasionally mace-head or weight for a digging-stick, small querns, mullers,

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[2]Sen, A.N. A Survey of Source Materials, in *A Concise History of Science in India*, pp. 11, 12

and rubbers. Large querns are comparatively very few, as agriculture was in its infancy. Negativ ly, this is confirmed by the absence of any grains, and the recovery of vast quantities of animal bones, among which those of cattle predominate. Pottery is wheel-made, and is matt with geometric paintings in black over a red surface. It is so well-baked that when struck, it gives a metallic ring. The shapes are again comparatively limited, carinated bowls of various sizes, vessels with tubular spout and flaring mouth and carinated belly, and vessels with globular body and high neck. Among the unpainted group there are storage jars, with finger-tip decoration, basins or troughs and fine black slipped ware with red coating.

The people of Nevasa lived in mud huts which were generally square or rectangular. These were built with the help of thick wooden posts (Fig. 133). The floors were made with lime and clay but at times with a bedding of sand or gravel. The size of the rooms is $2{\cdot}7 \times 1{\cdot}5$ metres. In a corner of the room was a squarish *chulah*.

Burials. Burial within the house was an approved custom. Of the 131 burials found by Sankalia at Nevasa, 126 were of children. This indicates heavy child mortality. Children were normally buried in two urns, placed horizontally facing each other (Fig. 133). Adults were buried in pits dug for the purpose. The body was extended and lay north-south. It seems that before burial the body was exposed and the flesh was allowed to dry up. Feet were cut off and the rest of the skeleton was placed in a pit dug up in the house. This practice was probably adopted to ensure that the soul of the deceased ancestor may not walk off, deserting the family. Pots and pans used by the deceased were placed near the skeleton.

DISCOVERY OF SILK

Several of the burials at Nevasa were endowed with funerary goods, such as small pots and beads made of shell, agate, carnelian and copper. In one burial, a copper bangle was found around the leg-bone of a child; the burial was very rich in pottery as well. The most remarkable find, however, was that of a necklace of 17 barrel-shaped copper beads strung with thread, worn round the neck of a child buried in urns. A.N. Gulati, who examined the thread, is of the opinion that it was of white silk, apparently spun from cocoons on a cotton nep. This is thus the earliest evidence of the use of silk in India.

Bombyx huttoni, the Indian silk moth of north-western Himalayas, is ancestral to several of the domesticated *Bombyx* species according to Zeuner. There are five silk-producing species of *Bombyx* in India. In addition to *Bombyx* silk, there are species of Saturniidae which are the producers of coarser and harder tusser silk. They include *Antheraea mylitta* of India (Fig. 134), which feeds on the leaves of *ber* tree, *Ziziphus mauritiana*.

Gulati found the presence of millet-cells and epidermal hairs, besides

fungal spores, in the earth sticking to the copper beads. This, according to him, would indicate the use of cattle-dung in the burial rite. In addition, he noticed the presence of oil-globules in the material surrounding the string, which suggests the use of oil for anointing the body. Polished celts and an adze were also recovered. The few copper objects included fish-hooks, wires and a bangle.

NAVDATOLI (THE NIMAD DISTRICT, MADHYA PRADESH), 1657 B.C.—1443 B.C.

Navdatoli is a key-site of the Chalcolithic culture of the Narmada basin. Now it is a small hamlet inhabited by boatmen (*nāvdas*). The Narmada, which in the past was below the hamlet, is now about 600 metres away.

Sankalia, who excavated this site, thus describes its culture. 'The inhabitants built round and square or rectangular huts, raised on thick wooden posts. Around these were put bamboo screens, plastered with clay from outside and inside. At Inamgaon in district Poona, huts were constructed in a similar manner (Fig. 138). The floor was also made of clay mixed with cowdung. Both were then given a thick coating of lime, so that the house when first built must have looked spick and span. The size of the largest rectangular room was 20 feet by 40 feet [6 metres by 12 metres]. But sometimes a circular hut was only three to four feet [0.9 to 1·2 metres] in diameter, the largest being of 8 feet [2·4 metres] in diameter. So, it is doubtful, if the small one was meant for habitation. Such small huts might have been used for storing grain or hay. But normally in Period II the size of a room was 10 feet × 8 feet [3 metres × 2·4 metres]. How many persons lived in a room or a house can only be guessed. But, possibly, not more than four in a room of 8 feet × 10 feet [2·4 metres × 3 metres]. Secondly, the settlement was so often rebuilt, as evidenced by house floors, that it is difficult to distinguish the house plans by mere occurrences of post-holes. But judging from the modern village of Navdatoli, one may guess that the prehistoric village might have had 50 to 75 huts, supporting a population of about 200 persons.

'In one house was found a well-made rectangular pit. Its sides are slightly bevelled; all round there are postholes; on either side at some distance is a pot-rest made into the ground, and possibly the remains of a single-mouthed hearth. Inside the pit were found two charred logs of wood and the remains of two pots. These have a high corrugated neck with everted rim, a ribbed ovalish body with one or two incised bands, filled in with lime and a high hollow base.

'These houses were built very close to each other. But between a row of 4 or 5 houses, it appears, there was an open space, like a *chowk*. These houses were furnished, as can be expected of those days and as we find in a farmer's house even today, with earthen pots for storing, cooking and drink-

ing. The large storage jars were strong and sturdy but generally decorated with an engraving along the neck. But what surprises us and delights our eye is their "table service", or dinner set. It is this which distinguishes these Early Navdatolians from the modern primitives like Santals and other tribes in Chota Nagpur, for instance. The Navdatolians had a large number of pottery vessels which according to their fabric, shapes and designs fall into four distinctive groups, each having certain shapes and designs associated with a particular period. The most common is a pale-red slipped fabric with paintings in black over it. Since this occurs throughout Malwa (an old geographical name for parts of Central India), it is called the "Malwa Ware". This occurs as a major pottery fabric right from the first occupation and runs through the entire Chalcolithic habitation. However, in the earliest period only certain shapes and designs figure, both becoming more varied later.

'Then there is a sprinkling of black-and-red ware, with paintings in white, comprising generally bowls with gracefully inturned sides and cups. This fabric is confined only to Period I, and seems definitely to be an import from the adjoining region of Rajputana, where at Ahar it occurs in profusion.

'The third important fabric is the white-slipped one. It is associated with the first two periods only, but died out later. It has several gradations in slip and texture, but the finest is smooth, lustrous and slightly greenish-white.

'Though it copies some of the shapes of the Malwa ware, its own distinctive shapes are a shallow dish with broad, flat rim and stand, and a high concave-walled cup with bulging bottom. An almost complete bowl of the latter in fine white slip recalls a similar vessel from the earliest period at Sialk, in Iran. A band of running antelopes and dancing human figures seem to be characteristic designs.

'A number of querns were found, as they were left by their users, right on the kitchen floor, near *chulhas* or hearths. The *chulhas* were quite large, made with clay and thinly plastered with lime. It is, however, not to be presumed that the inhabitants were strictly vegetarians. In the debris of their houses have been found remains of cattle, pig, sheep, goat, and deer. Except for the last, all must have been domesticated and eaten. But since the grains were varied and plentiful they relied less on animal food, and hence their remains are comparatively few in number as compared to those from Nevasa.

'The early inhabitants of Navdatoli were fairly well off. They were essentially farmers or peasants, though a section might be living by hunting and fishing. They used copper but sparingly in the shape of simple, flat axes (Fig. 135), fish-hooks, pins and rings. In a later phase possibly they used daggers or swords with a midrib. So for their daily needs of cutting

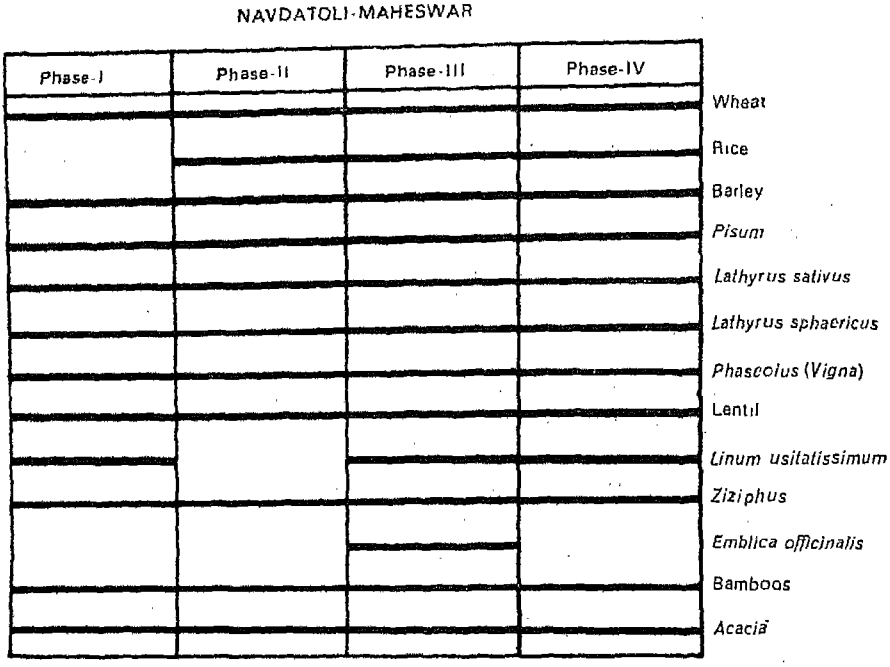

Fig. 126. Foodgrains, fruit and timber discovered from Navdatoli-Maheswar (After Vishnu-Mittre)

vegetables, scraping leather and piercing stone, they had to rely upon stone tools; their blades are so small that we call them "microliths". These were hafted in bone and wooden handles.

'The stalks of the crops were probably cut with sickles set with stone teeth, as thousands of such stone tools have been found.'[3]

CULTIVATION OF PULSES

Apart from two types of wheat and seeds of linseed (*Linum usitatissimum*), Navdatoli had five kinds of pulses, viz. (i) *masur*, or lentil (*Lens culinaris*), (ii) *urd*, or *mash* (*Vigna mungo*), (ii) *mung*, or green-gram (*Vigna radiata*), (iv) *khesari* (*Lathyrus sativus*), and (v) *Lathyrus* sp., besides four other leguminous weeds. This is the first record of pulses from India and shows their antiquity (Fig. 137).

Mung (Green-gram). Grains of *mung* were discovered at Navdatoli. This discovery indicates that this pulse was eaten by the people of Navdatoli.

[3]Sankalia, H.D. From Food Collection to Urbanisation in India, *Indian Anthropology, Essays in Memory of D.N. Majumdar*, pp. 89 to 93

Botanical evidence shows that the original home of *mung* is India. A wild relative of *mung*, *Vigna sublobata* (*Phaseolus sublobatus*) is found in the *tarai* jungle near Pantnagar, District Naini Tal. It is immune to yellow mosaic virus and is used in plant breeding. From India, *mung* spread to other countries in the ancient times. The regions between Afghanistan and the Soviet Republics of Tadjikistan and Uzbekistan have been proposed as the secondary homes of this pulse.

Mash, Urd (Black-gram). *Mash* was consumed as a pulse crop by the Chalcolithic (*c.* 1500 B.C.) people of Navdatoli, as already stated. In the Vedic (before 800 B.C.) and post-Vedic periods, *mash* enriched the Indian diet and cookery to a great extent. In fact, it was so much accepted in the ancient Indian culture that it was even used in the socio-religious ceremonies. It began to be used as a horse food from the Maurya and Sunga periods (300 B.C. to A.D. 75). The Sanskrit name *mash* gave origin to the word *masha*, used as a unit of weight in India. Botanical evidences suggest that the original home of *mash* is India, where it seems to have been first domesticated. From India this pulse spread to other countries in the ancient times and its spread is closely connected with the cultural histories of the recipient countries. The regions between Afghanistan, Soviet Republic of Tadjikistan, Uzbekistan and Western Tian Shan are proposed as the secondary homes of this pulse.[4]

Masur. The history of *masur* (*Lens culinaris*) is complicated. It was consumed by the Chalcolithic (*c.* 1500 B.C.) people of Navdatoli, as already stated. In the Vedic (before 800 B.C.) and post-Vedic periods, *masur* enriched the Indian diet and cookery. The fact that the *masur* pulse was interdicted in the *sraddh* ceremony would indicate its exotic origin. However, it was only after A.D. 1000 that *masur* was accepted as a sacred gift to Brahmins. It began to be used as a horse food after A.D. 800 but it was considered to be of lower quality than gram. Fig. 127 illustrates a *masur* plant with pods.

Vavilov proposed four centres of origin for *masur*, viz. the Central Asiatic Centre, the Near Eastern Centre, the Mediterranean region extending from N.W. India, Kashmir, N.W. Pakistan, Afghanistan and Soviet Republics of Tadjikistan, Uzbekistan and West Tian Shan, the interior of Asia Minor, the whole of Transcaucasia, Iran and the highlands of Turkmenistan, the Mediterranean region extending to Abyssinia, Eritrea and Somaliland. Helback believed the Anatolian-Caucasian region as the centre of origin of the *masur* pulse, from where it spread to Europe at an early date. The earliest record of *masur* is from Jarmo in Iraq, dating to the seventh millennium B.C. Renfrew considered Greece to be the centre of the origin and domestication of the *masur* pulse. The fact that the *masur* pulse

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[4]Mehra, K.L. History of *Mash* Pulse in India, V.I.J. Vol. III, 1970

Fig. 127. *Lens culinaris* (lentil)

was identified among the plant remains of an early neolithic habitation (6220 ± 150 B.C.) in Nea Nikomedia (N. Greece) would point to its ancient cultivation in Europe. Once domesticated as a cultivated plant in Europe, the *masur* pulse spread to Egypt and eastwards to India. Once grown in India, *masur* has enriched the Indian diet and cookery to such an extent that many of us hardly feel that it was first domesticated in ancient Europe.[5]

Pulses are now grown over one-seventh of the cultivated area of India.

[5]Mehra, K.L. History of *Masur* Pulse in India, V.I.J. Vol. X, 1972

They figure prominently in the crop rotations and crop mixtures practised by the farmers. They are legumes and, hence, help to maintain soil fertility. They are rich in proteins and supply the major part of the protein requirements of the population of India.

MILLETS

Jowar (Sorghum bicolor). Sorghum, or *jowar* as it is known in India, is an African plant. In Fig. 142, the stalk of a *jowar* plant is shown. Its cultivation started in East Africa 5000-7000 years ago. Its earliest record in India is from Ahar, Rajasthan, 1725 B.C. Its earliest record in Maharashtra is from Inamgaon, 1370 B.C. Its next record is from Bhatkuli, District Amraoti, fifth century B.C. and Paunar, third century B.C. From these centres, it seems, *jowar* spread to Karnataka, Andhra Pradesh and Madhya Pradesh.

At present, there are about 18 million hectares under *jowar*, with a production of 9 million tonnes of grain. *Jowar* occupies more area in India than any other food crop except rice. Maharashtra, Karnataka, Madhya Pradesh, Andhra Pradesh, Gujarat, Rajasthan, Uttar Pradesh, and Tamil Nadu, in that order, are the States where grain sorghum is chiefly grown. The largest area under *jowar* is in Maharashtra, i.e. to the extent of 34 per cent. Its grain is roasted when it is green. When ripe and dry, it is the favourite cereal of the Maharashtrians. There are two main types with regard to stem character: the pithy or dry stem, and the juicy stem. The stalks of the juicy type are relished by cattle.

About 25 species of *Sorghum* are found in India. Of these, about 12 species with a number of varieties and forms belong to the series Sativa, and are grown to a greater or lesser extent for their grain in different parts of the country; their stems and leaves are used as fodder. The most important among these are *S. cernuum*, *S. durra* and *S. subglabrescens*. The rest of the species are the so-called wild sorghums, although many of them are also grown for fodder; of these, *S. halepense* is widespread in India.

OILSEEDS

Linseed. Carbonized seeds of linseed (*Linum usitatissimum*) were found at Navdatoli (Vishnu-Mittre, 1962). Madhya Pradesh, Uttar Pradesh and Maharashtra are the main linseed-growing areas. It is noteworthy that the nuclear area, viz. the area from where the seeds were first reported, is surrounded by the area in which the crop has spread most. The total area under linseed in India is now about 1·37 million hectares, with a total annual production of about 370,000 tonnes.

Castor. A carbonized seed of castor (*Ricinus communis*) has been discovered from Ter in Maharashtra, 150 B.C. to A.D. 100 (Vishnu-Mittre, 1968).

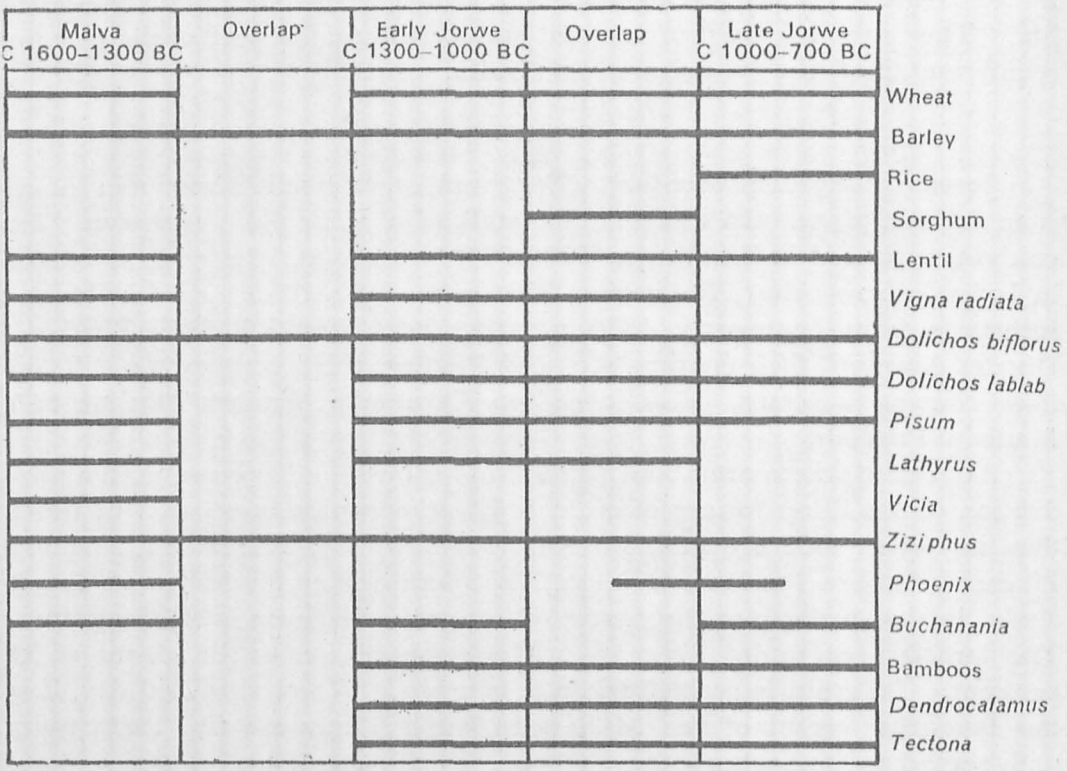


Fig. 128. Seeds of crops, fruits and timber recovered from Inamgaon (Maharashtra), 1600 B.C. to 1000 B.C.
(After Vishnu-Mittre)

Castor had its origin in India and North Africa. India, after Brazil, is the second largest producer of castor seed with about 26 per cent of world production. Castor is mainly grown in Andhra Pradesh, Karnataka and Maharashtra.

FRUITS

Ber (Ziziphus nummularia). Carbonized fruits of *ber* (*Ziziphus nummularia*) were found at Navdatoli (1660-1400 B.C.), and also from Kaundinyapur, Ter, and Inamgaon (Vishnu-Mittre) (Fig. 126). Wild *ber* grows all over India and Pakistan. In the food-gathering stage, it provided a fruit diet to the hunters. Its fruit is eaten fresh and is also sun-dried for storage.

Amla (Emblica officinalis). Carbonized seeds of amla (*Emblica officinalis*) dated 1600 B.C. were found at Navdatoli (Vishnu-Mittre). The *amla* fruit is rich in vitamin C. It is pickled and candied. Its medicinal

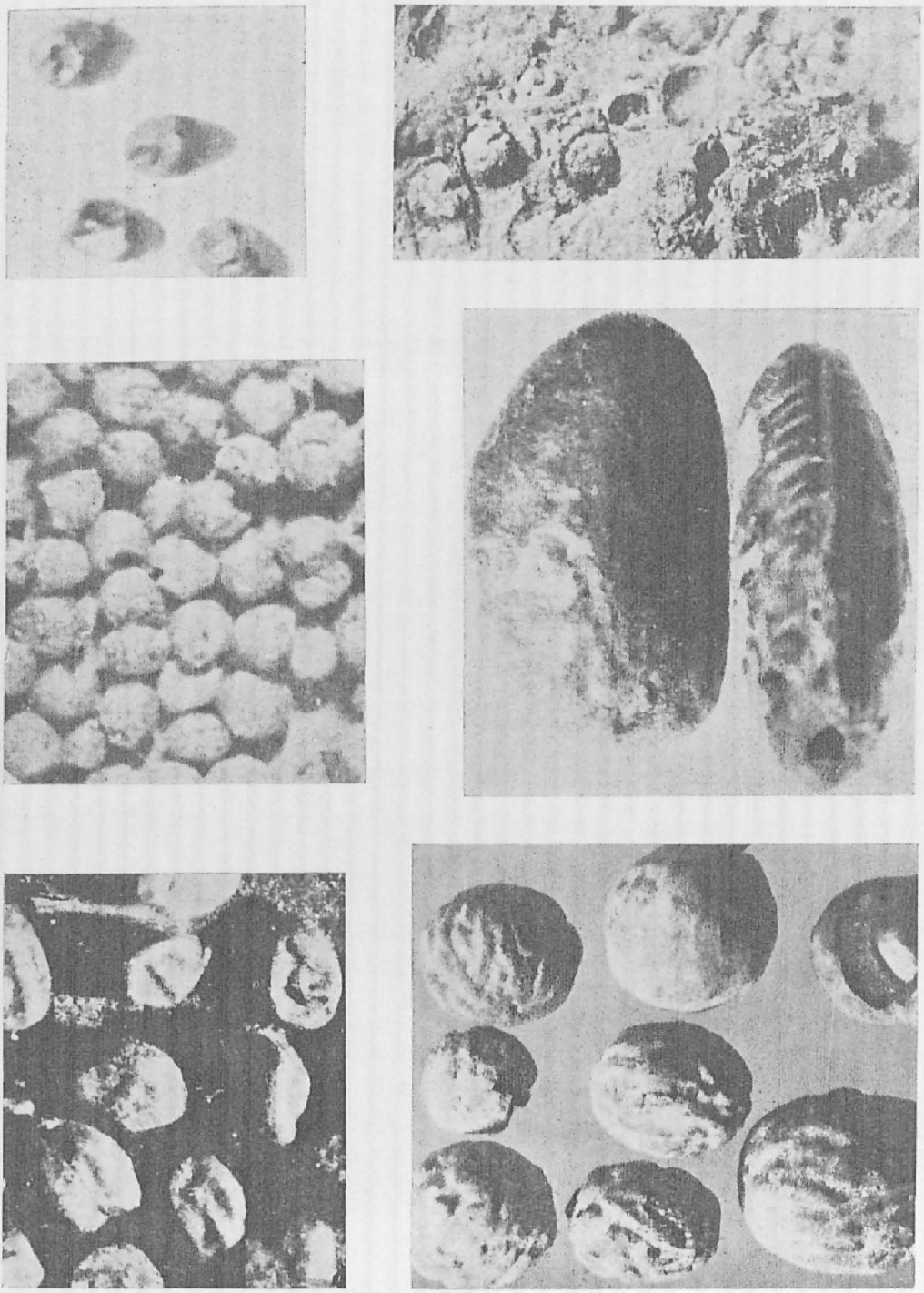


Fig. 129. Seeds of sorghum, gram and other crops from prehistoric sites
Top row, left: Eleusine coracana, Hallur, Karnataka, 1800 B.C.; *right*, impressions of *Sorghum* spikelets on a pots-herd from Ahar, Rajasthan
Middle row, left: Sorghum sp., carbonized grains from a charred mass, Bhatkuli, Maharashtra, fifth century B.C.; *right*, *Dolichos biflorus*, Tekkalakota, Karnataka, 1780 B.C.
Bottom row, left: Cicer arietinum, Bhatkuli, Maharashtra, fifth century B.C.; *right*, carbonized fruits of *Ziziphus nummularia* from Malva-Jorwe site, Inamgaon, Maharashtra
(After Vishnu-Mittre)

Fig. 130. Finger-millet, or *ragi* (*Eleusine coracana*), is commonly grown in Karnataka as a food crop
(Courtesy: Indian Agricultural Research Institute)

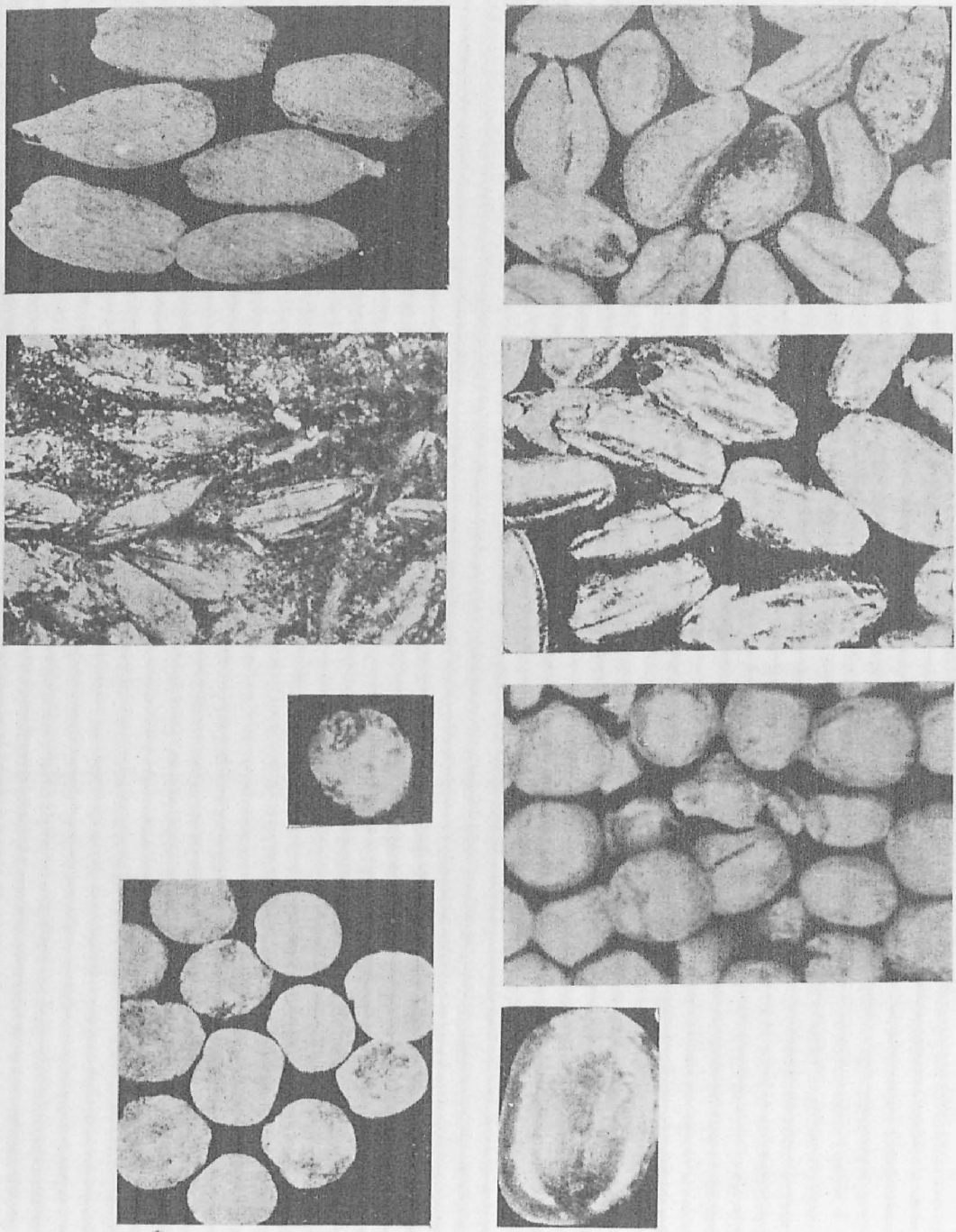
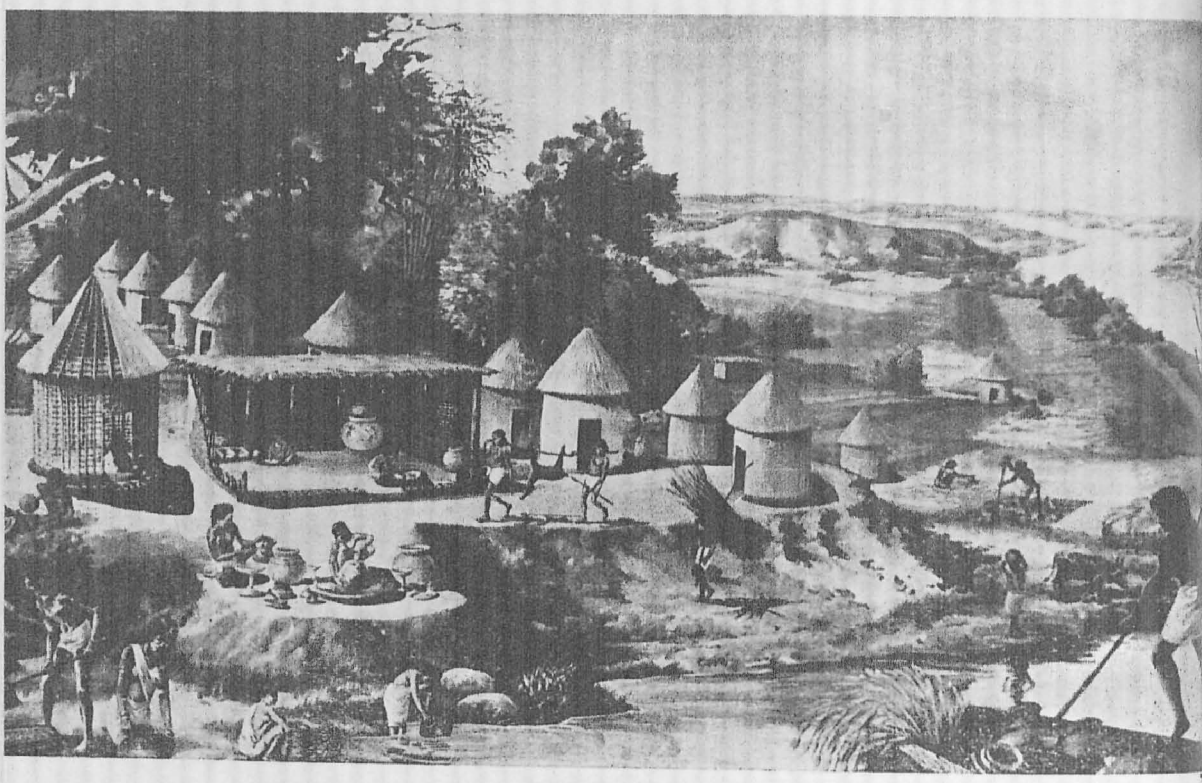


Fig. 131. Seeds of crops from early historical site of Ter, Osmanabad, Maharashtra
First row, left: Hordeum sp.; *right, Triticum sphaerococcum*
Second row, left: Carbonized spikelets of rice from a charred mass; *right,* spikelets of *Oryza sativa*
Third row, left: Paspalum scrobiculatum; right, Pisum sativum
Fourth row, left: Lens culinaris; right, Ricinus communis

Fig. 132. Reconstruction of the Chalcolithic village of Navdatoli, *c.* 1500 B.C. The inhabitants of Navdatoli lived in rounded huts raised on thick wooden posts. Around the framework were bamboo screens coated with clay and lime
(After H.D. Sankalia)



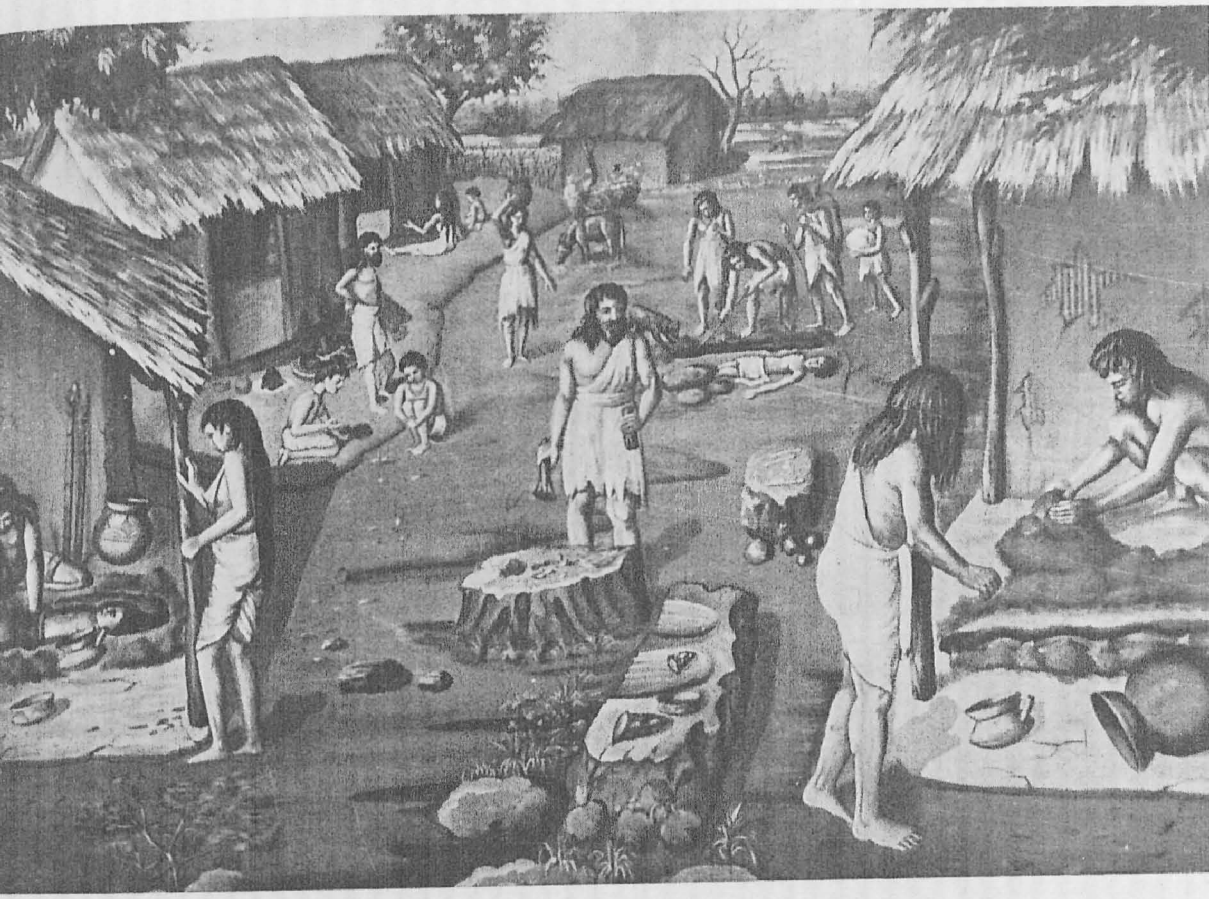


Fig. 133. Life and death at Nevasa, Chalcolithic, *c.* 1300 B.C. In the foreground is a potter's hut. Spouted pot and vessel with flaring mouth are his products. The corpse of a child is being buried enclosed in a pitcher. On a slab are polished stone-axes
(Reconstruction by H.D. Sankalia)

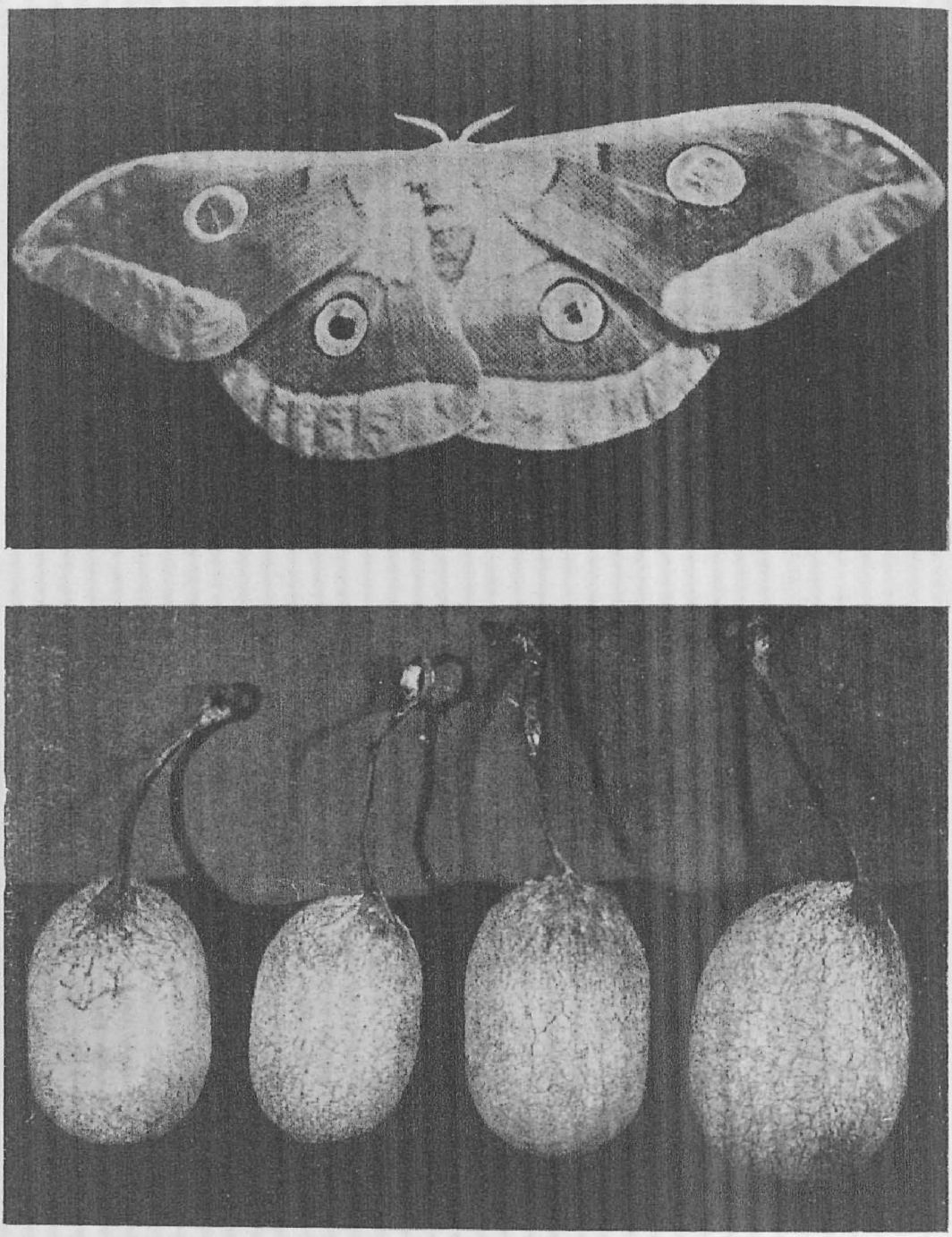


Fig. 134. *Antheraea mylitta*, the tusser silk moth (female). Below are the cocoons from which silk is spun out
(Courtesy: Indian Silk Board)

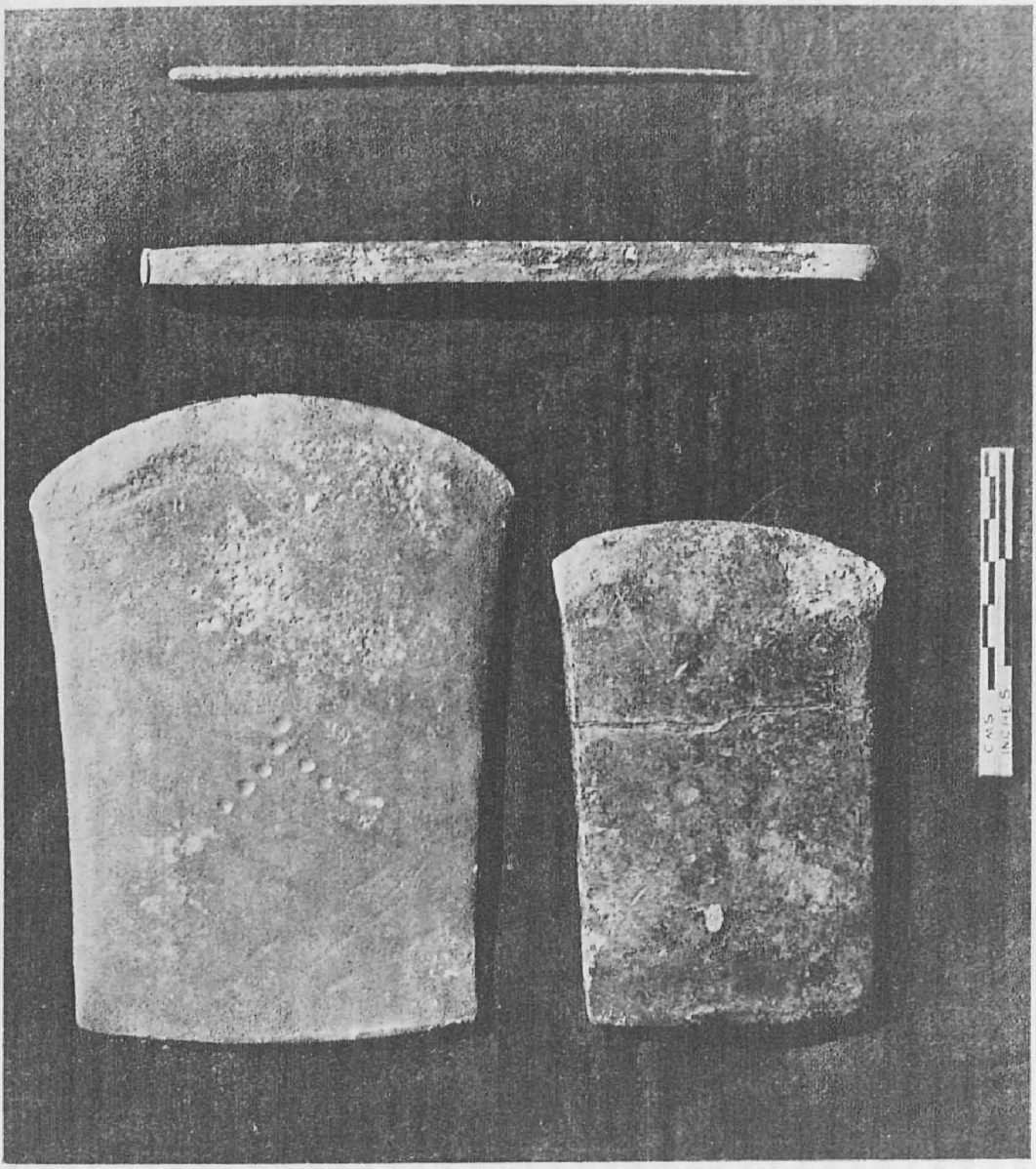


Fig. 135. Copper implements from Navdatoli (Madhya Pradesh), 1400 B.C., Nevasa (Maharashtra) and Jorwe (Maharashtra)
(Courtesy: Archaeological Survey of India)

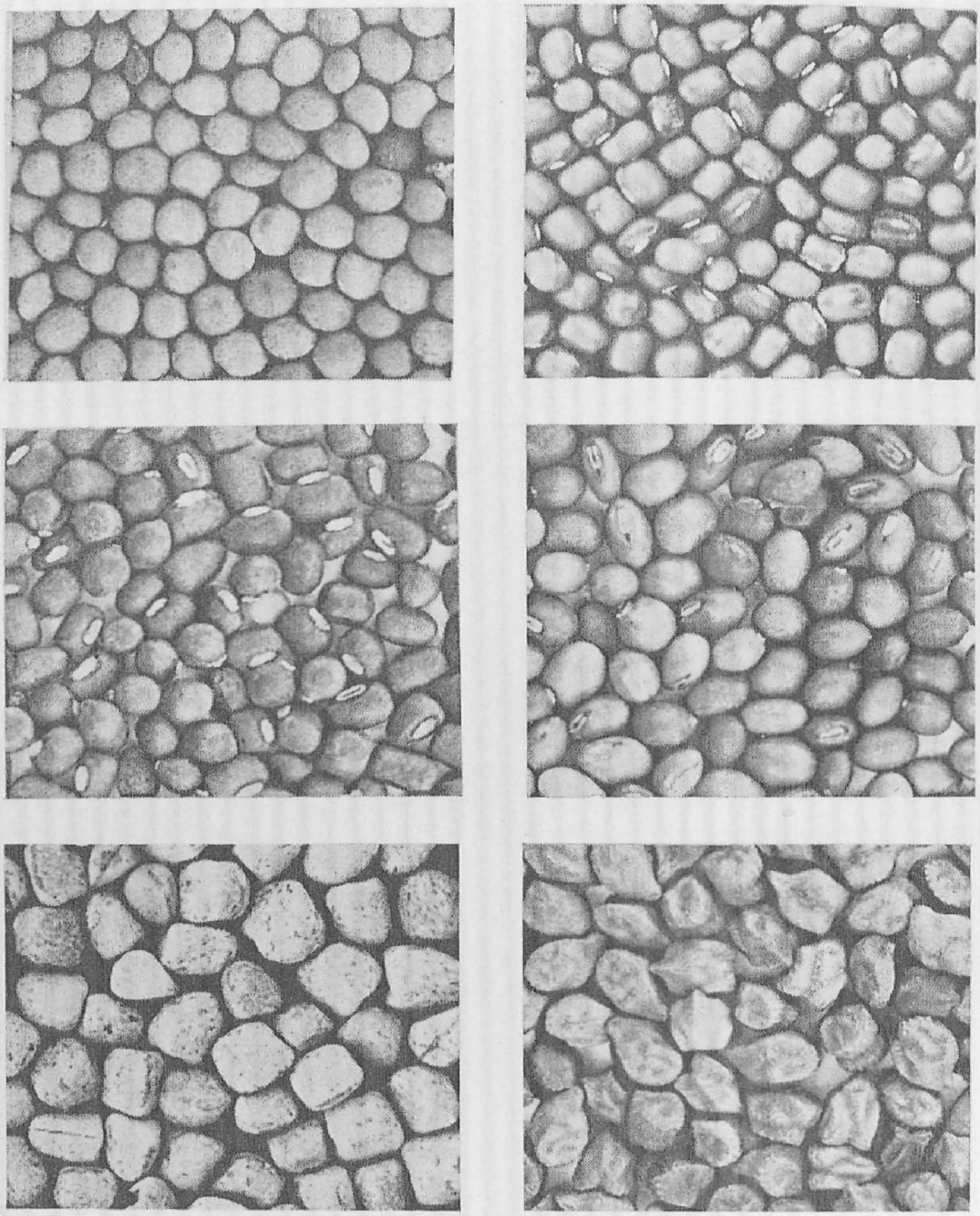


Fig. 136. Seeds of pulses
First row: Lens culinaris and *Vigna radiata*
Second row: Vigna mungo and *Cajanus cajan*
Third row: Lathyrus sativus and *Cicer arietinum*

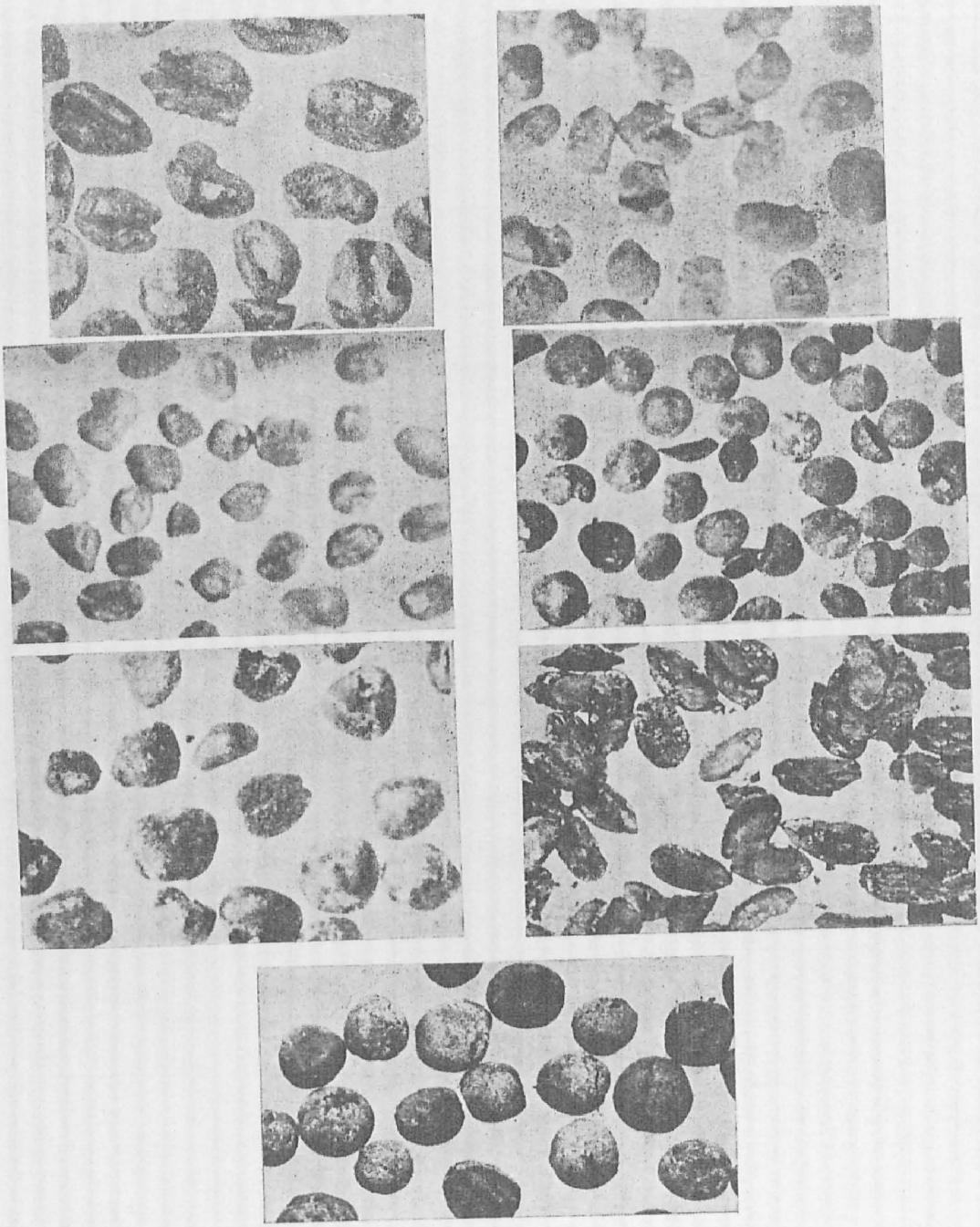


Fig. 137. Seeds of crops from Navdatoli-Maheswar
First row: Triticum aestivum and *Vigna mungo*
Second row: Vigna radiata and *Lens culinaris*
Third row: Lathyrus sativus and *Linum usitatissimum*
Bottom: Pisum sativum
(After Vishnu-Mittre)

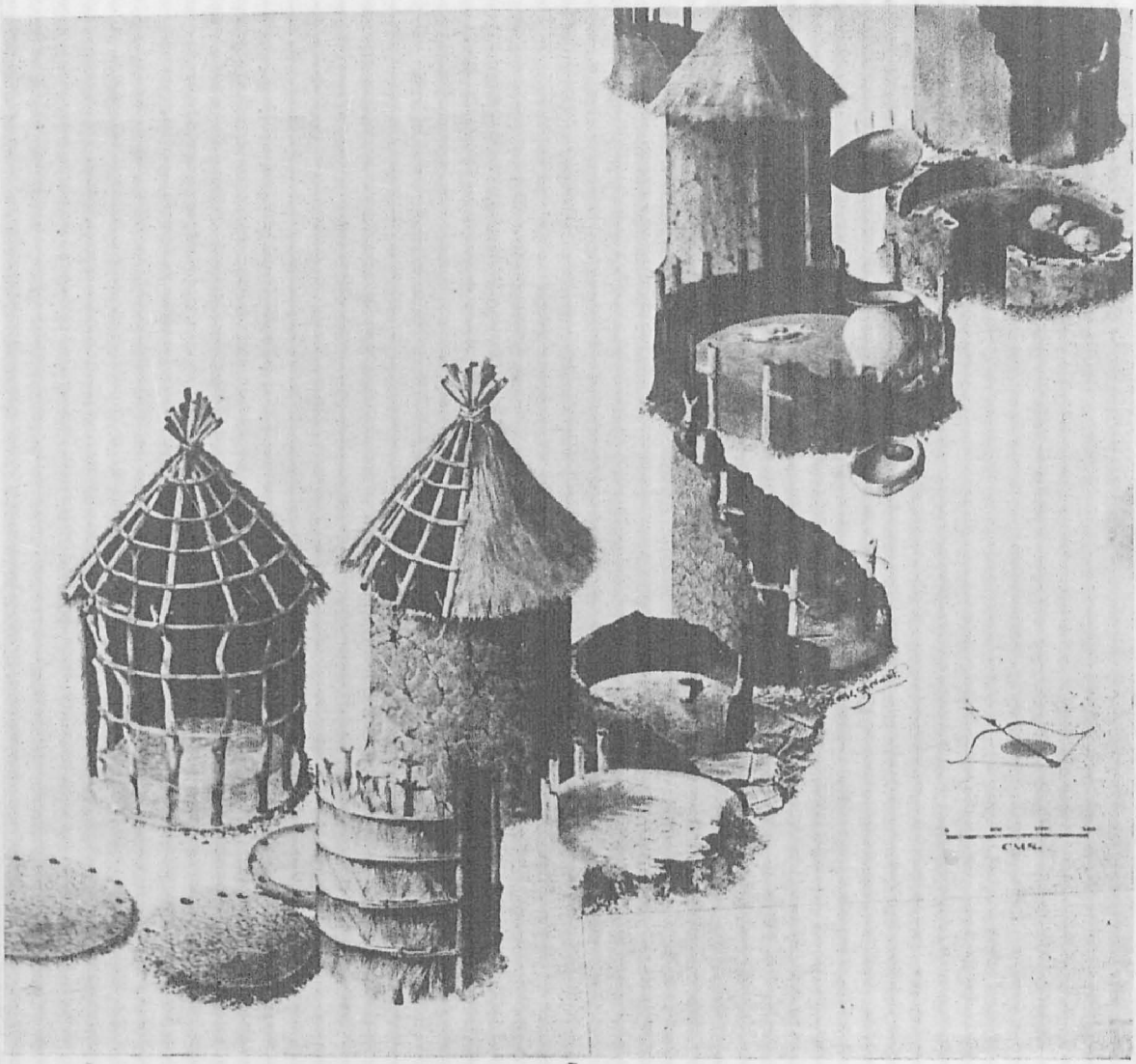
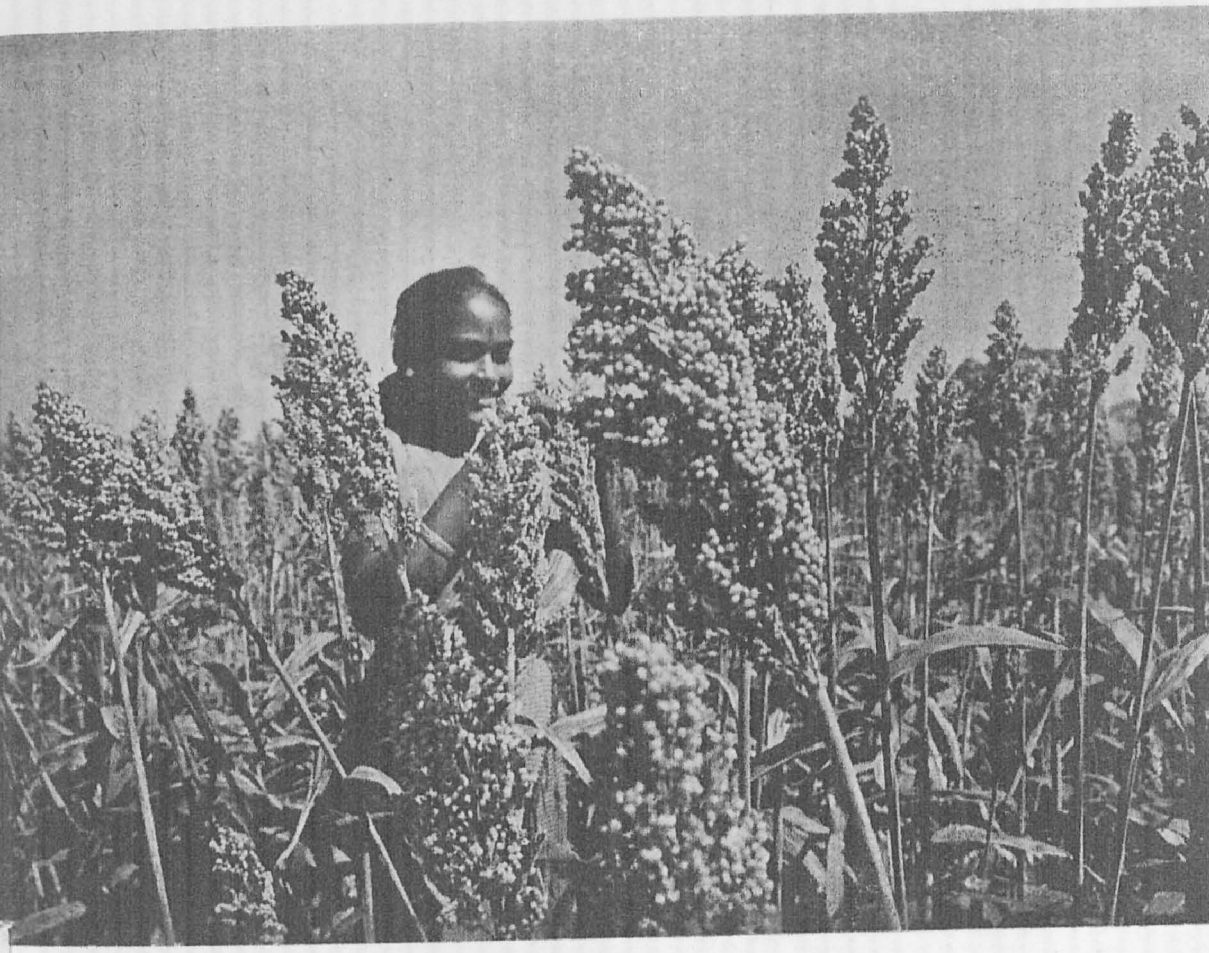


Fig. 138. Isometric reconstruction of Chalcolithic village, Inamgaon, District Pune, *c.* 700 B.C. Houses were rounded and had straw roofs supported by wooden poles (After H.D. Sankalia)

Fig. 139. *Sorghum bicolor*



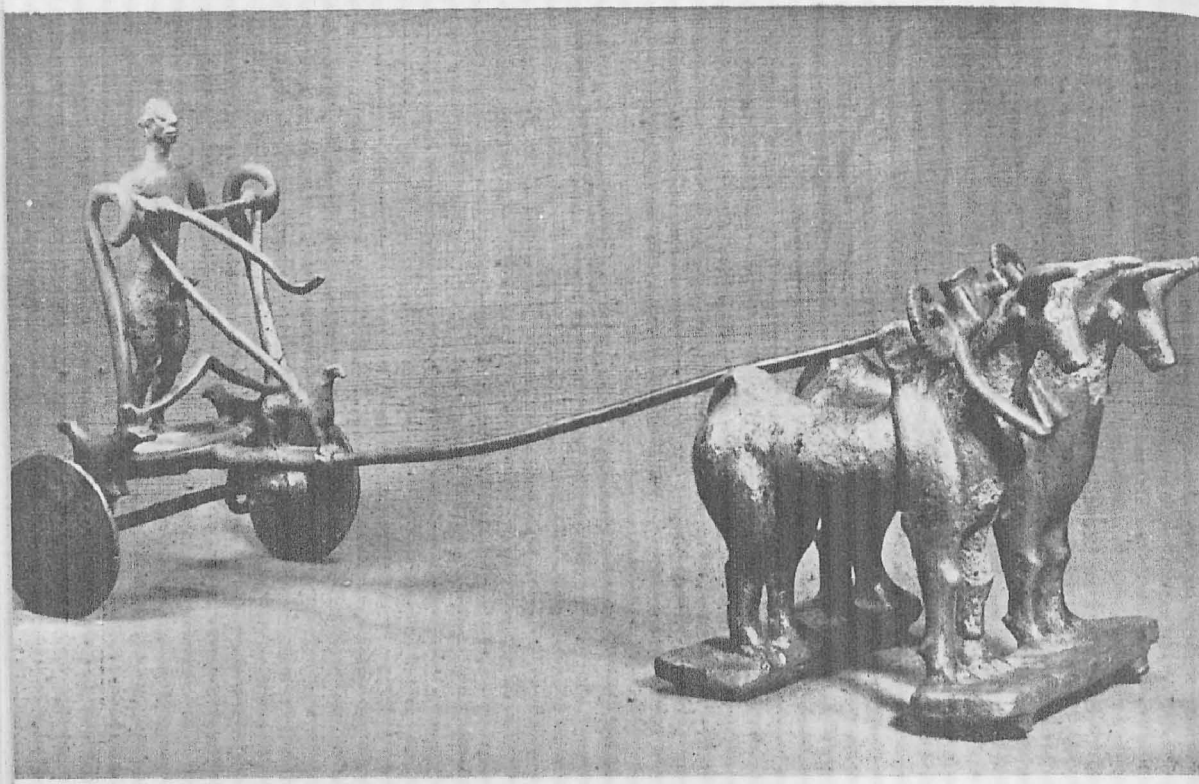


Fig. 140. A bronze chariot with a cult figure, possibly Pasupati, Shiva, from Daimabad, Ahmadnagar District, Maharashtra, of the Chalcolithic period, *c.* 1300 B.C.
(Courtesy : National Museum, New Delhi; Archaeological Survey of India)

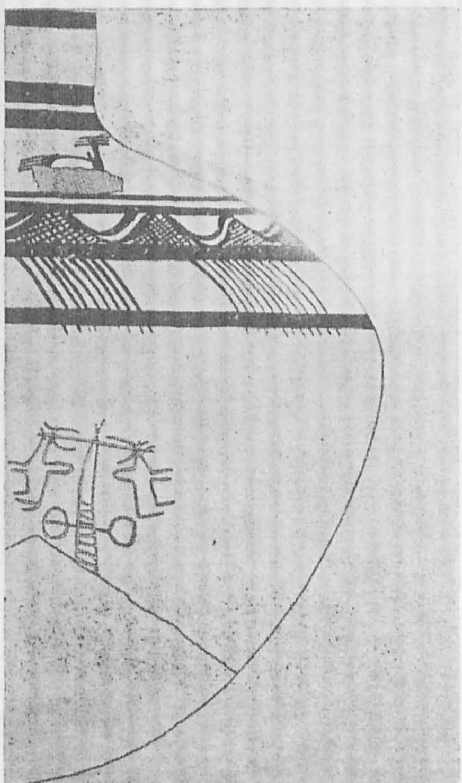


Fig. 141. A pot from Inamgaon with engraving of a cart drawn by zebu cattle
(After H.D. Sankalia)

value can be judged from the fact that it is one of the three ingredients of *triphala*, an Ayurvedic medicine and tonic.

Irrigation

The farmers of Inamgaon cultivated wheat, barley, *kulth*, *mung* and peas. A large mud embankment on a stone foundation for diverting flood water in the Ghod River through a channel dug for the purpose was also discovered at Inamgaon. According to Dhavalkar[6], this is the earliest evidence of irrigation in India.

THE LATE HARAPPANS IN THE GODAVARI VALLEY

S.A. Sali[7] has drawn attention to some late Harappans in the Godavari Valley in Maharashtra. From an ancient site at Kalivada on a bank of a small feeder stream of the River Pravara near the village of Ambhore, in the Sangamner Taluka of the Ahmadnagar District, potteries were found which closely resemble the late Harappan red ware. Sali believes that this is the first evidence indicating the southward extension of the Harappans into the Godavari Valley.

DAIMABAD

The Chalcolithic site at Daimabad on the Pravara River in the Ahmadnagar District was excavated by Deshpande in 1958-59. It yielded evidence of four phases, viz. Neolithic, Late Harappa, Buff and Cream Ware, Malwa and Jorwe cultures. Apart from potteries, charred grain of barley, a fragment of a copper celt, and microliths of chert and chalcedony were discovered from the Late Harappan phase.

In 1974, a hoard of bronzes was discovered by a Bhil from the roots of shrubs which he was uprooting for fuel. Sali ascribes them to the Late Harappan phase. These comprise a chariot with a pair of humped bullocks yoked to it. This must be the breed present in Maharashtra in 1300 B.C. It was used for ploughing, pulling carts and chariots (Fig. 140). The chariot is driven by a naked man. Attached to his penis is a four-hooded cobra. In front of him is a dog standing on the central pole. Other animals in the hoard are a rhino, a buffalo and an elephant. Obviously, it is a cult image. According to Sali, the man represents the Pasupati, Shiva, the Lord of Beasts.

A pot recovered from Inamgaon has a painting showing two zebus yoked to a bullock-cart (Fig. 141).

The Harappan Daimabad was a sizeable town covering more than 20

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[6]Dhavalkar, M.K. "First Farmers of Maharashtra," in *Dawn of Civilization in Maharashtra* (Ed. K. Khandalavala)

[7]Sali, S.A. The Harappan Contacts in the Deccan, *Indian Inst. Advanced Study, Seminar*, Simla, Nov. 1977

Fig. 142. Panicle of sorghum

hectares. The temple of Pasupati was surrounded by mud-walled houses with flat roofs. Sali believes that Daimabad may have been the capital of the Harappans of the region of the Godavari basin in Maharashtra.

Timber. Fragments of wood and charcoal have been recovered from some archaeological sites in southern India. They give a clue to the species of trees which were used by the Neolithic-Chalcolithic people. A piece of charcoal from Inamgaon turned out to be of a specimen of bamboo of the genus *Dendrocalamus. Holarrhena antidysenterica,* the Easter-tree, with fragrant white flowers, even now is abundant in the forests of Karnataka. A piece of charcoal from Hallur was of this species. A piece of charcoal from Tekkalakota in Karnataka was identified as belonging to *Soymida febrifuga.* The wood of *Ziziphus mauritiana* was used by the people of Harappa for making mortars (*moosal*). Possibly in south India a similar use was made of this wood, which is shock-absorbing. This selective use of wood indicates a knowledge of the characteristic qualities of the woods by the Neolithic-Chalcolithic people of south India. Wood of teak, *Acacia, Albizzia, Soymida febrifuga* and *Ziziphus mauritiana* was used as timber and for making agricultural implements and bullock-carts.

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CHAPTER 17

NEOLITHIC CULTURE OF EASTERN INDIA

CULTIVATION OF RICE, BANANAS, SUGARCANE AND YAMS

2000 B.C.

RICE is the most extensively cultivated crop in the world, and serves as the staple food for the largest population. China is the largest producer of rice in the world, followed by India. India accounts for nearly 21 per cent of the world production of this cereal. Other important rice-producing countries are Bangladesh, Japan, Indonesia, Thailand and Burma.

In India, rice has the largest area under it, i.e. about 30 per cent of the total area under all foodgrains. Though it is grown in all the States, its principal concentration is in eastern India, viz. Assam, West Bengal, Bihar, Orissa and Andhra Pradesh.

The Neolithic cultures of eastern India, viz. Assam (excavated site, Daojali Hading), north Bihar (excavated site, Chirand), West Bengal (excavated site, Pandu Rajar Dhibi), and Orissa (excavated site, Kuchai) have particular importance when we consider the problem of the origin of cultivation of rice.

According to Sankalia, the whole of eastern India, comprising Assam, Bengal and Bihar are pure Neolithic cultures, with ground stone axes as the basic industry. Ground tools of stone and bone are abundant in eastern India, with hand-made pottery in small quantities. The stone tools are of three main types, viz. triangular, rectangular and shouldered.

ASSAM AND NORTH-EASTERN REGION

The Garo Hills. Nearly 1,000 tools were collected from Rongram, Rengchangiri, Rangchigiri, Chitra Abri, Rongchugate, Rombhagiri, Tura and Phalbari. These sites are situated on the north-western face of the Arbela Range, 762 and 609 metres above sea-level.

The present distribution of these tools suggests that people in some areas in the Garo Hills preferred to make simple celts, whereas others made tanged or shouldered ones, though the purpose or function of both was probably the same, viz. hoeing. Thus it was essentially an agricultural tool.

The North Cachar Hills. There are three classes of Neolithic pottery found in the stratified site of Daojali Hading in the North Cachar Hills. Of these, the cord-impressed pottery is the most numerous and shows distinct influence from the Szechwan region in China.

Among the ground tools, the fully ground are by far the most numerous in the Garo Hills. Shouldered axes again form a major or dominant group

among the various types of tools (Fig. 145). These have been found for the first time in stratified context at Deojali Hading, where they occur along with small axes, flat or round on the sides, quadrangular adzes and cord-impressed pottery. According to Sankalia, 'The Assam Neolithic primarily drew its inspiration from Southwest China and Indo-China, and the Deojali Hading assemblage was comparable with the Late Bacsonian of South-east Asia. The major role was played by the Upper Yangtze Valley of Szechwan and Yunnan in developing the Neolithic cultures of Assam.'

The Naga Hills. The pecked and edge-ground axes of the Naga Hills compare with the excavated specimens from Yang Shao Taun in Honan, North China. The pecking technique seems to have been introduced into this region from China, whence also came the jadeite axes.

The pointed butt axes of the Naga Hills, being associated with shouldered axes, are derived from East Asia (Fig. 146).

Sharma has shown that the shouldered axes have affinity with the Hoabinhian of Thailand.

According to Sankalia, 'The life of these Neolithic people could not have been much different from that of most of the present pre-literates some 50 years ago, when modern civilizations had not reached them. Even now cord-impressed pottery and bark cloth are made by the Agaro, who also practise shifting cultivation.'[1]

No direct evidence for the domestication of animals has been obtained in eastern India. From circumstantial evidence it can be inferred that *jhooming* or slash-and-burn shifting cultivation must have been prevalent. This is a system which is widely prevalent even now in Assam, and contributes to the flood problem of that State. The tribals live on the hilltops and when they burn the forest, a good deal of fertile soil is washed away during the rains.

BIHAR

Chirand: District Saran. In eastern India, the lower layers of Chirand, District Saran, a site about 8 kilometres east of Chapra and situated near the confluence of the Ghagra and the Ganga, has given a truly Neolithic assemblage. The discovery only underlines the importance of the earlier but mixed assemblages from Sonpur (District Gaya), Uriup (District Bhagalpur) and a few other sites. Three things are noteworthy at Chirand. First, the earliest settlement rests under a thick debris of the Early Historic town and is 3·5 metres thick. Secondly, it is situated in the plain over the old reddish silt. Thirdly, ground or polished tools are few but there is an abundance and variety of bone tools. A ^{14}C determination from the topmost level of the Neolithic had given a date of 1650 B.C.

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[1]Sankalia, H.D. *The Prehistory and Protohistory of India and Pakistan*, pp. 297, 298

but there is an earlier date 1755 ± 155 B.C. It is, therefore, expected that the lowest deposit might go back to *c.* 2500 B.C.

The houses were circular, about 2 metres in diameter. The floors were paved and the walls were made of clay or mud, plastered over a bamboo screen from outside and inside. It is also thought that there were roofed "pit houses". The roofs were presumably conical and thatched. Villages with such circular huts may even now be seen on the way to Chirand.

The inhabitants used pots and pans. Though the details are not yet available, it seems there were four main fabrics: red, pale and deep grey, black and black-and-red. These are either hand-made or made with the help of a turntable.

It is said that the microliths made on chert, chalcedony and siliceous stones obtained from the Son were used by the Neolithic people.

A distinguishing feature is the repertory of tools made from bone and antler. These include picks, chisels with broad and narrow end, hammer, dagger, bar celt, shaft straightener, side- and end-scrapers, needle, bodkin, awl and drill.

There are also arrowheads, both tanged and socketed.

For cutting stalks of wild grasses, these Neolithic men employed microliths, set in bone, wood or clay hafts or used the larger parallel-sided blades.

Terracotta figurines, showing humped bulls, birds and toy-cart wheels, were also recovered. The ceramics associated with this culture included hand-made red, grey-black and black-and-red wares. The occurrence of mat impressions on a sherd indicate the knowledge of the technique of preparing mats out of reeds.

So far, no harpoons or fish-hooks have been found, though certain objects have been recognized as net-knitting tools. The only effective weapons of offence were bows and arrows, tipped with stone and bone points and terracotta sling balls.

The site has also yielded a number of ground stone artefact including hammerstones and rubberstones.[2]

It appears that the earliest Chirandians were not merely hunter-gatherers. They also cultivated foodgrains. Among the debris occur charred grains of rice, paddy husk, wheat, barley, pea and green-gram. Paddy-husk impressions on some of the pieces of burnt clay as also some grains of charred rice indicate the use of that cereal by the inhabitants. The rice grains belong to both the cultivated and wild *Oryza sativa* and *O. rufipogon*. The assemblage, as a whole, indicates an advanced stage of neolithic economy.

WEST BENGAL

Pandu Rajar Dhibi. A fairly extensive, early rice-growing, riverain

[2]Sankalia, H.D. *The Prehistory and Protohistory of India and Pakistan*, pp. 304-307

culture, with maritime contacts, once existed in West Bengal. Pandu Rajar Dhibi is one of the largest settlements in West Bengal. As the name connotes, it is reputed to be the home of King Pandu.

Pandu Rajar Dhibi is set in beautiful surroundings. Situated on the banks of the Ajay, it has banana groves, occasional tall coconut and *sal* trees, their greenery contrasting with the red, lateritic, undulating plain.

At Pandu Rajar Dhibi we see a gradual growth of a Chalcolithic culture.

In Period I, besides hand-made, thick grey ware, with impressions of paddy-husk, were found a wheel-turned thin ware of plain and sandy fabric, a pale-red ware and black-and-red ware.

Rice, fish and meat of *nilgai*, deer and pig were the staple diet of the inhabitants from the very beginning of the settlement.

Pandu Rajar Dhibi is not a solitary agricultural village of the Chalcolithic period in West Bengal. Small excavations at Mahisdal, Nanur, Haraipur, District Birbhum, and Tulsipur, District Bankura, have yielded similar evidence.

The objects from these small excavations not only confirm the evidence from Pandu Rajar Dhibi, with regard to the nature of the houses, pottery, and burial practices in Period I, but complement it in several ways. Among the microliths are lunates and short blades, a flat copper celt with convex cutting edge, tetrahedral stone weights, and a large quantity of charred rice. The impressions of paddy husks from Pandu Rajar Dhibi were identified by the Economic Botanist to the West Bengal Government as those of cultivated paddy, *Oryza sativa*.[3]

ORISSA

Kuchai. Kuchai Baidapur (District Mayurbhanj), Kiching, Kurkutie, Sini (District Singhbhum) are Neolithic sites in Orissa. At all these places grey-black, brownish red pottery, comparable with that of Pandu Rajar Dhibi, Period I, along with polished stone tools of phyllite, have been found.[4]

THAILAND

Chester Gorman[5], in a review of the latest evidence from the mainland sites in Southeast Asia, including his own excavations in the Spirit Cave and at Non Nok Tha and Ban Kao in Thailand, has shown that the initial date for the Hoabinhian occupation culture might be placed in the Late Pleistocene, about 13000 to 14000 B.P., as the four ^{14}C dates range from

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[3]Sankalia, H.D. *The Prehistory and Protohistory of India and Pakistan*, pp. 309 to 312

[4]Sankalia, H.D. *The Prehistory and Protohistory of India and Pakistan*, p. 312

[5]Gorman, Chestor, "The Hoabinhian and after....," *World Archaeology*, February 1971, pp. 300-320

455 ± 360 to 11690 ± 560 B.P. The oldest date derives from a mid-layer 4, and the samples from layer 5 are under analysis. The cultural and other remains continue until about 3500 to 3000 B.C. From here the story is brought forward by the two sites, Non Nok Tha and Ban Kao up to the historical period. Thus a unique time span from 12000 B.C. to 2000 B.C. is provided during which we witness "the shift from upland to lowland settlement and a concomitant shift in the subsistence base from hunting and gathering to early cereal agriculture."

It is worth noting in this context that 15 of the 18 sites cited by Gorman are located in the upland Karstic formations near small streams or in forest-clad submontane areas in close proximity to streams. An identical situation is found in Meghalaya (Garo Hills) and other hilly areas of Assam.

The discovery by Gorman of Hoabinhian culture in Thailand dating back to 12000 B.C. confirms Carl Sauer's guess that the earliest agriculture was in Southeast Asia. Sauer states, "As the cradle of earliest agriculture, I have proposed South-eastern Asia. It meets the requirements of high physical and organic diversity, of mild climate with reversed monsoons giving abundant rainy and dry periods, of many waters inviting to fishing, of location at the hub of the Old World for communication by water or by land. No other area is equally well situated or equally well furnished for the rise of a fishing farming culture."

EARLIEST AGRICULTURE WAS BY VEGETATIVE PROPAGATION
(Bananas, Sugarcane, Yams, Sago Palm, etc.)

Sauer is of the view that the earliest agriculture was by vegetative propagation of parts of plants. He states, 'The creative curiosity of man in the monsoon lands has operated strongly with asexual plant reproduction. Multiplication and selection is from clones. A piece of a plant is set into the ground to make a new plant. This may be by an offset or sprout from the parent, by dividing a root stock, by a stem cutting, or by a piece of underground stem or tuber. An individual plant is divided and multiplied indefinitely.'

The list of such man-made plants, or cultigens, is large, with eastern India in the first place as regards origin. Botanically, it includes many and important monocotyledons: Southeast Asia is the original home of the bananas and ginger. Musaceae and Zingiberaceae are predominantly Southeast Asian. The principal area of diversity of Musaceae is Assam-Thailand with 10-20 species, followed by Borneo-Indonesia with 11-13 species. Genetic studies lately have resolved the variations in the Asiatic bananas with the result that the old distinction between bananas and plantains must be abandoned. One cultigen line derives directly from *Musa balbisiana*, native from Bihar, up to the Himalayas, another from the Malayan

M. acuminata, and the third main line involves hybrids between the two.[6] *Musa acuminata* in the broad sense is geographically nearly coextensive with the genus as a whole, and its centre of diversity lies in the Malayan area, where four out of the known five subspecies overlap. This area was also the primary centre of origin of the cultivated bananas, which sprang from *M. acuminata*.

Discussing the evolution of edible bananas, Cheesman observes, 'The early cultivators seized upon the first signs of parthenocarpy and female sterility. Thus began the evolution of edible bananas, and jungle weeds were transformed into a fruit crop with sweet, moist and aromatic flesh. There was selection in favour of triploidy, because of the vigour, yield and sterility. The AAB group has 20 clones in India and eastern Malaysia. There are many mutants in India. The dispersal of the edible bananas outside Asia was accomplished by the transport of vegetative planting material by human agencies. The first movement was across the Pacific. The second movement was across the Indian ocean to Africa.'[7] According to Murdock, the Indian element entered Africa by the Sabean lane during the first millennium B.C. The Malaysian elements, which include the bananas, taros, yams, breadfruit and coconut, were introduced by the Indonesian migrants about the time of Christ in Kenya and Uganda, from where they diffused across the African continent to western Sudan. The Bantus carried these crops westwards and southwards. It was followed by a population explosion.

The domesticated forms of the ginger family, such as turmeric, appear to be mainly Indian. For the home of the greater yam (*Dioscorea alata*), Burkill favours the eastern side of the Bay of Bengal; for *D. esculenta*, Indochina.[8] 'A half-dozen species of cultivated yams, some of them carried to the farthest Pacific Islands, throw important light on cultural radiation from the Southeast Asiatic mainland. Certain palms, especially the sago palm, pandanus, bamboos, and sugarcane, have been widely carried out of India and Indochina and greatly altered by man.'

It may be noted that no archaeological evidence of such plants would be available as climate precludes the preservation of herbaceous cultigens.

Who were the earliest farmers in South-Eastern Asia. According to Sauer, 'The improvement of plants by selection for better utility to man was accomplished only by a people who lived at a comfortable margin above the level of want. The needy and miserable societies are not inventive, for they lack the leisure for reflection, experimentation, and discussion.

'The hearths of domestication are to be sought in areas of marked

[6]Cheesman, E.E. On the Nomenclature of Edible Bananas, *Jour. Genetics*, Vol. 48, 1948, pp. 293-296

[7]Cheesman, E.E. *The Evolution of Bananas*, pp. 132, 143, 144

[8]Burkill, I.A. *Dictionary of Economic Products of the Malay Peninsula*, 159

diversity of plants or animals, where there were varied and good raw materials to experiment with, or, in other words, where there was a large reservoir of genes to be sorted out and recombined. This implies well-diversified terrain and perhaps also variety of climate.

'Primitive cultivators could not establish themselves in large river valleys subject to lengthy floods and requiring protective dams, drainage, or irrigation. Thus earliest agriculture had its origin in hill and mountain lands.

'Above all, the founders of agriculture were sedentary folk. Groups move as little as their needs of food, water, fuel, and shelter require. Mobility as a dominant character goes with specialized hunting economies or with life in meagre environments. Growing crops require constant attention. I have never seen primitive plantings that are not closely watched over until the crop is secured. A planted clearing anywhere is a feast set for all manner of wild creatures that fly, walk, and crawl to come in and raid fruits, leaves, and roots. What is food for man is feast for beasts. And, therefore, by day and night someone must drive off the unbidden wild guests. Planting a field and then leaving it until the harvest would mean loss of harvest.

'The progenitors of the earliest agriculturists I have sought in some well-situated, progressive fishing folk living in a mild climate along fresh waters. Fresh water is postulated rather than salt because seaside vegetation has contributed little to the making of crop plants. For sedentary living there must have been available a long season or year-round staple resource in fish and other aquatic life. Clustering of groups in permanent villages was made possible at sites continually advantageous for fishing, such as stream junctions, lake outlets, rapids. Waterways served as lines of communication with other villages and so for the exchange and growth of ideas. Waterfowl, riparian mammals, water-side plants gave diversity to food. Basts and fibers were used to make nets and lines and suitable woods were at hand for boats and paddles.'[9]

Sauer states that the art of seeding is relatively recent in the Old World and marginal to the art of planting. Archaeological excavations in the Fertile Crescent area of the Near East have shown that the art of seeding is as old as 7000 B.C. In the lands with cold winters the art of seeding is not marginal. Here vegetative propagation of crop plants is marginal. In tropical areas no doubt vegetative propagation is of prime importance.

HEARTHS OF AGRICULTURE

Sauer's theory of diffusion of agriculture from one centre suffers from overstatement. Sauer states, the Near East and Mediterranean regions

[9]Sauer, O.C. *Agricultural Origins and Dispersals*, pp 24 to 26

are no more than recent peripheral developments of the dispersal from the original hearth in Southeast Asia. Agriculture did not diffuse from one centre to the rest of the world. In fact, there were seven hearths in the Old World, and four in the New World, from which diffusion of crop plants took place. The oldest centre of diversity and origin of cultivated plants is South-East Asia comprising Thailand, Malaya and adjoining areas. In this centre, rice, sugarcane, banana, coconut, cardamom and turmeric were cultivated. The second oldest centre is that of the Fertile Crescent in the Middle East where wheats, forage crops, olive, grapes and almonds were cultivated. The third centre is in South India which is the home of rice, jute, desi cotton, pulses, mango, citrus fruits and black pepper. The fourth centre is the Chinese, the home of soybean, loquat, litchi, some citrus fruits and tea. North India, Afghanistan and Iran comprise another centre which is regarded as the home of bread wheats, rye, linseed, apple, pear, and walnut. The countries bordering the Mediterranean Ocean are the home of oats, temperate fruits and vegetables like cabbages, cauliflowers, etc. Abyssinia is the home of wheats, sorghum, castor, barley, coffee, and water-melon. The new world has four centres of origin of cultivated plants. Of these one is in Mexico in Central America, which is regarded as a home of maize, sweet-potato, cotton, chilli, papaya, guava, pumpkin, and beans. The other centre is in Peru and Bolivia in South America, which is the home of potato, tomato and tobacco. Argentina and Brazil are the home of rubber, groundnut, pineapple, cashew, tapioca and cocoa (Fig.143).

RICE—ORIGIN AND CULTIVATION

The genus *Oryza*, to which rice belongs, has 28 species and subspecies, of which 26 are wild and two, *O. sativa* and *O. glaberrima*, are cultivated. All the rice varieties of Asia, Europe, and America belong to *O. sativa*, and of West Africa to *O. glaberrima*. India has five wild species, of which *O. sativa* var. *fatua* is a common weed in many states. *O. perennis*, found wild in Orissa, has a short rhizome, a branched floating stem and perennial habit. In wild rices, grains shatter easily and are difficult to harvest.

Among the wild species, there has been a regular trend of evolution from perennial to annual habit, from cross-pollination to self-pollination and from lesser to greater fecundity.

Looking back in history and considering the evolution of cultivated rices it must be supposed that man took annual wild types (*nivara, brevili-gulata*), subjected them to the selection pressure of cultivation, harvesting and sowing and thereby gave rise to the *sativa* cultivars in Asia. The west African rice, *O. glaberrima*, represents the cultivated member of a series parallel to that occurring in Asia. There is no evidence of exchange between

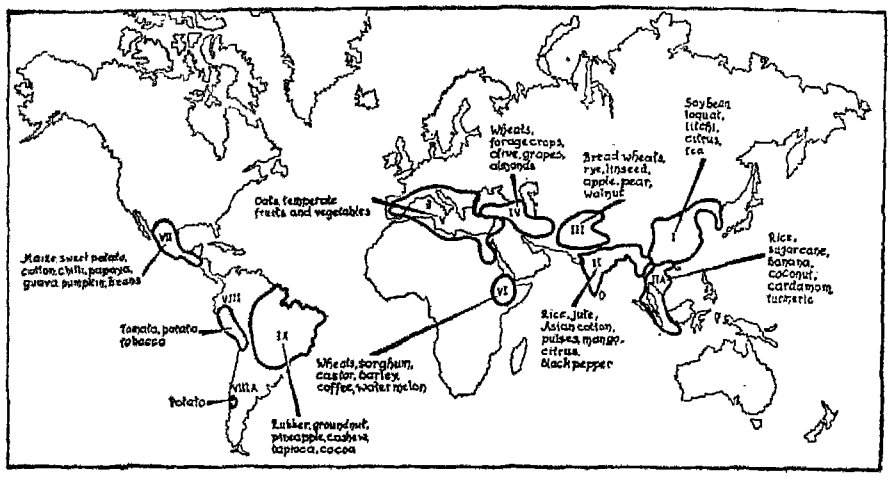

Fig. 143. Centres of diversity and origin of cultivated plants (general assignment after Vavilov, 1935, and Darlington and Janaki Ammal, 1945)

Asia and west Africa in prehistoric times to account for the existence of *O. glaberrima* and it must be accepted as a separate domestication.

It is considered that *O. sativa* evolved from the wild rices by mutation and selection. It is thought that rice cultivation originated in India, Burma or Indochina. India has more than 4,000 varieties of rice.

Malayan migrants introduced rice cultivation in Indonesia in proto-historic times. Rice was introduced into the Philippines by immigrants from South China in the first millennium B.C. It is they who developed the vast terrace system in the mountains of the Philippines. On account of its heavy yields, rice could support a far denser population than any other cereal, and consequently population in rice lands increased at an explosive rate.

According to Shastry and Sharma[10], the genus *Oryza* started initially as a small plant growing in well-drained soils in the humid atmosphere of forests. The hydrophytic habitat with preference for open sunshine and a larger size of plant (e.g. *O. officinalis*) were later phylogenetic developments. The tuberculations on the surface of the fertile lemma and palea and the development of awns are also advanced characters in *Oryza*, though in the most advanced, cultivated species, *O. sativa* and *O. glaberrima*, the awns are often suppressed. Lastly, it follows that South-East Asia is the probable centre of origin of the genus, and its spread to the African and American continents was a later development.

[10]Shastry, S.V.S. and Sharma, S.D. *Rice* in *Evolutionary Studies in World Crops* (Ed. Sir Joseph Hutchinson), pp. 56 to 58

Most species of *Oryza* are diploid, with 2n=24 chromosomes. The diploids are distributed in the tropics of Asia and Africa, whereas the tetraploids are to be found in the tropics of America as well as of the Old World.

The basic type is a wild perennial grassy species which grows in ponds, ditches and canals, and which sometimes occurs as a weed in rice cultivations. It has panicles which shatter on ripening and seeds with hard seed-coat and considerable dormancy. It is found throughout the Old World tropics from south China and the Philippines to west Africa and it has been recorded from Cuba and from South America.

Numerous specific names have been given to the forms of this wild perennial from different geographical areas. In Asia, the names *O. perennis*, *O. balunga*, and *O. rufipogon* have been used, and in Africa *O. longistaminata* and *O. barthii*. The New World form is usually described as *O. cubensis*.

The cultivated rices fall into two species, namely *O. sativa* in Asia and *O. glaberrima* in west Africa. The Asian species falls into two genetically and geographically distinct races, the *indica* race of the Indian subcontinent and the *japonica* race of Japan and north China.

Archaeobotanical Record of Rice. The earliest archaeobotanical record of rice in India is from Lothal (2300 B.C.) and Rangpur (2000 to 1800 B.C.) in Gujarat. This is in the form of impressions of spikelets on potsherds. Gujarat, which is largely a dry area, is hardly the habitat for rice. It is what is known as an accident of archaeology and no attempt should be made to read too much in it. In due course, older sites may be discovered in eastern India, which is the true home of rice. It is the find of *Oryza sativa* from Neolithic Chirand in Bihar (2000 to 1300 B.C.) which is much more significant. *Oryza sativa* was also found from Pandu Rajar Dhibi (second millennium B.C.) from West Bengal. It is also recorded from Navdatoli (1550-1400 B.C.), Hastinapur (1100-800 B.C.) and Atranjikhera (1200-600 B.C.) in Uttar Pradesh. The location of these sites is shown in Fig. 144. Spikelets, husks and grains of rice found in an excavation at Hastinapur are shown in Fig. 147.

The earliest record of rice in the world, however, comes from Non Nok Tha in Thailand, where it dates to 3500 B.C. Here, impressions of rice grains have been found on potsherds. It was also found in late Neolithic of China which dates to 1650 B.C.

Diffuse Origin of Rice. Rice has had a diffuse origin (cf. Harlan, 1965) both in space and time. Several centres of origin have been proposed for Asian rice : southern India (Watt, 1892; Ramiah and Ghose, 1951; Nair *et al.*, 1964), Jeypore tract in Orissa, in south-eastern India (a secondary centre, Ramiah and Ghose, 1951), the Philippines (Ramiah and Ghose, 1951), China (de Candolle, 1886; Roschevicz, 1931; Ting, 1949), Indochina (Hamada, 1949) and the western Indo-Pacific area (Barrau, 1966). All

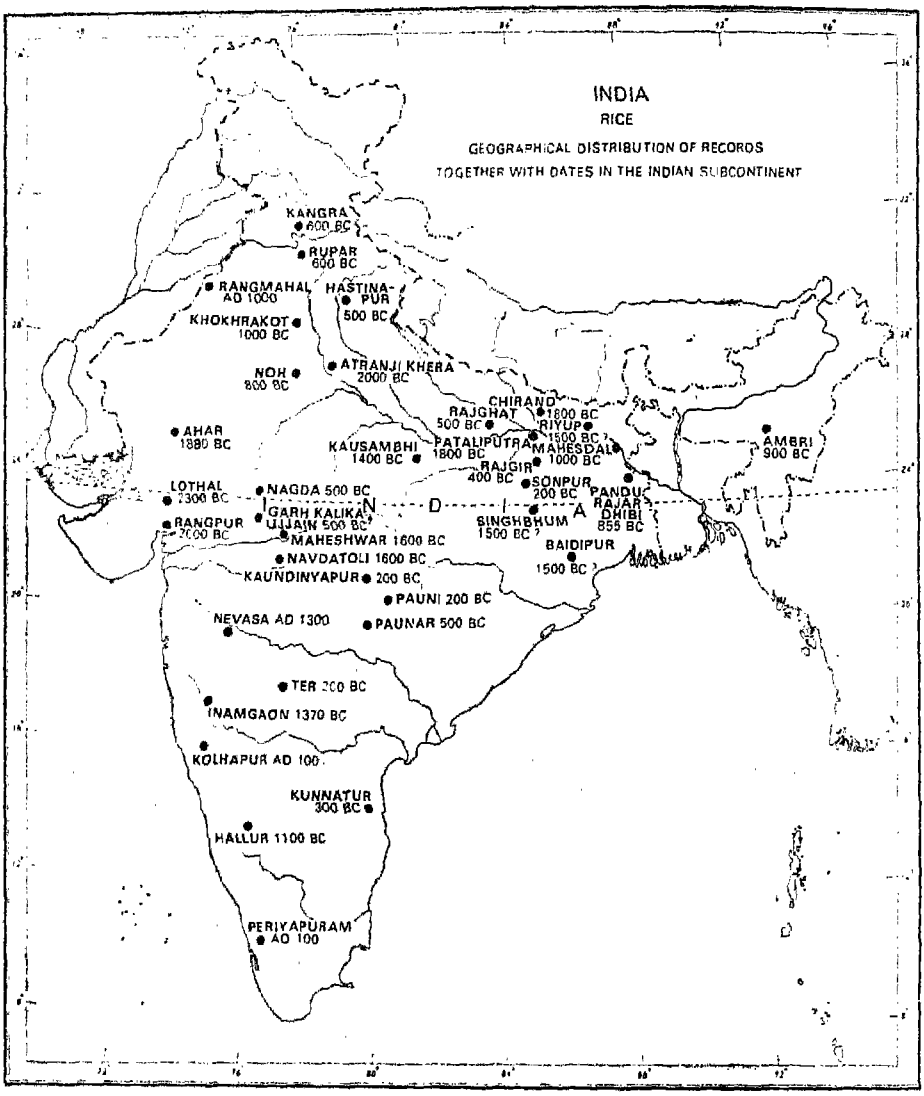

Fig. 144. Geographical distribution of records of rice, together with dates in the Indian subcontinent
(After Vishnu-Mittre)

these areas show today considerable varietal diversity. In addition, the north-western and north-eastern foothills of the Himalayas (Ramiah and Ghose, 1951) and the Guyanas (Porteres, 1949) are known to show much variation. The difficulties resulting from considering the centres of diversity as centres of origin are well known by now (cf. Zohary, 1970). With the ancestral species present in its original habitat in all these regions of variability and with the knowledge that this species is found good enough even today for harvesting, the changeover from rice-gathering to rice-culture could have been attempted in each of these regions and at various times. This can be witnessed even today in some areas such as the Jeypore tract in Orissa in eastern India. Further, the transition from the wild to the cultivated form in rice is of a much lower magnitude than that involved in at least the principal cereals. And this ennoblement could have been effected by the people inhabiting these regions.[11]

Nayar seems to be correct when he says that rice had a diffuse origin both in space and time. Among centres of origin proposed in India are the Malabar Coast in Kerala, the Jeypore tract in Orissa, and the north-eastern foothills of the Himalayas. In these areas are several wild taxa, including both annual and perennial *rufipogon*, and high varietal diversity.

When one examines rice cultivation in India at present, one finds that its largest concentration is in eastern India, viz. West Bengal, northern Bihar and Orissa (Fig. 144). This fact also lends support to the theory that this area is the main centre of the origin of rice in India.

ACHIEVEMENTS OF NEOLITHIC CULTURES

It must be clearly understood that the term Neolithic denotes a stage in economic and technological development, and is not necessarily a period of time. While in the Fertile Crescent area in Western Asia it may date back to 7000 B.C. and in Thailand even earlier, in the Indo-Pakistan subcontinent it may extend from 3000 B.C. to 1300 B.C. Still in India there are inaccessible areas which are not far removed from the Neolithic stage.

When we talk of Neolithic revolution, we should understand that it is a process and not an event. As such, it extends over a vast span of time. The major achievement of the Neolithic revolution was the discovery of agriculture, horticulture, vegeculture and animal husbandry.

Concluding the account of the Neolithic cultures of India, we may as well review their achievements. With their polished stone axes, the Neolithic men cleared the jungles close to their sites of habitation. They built underground shelters or huts, thus creating the first villages. They made hand-made pottery for storing foodgrains. They invented textile-

[11]Nayar, N.M. Origin and Cytogenetics of Rice, in *Advances in Genetics*, Vol. 17, 1973, pp. 177-78

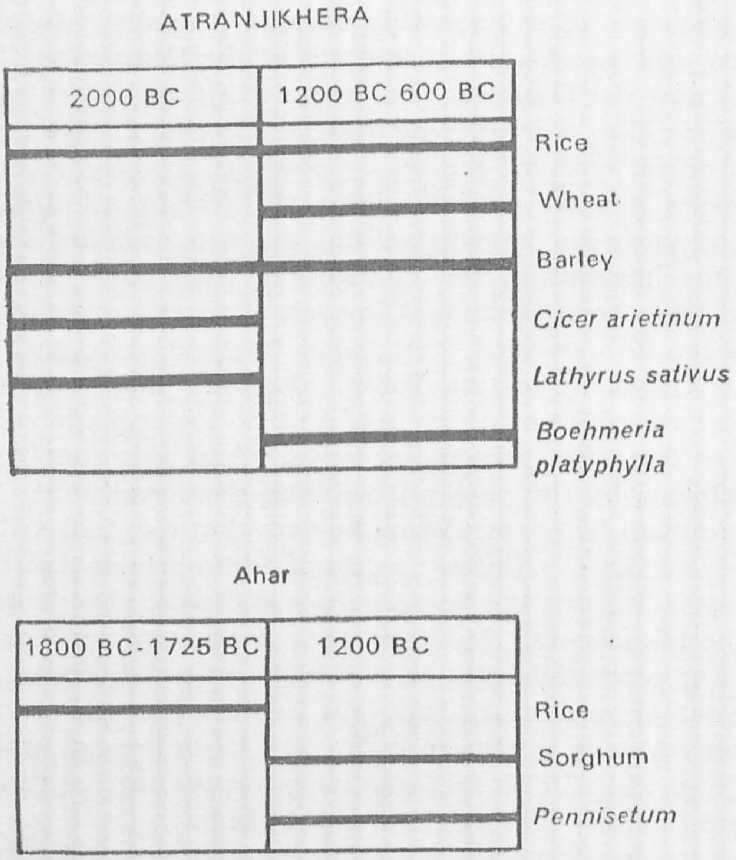

Fig. 148. Foodgrains discovered in the excavations at Atranjikhera and Ahar and their age
(After Vishnu-Mittre)

weaving and basketry. As Boule and Vollois observe, 'The Neolithics were the first Men who succeeded in breaking away from a passive attitude towards their physical environment, who attempted to render nature subservient to their needs by exploiting the forests, cultivating the plains and capturing animals, in order to make of them valuable auxilliaries. Hence a new upsurge of the spirit of invention. Hence, too, new social organizations leading to fixed agglomerations of dwellings, that is to say, to true villages. We cannot lay too much stress on the moving grandeur of the changes that must have taken place in order to turn the more or less nomadic hunters of the Palaeolithic into cultivators, the first peasants living on their crops, henceforth attached to a soil which fed them and which therefore gave them, for the first time, the idea of a Country. We are in the presence of a major stage in the evolution of Humanity, at the very origin of true civilizations. This stage can only be compared with

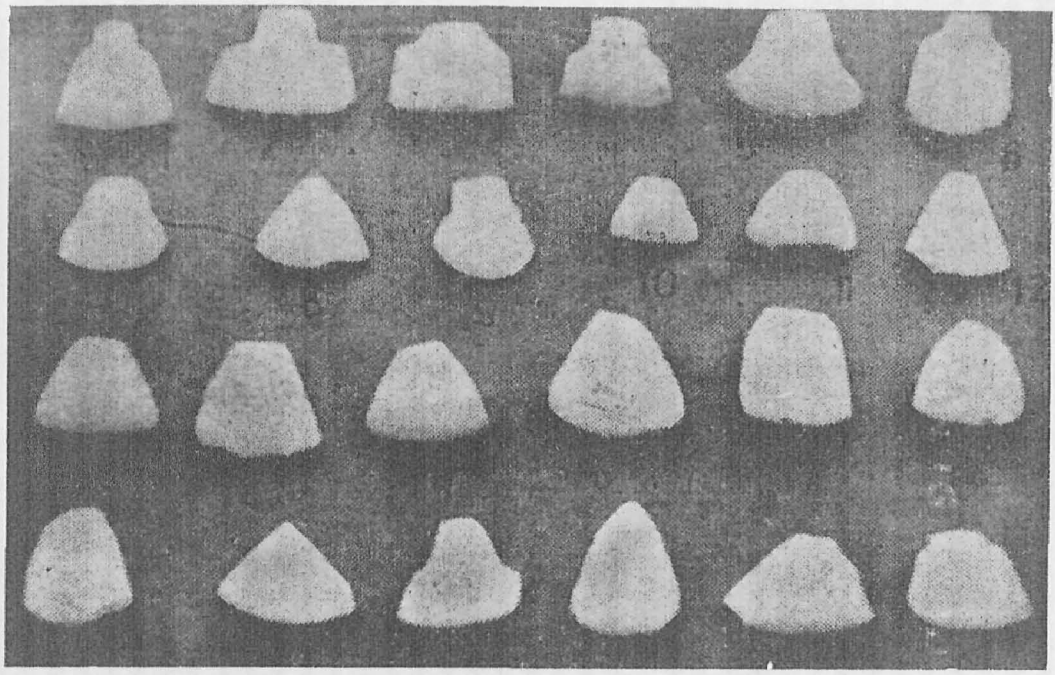

Fig. 145. Polished Neolithic axes from Deojali Hading, North Cachar Hills, Assam. The upper row contains shouldered ground stone-axes, with rectangular tang. These axes served as hoes for digging the soil
(Courtesy: Archaeological Survey of India)

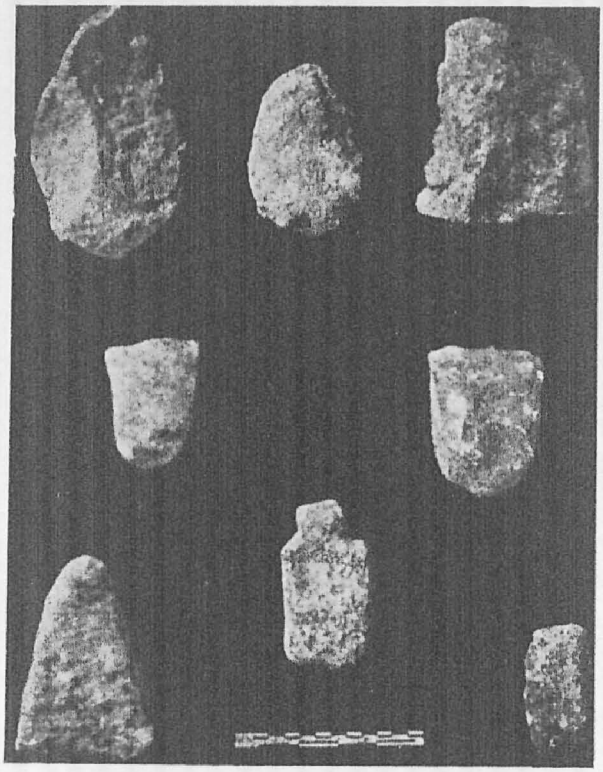

Fig. 146. Palaeolithic and Neolithic tools from the Lohit District. In the last row at left is a fully ground sandstone Neolithic axe. In the middle is a shouldered axe, with a rounded rectangular section
(Courtesy: Archaeological Survey of India)

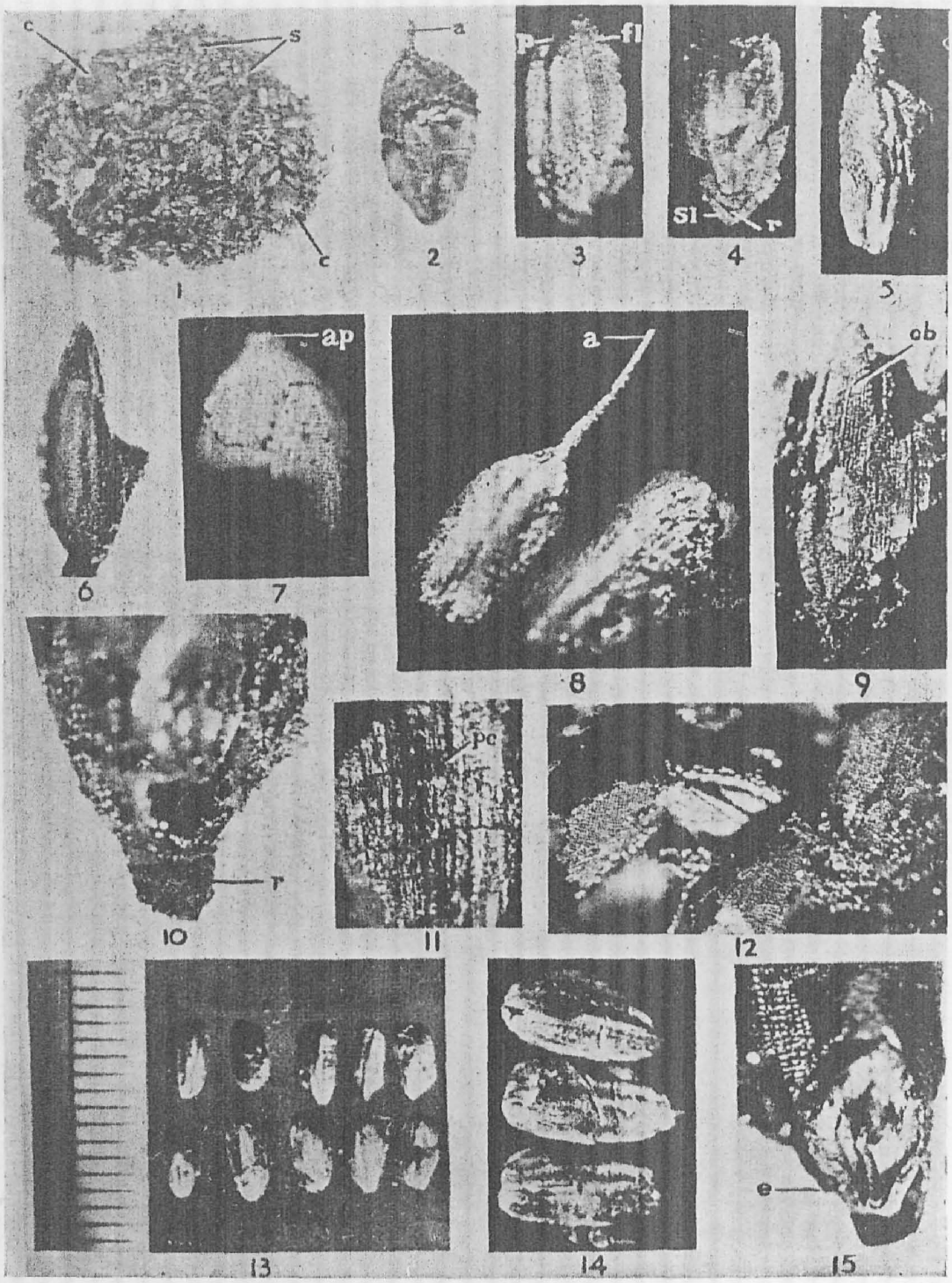

Fig. 147. Spikelets, husks and grains of rise found in an excavation at Hastinapur, Meerut District, Uttar Pradesh (Legend on facing page)
(Courtesy: Archaeological Survey of India)

that, infinitely older, of the conquest of fire.'[12]

Our civilization still rests on the discoveries made by the Neolithic people. Historic man has added no plant or animal of major importance to the domesticated forms on which he depends.

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Fig. 147. Legend

1. Charred rice spikelets (s) and charcoal chips (c)
2. Broken spikelet with awn (a). The lower portion of the grain is exposed due to the breaking off of the husk
3. Another spikelet showing fertile lemma (fl) and palea (p)
4. Collapsed spikelet showing sterile lemma (sl) and expansion of rachilla(r)
5. Another flattened spikelet with awn
6. Grain embedded in tar-like substance
7. Part of spikelet showing tri-dentate nature of apiculus (ap)
8. Two spikelets, one with awn (a)
9. Outer surface of the paddy with chess-board pattern (cb)
10. Portion of the spikelet showing thickening of the rachilla (r)
11. Inside view of the husk with pericarp (pc) attached
12. Surface view of the husks
13. Grains of different shapes and sizes
14. Enlarged view of grains
15. Basal part of the grain showing embryonic region (e)

CHAPTER 18

THE EARLY ARYANS—A BRONZE AGE PEOPLE

DOMESTICATION OF THE HORSE, AND MIGRATION TO INDIA

THE home of the Aryans is believed to be in South Russia in the steppes between the Danube, the Volga and the Urals. About 1800-1600 B.C., they left their homeland and dispersed east and west in large hordes. They left their ancestral land perhaps due to a prolonged drought, followed by famine. A large group known as Kassites penetrated into Akkad, and, in due course, became the rulers of Babylon in 1746 B.C. One horde occupied northern Iran, another, the Mittanis, conquered Asia Minor, where they introduced horse-breeding. The third horde entered India through Afghanistan and Baluchistan (Fig. 149) and overwhelmed the Harappans.

The earliest evidence about the Aryans and their language is from philology. During the period from A.D. 1767 to A.D. 1786, two European scholars, Coeurdox, a French missionary, and Sir William Jones, the founder of the Royal Asiatic Society of Calcutta, made an outstanding linguistic discovery. According to them, the Sanskrit of the *Rig-Veda* had remarkable affinities with Latin and Greek in vocabulary and grammar. Such striking similarities could be accounted for only by supposing that these languages had a common origin in some extinct language. This supposition was supported by the work of Bopp, a grammarian. By 1813, someone had suggested the word 'Indo-European' as a convenient term for the group of allied languages and their presumed original.

The findings of these scholars were confirmed by Max Müller, who worked in England from 1849 to 1862 under the patronage of the Directors of the East India Company, and translated the Vedas and other sacred texts of the Hindus into English. Max Müller states that a language bears the impress of the earliest thoughts of men often buried under the layers of new thoughts, and philology reveals the very elements and roots of human speech and thought. He concluded that Sanskrit, Greek, Latin and Zend are sister languages derived from a common ancestral language which was spoken by the Aryans in their original home. The terms for god, house, father, mother, brother, sister, son, daughter, dog, cow, heart, tears, axe and tree are identical in Sanskrit, Greek, Latin and German languages. The domestic animals are generally known by the same name in these languages while wild beasts have different names. "Before the Hindus migrated to the southern peninsula of Asia", observes Max Müller, "and before the Greeks and Germans had trodden the soil of Europe, the common ancestors of these three races spoke one and the same language,

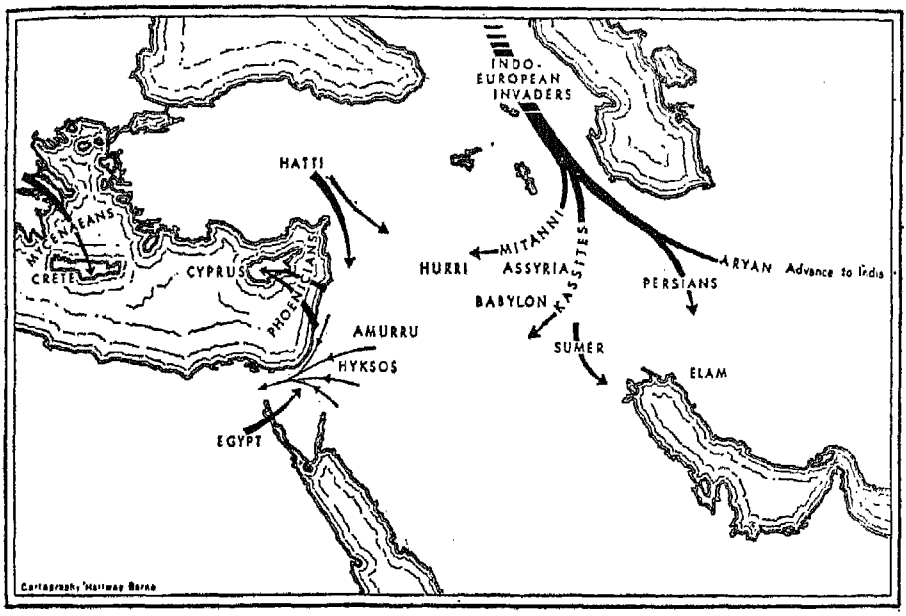

Fig. 149. The home of the Aryans is southern Russia—the land around the Caspian Sea and Black Sea. From that area they spread to Iran and Asia Minor. From Iran some hordes migrated to India
(Courtesy: UNESCO)

a language so well regulated and so firmly settled that we can discover the same definite outlines in the grammar of the ancient songs of the Veda, the poems of Homer, and the Gothic Bible of Ulphilas."[1]

The Zend *Avesta*, the religious book of the Parsis, reflects beliefs dating back to the era of the emergence of the Indo-Iranian community. Zoroastrianism was characterized by a cult of fire. Zarathushtra, the prophet of Zoroastrianism, condemned the old practice of making large-scale sacrifices and drinking *haoma* (Persian) or *soma* (Sanskrit). He directed his prophecies against the old caste of priests who adhered to these rites. These customs were apparently widespread among a certain section of Indo-Iranians in ancient times.

The *Avesta* divided society into three classes: priests, chariot warriors (*rataishtar*—the one standing on the chariot), and husbandmen and cattle-breeders. The *Rig-Veda* also mentions chariot warriors.

[1]Max Müller, *Chips from a German Workshop*, Vol. II, p. 255

The *Avesta* frequently stresses that cattle are the basis of the welfare of society. In some places appeals are made to people to engage in farming. The bronze reaping-hook and the stone grain-grinders show that the local inhabitants knew farming.

In the list of the countries given by the *Avesta* one finds the legendary *Aryanam-Vaichakh* (Aryan spaces). This country probably lay in the steppes of the southern Urals, near the Caspian Sea and to the north of the Aral Sea.

Iran means the homeland of the Aryans. The people of Iran take pride in their Aryan ancestry. Darius I, in an inscription at Naksh-i-Rustam, described himself as 'an Aryan of Aryan descent'. Muhammad Reza Shah Pahlavi assumed the title of Arya Mehr, the Sun of Aryans, following the same tradition and pride in Aryan ancestry.

'The most reasonable hypothesis, and one which seems best to satisfy the demands of philology and archaeology', states Piggot, 'is that originally put forward by Professor J.L. Myres and the late Harold Peake, and developed by Professor Childe, which sees the Indo-European languages evolving among the earliest agriculturists of the South Russian steppes and the lands eastwards to the Caspian Sea. In this South Russian area the basic culture in the late third and early second millennium B.C. was that of agriculturists, perhaps partly nomadic but sufficiently sedentary for small cemeteries to be formed, presumably close to relatively stable settlements. They domesticated sheep and cattle, and the horse was certainly tamed in the latter phases of the culture, if not at the beginning; burials in separate graves, sometimes under a mound or barrow and often accompanied by a stone (exceptionally a copper) battle-axe, emphasize the presence of a stratum of warriors and chieftains in the social structure.'[2]

Investigations by Soviet linguists V. Abayev, V. Ivanov and others show that the words for *a four-wheeled cart, wheel, yoke, pole, road, bridge, stake, cart, oxen, horse* are the same in all the Indo-European languages. The plough is called *krish*, both in Sanskrit and Persian. Agriculture is called *krishi*. It is clear from this account that the disintegration of the unity of the Indo-Aryan tribes took place after they had domesticated the horse and learnt to use the plough, the cart and the chariot.

Archaeological evidence about the Aryans was lacking so far. In 1972-74 came a remarkable discovery. The archaeological expedition of the Urals University (Sverdlovsk) explored an interesting site: a settlement and burial mound, dating back to the middle of the second millennium B.C., on the banks of the Sintashta River in the south of the Trans-Urals region in the Soviet Union.

According to Gening the Sintashta relics date back to the sixteenth

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[2]Piggott, S. *Prehistoric India*, pp. 250, 251

century B.C., i.e. to the period of the Indo-Iranians' advance to the East. Parallels in funeral rites, beliefs and social systems can be drawn with the Indo-Iranians, and make it possible to advance a hypothesis concerning the connection between these relics and the ancestors of the Indo-Iranians. Contacts must have been made at the time of their movement to the East from the Volga and the Black Sea steppes. The Sintashta findings make it possible to form the hypothesis that the Iranians had mixed with large groups of local tribes, most probably of Ugro-Finnish origin. The very name of the Indo-Iranians, "Aryans", was probably inherited from local tribes along with other tribal names.

What did the expedition find at Sintashta mound? Several dozen big mud huts, grouped in rows, each row having 5-6 huts. They stood close to one another and looked like one "big house". Inside there were usually two big clay ovens standing by the wall. The chief occupation of the population was most probably animal husbandry, but they also engaged in farming.

Archaeologists obtained particularly valuable information when, digging in the burial mound situated some 200-300 metres away from the habitation, they discovered bronze knives, awls, a reaping-hook, fishhooks, combat axes, spear-heads, stone arrowheads, maces, grain-grinders, whetbars, piles of costume jewellery: copper-gilted headgear rings, beads (some of opaque glass), and a chestplate made of silver.

Gening states that the most important was the discovery of combat chariots. Having studied their imprints on the mud, the Soviet archaeologists established that the wheels consisted of at least 10-11 spokes. This set them apart from the wheels of the heavy Assyrian chariots having only four spokes and a heavy rim, and from the chariots found in the tomb of the Egyptian Pharaoh, Tutenkhamon, which had six spokes.

In one of the burial chambers there were skulls and four horse legs in each corner of the chamber where the chariot had been placed. The "horses" were "harnessed" to the chariot. More frequently the burial chambers contained horse carcasses. Next to the horses stood clay vessels, apparently containing some holy drink.

The articles discovered attest to a high level of animal husbandry. In the third millennium B.C. animal husbandry existed in the steppes of Eurasia. The discoveries in the Sintashta burial mound, with remains of a large number of sacrificial horses, cows, sheep and dogs, have for the first time shed light on the development of this branch of the economy in that region.[3]

Apart from philology and archaeology, one cannot ignore evidence of ethnology. The inhabitants of the Punjab in India and Pakistan have great

[3]Gening, V. Ancient Settlements of Indo-Iranians, *Soviet-Land*, Oct. 1977

resemblance with the people of Iran and southern Russia. It was Punjab which was the land where the aryans settled and the Vedas were composed.

EVOLUTION AND DOMESTICATION OF HORSE

The evolution of the horse took place in North America. The earliest ancestral horse, known as *Eohippus*, was of the size of a fox. It had four toes on the front feet and three on the hind feet. In the Oligocene, the descendant of *Eohippus* was *Mesohippus*, a three-toed horse.

In the Middle Miocene-Lower Pleistocene, the *Hipparion*, an ancestor of the horse, had three toes, but the side ones did not touch the ground. Its remains have been found in the Chinji beds of the Salt Range in Pakistan, and it became abundant in the succeeding Dhok Pathan beds. No earlier ancestor of horse than *Hipparion* is found in India. It seems that it crossed from North America into Asia in the Hipparion stage during the Miocene. During the Miocene, there was a general uplift of the continents. The northern land masses grew cooler and drier. Forests retreated and grasslands expanded, providing much scope for the development of the hoofed animals. The uplift of land brought Eurasia and North America into contact across what is now the Bering Strait.

During the Quaternary Period, camels and horses migrated from North America to Eurasia. *Equus*, or true horses, appeared in the Pleistocene. Their side toes were reduced to mere splints of bones, while the middle toe hardened into a large tough hoof. The teeth also became adapted for chewing of the grasses that grew in the plains.

A strange fact about the horses is that although North America was the centre of their origin, they spread into Eurasia in the Miocene and became extinct in North America in the Pleistocene.

Equus namadicus has been found in the middle Pleistocene alluvium of the Narmada Valley in Madhya Pradesh, and also in the Siwaliks, above Chandigarh.

The genus *Equus* includes seven species. The true Caballine horses occupy the plains of Eurasia north of the great mountain ranges. The asses are in north Africa. The two species of half-asses or hemiones or onagers are in the dry zone of Asia, viz. Iran, Arabia, Gujarat (India) and Sind (Pakistan). In addition, there are three species of zebras in East and South Africa (Fig. 150). This distribution suggests that late in the Tertiary, an ancestral type of horse spread over the regions mentioned above and subsequently developed geographical subspecies which have since become distinct species.

Two races of wild horse survived into the twentieth and nineteenth centuries respectively. One is Przewalskis horse, which roamed about in Mongolia until the Russian Revolution. About forty individuals of this wild horse still survive in the Tachin Shara Nuru Mountains in Mongolia.

The other is the tarpan, the horse of south Russia which became extinct in 1851 in the Ukraine. Originally, both were widely distributed in the temperate zone.

Domestication. According to Zeuner, 'From 2000 B.C. onwards the horse-drawn chariot swept across the Western world, a contraption which requires elaborate domestication and special training. The chariot itself, of course, is older. It is therefore reasonable to assume that the horse was domesticated considerably before 2000 B.C.

The domesticated horse is almost exclusively of tarpan stock. The probable area of domestication of the horse is Ukrainian and east Russian steppes, Kazakhstan and the steppes of western Asia mainly around Lake Aral and including the plains of Turkestan, Ust-Urt Plateau and Turan. The horse was tamed by the inhabitants of this immense grassland. The western part of this zone was still a centre of horse domestication in Scythian times.

The horse gave man greater mobility than he had ever had before, and it made possible a *secondary* nomadism, combined with temporary crop-raising.

The people who brought the horse across the mountains to the Near and Middle East appear to have spoken Indo-Germanic languages. Thus the original centre of the domestication of the horse might briefly be circumscribed as Turkestan. This view is, however, not based on archaeological evidence, but on biological considerations.

Remains of the 'horse' have been found in some of the early prehistoric sites of the East and often been quoted as evidence for domestication. Unfortunately, not one of them bears the test of critical examination. The important ones are Anau, Sialk and Shah Tepe. These bones were found to be of half-asses or hemiones and not of true horses.

Gordon Childe (1951) worked out the spread of wheeled vehicles into Europe. He believes that the wheeled cart and the potter's wheel are both inventions of the Uruk culture of southern Mesopotamia and that this happened before 3500 B.C. There is evidence that the wheeled cart was preceded by the sledge, and sledges have been found in the royal tombs of Ur which are at least 1000 years younger. The earliest evidence consists of script signs on late Uruk tablets.

Childe held that wheeled vehicles reached the Indus Valley by about 2500 B.C., north Syria by 2200 B.C., Crete by 1900 B.C., Greece by 1550 B.C., south Russia by 1400 B.C., north Italy by 1100 B.C., central and northern Europe by 1000 B.C. and Britain by 500 B.C.

According to Zeuner the ancient civilizations of Mesopotamia became acquainted with the horse in the course of the third millennium B.C. Horse is mentioned for the first time in the Chagar Bazar tablets, written in the reign of Samsi-Adad (*c.* 1800 B.C.). Even in the days of Hammurabi

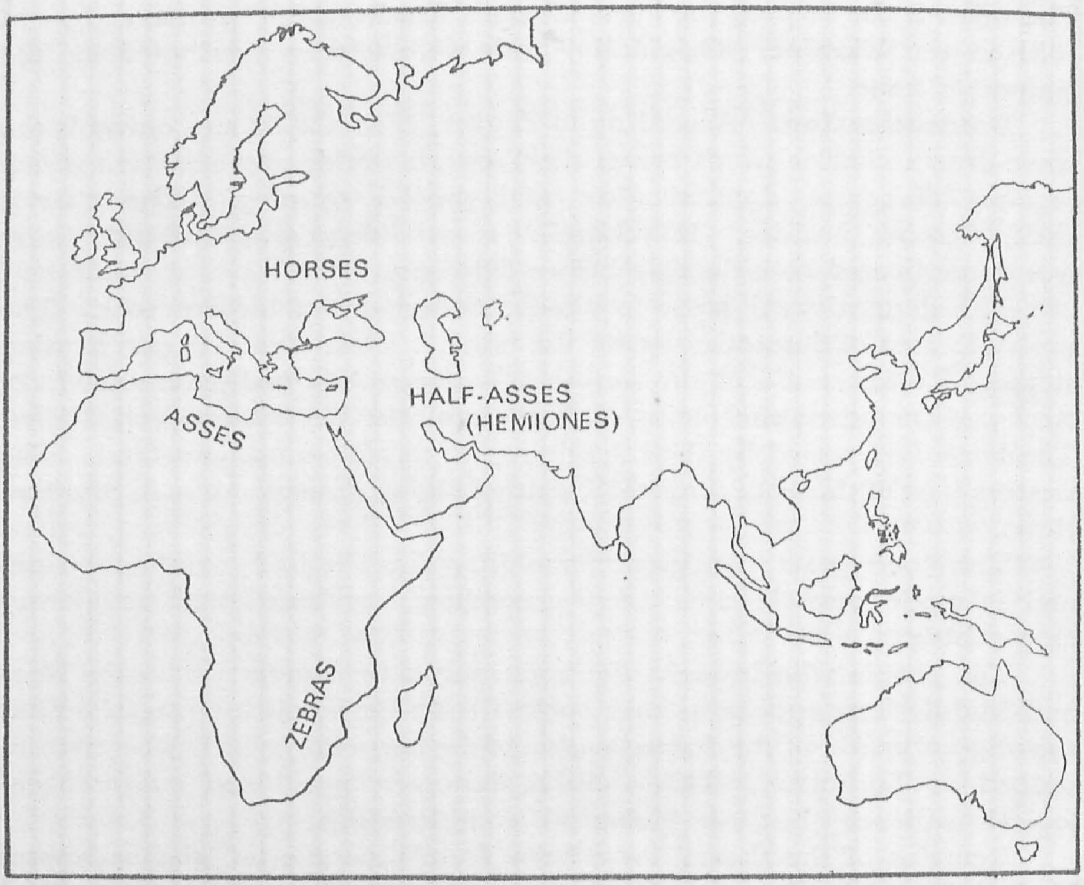


Fig. 150. Late Pleistocene distribution of the members of the genus *Equus* (horse). The asses and zebras were confined to Africa and hemiones or half-assess to the Middle East and northern India. There are no overlaps (After Zeuner)

(*c.* 1750 B.C.) the horse seems to have been of little economic importance, as it is not mentioned in his code of law. But a letter, apparently written during the reign of his successor, Samsulluna, says that about that time large movements of peoples took place, which brought many horses to Mesopotamia. The same movements would have brought it to Egypt in the west and to India in the east. About 1700 B.C., or slightly later, the horse was known in all countries of the Near and Middle East, viz. Kassite Babylonia, Syria, Mitanni on the Upper Euphrates, the Hittite state in Asia Minor, the Amorite principalities of Palestine and the New Kingdom of Egypt. In this entire area the horse was at that time used exclusively to draw the two-wheeled chariot.

From Mitanni, of about 1360 B.C., a remarkable document is available. It is called the Kikkuli Text and was studied by Hrozny (1931). This

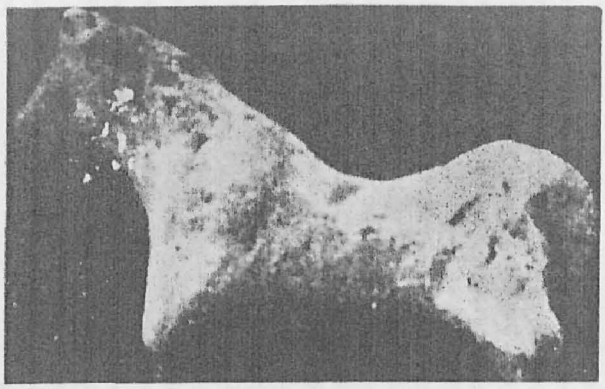


Fig. 151a. A terracotta horse, Lothal (Gujarat), *c.* 2000 to 1800 B.C.
(*Courtesy*: Archaeological Survey of India)

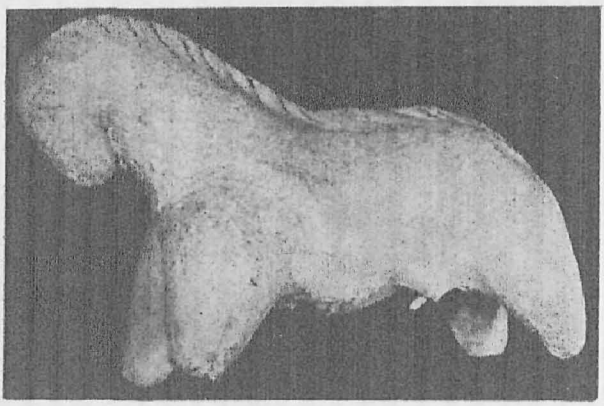
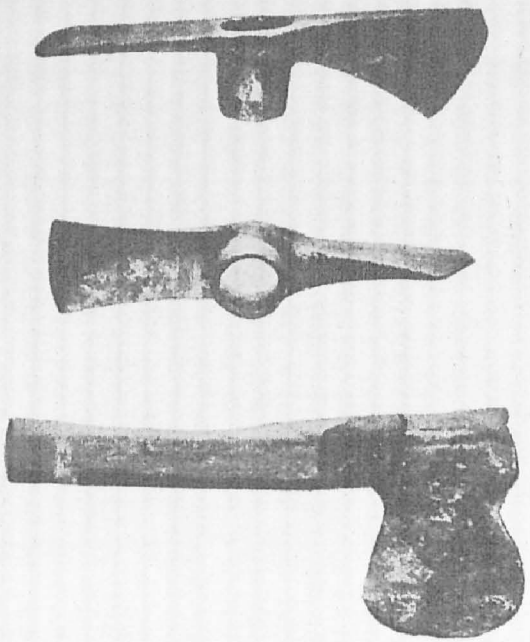


Fig. 151b. Clay figure of a horse from Kaiyatha, District Ujjain, Madhya Pradesh, *c.* 1700 B.C.
(Courtesy: H.D. Sankalia)

Fig. 152. Bronze axes with shaft holes recovered from upper layers of Mohenjodaro, dated to about 1800 B.C. to 1600 B.C., which probably belonged to Aryan invaders from Iran
(Courtesy: Archaeological Survey of India)



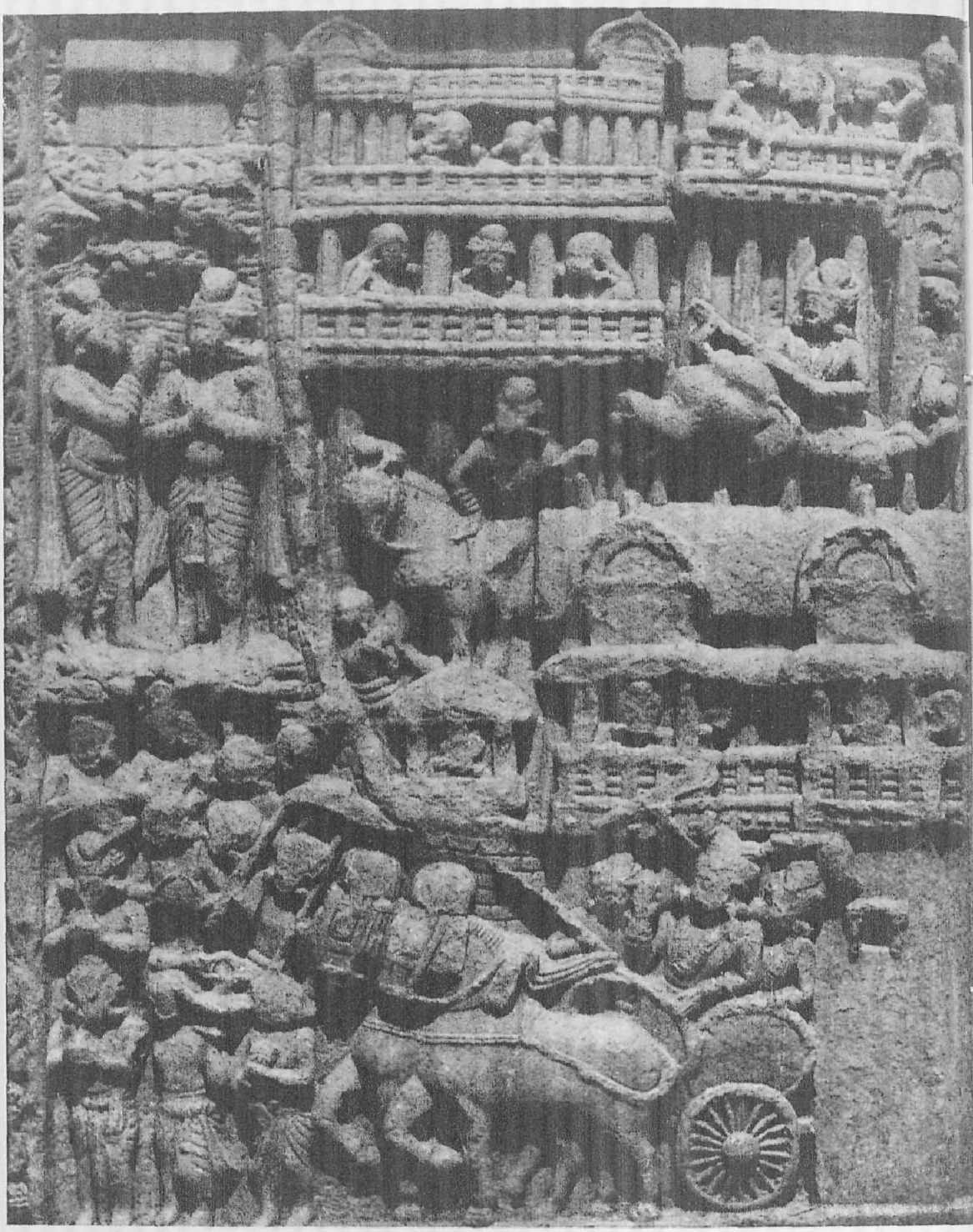


Fig. 153. Chariots drawn by horses were commonly used by the nobles in the Buddhist period. Houses were multi-storeyed with wooden balconies. The dress of the people was a dhoti and a turban. Pillar details of East Gate Stupa I, Sanchi, first century (Courtesy: Archaeological Survey of India)

treatise gives detailed directions for training and is apparently exclusively concerned with chariot-horses. Strangely enough, several technical terms used are reminiscent of Sanskrit expressions. Whilst this document provides a vivid picture of horse-breeding in the fourteenth century B.C., it is relatively late. Hrozny indeed argues in favour of an Aryan horse-equipped invasion which happened about 2000 B.C.

The picture of a horse on the silver cup of Maikop, in the Caucasus in Russia, is dated at 2000 B.C. This is the earliest pictorial record of the horse.

By 2000 B.C. the horse was known in the Caucasus area, as already stated, and made its appearance in Asia Minor (Mitanni). By 1800 B.C. it had reached Troy, and within the century that followed it spread over the whole of the Near and Middle East, in conjunction with the two-wheeled chariot. In Greece it was established in the sixteenth century, and thereafter it must be regarded as a normal piece of equipment of Mediterranean economy.'[4]

Horse in India and Pakistan. The wild horse that reached India early in the Pleistocene was long extinct. There is no evidence about the presence of the domesticated horse in India prior to the invasion of Aryan nomads about 1600 B.C. We do not find any figure of horse in the seals of Mohenjo-daro, Harappa and Kalibangan. However, the bones of horse (*Equus caballus*) have been discovered from Surkotada in Gujarat in sub-period IC, and from earlier levels as well. A terracotta horse has been discovered from Lothal, *c.* 2000 B.C.—1800 B.C. (Fig. 151,a) and clay figure from Kaiyatha, District Ujjain, Madhya Pradesh, has been dated *c.* 1700 B.C. (Fig. 151,b). However, these do not indicate any significant use of horses. There is no evidence of domestication of the horse in India.

The earliest horse remains so far reported come from Rana Ghundai in northern Baluchistan. According to Zeuner, the remains attributed to this species more probably belong to the hemione.

The same doubts apply to the rare finds of horses made in the Indus Valley culture. It is only with the Aryan invasion that the horse becomes frequent in India, an invasion affording a parallel to those that occurred in the eighteenth and seventeenth centuries B.C. in western Asia and in Europe.

Apart from cattle, the really characteristic domesticated animal of Aryans was the horse. Pack horses, riding horses, chariot horses, war horses, race horses and even ploughing horses, all find frequent mention in the Vedas.[5] From the descriptions of the colouring of horses in the *Rig-Veda*, Ridgeway concluded that they had chestnut heads and backs, shading off into dun on the lower parts of the body, in the manner of the wild horse of the steppes known as Przewalski's horse, and that they were of

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[4]Zeuner, *A History of Domesticated Animals*, pp. 300, 303, 313, 329, 332 and 333

[5]Aiyer, A.K.Y.N. *Agriculture and Allied Arts in Vedic India*, p. 47

Mongolian or Upper Asiatic stock. They seem to have been kept in stalls on occasion at least, and were hobbled when put out to graze. Stallions were sometimes gelded, but mares were especially used as draught animals in war-chariots, and riding seems to have been very exceptional and never formed a technique of warfare. This may well have been partly due to the fact that the invention of stirrups seems to come unaccountably late in the development of horse-harness, and that a secure seat for a fighting man could hardly be attained without them. Military cavalry was known to the Assyrians and the Achaemenids, and the invention of stirrups must be an ancient oriental contribution to horsemanship.

The Aryan horses seem to have been used essentially as chariot-animals, whether in warfare, or for chariot-racing, which was a favourite sport. It seems to have been indulged in purely for amusement and for prizes (except on a few formal religious occasions, such as the royal consecration), and the race took place along a course to a mark round which the chariots turned and came back again—the *aikavartana* and so forth of the Mitannian Guide to the Turf.[6]

The Aryan chariot, as it appears in the *Rig-Veda*, has a name (*ratha*) which is an Indo-European 'wheel' word, represented by the Latin *rota*, Celtic *roth*, Old High German *rad*, and Lithuanian *ratas*, and similarly common to the whole language group are the words for wheel, axle, nave, and yoke. It resembled the two-wheeled chariot depicted on East Gate of Stupa I at Sanchi (Fig. 153). Chariots drawn by four horses are also depicted in Sanchi reliefs.

The Aryans were the first people to introduce the idea of rapid transport made possible by the use of horses. For their farm work, ox-drawn four-wheeled carts were used, and horses were bred solely for use with the light two-wheeled chariot.

Piggott states that 'the evidence from Baluchistan and from Sind and the Punjab is reasonably consistent in implying that at some period likely to have been before 1500 B.C. the long-established cultural traditions of North-Western India were rudely and ruthlessly interrupted by the arrival of new people from the west. Thick layers of burning indicate violent destruction of Rana Ghundai, Dabar Kot and other Baluchi settlements. The burning of the Baluchi villages and the equipment of the graves at Shahi-tump suggest that these new arrivals were predominantly conquerors who travelled light, and adopted the pottery traditions of the regions in which they established themselves. In Sind, at Chanhu-daro, a barbarian settlement appears in the deserted ruins of the Harappa town.[7]

Groups of skeletons of men, women and children, some bearing axe

[6]Piggott, S. *Prehistoric India*, pp. 268, 269
[7]Piggott, S. *Prehistoric India*, pp. 240, 241

or sword-cuts were found lying on the topmost level at Mohenjo-daro. Mortimer Wheeler attributes this massacre to the invading Aryans. Two bronze axes with shaft-holes were discovered from the upper levels of Mohenjo-daro (Fig.152). Apart from these axes two bronze daggers with thickened mid-rib were also discovered. Piggott regards them as an import from Iran. The axes resemble those recovered from sites in north of Iran, e.g. Hissar III, Shah Tepe and Turang Tepe. A shaft-hole axe represents a technological advance over the flat axe. These were the type of weapons which could be associated with the Aryans.

The Aryan conquest of the Harappan towns is indicated by references in the *Rig-Veda* to their god Indra, who is described as Purandara, or the destroyer of fortresses. Dange has suggested that the expression can also mean destroyer of canals. So, it may refer to destruction of Harappan irrigation systems. The following are references to the destruction of fortresses and cities in the *Rig-Veda.*

"Indra has overturned a hundred stone-built cities" (R., IV. 3.9.20). "Indra, you are the blaster of fortresses" (Y., 386.38). "Indra demolished the ancient cities of Ashna" (R., II. 2.9.5). "Invincible, destroying the phallus-worshippers, he won by his prowess whatever wealth (was concealed in the city) with the hundred gates" (R., X.8.9.3.). "Thou hast destroyed the impregnable cities of the Dasyu Shambara" (R., VI. 3.8, 4).[8]

No doubt there is an element of exaggeration in these hymns as conquerors always boast of their superiority to their rivals, but most of the Harappan towns were walled and had citadels.

The Aryans' advantage lay in superior weapons of warfare, the trained horse and the bronze sword with thickened mid-rib. The training of the horse for war, and of milch-mares as a source of an exceptionally complete food must have an immense advance, giving the herdsman a power over great spaces, and enabling him to organize vast stretches to gratify his ambitions and to meet his needs. After acquiring command over the horse, the nomad horsemen marched into peripheral fertile lands of Iran, Mesopotamia, southern Europe and India. The domestication of the horse caused a great crisis in human history which may be compared to the invention of the steamship and later on of the aeroplane in modern times. The ancient civilizations of India and Syria were shaken to their foundations and ultimately crumbled before the onslaught of the horse and the bronze sword. The horse was used by the Aryan nomads for management of herds of cattle, sheep and goats in the grassland of the southern steppe, and it served a new purpose in the peripheral fertile lands. The Aryans found that not only sheep and goats but subject people could be just as well controlled with the aid of the horse.

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[8]Aiyer, A.K.Y.N. *Agriculture and Allied Arts in Vedic India*, p. 51

CHAPTER 19

THE VEDIC AGE

PASTORALISM, HUNTING AND CULTIVATION OF BARLEY

1500 B.C. TO 1000 B.C.

THE extent of the country occupied by the Aryans, as mentioned in the Vedic texts, is eastern Afghanistan, North-West Frontier Province, Kashmir, the Punjab and parts of Sind and Rajasthan. The Aryan land is called *Saptasindhavah*—the land of seven rivers. The seven rivers are the five rivers of the Punjab, viz. the Sutudri (Satluj), the Vipas (Beas), the Parushni (Ravi), the Asikni (Chenab) and the Vitasta (Jhelum). The other two rivers are the Indus to the north and the Sarasvati in the present-day Haryana. Drishadvati, now represented by the Chutang, is also mentioned along with the Sarasvati. The Punjab was the land of the *Rig-Veda*. The Vedic people knew the whole of the Punjab, and occupied the best part of it along the river-beds. The rest was a jungle of xerophytic plants, e.g. *Salvadora persica* and *Prosopis cineraria (P. spicigera)* and remained as such till this arid area was irrigated by canals in first quarter of the current century.

The territory occupied by the Aryan settlers was divided into a number of tribal principalities ruled by Rajas. There were five principal tribes called Panshajana. Of these, the most important were the Bharatas, who had settled in the region between the Sarasvati and the Jamuna. They were supported by Vasishtha Rishi. The Bharatas, under the leadership of Sudās, fought a tribal confederacy of five tribes, viz. Puru, Yadu, Turvasa, Anu and Druhyu, along with five of little note, viz. Alina, Paktha, Bhalānas, Siva, and Vishāṇin. The priest of the Purus was Vishwamitra. The battle was fought on the banks of the Parushni (Ravi) and is known as Dashrajana, or the battle of the ten kings. In this battle, the Bharatas defeated the Purus. Purukutsa, Raja of the Purus, was killed in this battle. It is from the Bharatas that India derives its name.

In the north-west of India lived the Gandharis. The *Rig-Veda* mentions the fine-quality wool of the sheep kept by them.

The indigenous inhabitants are mentioned as Dasyu and the Dāsas. Dasyus are described as black-skinned, snub-nosed people, and were the original inhabitants of the Punjab and Sind. They were conquered by the Aryans and were treated as Shudras. There are many references to the slaughter of Dasyus in the *Rig-Veda*, and the term *Dasyu-hatya* occurs frequently.

Most of the tribal wars were fought for acquiring cows, which were a

symbol of wealth. The term for war in the *Rig-Veda* is *Gavisthi* or search for cows.

Most of the tribal problems were settled in assemblies, known as *sabha* and *samiti*. The Aryans gave their primary loyalty to the tribe which was called *Jana*. The Aryan society was patriarchal, with several generations of the family living under the same roof. Preference was for sons, who could help actively to look after cattle and in war and hunting.

THE RIG-VEDA AND THE ARYAN DEITIES

The *Rig-Veda* is the oldest book of the Aryans. According to Max Müller, its hymns comoposed between 1200 B.C. and 1500 B.C. were handed down orally from the father to the son. The manuscript on which Max Müller based his translation was a commentary by Sayana Akarya, dated back only to A.D. 1400. I-tsing, the Chinese traveller, who visited India between A.D. 671 and A.D. 695, says that the four Vedas contain about one hundred thousand verses, and in every generation there were intelligent Brahmins with prodigious memory who could recite all these verses.

'In the Vedas the gods are constantly invoked to protect their worshippers, to grant them food, large flocks, large families, and a long life; for all which benefits they are to be rewarded by the praises and sacrifices offered day after day, or at certain seasons of the year. Deities are invoked by different names, some clear and intelligible, such as *Agni*, fire; *Surya*, the sun; *Ushas*, dawn; *Maruts*, the storms; *Prithvi*, the earth; *Ap*, the waters; *Nadi*, the rivers: others such as Varuna, Mitra, Indra, which have become proper names, and disclose but dimly their original application to the great aspects of nature, the sky, the sun, the day.' [1]

The Mittanis. Here we may refer to Mittanis of Asia Minor who were the contemporaries of the Rig-Vedic Aryans of north India. In the fourteenth and fifteenth centuries B.C., Aryan names were frequent among the Mittanian rulers, and appear in the diplomatic correspondence from El Amarna in Egypt and Boghaz Keui, the Hittite capital in Asia Minor, in documents written in modified cuneiform script on clay tablets. In a treaty between the Hittite king Subiluliuma and the Mittanian Mattiuaza, son of Dusratta, in about 1380 B.C., in which the latter invokes his gods as witness, in the formula *ilani Mi-it-tra-as-si-il-ilani U-ru-w-na-as-si-il ilu In-da-ra ilani Na-sa-at-ti-ia-an-na.* These can only be the gods Mitra, Varuna, and Indra. The last deity is the Nasatyas, an alternative name for the Asvins. This Hittite treaty points to a common stock of mythology among the Indo-European peoples of India and Asia Minor.

ARCHAEOLOGICAL REMAINS OF THE ARYANS

Gandhara Grave Culture. The archaeological evidence of the

[1] Max Müller, *Chips from a German Workshop*, Vol. I, p. 27

arrival of the Aryans in the North-West Frontier Province, according to Thapar, is available in the Gandhara Grave Culture, covering Periods I-III, and the occurrence of objects of copper or bronze, viz. copper celts, swords, shaft-hole axes, and spiral-headed pins, which have a wide distribution in time and space (Heine Geldern, 1936, 1937, 1956; Piggott, 1950; Gordon, 1958; Allchin, 1968).

The Gandhara Grave Culture, was brought to light by the excavations at Buthara II, Katslai I and Loebanr I Butkara, Barama, Timargarh and Balambat in Swat by Dani. It is characterized by: (a) three distinct types of burial practices (inflexed articulated inhumation, cremation in urns and fractional and multiple), corresponding to three periods of occupation I, II and III; (b) two classes of pottery (red ware and grey ware); (c) the use of copper-bronze during Periods I and II and of iron during Period III; and (d) the knowledge of horse-breeding. On the basis of a comparative study and ^{14}C determinations, Period I is dated to sixteenth-thirteenth century B.C., Period II to twelfth-tenth century B.C. and Period III to ninth-sixth century B.C. The settlement pattern of this culture indicates the location of the habitation sites along the slopes extending to the river, permitting the use of river for terrace cultivation. Higher slopes would no doubt have been used for cattle-grazing.

A detailed study of the skeletal material (Bernhard, 1967) obtained from the graves indicates the presence of two dominant groups of foreign peoples in the graves: *Eurydolichomorph* or Proto-Europoid in Period I and *Leptodolichomorph* or the Mediterranean in Period III, 'closely connected the southern migration of foreign people into the Pakistan-India sub-continent which began in the second millennium B.C. and continued in the first'. On the basis of this evidence, the excavator felt that these migrations represented two waves of invasions of the plain grey ware-using people, the first associated with copper or bronze in about the middle of the second millennium B.C. and the second with iron in the beginning of the first. On circumstantial evidence, the people associated with these migrations are identified with the Aryans, the two waves being further explained by the use of the words *ayas* (generally taken to be copper) in the Rig-Vedic literature, and *tamra-ayas* (copper) and *krishna-ayas* (iron) in the later Vedic.[2]

THE ARYANS

The Aryans were tall and handsome people of fair colour. Men wore ear-ornaments and there is mention of an ornamental headdress for women, which stood up like a 'horn'. Gold was used for bracelets, anklets, earrings, and neck-ornaments.

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[2]Thapar, B.K. *The Archaeological Remains of the Aryans in North-Western India*, I.C.H.R.

Dress. The Vedic Aryans used the deer-skin or woollen cloth for garments. The dress usually worn consisted either of three or of two garments. Luxury manifested itself in the wearing of variegated garments or clothing adorned with gold. The hair was carefully combed and oiled. Women wore it plaited, and in some cases men wore it in coils : it was a characteristic of the Vasishthas to have it coiled on the right. Shaving was not unknown, but beards were normally worn, and on festive occasions men bore garlands.

Food. Milk formed a considerable part of the ordinary food, being taken in its natural state or mixed with grain. *Ghee* or clarified butter was also much used for frying food as well as for feeding the sacrificial fire. Grain was either parched or ground into flour, and mixed with milk or butter, and made into cakes. As throughout the history of India, vegetables and fruits formed a considerable portion of the dietary. But the Vedic Indians were a nation of meat-eaters, nor need we believe, 'that they merely ate meat on occasions of sacrifice'. Rather, as in the Homeric age, the slaughter of animals was always in some degree a sacrificial act, and one specially appropriate for the entertainment of guests. The sheep and the goat were the normal food eaten by men and offered to their gods: horse-flesh was probably eaten only at the horse-sacrifice, and not so much as ordinary food as to gain the strength and swiftness of the steed. 'There is no inconsistency between this eating of flesh and the growing sanctity of cow, which bears already in the *Rig-Veda* the epithet *aghnyā*, not to be killed.' If this interpretation of the term is correct, it is merely proof of the high value attached to that useful animal, the source of the milk which meant so much both for secular and sacred use to the Vedic Indian. The flesh eaten was either cooked in pots of metal or earthenware or roasted on spits.[3]

In addition to milk, the Aryan had at least two intoxicating drinks. The first was the *soma*, which however, by the time of the *Rig-Veda*, appears almost exclusively as a sacrificial drink. Basham[4] believes that *soma* was possibly *bhang* (*Cannabis sativa*), whose consumption produces vivid hallucinations and expansion of consciousness. *Bhang* grows wild in the submontane districts of the Punjab and Uttar Pradesh as well as in Central Asia and South Russia. It is the favourite drink of *sadhus* and hippies. *Bhang* is most likely the *soma* plant.

The popular drink was, however, the *surā*, which was distilled from barley. It was extremely intoxicating, and the priests regarded it with disapproval: in one hymn mention is made of men made arrogant by the *surā* reviling the gods, while another couples it with anger and dicing as the cause of sin.

Sports. Among the amusements of the Aryans the first place must

[3]Rapson, E.J. (Ed.), *The Cambridge History of India*, Vol. I, pp. 88, 90
[4]Basham, A.L. *The Wonder that was India*, p. 236

clearly be given to the chariot race, a natural form of sport among a horse-loving and chivalrous people. The second belongs to dicing. Dancing was also practised, and the dancing of maidens is several times mentioned; it seems that men also, on occasion, danced in the open air, as a metaphor alludes to the dust of the dancing feet of men.

The Village. 'All the evidence points to the absence of city life among the tribes. The village probably consisted of a certain number of houses built near each other for purposes of mutual defence, surrounded by a hedge as protection against wild beasts. The *pur*, which is often referred to and which in later days denotes a 'town', was probably no more than a mere earthwork fortification which may in some cases at least have been part of the village. In certain passages, these *puras* are called autumnal; and by far the most probable explanation of this epithet is that it refers to the flooding of the plains by the rising of the rivers in the autumn, when the cultivators and herdsmen had to take refuge within the earthworks which at other times served as defences against human foes. In the midst of each house burned the domestic fire, which served both for practical and sacrificial uses.'[5]

All the Aryan buildings, however, appear to have been of wood, and the house seems to have been rectangular, with a thatched roof, divided into more than one room or compartment. Possibly the cattle and sheep, as well as the household, were under a single roof. This pattern of living still prevails in the Kulu Valley.

Chaupals. The community had periodic assemblies in a meeting-hall, from which women were excluded. Here, the business of the clan was discussed, and gossip retailed. The men gambled at a game of chance played with nuts. One is reminded of *chaupals* in the present-day Haryana.

Artisans. The carpenter, working with an axe or adze, and making ploughs and chariots, or the door-posts of a house, was an honoured person. His equipment included the bow-drill, the use of which is implied in the fire-making appliance with which fire was kindled. Next in importance was the worker in metal who smelted the copper ore in a furnace, using the wing of a bird in place of a bellows to fan the flame. Bronze seems to have been the only metal worked; it follows that copper must also have been used, although the word for this metal occurs only later than the *Rig-Veda*, as does that for tin.

Leather-workers were certainly there. Leather was used for chariot-races, reins, whips, slings, bow-strings, cuirasses, bellows, bottles, and large containers. It was also used for making carboy-like holders for storing *ghee* and oil, cattle troughs, shoes and sandals, leather arm protectors for archers, harness and saddles for horses, floor spreads and drum leather.

[5]Rapson, E.J. (Ed.), *The Cambridge History of India*, Vol. I, p. 91

Potters made pots which were used for boiling milk, keeping curds and storing grains. They made pitchers for storing water and *soma* juice.

Pastoralism. The Vedic Aryans were primarily pastoral. When they settled in the Punjab, they cut the jungles, and built their villages. They grazed their cattle in the jungles, and planted barley in the land close to the *abadi* (habitation) where it could be protected from wild animals. Like the Gujars of Jammu and Kashmir, they often travelled for long distances in search of pastures, but ultimately returned to their homes along with their cattle.

The village maintained, on pay or on a share of produce, cowsherds, who were entrusted with the work of taking the cattle to the pasture ground in the morning and bring them back in the evening (*Anguttaranikaya*. I. 205; *Rig-Veda*, X. 10. ef). Such a practice still survives in many villages of Haryana.

A number of hymns in the Vedas are addressed to Indra for gifts of cattle. "May we escape poverty by means of cattle" (R., X. 4. 2. 10). "Grant to us Indra wealth of barley and cattle" (R., X. 3. 13. 7). "Shedder of rain, set open these clouds, set open the cow pastures, send us liberal kine liberally" (R., I.3.3.7, 8). "Givers of horses, cows and garments" (R., V. 3. 10, 8). "Lord of wealth (Indra) visit us as of old to give us cows, horses and chariots" (R., VIII. 6.4. 10).

The sixth Anuvaka of the eighth Mandala of the *Rig-Veda* relates wholly to the liberal gifts in cows, mares, camels and horses, one of which is characteristic, viz. "I have received sixty thousand horses, and tens of thousands—a score of hundreds of camels, a thousand brown mares, and ten times ten thousand cows with red patches." (R., VIII. 6.4. 22).

The name of the sacrificial fee, *dakshinā*, is explained as referring originally to a cow placed 'on the right hand' of the singer for his reward. The singers delight to compare their songs to Indra with the lowing of cows to their calves. At night and in the heat of the day the cows seem to have been kept in the fold; while for the rest of the day they were allowed to wander at will.

The Aryan vocabulary is rich in names for every aspect of the herd, states Piggott, with special words for 'a cow with a strange calf', 'a cow barren after calving', 'a three-year-old ox', and so on. Red, black, dappled, and light-coloured cows are mentioned, and herds were differentiated by distinctive nicks cut in the ears. One may compare the infinite variety of Punjabi words for buffaloes. The cows were milked three times a day, and castration was practised. Oxen were used for the normal purposes of farm transport.

Churning of milk was done with a wooden beater, twirled with a rope, now one way, now the other. This practice still continues in the rural areas of India. The churning-stick is called *madhani*, and the churning-

pot *chāṭī* in Punjabi.

Cows which gave abundant milk and which could be milked with ease are prayed for, thus: "These white kine giving milk like wells" (R., VIII.7. 10.3). "I invoke the milk cow that is easily milked, that the handy milker may milk her" (R., I. 22. 8.26). The quality of some cows which let down their milk merely on the sight of their calf has been well observed and referred to thus: "As a cow having a copious stream of milk yields it coming into the presence of the calf" (R., IX. 4.2. 1).[6]

To the Vedic Aryans, the buffalo was a new animal and they were only accustomed to cows. When they came across the buffalo in India, they called it *gauri* and *govala*, extension of the term *go* (cow).[7]

As cows were the principal wealth of the Aryans, they were often stolen, and expeditions were organized for their recovery with prayers to Indra. "Recover thou our cattle, Indra; bring them back; the drum sounds repeatedly as a signal; our leaders mounted on their steeds, assemble; may our warriors be victorious" (R., VI.4.4. 31).

Sheep and Goats. Dogs were used for guarding houses and for boar-hunting, and they got driven away from the sacrifices, but there is no direct evidence of their use in herding, which seems to have been carried out by a herdsman armed with an ox-goad. The flocks included both sheep and goats, kept for their wool as much as for their flesh. The Sanskrit word for a sheep is used by transference for wool, and no doubt sheep's wool was mainly used, but there is evidence that goat's wool was also used, presumably from such long-haired animals as those of Kashmir. The wool, when spun, was woven, probably by women, on a loom of which the names of warp, woof, and shuttle are preserved.[8]

The art of weaving was well known and there are numerous references to it in the Vedas. The fibre used was wool. Wool was woven into carpets and fabrics for garments. The use of the needle was also known, and stitched garments were presumably in use. Softness was a great attribute of the best carpets and of the fabrics for the best garments.

Hunting. Hunting seems still to have played a considerable part in the life of the Aryans. The hunter used both bow and arrow and snares and traps. There are clear references to the capture of lions in snares, the taking of antelopes in pits, and the hunting of the boar with dogs. Birds were captured in nets stretched out on pegs. Buffaloes seem to have been shot by arrows, and occasionally a lion might be surrounded by hunters and shot to death.

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[6]Aiyer, A.K.Y.N. *Agriculture and Allied Arts in Vedic India*, pp. 42, 46
[7]Sharma, R.S. *Conflict, Distribution and Differentiation in Rigvedic Society*, I.C.H.R.
[8]Piggott, S. *Prehistoric India*, pp. 267, 268

AGRICULTURE

There are exhortations to idlers to work rather than wasting time in gambling. "Play not with dice; pursue agriculture; delight in wealth so acquired; there, gambler, are cows, there is a wife (to look after)" (R.,X.3.5.13).

While the profession of agriculture and the possession of vast cultivated land were extolled, the man behind the plough, the man who is actually the tiller of the land, was looked upon as a dull individual, not a fit company for the members of the upper classes. The profession was regarded as fit only for the unlearned, and those devoid of wisdom. It remained so for centuries.

Ploughs were drawn by teams of two to eight bullocks. Plough-oxen may be employed for the whole day when they are eight-strong per plough. If the number of oxen yoked to one plough is six, they should not be engaged for more than three-quarters of the day. If the number is four, not more than half the day, and if the number is two, not more than one-quarter of the day.

Atri, Parasāra, Āpastamba and others say 'one who yokes eight oxen to a plough is a pious man. One who yokes six is just a businessman. Cruel are those who employ four and those who employ two are but beef-eaters.'[9]

Employment of large team of bullocks indicates that the bullocks were weaker than the present-day breeds. Besides, the ploughs were made of wood, and they were not provided with iron ploughshares, and to plough hard clay soil more bullock-power was necessary.

There are 21 references to agriculture and ploughing in the *Rig-Veda*, the bulk of which are in Books I and X. R.S. Sharma[10] states, Books I and X, which account for a good bulk of the *Rig-Veda*, are admittedly late, both from the point of view of style and the nature of material culture they reveal. Most references to field agriculture are confined to these *mandalas*, and evidence furnished by them shades off into post-Rig-Vedic period from around 1000 B.C.

Ploughing. The rains have fallen, and the ploughing of fields begins. The first ploughing of the season was inaugurated amidst much ritual.

Here are hymns addressed to Shuna, Sita, and Shunashira. Addressed to Shuna: "May the oxen draw happily; the men labour happily; the plough furrow happily; may the traces bind happily; wield the goad happily."

Addressed to Sita, the earth goddess: "Auspicious Sita, be present,

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[9]Gangopadhyay, R. *Some Materials for the Study of Agriculture and Agriculturists in Ancient India*, pp. 86, 87

[10]Sharma, R.S. *Conflict, Distribution and Differentiation in Rigvedic Society*, I.C.H.R.

we glorify thee; that thou mayest be propitious to us; that thou mayest yield us abundant fruit. May Indra take hold of Sita; may Pushan guide her; may she, well-stored with water, yield it as milk year after year."

Addressed to Shunashira: "May the plough-shares break up our land happily; may the plough go happily with the oxen; may Parjanya water the earth with sweet showers happily; grant, Shuna and Shira, prosperity to us" (R., IV. 5.12. 1-8).

Here is a reference to ploughs and ploughing. "Our auspicious ploughs with their ornamental handles, and their sharp-pointed shares, cleave the ground to the happiness of cows, sheep and well-grown maidens." The ploughs were wooden and so were the ploughshares.

"May the ploughmen plough round and round, happy with the prospect of heavy crops—may the rain god grant us plenty with milk and honey." "Fit up the ploughs, and yoke them close to each other." "May Indra press the plough deep into the soil; may the sharp-pointed share cleave the soil and push the ploughed earth on both sides of the furrows" (Y., 189. 13-20).

"O, Indra, I ask your help in ploughing for the increase of grain" (Y., 16.10). "May the lowlying lands so ploughed and rich with milk, and wet with honey and ghee come back to us much fertilized" (Y., 189.20). "The ploughshare furrowing the field provides food for the ploughman" (R., X. 10.5.7).

The plough used was large and heavy, but a yoke does not seem to have been used. Maybe the plough traces were tied to the horns of bullocks as in Early Dynastic Sumer and Third Dynasty Egypt.

Irrigation. As already stated, the Aryans' land of Northern India is well-watered and has seven rivers. There is reference to craftsmen (*ribhus*) who led forth the rivers (R., IV. 4.1.7). The reference is to irrigation by channels taken from the rivers. There is also reference to soil erosion by rivers. "Rivers, the corroders of their banks, like armies destructive of their foes" (R., IV. 2. 9. 7).

Wells. Wells were in use for supply of drinking-water to men as well as to animals, and also for irrigation. "As a thirsty ox or a thirsty man hastens to a well" (R., I. 19.4.2). "Our praises converge towards you, like herds towards a well" (R., X. 2.9.4). "Tie the ropes tight to the waterpots, let us draw water from this unfailing well. Set up the cattle trough; bind the straps to it; let us pour out the water from the well which is not easily exhausted" (R., X. 9.2.5).

There were *kucha* wells, which were just holes dug in the ground. Even now such wells are in use in the riverain areas of northern India. These were a source of danger to unwary men and cattle. Prayers were offered for the safety of cattle that they may not fall into such wells. "Let not, Pushan, our cattle perish, let them not be injured, let them not be hurt by

falling into a well" (R., VI. 5.5.7).

Fields. Land was laid out into regular fields, ploughed and sown, and crops were reaped and stored. Land was also measured and fields of definite sizes were laid out. This system implies individual ownership. Thus: "Wide fields, vast treasures, spacious pastures, has Indra bestowed on his friends" (R., III. 3.2.15).

Measuring-rods of presumably standard lengths were used for measuring fields. "Like a field measured by a rod" (R., I. 16.5.5).

Here are references to seed and sowing. "Sow the seeds; may the earheads be many and heavy for the sickles to cut and pile in heaps; may these auspicious ploughs (used at sowing time to cover the seeds) bring us wealth in cows, sheep, chariots and well-nourished and strong women" (A. 88.1.7).

"Harness the ploughs, fit on the yokes, now that the womb of the earth is ready to sow the seeds therein; and our praise to Indra, may there be abundant food, may the grains fall ripe towards the sickle" (R., X. 9.2.3).

Harvesting of Crops. Harvesting began with a prayer. The harvesting tool was the sickle. Thus: "I take the sickle also in my hand with a prayer to thee" (R., VIII. 8.9.10). "May the crop swell at my prayers; let the sickles cut down the heavy crop of grain" (R., V. 6.12.9.10) "May there be abundant food, may the grain fall ripe towards the sickle" (R., X. 9.2.3). Some form of container or measure was used for which the word *urdara* is used.

Harvesting was both by cutting down the crop at the level of the ground and also by cutting the earheads. "As barley is harvested by separating the earheads from the stalk" (Y., 122.1). "Thou milkest the nutritious grain from the humid stalk" (R., II. 2.2.6).[11]

Even now in the Kumaon Himalaya at higher altitudes, barley is harvested in this manner and the ears are snipped off with a pair of sticks, while the straw which is allowed to stand in the field is burnt.

BARLEY. Barley (*Yava*) is the grain crop mentioned frequently and in many contexts, such as sowing, harvesting, winnowing and storing. Thus, "As a husbandman repeatedly ploughs the earth for barley" (R., I. 5.6.15). "Causing the barley to be sown in fields properly prepared by the plough" (R., I. 17.2.21). "The cattle feed upon the barley" (R., X. 2.11.8).

SESAMUM: This is the only oilseed mentioned. Both the black-seeded and the white-seeded varieties were grown, and the seed was pressed for oil.

SUGARCANE: This crop seems to have been grown by the Aryans. "I offer you dried sugarcane, white sesamum, reeds and bamboos" (A., 475, 53 and 54).

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[11]Aiyer, A.K.Y.N. *Agriculture and Allied Arts in Vedic India*, pp. 3, 5, 6, 12, 14, 16 and 17

CUCUMBER AND BOTTLE-GOURD are specifically mentioned, "May I be liberated from death like the *urvaruka* (cucumber) fruit from its stalk" (R., VI. 4.5.12). An idiot is thus described. "He is like an empty bottle-gourd" (A., 720.1-4).

There is no mention of wheat and cotton in the Vedas, though both the crops were cultivated by the Harappans. It seems that the Aryans were accustomed to barley diet in their original homeland and they stuck to it. Barley is good for men, cattle and horses. Barley is used in Hindu rituals even at present in India. For clothes the Aryans continued to prefer wool to cotton even in the hot climate of the Punjab.

Rice is not mentioned in the early Vedic literature. It is highly probable that the Aryans were not aware of rice in the early stages of their colonization of India and learnt its cultivation from the aborigines of this country when they reached the areas now described as Uttar Pradesh and Bihar. Rice does not find a place in the basic rituals of the Aryans; however, it does find a place in secondary rituals which were later elaborations.

CHAPTER 20

THE LATER VEDIC PERIOD

YAJUR-VEDA, SAMHITAS AND BRAHMANAS
The Age of Iron and Painted Grey Ware
The Invention of the Iron Ploughshare and Axe
Clearance of Jungles, Expansion of Cultivation

1000 B.C. to 600 B.C.

THE invasion of India by the Aryans was not a single action. It extended over centuries, and wave after wave of the Aryans came and poured into India through the passes, viz. Khyber, Gomel, Bolan and Tochi. It seems that about 1100 B.C. a large wave of iron-using Aryans entered India. Slowly, they moved from north-west to east. They entered the area now known as western Uttar Pradesh about 1000 B.C. From about 1000 B.C., the use of iron spread from Baluchistan, Gandhara to eastern Punjab, western Uttar Pradesh and Rajasthan. It reached eastern Uttar Pradesh and Bihar in the seventh century B.C. Apart from iron objects, a grey pottery, known as Painted Grey Ware, is also associated with the later Aryans. The location of some of the important sites of Painted Grey Ware is shown in Fig. 154. This type of pottery has been found in numerous sites in the Punjab, Haryana, and Uttar Pradesh. It always overlies the layers associated with the Harappan culture.

SAMHITAS AND BRAHMANAS

From 1000 B.C. to 600 B.C., a number of Vedic texts were compiled in western Uttar Pradesh. They include the *Samhitas* and *Brahmanas*. The collections of the Vedic hymns or *mantras* were known as the *Samhitas*. The *Rig-Veda Samhita* is the oldest Vedic text, on the basis of which we have described the early Vedic age. For purposes of singing, the hymns of the *Rig-Veda* were set to tune, and this modified collection was known as the *Sama-Veda Samhita*. In addition to the *Sama-Veda*, in the post-*Rig-Vedic* times, two other collections were composed, viz. the *Yajur-Veda Samhita* and the *Atharva-Veda Samhita*. The *Yajur-Veda* contains not only hymns but also rituals which have to accompany their recitation. The rituals reflect the social and political milieu in which they arose. The *Atharva-Veda* contains charms and spells to ward off evils and diseases. Its contents throw light on the beliefs and practices of the Aryans.[1]

A variety of plants providing food, fibre and medicines find mention

[1]Sharma, R.S. *Ancient India*, p. 49

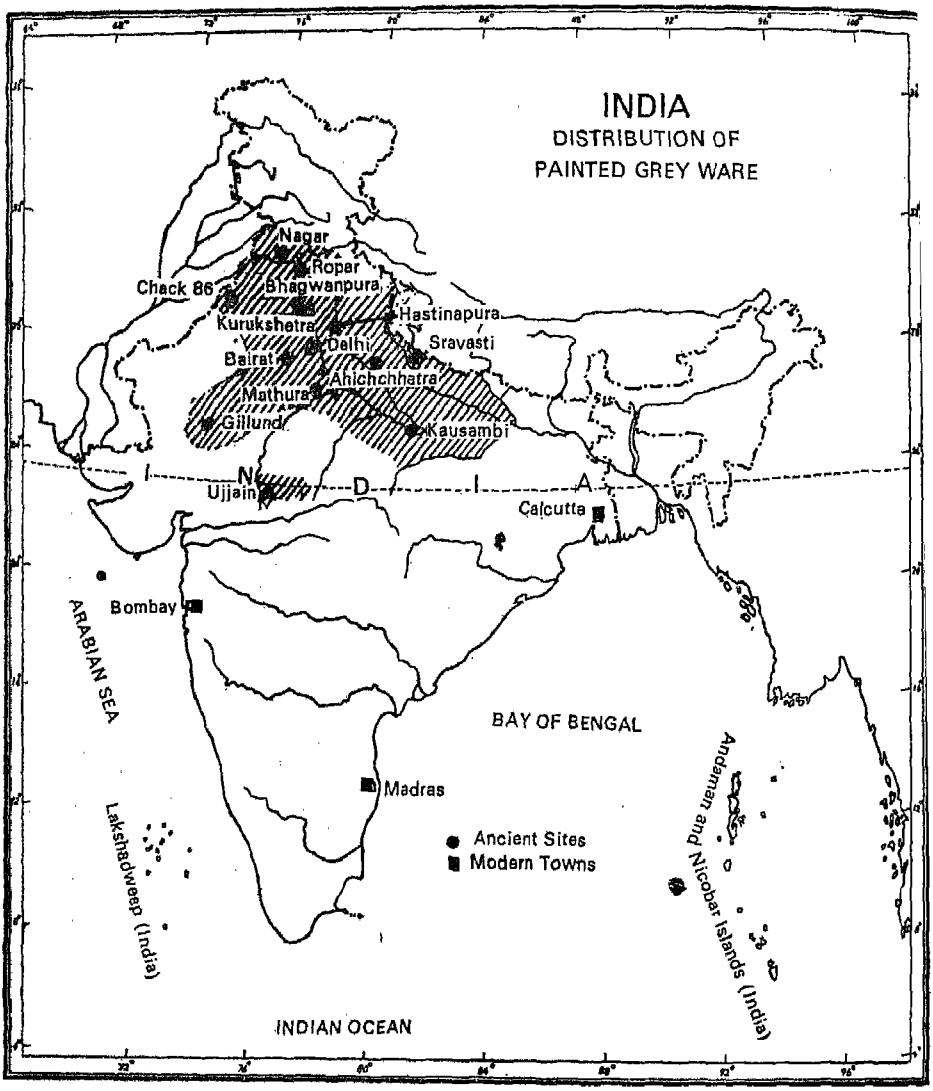

Fig. 154. Important Painted Grey Ware sites in northern India. In the Punjab, Haryana and western districts of Uttar Pradesh, a large number of Painted Grey Ware sites have been discovered. Now the northernmost limit of Painted Grey Ware is Jammu

in a hymn of the *Atharva-Veda,* addressed to *Prithivi*, the earth goddess.

'The Earth has her hill-sides and her uplands,
Hers is the wide plain,
She is the bearer of plants of many uses:
May she stretch out her hand and be bountiful to us!'

Atharva-Veda, XII, i.

From *c.* 800- 600 B.C. was a period of great intellectual ferment among the Aryans. Out of the classics of this periods, the first were the *Brahmanas*, which comment on and expound the doctrines of the Vedic hymns, especially in their relation to the ritual of sacrifices. They explain the social and religious aspects of the rituals. To the *Brahmanas* were added the *Aran'yakas*, "forest books". The expository appendices to the *Aran'yakas* are called the *Upanishads*, "the sittings down", or "the sessions"—in which the pupil sat at his master's feet. They were compiled around 600 B.C. 'For the first time,' says Macdonell, 'we find the Absolute grasped and proclaimed'. The *Upanishads* claimed that *Atma* is the World Soul, of which all individual souls are a part. These forest books were the works of *rishis*, sensitive and highly intelligent men who had relinquished the material world and lived in forests in communion with nature. 'These *rishis* looked upon nature with the poet's eye. They symbolized everything, but they revelled also in the gorgeous beauty of dawn and evening, the luxuriance of Indian trees and flowers, the serene majesty of Himalayan mountains, the cascades, the rivers, and the shining lakes.'[2]

The later Vedic literature is the main source of information on the life and culture of the Aryans. We learn about the agriculture and animal husbandry of the period—the crops grown, the implements used, trades, crafts and social system.

THE EPICS

The *Mahabharata* and the *Ramayana* are the epics of the Aryan Hindus. According to Winternitz, the epic of *Mahabharata*, whose authorship is attributed to Vyasa, was compiled in 400 B.C., and additions and alterations were made to it up to A.D. 400. Hence the *Mahabharata* cannot be considered a contemporary record of conditions prevailing about 900 B.C. So far as agriculture is concerned, it is safer to rely on archaeological finds.

The *Mahabharata* war was fought at Kurukshetra in Haryana. Basham's guess that it took place in the beginning of the ninth century B.C. seems to be reasonable. It was a war between the Pandavas and the Kauravas, both of them belonging to the Kuru tribe. The five Pandava brothers, Yudhishthira, Bhima, Arjuna, Nakula and Sahadeva, sons of

[2]Mackenzie, D.A. *Indian Myth and Legend*, p. 34

Pandu, had their capital at Indraprastha. The Purana Qila of New Delhi was later on built on this site. The Kurus headed by Duryodhana had their capital at Hastinapur, an Iron Age site in the Meerut District of Uttar Pradesh. The weapons used by the contestants were probably bows, iron-tipped arrows, spears and swords. Chariots drawn by two or more horses were their war vehicles. Each chariot carried two warriors armed with bows and arrows. The Pandavas won the war, and Yudhishthira became the king of the Kurus and reigned at Hastinapur.

The *Ramayana* is dated between 200 B.C. and A.D. 200. The author of the *Ramayana* was the sage Valmiki. Briefly, the story is as follows: Dasaratha was the king of Ayodhya. His eldest son Rama was married to Sita, daughter of King Janaka of Mithila in Bihar. Janaka is called *Sira-dhwaja*, 'he of the plough-banner', because his daughter Sita sprang up ready-formed from the furrow when he was ploughing the ground and preparing for a sacrifice to obtain offspring. The legend indicates the esteem in which agriculture was held.

Kaikeyi, the younger and favourite wife of the ageing Dasaratha, prevailed upon him to banish Rama and to install her son Bharata as the king. Rama, a dutiful son, accompanied by Sita, and his younger brother Lakshmana, left for the forest. For a while, they lived in Chitrakut in the Banda District, and later in the Dandaka forest, near modern Nasik, on the banks of the Godavari. Sita was carried away by Ravana, king of Lanka. She was recovered after a lengthy war in which Rama was assisted by South Indian tribes, whose totems were bears and monkeys.

Sita was banished by Rama and she was in exile at the hermitage of Valmiki, where she gave birth to twins, Kusha and Lava. Ultimately, Sita came to Rama and she declared her purity in a public assembly. She called upon the earth to verify her words. The ground opened and received the daughter of the furrow.

The *Ramayana* represents the expansion of Aryan culture in Bihar, the Deccan and South India. According to some, it describes events which are later than those of the *Mahabharata*. It represents a state of society more refined than that of the *Mahabharata*.

MASTERY OF IRON TECHNOLOGY

Invention of the iron axe and the ploughshare. The mastery of iron technology is an outstanding achievement of mankind. Iron ores are widespread as compared with copper. Smelting of iron ore gave a hard metal to which copper or bronze are no match. This was a big step forward in metallurgy but was not easy to achieve. Without carbon this new metal had not the sharpness or hardness of copper or bronze. It was only gradually, through trial and error, aided by lucky accidents, that the high temperature of 1535°C required to smelt iron, and the use of a

catalytic flux to produce a slag and thus separate molten iron from impurities were slowly achieved. The iron metal so produced was yet soft and spongy in comparison with copper or bronze. It was not until the achievement of the characteristic hardness as a result of the admixture of carbon with iron in proper proportion that the special properties of iron were fully realized.

The invention of the socketed iron axe gave an efficient tool to man which enabled him to clear jungles for cultivation. It was with the use of fire and iron axes that the Aryans cleared the dense jungles of Uttar Pradesh and Bihar.

The hard clayey soil of Uttar Pradesh and Bihar could not be easily cultivated with wooden ploughs. When the wooden ploughs were provided with iron ploughshares, their efficiency increased. This improvement enabled the Aryans to cultivate virgin lands, thus leading to greater mastery over food production. It almost led to a Green Revolution, which was sparked off by the invention of two most important tools, viz. the socketed iron axe and the iron ploughshare. In due course, all small tools of agriculture, viz. sickles and hoes, were also manufactured from iron.

Painted Grey Pottery. The Painted Grey pottery was first isolated in a stratified context in 1946 from Ahichchhatra in the Bareilly District of Uttar Pradesh. At Rupar, it overlies the Harappan pottery and bronze implements. The Painted Grey Ware has also been recorded from the Purana Qila of New Delhi, from Hastinapur in Meerut and from a number of sites in the Punjab. Its other important sites are Panipat and Sonepat in Haryana, Baghpat, Alamgirpur, Atranjikhera, Mathura, Shravasti and Kausambi in Uttar Pradesh, and Noh in the Bharatpur District in Rajasthan. The northernmost site is at Manda in Jammu. The antiquities of Period III of Manda include glass bangles, a terracotta horse with a saddle, iron daggers and arrow heads, and copper-antimony rods and stone rotary querns.

Excavation at Atranjikhera in the Etah District was undertaken by the Department of History, Aligarh Muslim University, under R.C. Gaur. Period II, extending to a height of 4 metres, was characterized by the occurrence of the Painted Grey Ware in association with plain grey, black-and-red, black-slipped and red wares. The other finds included iron arrow and spear-heads, bone styluses, gamesmen, beads and terracotta discs.

The excavations conducted at Hastinapur in 1962 yielded specimens of finished iron objects in the form of nails and knife-blades from the middle levels of the Painted Grey Ware deposit. Earlier, in the excavations of 1950-52, only slags had been found. At the same time, it is to be noted that iron has not so far been found stratigraphically below the deposits of the Painted Grey Ware anywhere. The presence of the bones of a horse at Hastinapur in association with the Painted Grey Ware recalls the traditional

concept of the association of the horse with the Aryans. The proven association of iron with the Painted Grey Ware, which is the earliest stratigraphic evidence of iron in India, points to the presence of a second wave of iron-using Aryans in India.

When one examines the shapes of painted grey potteries, one is struck by the persistence of some designs even in the present. Some potteries and dishes recovered from Hastinapur are shown in Fig. 155. The pot, with a narrow neck, is the present-day *garbi*, now manufactured in bronze metal. The small cup in the foreground is the *katori*. 'The flat dish in the centre, resembling a *thali*, is suitable for eating rice. Commenting on such dishes from Swat, B.K. Thapar states, 'This type is very convenient for eating rice and its occurrence in Period III accords well with the literary evidence for rice seems to have been mentioned only in the later Vedic literature.'[3]

THE IRON AGE IN PENINSULAR INDIA

Megalithic tombs have been found in large numbers in Peninsular India to the south of the Godavari. This region is marked by outcrops of granite of which megaliths are constructed. Whereas single standing stones (menhirs) are rare, there are dolmens (table-like cists above the ground), menhirs or standing stones (the Deccan and Kerala) and umbrella stones (*topikals*) in Kerala. Sometimes, there are only circles of stones with an underground grave in the centre. These megaliths are funerary structures. Corpses were exposed, the bones were collected and interred in sarcophagi, in urns, in pits or dolmenoid cists. These monuments are usually located on rocky highgrounds close to irrigation tanks and arable land. Sastri believes that this was perhaps the beginning of irrigated rice cultivation in southern India.

The pottery from these megaliths is black or black and red. The shapes of pottery are simple and utilitarian, viz. globular vessels, flat dishes, bowls and tall lids (Fig. 159). The dishes are very suitable for rice-eating. At Adichanallur in the Tinnevelly District in Tamil Nadu earthen-ware bowls containing husk of paddy, and bronze bowls with rice grains in them have been found.[4]

All the megalithic graves contain iron implements, viz. iron tridents, the favourite weapon of Murugan, a popular deity of the Tamils, and flat iron axes with crossed iron bands for hafting. Axes with ring fasteners, iron arrow-heads, spears and swords have also been found. Among agricultural tools, the discovery of iron sickles is most significant (Fig. 160). Knives, bill-hooks, hoes, wedges and horse bits were also discovered from

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[3]Thapar, B.K. *The Archaeological Remains of Aryans in North-Western India*, I.C.H.R., 1977
[4]Shastri, N. *A History of South India*, pp. 54, 55

some sites. As Mortimer Wheeler remarks, a liberal and developed iron industry is the outstanding feature of grave-goods discovered from megaliths.

Wheeler who excavated the site at Brahmagiri in Karnataka was of the view that none of the south Indian megaliths was earlier than the third century B.C. Allchin[5] states that one pair of dates from Hallur suggests that the introduction of iron followed between 1050 B.C. and 950 B.C. Horse bones were also discovered in the transitional Chalcolithic-Iron Age levels of Hallur. Allchin observes, 'The south Indian graves appear as a developing complex with several streams of influence combining in them. First, some grave types are reminiscent of those of Central Asia, Iran or the Caucasus, and could well represent traits brought from these areas by Indo-European-speaking immigrants. Next, some appear as developments of the indigenous Neolithic-Chalcolithic burial customs of the Deccan. A third series points to influences from outside India, and comparable types may indicate the source of the influences. Thus, stone cist graves, with and without port-holes, are found in the Levant, and on the coasts of south Arabia. Pottery sarcophagi occur in Mesopotamia and the Persian Gulf region during the late centuries B.C., and legged urns identical to Indian types are reported from the Yemen. The same regions provide evidence of rock-cut graves with shaft-like entrances, in forms strikingly reminiscent of those of the Malabar coast. Strictly speaking, not all these examples are dated with any precision, and therefore they can scarcely provide a firm basis for comparisons; but they suggest that during the first millennium B.C. India received them as influences by dint of maritime contacts with the Middle East. A fourth stream also cannot be excluded, being the possibility of local development in peninsular India itself.'[5]

It is clear that this iron-using culture did not grow out of the earlier Neolithic culture in South India. The presence of iron in the north at about 1050 B.C. is also significant. The iron-users may have come via the ocean from the Middle East, or they may have migrated from northern India where they were well-established in the period 1100 B.C. to 1000 B.C.

LIFE IN THE EARLY IRON AGE IN NORTH INDIA

Banerjee thus describes the pattern of life in the Early Iron Age. It was a period when forts were constructed to safeguard the township against surprise attacks, as exemplified at Ujjain or Kausambi. As the towns grew up on river banks, the advantage of the river waters was also taken to protect the forts with deep moats. The forts were provided with gateways and passages. A fort conjures up pictures of warfare. The equipments of the times were, however, flimsy and consisted of iron arrow-heads, spear-heads and daggers.

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[5]Allchin, B. and R. *The Birth of Indian Civilization*, pp. 229, 230

The repertoire of iron objects comprises knives, arrow-heads, spear-heads, wedges and axes. There are indications of local manufacture of iron objects in the form of slags found at Hastinapur. This manufacturing meant indeed not only the mining of ores but also the existence of smithy, involving smelting and forging.

Fishing must indeed have been resorted to, as indicated by conical terracotta net-sinkers.

The use of a copper borer points to craftsmanship in wood or metal.

The articles of toiletry consisted of antimony rods, nail-parers of copper, and of a hollow terracotta object with segmented interior that has been described as a hair-cleaner.

Among ornaments were glass bangles. This is the earliest evidence of glass manufacture in India.

Beads were made of materials like agate, carnelian, jasper, glass, copper, bone and terracotta. The beads of terracotta are pear-shaped and often biconal. These were supplemented by ear-ornaments in the shape of convex discs with concave sides, made of bones or agate and brightly polished.

The weaving of baskets was practised and their impressions upon the soil were preserved.[6]

The Caste System. The caste is foreshadowed in the *varnas* of the early Aryans, but it became a reality in the later Vedic period. The Brahmanas, Kshatriyas and Vaishyas were the white-skinned Aryans. The Brahmanas who expounded the Vedic texts spread the Aryan culture in the newly conquered regions of central and eastern India. The Kshatriyas (Rajanya), who were the rulers and warriors, established the Aryan colonies in the east and the south. The Vaishyas were the agriculturists and traders. Some of them worked as artisans. At the bottom of the social pyramid were the Shudras, the aborigines, who were the farm labourers, hewers of wood and drawers of water. The Shudras were not allowed to read the sacred texts nor to approach the sacred fire. The aborigines who lived in the jungles were the Nagas, who worshipped the cobra (*nāga*).

The economic classes of other countries are represented by castes in India. Kosambi states that caste is class on a primitive level of production. Peasant families engaged in agriculture formed a distinct caste. They were served by carpenters, blacksmiths, goldsmiths, weavers, leather-workers, tailors, drawers of water, oil-pressers, etc., who formed distinct castes. This type of division of labour continues even now in rural India. Only in States with modern agriculture and industry there are signs of its break-down.

Occupations. The passage below in which the names of castes and variety of professions are given indicates the richness and variety of the socio-cultural and economic life of the Aryans of the later Vedic period.

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[6]Banerjee, N.R. *The Iron Age in India*, pp. 196 to 199

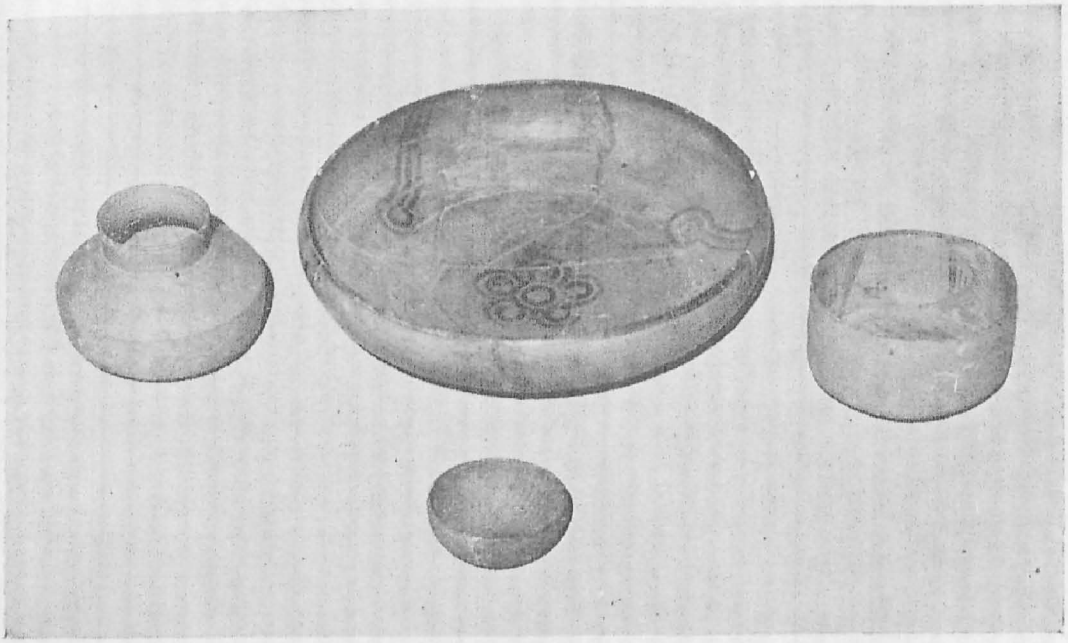
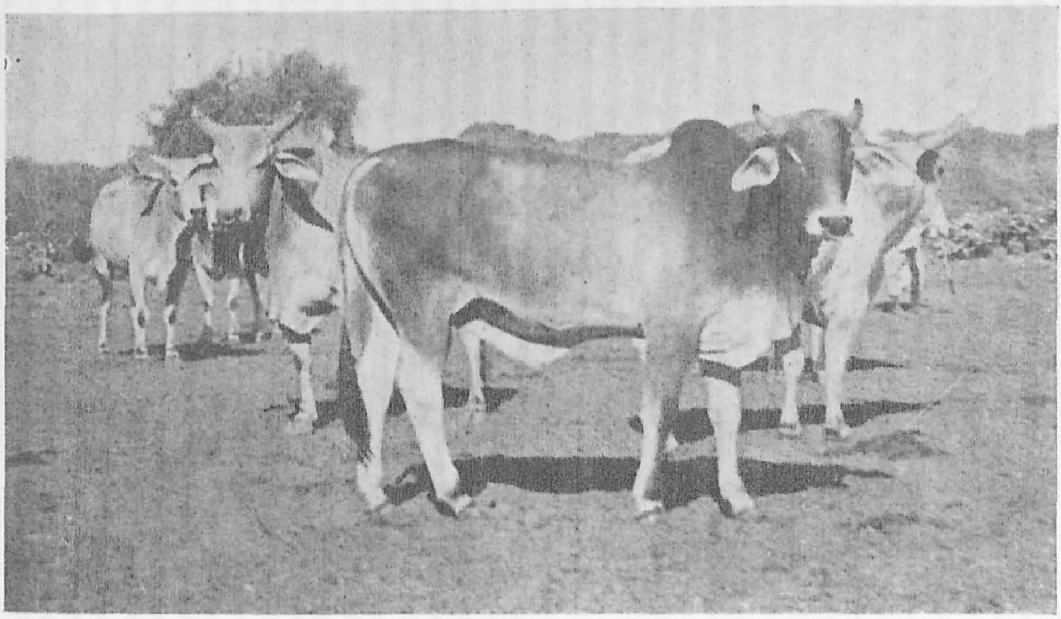


Fig. 155. Painted Grey Ware pots and dish from Hastinapur, 1000 B.C. to 800 B.C. (Courtesy: National Museum, New Delhi)

Fig. 156. Young Hariana bulls at the Hissar cattle farm. The Hariana breed of cattle is associated with the Aryans. It is confined to the Punjab, Haryana, Delhi and western Uttar Pradesh where the Aryans settled



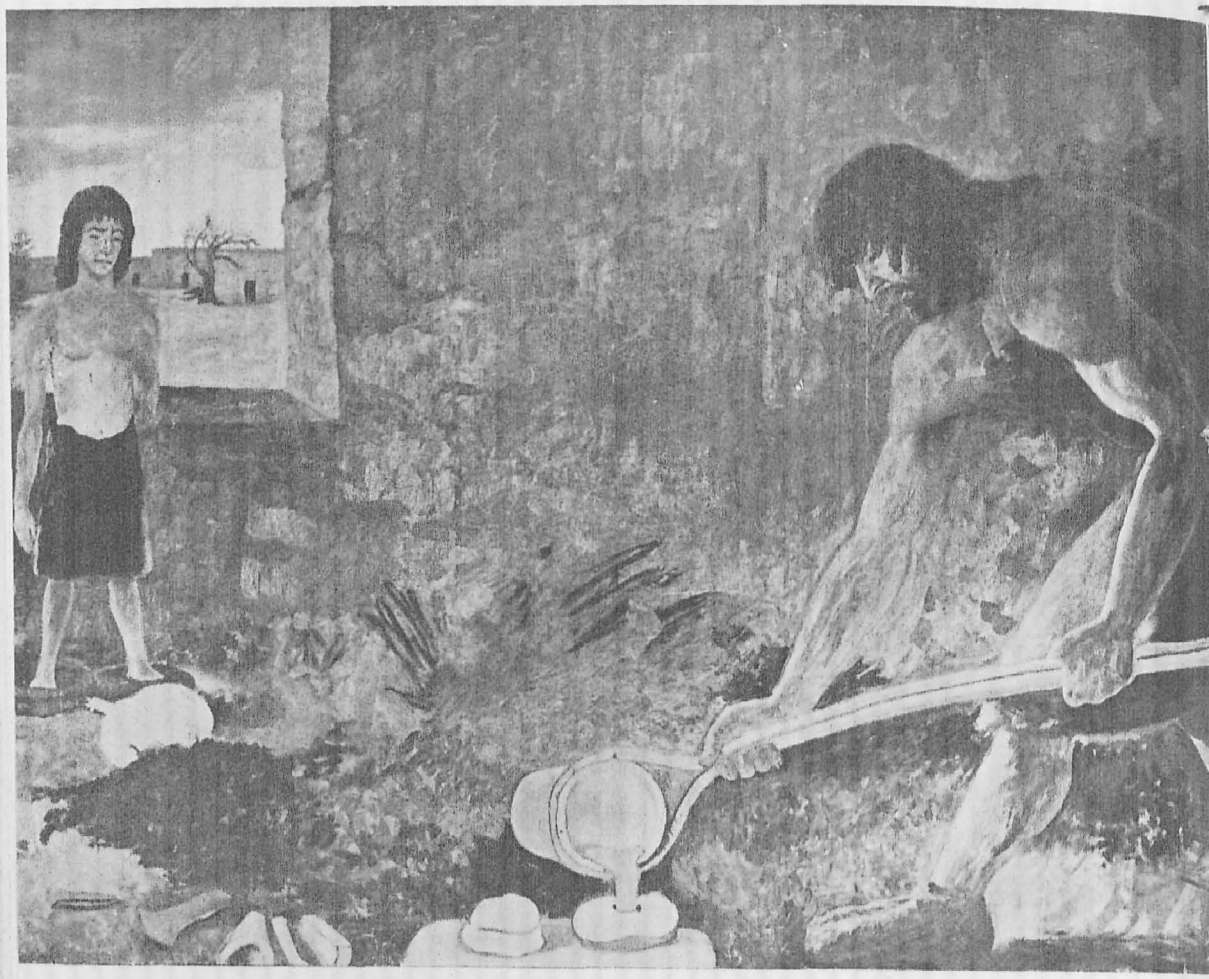


Fig. 157. Smelting of iron was a major achievement. Iron provided a hard metal from which axes, ploughshares and sickles were fabricated. This led to great progress in agriculture
(Reconstruction from the Museum of Evolution of Life, Chandigarh)

Fig. 158. The girl is scaring away birds from a pearl-millet field with a sling
(Courtesy: Indian Agricultural Research Institute, New Delhi)

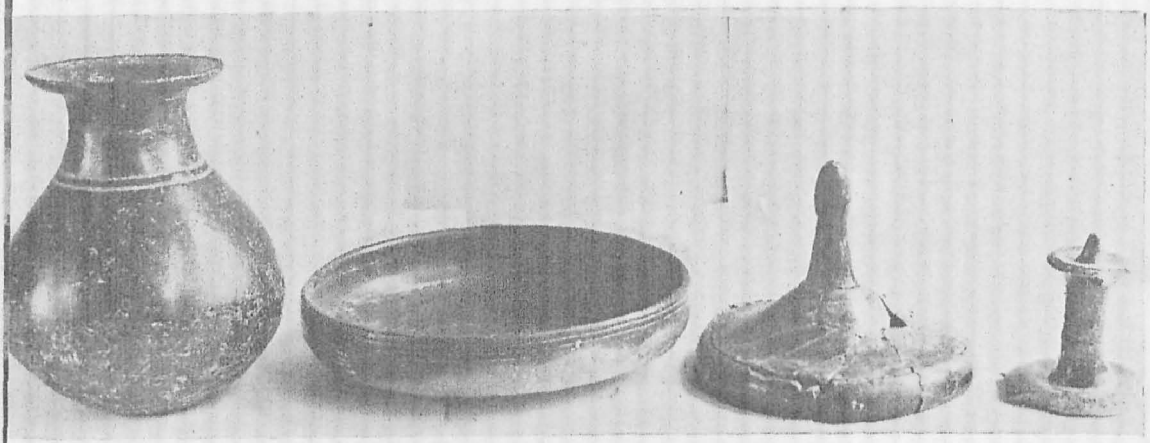
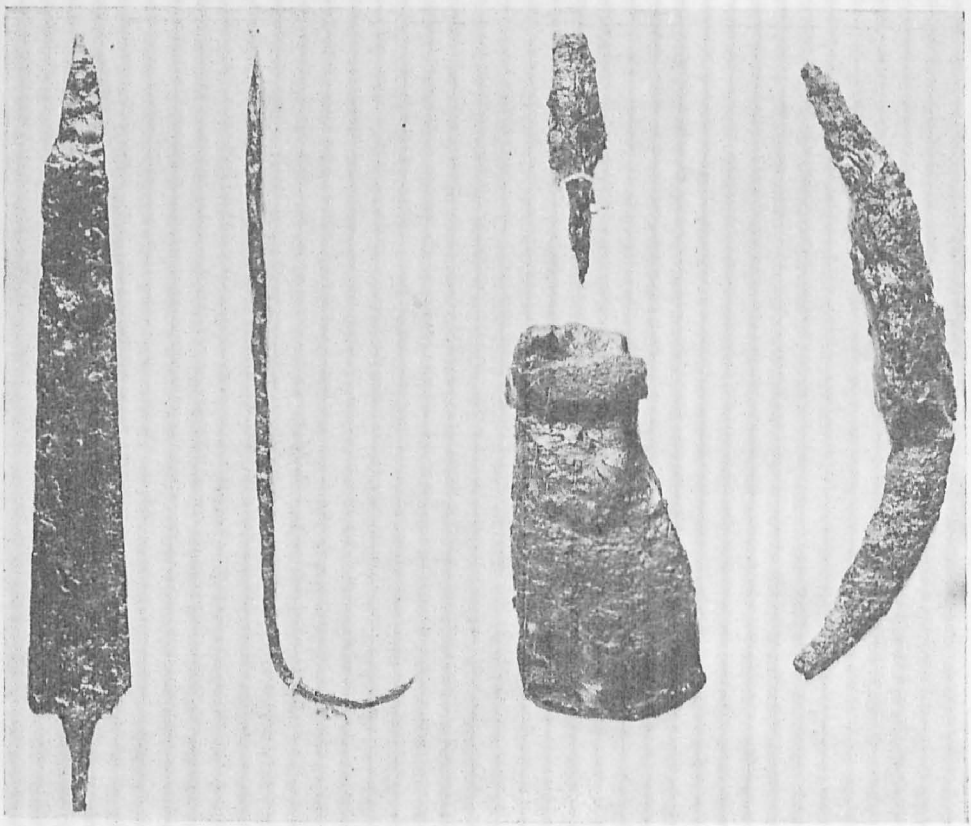


Fig. 159. Black Polished Ware from Yelleswaram, an Iron Age site in Tamil Nadu (Courtesy: Archaeological Survey of India)

Fig. 160. Iron objects from Megaliths in South India. At the right is a sickle and at the left is a sword. In the middle is an axe with a ring-fastener. At the top is an arrow-head. *c.* 300 B.C.
(Courtesy: Archaeological Survey of India)



'Brahmin, Rajanya, Vaishya, Shudra, thief, eunuch, adulterer, dancer, *nattuva* (dancing master), drummer, veena-player, gambler, secret lover, maidens, lovers, flatterer, unbeliever, courtesan, clown, bald-headed one, hairy one, the too tall one, the dwarf, the fat one, village headman, accountant, graceful girl, hunchback, sluggard, sleepy one, the garrulous one, loud musicians, conchshell-blowers, the half-blind one, the deaf one, unmarried elder brother, goldsmith, engraver, potter, chariot-maker, carpenter, bow-string-maker, hunter, fisherman, keeper of dogs, tanner, trader, iron-smelter, watchman, ploughman, elephant-keeper, shepherd, butcher, rope-maker, author, investigator, physician, the star-gazer (astronomer), inciter to quarrels (war-monger), women who make scented oils, the barren woman, the leper, the mother of twins, the dumb, the lame, the rogue, and a host of others (*Sukla Yajur, Anuvaka,* 396). The list is not however a catalogue of mere names, but a study of the characteristics of each, in which its special feature or character is touched off by an illuminating epithet denoting the object or quality associated with it. Thus, the ploughman with food, the rich man with prosperity, the woodcutter with light (fire), the dancer with music, the star-gazer with scientific knowledge, the investigator with vast knowledge, the thief with darkness, maiden with love, the war-monger with suffering and poverty, the iron-smelter with anger, the adulterer with lust, the sower of seeds with auspiciousness, the courtesan with pleasure, and so on.'[7]

The subdivision of occupations is an indicator of progress in economy. We hear of hunters, of several classes of fishermen, of attendants on cattle, of fire-rangers, of ploughers, of charioteers, of several classes of attendants, of makers of jewels, basket-makers, washermen, rope-makers, dyers, chariot-makers, barbers, weavers, butchers, workers in gold, cooks, sellers of dried fish, makers of bows, gatherers of wood, doorkeepers, smelters, footmen, messengers, carvers, seasoners of food, potters, smiths and so forth. Professional acrobats are recorded, and players on drums and flutes. Besides the boatman appears the oarsman, and the poleman.

Social Life. On the whole, there seems to have been some decline in the position of women in this period : in one of the Sūtra texts, her wergild is assimilated to that of a Shūdra and her lack of proprietary power must have tended to decrease her prestige. The polygamy of the Kings is now fully established; and, presumably, the practice of the sovereigns was followed by the richer of their subjects. On the other hand, the preference for sons becomes more and more pronounced: 'a daughter is a source of misery, a son a light in the highest heaven.'

Two important features of later village life in India appears in the forms of the astrologer and the barber. Of women's work we learn of the dyer,

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[7]Aiyer, A.K.Y.N. *Agriculture and Allied Arts in Vedic India,* p. 65

the embroiderer, the worker in thorns, and the basket-maker. The merchant is often mentioned, and the usurer has a special name: it is of interest that the term Sreshṭhin occurs several times, denoting at least a wealthy merchant, and possibly already the word has its later technical sense of the head of a merchant guild.

The advance of civilization is seen also in the more extended knowledge of the metals; as compared with the gold and the *ayas*, of doubtful meaning, of the *Rig-Veda*, this period knows tin, lead, and silver, of which ornamented bowls are made, while *ayas* is differentiated as red *ayas*, presumably copper, and dark or black *ayas*, which is iron.

Houses. Houses were constructed of mud, or at best of sun-dried mud-bricks, and no more than barely recognizable lengths of walls in crumbling desolation can be accounted for in the excavated sites. Burnt bricks were not, however, unknown as excavation at Ahichchhatra has shown.

A variety of wild cane was used, along with the husks of rice, to reinforce the mud or mud-brick walls with plaster, as observed at Hastinapur. As rains were heavy in the region where the Painted Grey ceramic occurs, the roof was thatched.

Money. There were no coins, though the path to this development was already opened by the use of the *krishṇala*, the berry of the *Abrus precatorius* (*rati*), as a unit of weight. We hear in the Brahmaṇas of the *çatamāna*, a piece of gold in weight equivalent to a hundred *krishṇalas;* and such pieces of gold were clearly more or less equivalent to currency and must have been used freely by the merchants, of whose activities we hear so little in the sacred texts. The *nishka*, originally a gold ornament, was also at this time a suit of value; and the cow as a unit was probably in course of supersession.[8]

Clothes. The style of clothing seems to have continued unchanged, though we hear more of the details; among other things are woollen garments, robes dyed with saffron, and silk raiment.

Sports. The amusements of the day were, as in the period of the *Rig-Veda*, the chariot race, dicing and dancing.

Food. Various eatables are mentioned in the texts of this period. The *apūpa* is a cake mixed with *ghee* (clarified butter) or made of rice or barley; *odana* is a mess, generally of grain cooked with milk. Special varieties are those made with water, milk, curds or *ghee* and beans, sesame or meat, and named appropriately, such as "*tilaudana*". A porridge made of grain, barley or unhusked sesame, slightly parched and kneaded, is called *karambha*. Barley-gruel (*yāvagū*) and decoctions of other grains are also referred to.

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[8]Rapson, E. J. (Ed.) *The Cambridge History of India*, Vol. I, pp. 120, 122, 123

Meat-eating seems to be fairly common. The *Satapatha Brāhmaṇa* prescribes the killing of a goat in honour of a guest. Generally, meat was eaten on the occasion of some ceremony or other, but such ceremonies were performed almost every day. It appears that the killing of cows gradually came into disfavour. The normal meat-diet consisted of the flesh of the sheep and the goat, the usual sacrificial victims.

Among the chief products of milk may be mentioned curds (*āmikshā*), sour milk (*dadhi*), fresh butter (*nava-nita*), *payasya* or curds consisting of a mixture of sour milk and hot or cold fresh milk, butter, mixed with sour milk (*pṛishad-ājya*), *phānta*, the first clotted lumps of butter produced by churning, and finally *vājina*, a mixture of hot fresh milk with sour milk. This formidable list of milk-products and their mixtures shows the great popularity of milk.

Surā, an intoxicating spirituous liquor, is often mentioned. Though tolerated as an ordinary drink, it is often condemned as leading to quarrels and as seducing men from the path of virtue, like dicing and meat-eating (A. VI.70.1). The Sautrāmaṇī sacrifice is of the nature of an expiation or penance for an indulgence in *surā*. Probably, it was prepared from fermented grains and plants. It was kept in skins. The *Yajur-Veda Saṁhitās* mention a beverage called *māsara*, which appears to have been a mixture of rice and *śyāmāka* with grass and parched barley, etc. *Madhu* primarily means "sweet" as an adjective, and so denotes any sweet food or drink such as the Soma or milk. The sense "honey", though known in the *Rig-Veda*, is only now its most definite sense, and there are taboos against its use by students and women under certain circumstances.[9]

Pastoralism. The *Yajur-Veda* helps us to draw some conclusions about the mode of life of the Aryans for the period 1000-800 B.C. and the attached book, the *Satapatha Brāhmaṇa*, extends the information to about 600 B.C. 'Even cursory reading', says Kosambi, 'shows that pastoral life formed the basis of Yajur-Vedic society, as of its ritual. Nevertheless, the growing importance of agriculture and of metals is made very clear in a prayer (still recited): 'May for me....milk, sap, clarified butter, honey, eating and drinking at the common table (*sagdhi* and *sapiti*), ploughing, rains, conquest, victory, wealth, riches, prosperity....low-grade grain (*kuyava*) food, freedom from hunger, rice, barley, sesame, kidney-beans, vetches, wheat, lentils, millet and wild rice (prosper through the sacrifice). May for me the stone, clay, hills, mountains, sand, trees, gold, bronze, lead, tin, iron, copper, fire, water, roots, plants, what grows on ploughed land, what grows on unploughed land, tame and wild cattle prosper through the sacrifice (*yajna*)'. 'This may be dated at about 800 B.C., and shows that

[9]Majumdar, R.C. and Pusalker, A.D. (Ed.). *The History and Culture of the Indian People—The Vedic Age*, pp. 457, 458

the Aryans had begun to face new problems of production in the Iron Age.'[10]

DOMESTIC ANIMALS

We get evidence of domestic animals kept by the later Aryans from some excavations in Haryana. A quantity of animal bones have been found from different levels at Bhagwanpura in the Kurukshetra District. The assemblage consists of a large number of charred bones of cattle. The bones of cattle, sheep, goat, dog and *Equus* were present in the assemblage. Cattle from the lower levels are mostly of massive size. A few of the cattle bones show incomplete ossification. Charred tortoise shells are also present, which indicates that the flesh of the tortoise was eaten. Even at present, Sansis eat the flesh of the tortoise. Cattle bones from the upper levels show a weaker and small breed.

What was the breed of cattle kept by the Aryans? According to Olver (1938), the Hariana breed of cattle entered India through the northern passes with the Aryans. Ware (1942) also supports Olver's view.[11] The Hariana breed is found in Pakistan, the Punjab, Haryana and western Uttar Pradesh. The related breeds are the Mewati, Rath, Ongole, and Krishna Valley. The Mewati breed is found in the Alwar and Bharatpur districts of Rajasthan as well as in the Kosi tract of the Mathura District. The Rath breed is found in the Alwar District of Rajasthan. The Ongole breed is found in Bapatla, Sathanapalli, Vinukonda and Kandukur taluks of the Nellore and Guntur districts of Andhra Pradesh. The Krishna Valley breed is found in the southern areas of Maharashtra and Andhra Pradesh. It is notable that all the breeds represented in this group are located along the route taken by the Aryan invaders stretching from Kalat in Pakistan and then passing through the Punjab, Haryana and western Uttar Pradesh to south India.

However, it is the Delhi-Rohtak-Gurgaon and Hissar tract in which the Hariana breed is found at its best. The Hariana bullocks are short-horned, white or light grey, the body is proportionate, moderately long and has a compact appearance (Fig. 156). The head is carried high, the horns are short and, in castrated bullocks, curving upwards and inwards. The ears, the dewlap and the sheath are small. There is a big and well-developed hump; the feet are small and the hoofs are well shaped, hard and black. The tail is rather short, thin and tapering, and carries a black switch reaching just below the hocks. The Hariana breed is a dual-purpose breed, used both for draught and milk production. The bullocks

[10]Kosambi, D.D. *The Culture and Civilization of Ancient India in Historical Outline*, p. 85

[11]Joshi, N.R. and Phillips, Ralph W. *Zebu Cattle of India and Pakistan—An FAO Study*, p. 87

are excellent for fast ploughing and for road transport. The cows are good milkers.

Elephants and Horses. Another sign of the new era is the definite references to the keeping of tame elephants, the guarding of elephants being one of the occupations occurring in the *Yajur-Veda* texts. The use of horses for riding had certainly become more common.

AGRICULTURAL IMPLEMENTS

The agricultural implements mentioned in the Vedic literature include the plough (*langala, phala, sira* and *sita*) and *daira, srni.* The *langala* was of a lace-pointed type, having a smooth handle, whereas the *sira* was a large and heavy plough. Sieve (*titau*) was in use to separate the grain from the straw, and winnowing (*surpa*) was resorted to. *Urdara* was the vessel used for measuring grain.

The plough (*langala*) was used extensively, drawn by oxen in teams of six, eight or even twelve, and repeated ploughing was resorted to with a view to enabling the soil to acquire the desired tilth. The ploughland was called *urvara* or *kshetra.* Cowdung (*sakrt*) was used as manure and the dried cowdung (*karisha*) was found to be better. The *Kathaka Samhita* describes a process of cultivation as well as of harvesting, using the plough and sickle respectively.

AGRICULTURAL PRACTICES

Generally, in the Vedic period, two harvests a year were gathered. The number of references pertaining to agriculture found in the Vedic literature indicate that the cultivator in the Vedic period possessed a fair knowledge of the fertility of the land, selection and treatment of seeds, seasons of sowing and harvesting, rotation and other cultural practices of crops, manuring for increased production of crops, and the like.

The Vedic farmers knew the method of improving the fertility of the soil by using the method of rotation. The *Taittirīya Saṃhitā* mentions that rice would be sown in summer and pulses in winter on the same field.[12]

CROPS

'In place of the *yava* of the *Rig-Veda* many kinds of grain are mentioned, and *yava* is restricted, in all probability, to the sense 'barley'. Among these names are wheat, beans, corn, sesamum from which oil was extracted, *Panicum miliaceum, Echinochloa frumentacea* (*Panicum frumentaceum*), and *Setaria italica* (*Panicum italicum*), *Wrightia antidysenterica, Dolichos uniflorus, Ervum hirsutum, Chionachne koenigii* (*Coix barbata*), and various others. Rice, both

[12]Raychaudhari, S P., Lallanji Gopal and Subbarayappa, B.V. *A Concise History of Science in India,* pp. 252, 353

domesticated and wild, was much used. Rice grains have been discovered from Hastinapur (Fig.147). The term used for rice of good quality is *taṇḍula, vrihi* and *sali*, and for the wild variety, *nīvara*. The *Taittirīya* even refers to the husked (*karṇa*) and unhusked (*akarṇa*) rice. The seasons of the different grains are briefly summed up in the *Taittirīya Samhitā:* barley, sown no doubt, as at present, in winter, ripened in summer; rice, sown in the rains, ripened in autumn; beans and sesamum, planted in the time of the summer rains, ripened in the winter and the cold season. There were two seasons of harvest according to the same authority, and another text tells us that the winter crops were ready in March. The farmer had, as now, constant troubles to contend with: moles destroyed the seed, birds and other creatures injured the young shoots; and both drought and excessive rain were to be feared. The *Atharva-Veda* provides us with a considerable number of spells to avoid blight and secure a good harvest. Cucumbers are alluded to, perhaps as cultivated; but there is no certain reference to tree culture though frequent mention is made of the great Indian trees like the Acvattha, *Ficus religiosa*, and the Nyagrodha, *Ficus benghalensis (F. indica)*. The different forms of the jujube are specially named.'[13]

Bajra, Pearl-Millet (Pennisetum typhoides). *Pennisetum typhoides*, commonly known as pearl-millet, bulrush, or spiked millet in English and *bajra* in Hindi, is the most important of all the millets. It is a robust, quick-growing, summer cereal grass with large stems, leaves, and heads. It is efficient in its utilization of moisture and has a higher level of heat tolerance than sorghum and maize. It thrives on light-textured and well-drained soils, but does not tolerate water-logging and flooding as well as sorghum.

Bajra is most extensively grown as a cereal in the drier areas of western and southern India and the southern peripheries of the Sahara in Africa. *Bajra* is one of the principal millets grown in India, next in importance only to *jowar* (sorghum) among the coarse grains. As its grain is a great favourite with sparrows, it is a common sight in Rajasthan and Maharashtra to see girls standing on a *machān* (scaffolding), scaring the birds by throwing earthen balls with a sling (Fig. 158). The total production of *bajra*-grain in India is about three million tonnes. It is drought-resistant and can be grown in tracts of low rainfall. Rajasthan, Gujarat, Maharashtra, Andhra Pradesh, Tamil Nadu and Haryana are the main *bajra*-growing States.

Krishnaswamy (1951 and 1962) studied taxonomically and cytologically several *Pennisetum* species as well as interspecific crosses among them (primarily those involving *P. typhoides* × *P. purpureum*) and concluded that the originating centre of pearl-millet was Africa, from where it might have

[13]Rapson, E. J. (Ed.). *The Cambridge History of India*, Vol. I

Fig. 161. A pearl-millet (*bajra*) crop in Rajasthan. The earliest record of pearl-millet in India is from Rangpur, Gujarat, 1100 B.C. to 800 B.C.
(Courtesy: Indian Agricultural Research Institute, New Delhi)

Fig. 162. Barley was a favourite crop of Vedic Aryans, and they called it *yava*. The largest area under this drought-resistant crop is in Uttar Pradesh and Rajasthan
(Courtesy: Punjab Agricultural University)

migrated to India and might have been domesticated. He points out that only two of the 32 species in section Penicillaria of the genus *Pennisetum* (*P. typhoides* and *P. purpureum*) have been known outside Africa, and no wild species of this genus has yet been reported from India or other parts of Asia.

The question regarding the African centre which may be the origin of the various species of *Pennisetum* is perhaps more difficult. Wild species occur in both the Abyssinian and West African localities. In the drier regions of Niger, a wild species (*P. molissimum*) occurs which is closely akin to the cultivated species. This is one of the six annual species considered as possible contributing ancestors of the cultivated *P. typhoides*. Several unidentified wild species as well as cultivated varieties were collected in Ethiopia—some at elevations above 2,000 metres—in late 1967. If the species of *Pennisetum* did originate in the Abyssinian region, it may be assumed that a very early migration to West Africa occurred.

In Africa, its archaeobotanical record is noted at the Nagez phase which dates from 1255 to 105 B.C. It is a Neolithic site. It is not certain whether the grains belong to wild or domesticated species. At Le Baidla I site, 60 per cent of the grain impressions are those of *Pennisetum*, out of which 1/3 exhibit characters of cultivated grain. The site dates from 80 to 105 B.C.

Archaeological sites in India from which *bajra* has been reported are in States with semi-arid climate. The earliest record of *bajra* is from Rangpur (Gujarat), in Period II, 1100 B.C. to 800 B.C. and from Hallur (Karnataka) between Neolithic and Megalithic periods.

The introduction of *bajra* in India seems to have taken place during the Painted Grey Ware phase. How far were the Aryans responsible for this introduction can only be conjectured. Perhaps it would be more accurate to assume that *bajra* reached India at a relatively early time about the beginning of the second millennium B.C. but was not extensively grown until the growth in population brought the marginal, drier lands into cultivation.

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CHAPTER 21

THE BUDDHIST PERIOD

SIXTH CENTURY B.C.
BIRTH OF BUDDHISM AND JAINISM
SACRED GROVES AND TREE-WORSHIP
EXPANSION OF CULTIVATION IN BIHAR AND EASTERN UTTAR PRADESH

In the sixth century B.C., India had sixteen large States called Mahajanapadas. The administrative unit at the district level was called Janapada. Of Mahajanapadas, Magadha, Kosala, Vatsa and Videha in eastern India were powerful States. Kosala had its capital at Sravasti, which has been identified as the present Sahet-mahet on the borders of Gonda and Bahraich districts in eastern Uttar Pradesh. Ayodhya, which is associated with the *Ramayana*, was the capital of Kosala. Kosala also included the territory of Sakyas of Kapilavastu, where the Buddha was born. In the west was the State of Avanti with its capital at Ujjain. In western Uttar Pradesh and the adjoining areas of Rajasthan and Haryana were the States of Panchala, Surasena, Matsya and Kuru.

The Punjab was no longer important, and eastern Uttar Pradesh and Bihar, where forests were cleared and the land was colonized under the patronage of the ruling monarchs, occupy the stage of history. Wild elephants also abounded in the jungles of eastern India. Tamed and trained, they were a source of military power to the Nanda and Maurya Kings, who used them in warfare. They had the same role in wars as tanks in the present age.

Birth of New Religions

In the sixth century B.C. were born four great religions of the world, Confucianism in China, Zoroastrianism in Iran, and Buddhism and Jainism in India. Out of these, Buddhism had a universal appeal. Shorn of its excrescences, it attracts a number of people even in the present age of science. It preached truthfulness, purity of heart, non-violence and kindness to all living beings. It taught people to avoid greed, falsehood, fault-finding, hatred and anger. As it was a revolt against Brahmanical ritualism and caste-system, it appealed to a large number of people, particularly the oppressed lower castes. The founder of Jainism, Vardhamana Mahavira, and of Buddhism, Gautama the Buddha, belonged to the Kshatriya caste. They used Prakrit, the language of the masses, for their teaching rather than Sanskrit, the language of aristocracy. As such, their message reached the masses and made a deep impact on their lives.

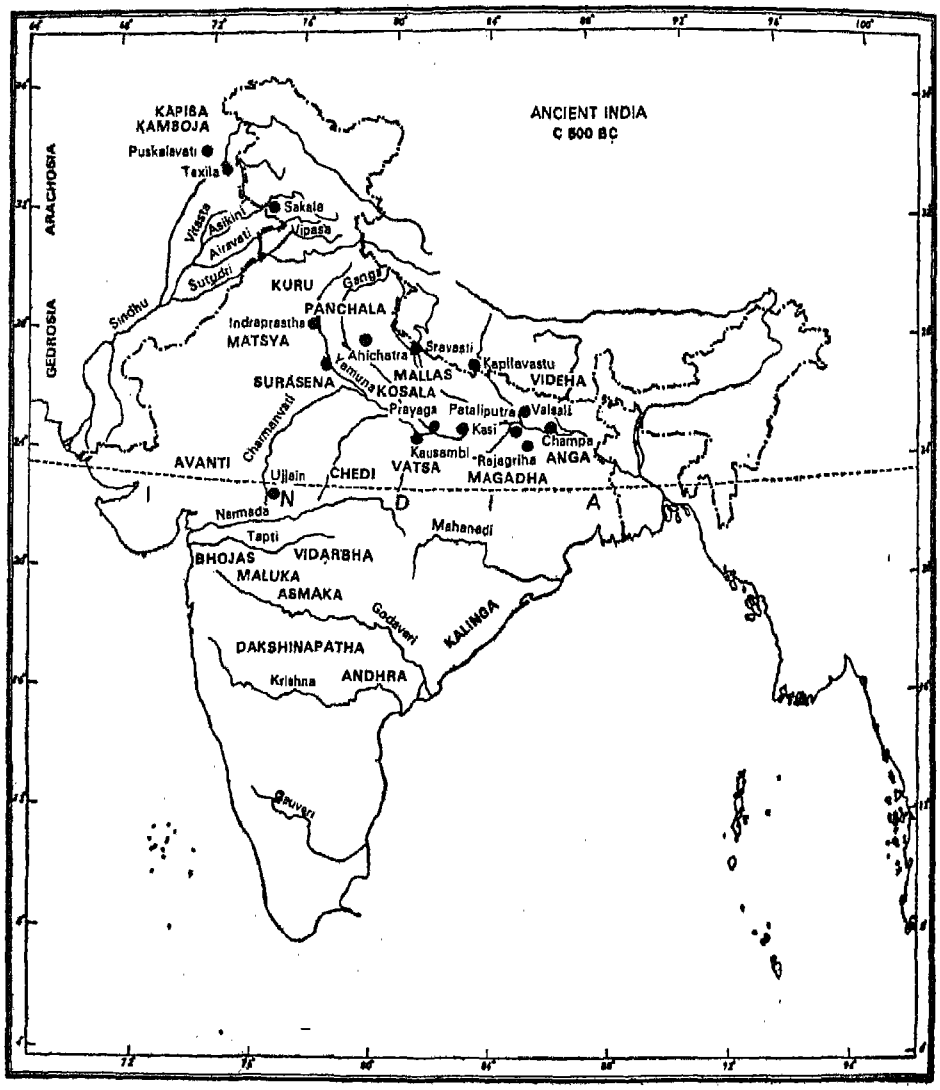

Fig. 163. India in the sixth century B.C. was divided into sixteen States called Mahajanapadas

Sacred Trees

Gautama was born under an *asoka*-tree, received enlightenment under a *pipal*-tree, preached his new gospel in mango groves, and under shady banyans, and died in a *sal* grove. Never before or after has a religion

been so much associated with vegetation.

Buddhism adopted the cult of tree-worship from the older religions which prevailed in the country. The trees which are associated with the birth of the Buddha are *sal*, *asoka* and *plaksha*, and hence they were regarded as sacred by the Buddhists.

To understand the association of trees with the Buddha, it is necessary to know the facts regarding his life. Gautama belonged to the Sakya Tribe of the Aryans. His father was Suddodhana, the Raja of Kapilavastu, a petty principality on the border of Nepal. Green rice fields surrounded by *sal* forest with the backdrop of the snow-covered peaks of the Himalayas provided an inspiring environment to Kapilavastu. Here, Gautama was born in 563 B.C. The birth of the Buddha has been thus described: 'Queen Mahamaya bearing the Bodhisattva for ten months like oil in a bowl, when her time was come, desired to go to her relatives' house, and addressed king Suddodhana, "I wish, O king, to go to the Devadaha, the city of my family". The king approved, and caused the road from Kapilavastu to Devadaha to be made smooth and adorned with vessels filled with plantains, flags, and banners, and seating her in a golden palanquin borne by a thousand couriers sent her with a great retinue. Between the two cities and belonging to the inhabitants of both is a pleasure grove of *sal*-trees named the *Lumbini* grove. At that time from the roots to the tips of the branches it was one mass of flowers, and from within the branches and flowers hosts of bees and flocks of birds sported, singing sweetly.

'When the queen saw it, a desire to sport in the grove arose. The courtiers brought the queen and entered the grove. She went to the foot of a great *sal*-tree, and desired to seize a branch. The branch like the tip of a supple reed bent down and came within reach of her hand. Stretching out her hands she seized the branch. Thereupon she was shaken with the throes of birth. So the multitude set up a curtain for her and retired. Holding the branches and even while standing she was delivered.'[1]

In another account it is stated that Maya saw in a dream the descent of the Bodhisattva in the form of an elephant. 'On waking she goes with her women to a grove of *asoka* trees and sends for the king, who is unable to enter, until the gods of the Pure Abode inform him of what has happened.' It is further mentioned that 'she seizes not a *sal* branch, but a *plaksha* at the moment of birth'. *Sal* (*Shorea robusta*) and *plaksha* (*Butea monosperma*) are both common trees in the Nepal *tarai* in which the birth-place of the Buddha is situated.

The Lumbini garden was visited by the Chinese traveller Hiuen Tsang. He came to India in A.D. 630 and stayed until A.D. 645. He mentions an *asoka*-tree under which the Buddha was born. "To the north-east of the

[1]Thomas, E.J. *The Life of Buddha*, p. 33

arrow well about 80 or 90 li, we come to the Lumbini (Lavani) garden. Here is the bathing tank of the Sakyas, the water of which is bright and clear as a mirror, and the surface covered with a mixture of flowers. To the north of this 24 or 25 paces there is an *asoka*-flower tree, which is now decayed; this is the place where Bodhisattva was born."

Gautama was married to Yasodhara, by whom he had a son, Rahula. Apart from his wife, the palace was full of beautiful women who served as cooks and servants. When Gautama realized that life was not merely a cycle of pleasures, but also had its miseries, like disease, old age, and death, the idea of renunciation of worldly life came to him. The *Buddhacharita* mentions a garden full of beautiful women to which King Suddodhana sent him. "Behold the god of love, says the *Buddhacharita*, 'behold Kama, they murmured on seeing his arrival. Curious and with wide-eyed admiration they gathered round him, and saluted him with their smooth hands, like the cups of the lotus-flower. By the King's instructions, Udayin, a friend of his childhood, encouraged them to exert all their fascinations. Some, wreathing their arms round Siddhartha like twining plants, sought to hold him by force; others, whether carelessly or feigning to be almost carried away by their transports, allowed the gauzy draperies which veiled their youthful forms to slip aside; others swung their tempting forms on the branches of the mango-trees; and, lastly, yet another sang in the prince's ear the song of the forest, full of furtive desires and of the emanations of the spring. But his consciousness of the vanity of all things now rendered him insensible to these blandishments, and he returned to the palace, resolved to abandon the world."[2] Accompanied by his groom Chandaka, and riding his favourite horse Kanthaka, he left the palace (Fig. 164). This sculpture from Sanchi also depicts domestic architecture during the Buddhist period. The lower part of the house was built of stones and bricks, and the balconies and upper storeys were made of wood.

It was under a *pipal*-tree (*Ficus religiosa*) at the place, now known as Bodh Gaya, that Gautama received enlightenment. This tree was also seen by Hiuen Tsang, who has given the following account. "From this south-west 14 or 15 li, not far from the place of penance, there is a Pippala (Pi-po-lo) tree under which is a 'diamond throne'. All the past Buddhas seated on this throne have obtained true enlightenment, and so will those yet to come. Pray, then, proceed to that spot. The Bodhi tree above the diamond throne is the same as the Pippala tree. In old days, when Buddha was alive, it was several hundred feet high. Although it has often been injured by cutting, it still is 40 or 50 feet [12 to 15 metres] in height. Buddha sitting under this tree reached perfect wisdom, and therefore it is called the *Samyak Sambodhi*, tree of knowledge (Pu-ti-Bodhi). The bark

[2]Rene Grousset, *The Civilization of the East India*, Vol. II, p. 38

is of a yellowish-white colour, the leaves and twigs of a dark green. The leaves wither not either in winter or summer, but they remain shining and glistening all the year round without change. But at every successive Nirvana-day (of the Buddhas) leaves wither and fall, and then in a moment revive as before. On this day (of the Nirvana) the princes of different countries and the religious multitudes from different quarters assemble by thousands and ten thousands unbidden, and bathe the roots with scented water and perfumed milk; whilst they raise the sounds of music and scatter flowers and perfumes, and whilst the light of day is continued by the burning torches, they offer their religious gifts.

"On the left side of the road, to the north of the place where the Buddha walked, is a large stone, on the top of which, as it stands in a great vihara, is a figure of the Buddha with his eyes raised and looking up. Here in former times Buddha sat for seven days contemplating the Bodhi tree; he did not remove his gaze from it during this period, desiring thereby to indicate his grateful feelings towards the tree by so looking at it with fixed eyes."[3]

A sapling of the Bodhi-tree was taken by prince Mahindra, son of Asoka, to Ceylon, about 250 B.C. and was planted at Anuradhapura. Its great branches are supported by pillars. It is the oldest historical tree in the world.[4]

The banyan, together with the Ganges and the Himalayas, completes the picture of India. "It is probably the most astounding piece of vegetation on the face of the earth", observes Lassen. "From one single root it produces a vast green temple of many halls, with cool, shady bowers impervious to the light, and seems created expressly and exclusively for the purpose of supplying shelterless primeval humanity with ready-made dwellings. For neither is its wood of much use, nor are its fruits eatable for man, and if it inspires the Hindus and their neighbours with profound veneration, it is owing to the surpassing marvel of its wellnigh preternatural growth, its indestructible duration and everlasting self-renewal: to which traits and mysterious gloom of its galleries and avenues adds not a little, yielding a most grateful retreat from the torrid summer heat. The trunk of the tree, at a moderate height from the ground, branches out into several stout limbs which stretch from it horizontally; from these, slender shoots—the so-called "air-roots"—grow downwards until they reach the ground, where they take root, whereupon they increase in thickness and become strong supports for the mother-limb. The central trunk repeats the branching out process at a greater height, and the second circle of limbs in its turn sends down a number of air-roots which form an outer circle of props or pillars. As the central trunk increases in height, it goes on producing tier upon tier of

[3]Beal, S. *Chinese Accounts of India*, Vol. II, p. 350
[4]Wells, H.G. *The Outline of History*, p. 392

horizontal limbs, and these add row after row to the outer circle of pillars, not indeed with perfect regularity, but so as to form a grove of leafy halls and verdant galleries multiplying ad infinitum. For this evolution is carried on on a gigantic scale. The highest tier of horizontal limbs is said to grow sometimes at an elevation of two hundred feet [61 metres] from the ground and the whole structure is crowned with the dome of verdure in which the central trunk finally culminates. The leaves, which grow very close together, are five inches long by three and a half broad [12 × 9 cm], and their fine green color pleasantly contrasts with the small red figs."[5]

In every village, the planting of banyan- and *pipal*-trees was enjoined. Apart from shade, it was also a measure for saving crops and fruits from destructive birds. Banyan- and *pipal*-trees, when covered with figs, provide food for thousands of birds. Thus, indirectly they save crops and fruit-trees from damage by birds which are kept busy eating their figs for weeks. They also provide a home for birds and to preserve a tree is to save a large number of them that find shelter in it.

The remains of the Buddha were enshrined in a number of stupas by Asoka. The famous Stupa of Bharhut, discovered by Cunningham in 1873, was situated in the State of Nagod, now merged in Madhya Pradesh. Bharhut is the site of an old city called Bhaironpur, which extended for 12 *kos*. Cunningham dated the Stupa between 200 and 250 B.C. Later research has assigned 184–72 B.C. as its probable period. The discovery of Bharhut Stupa is a landmark in the history of India. Its sculptures provide us with a glimpse of religion, manners, customs, dress, fashions as well as the architecture of India during the Sunga period.

Apart from the Jatakas or legends of the previous lives of the Buddha, a number of trees are represented in the sculptures. Cunningham identified seven Bodhi trees. Of these, *pipal* (*Ficus religiosa*) is the Bodhi tree of Sakya Muni. The other five trees of the other Buddhas are: banyan or Nyagrodha (*Ficus benghalensis*), the Bodhi tree of Kasyapa; gular or udumbara (*Ficus glomerata*), the Bodhi tree of Kanaka Muni; Sirisa (*Albizia lebbeck*), the Bodhi tree of Krakuchhanda; Sal (*Shorea robusta*), the Bodhi tree of Vishwabahu; Patali tree (*Bignonia suaveolens*), the Bodhi tree of Vipaswi. All these trees are shade-giving, and it is not surprising that in a hot country man expressed his gratitude to them in this manner, and gave them the title of 'Bodhi'. Apart from these six trees, Pundarika or White Lotus, is the symbol of Sikhi. While his remaining identifications are correct, what Cunningham identified as Patali tree is in fact the *asoka* tree, *Saraca asoca (S. indica)*. The sacred Bodhi trees at Bharhut are so accurately sculpted that it is easy to identify them (Fig. 165b).

The Buddha faced many trials. Devadatta, a jealous kinsman, let

[5] Ragozin, Z.A. *Vedic India*, pp. 26,27

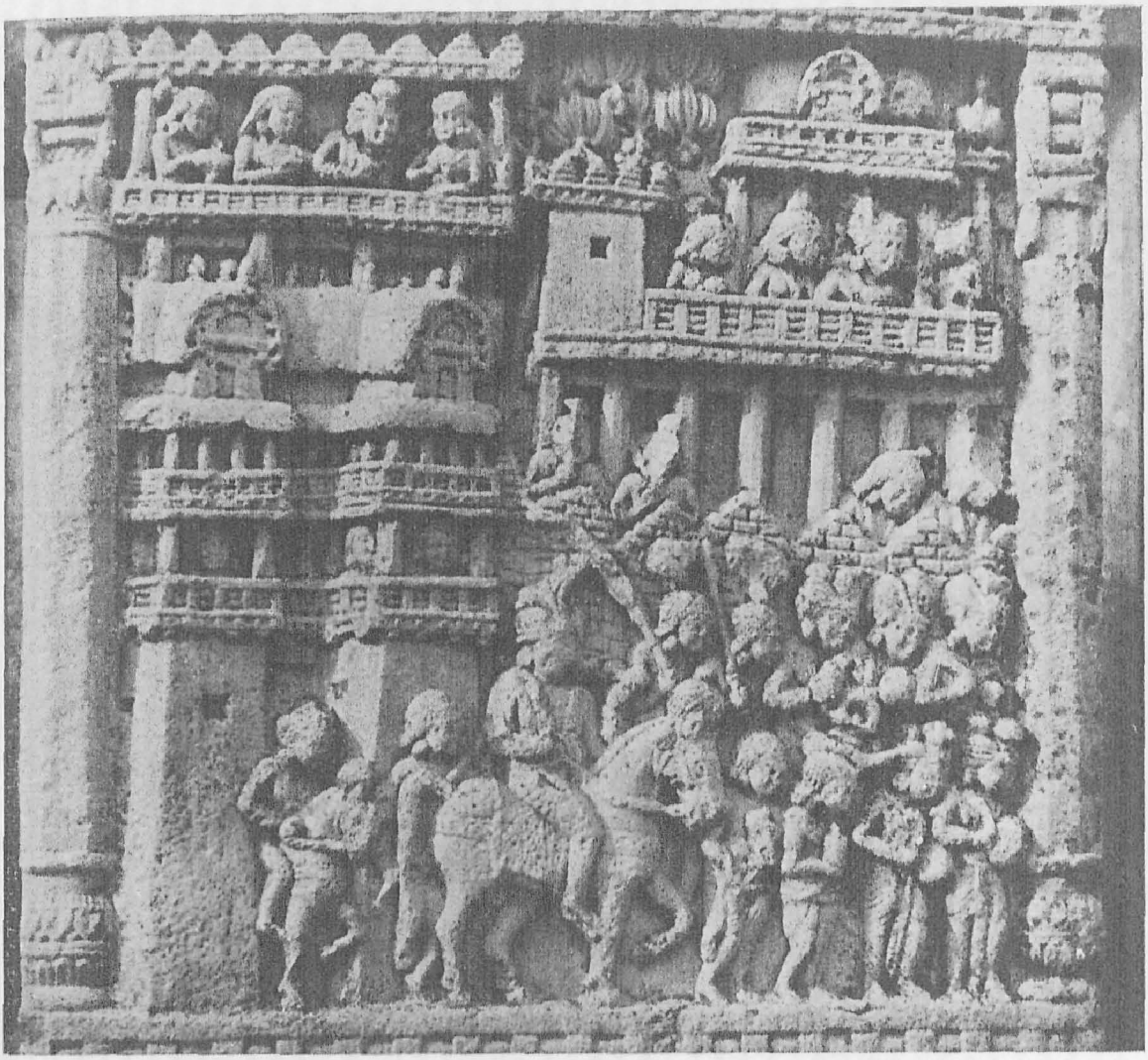

Fig. 164. The great departure. In the background are several-storeyed buildings. Women seated in wooden balconies watch the procession. North gate, Stupa I, Sanchi, first century B.C.
(Courtesy: Archaeological Survey of India)

Fig. 165a. An illustration to a Jataka story, showing, among others, banana plants (*Musa paradisiaca*)

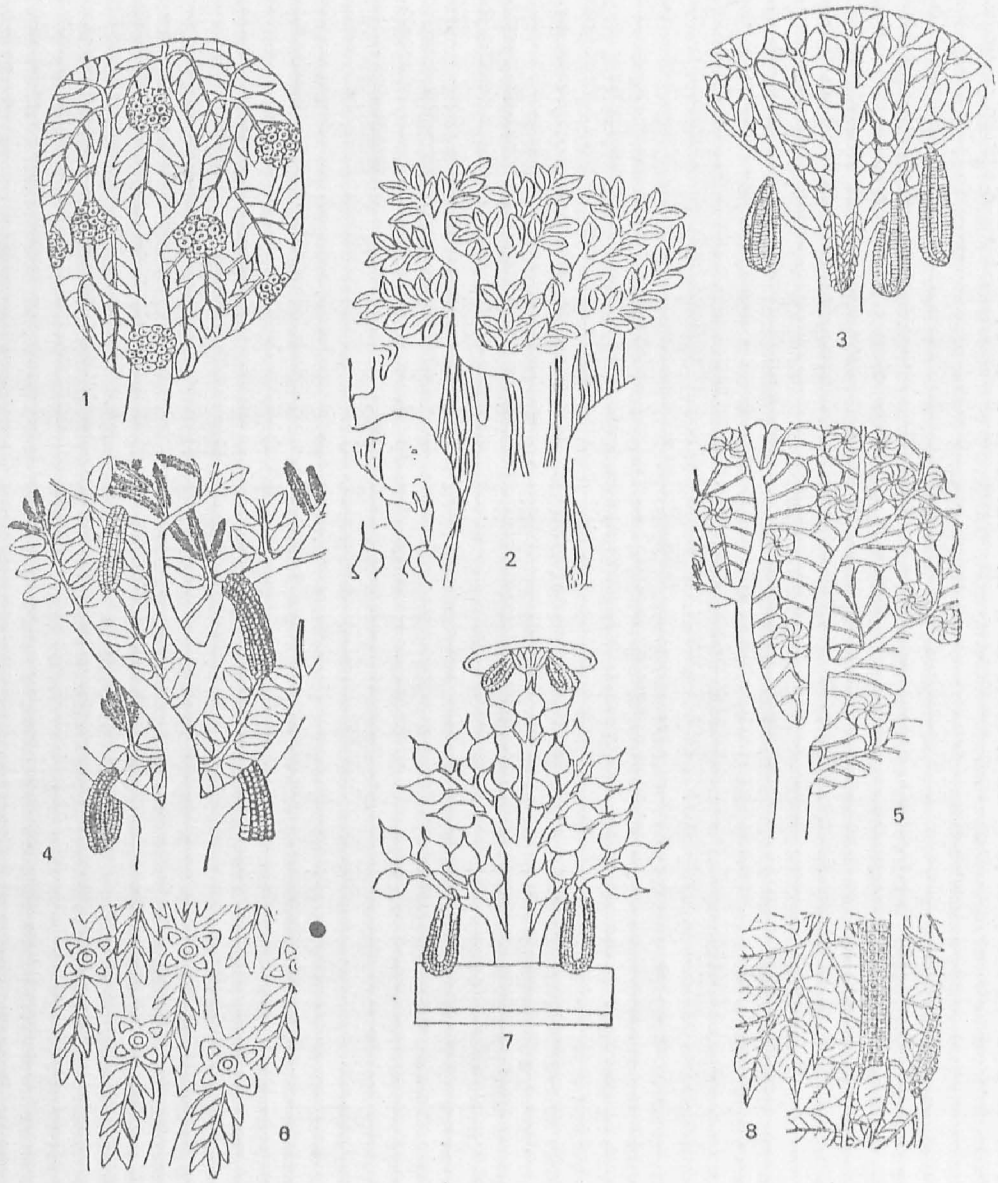

Fig. 165b. Sacred trees of the Buddhists. 1, Asoka-tree (*Saraca asoca*; syn. *S. indica*); 2, Banyan (*Ficus benghalensis*); 3, Cluster-fig (*Ficus glomerata*), Bharhut; 4, Lebbeck-tree or *siris* (*Albizia lebbeck*), Bharhut; 5, Sal (*Shorea robusta*), Bharhut; 6, Iron-wool or Nagkesar (*Mesua ferrea*), Bharhut; 7, Pipal (*Ficus religiosa*), Sanchi; and 8, Foliage of pipal, Bharhut (After R.V. Sitholey)

loose a dangerous elephant to destroy him. In his mad onslaught, the elephant trampled a man, but when he faced the Buddha he knelt down at

his feet (Fig. 166). This medallion from Amaravati shows the mastery of Indian sculptors in depicting elephants. Incidentally, it also conveys to us an idea of architecture during the Buddhist period. The lower parts of houses were made of stones or bricks. Multi-storeyed houses were common in towns, and they had beautifully carved wooden balconies from which women watched royal processions and street scenes.

Jainism

Vardhamana Mahavira was born in 540 B.C. in a village near Vaisali in northern Bihar. His father was head of a Kshatriya clan and his mother was a Lichchhavi princess. Mahavira became an ascetic at the age of thirty and wandered from place to place preaching his doctrine of non-violence. He died at the age of seventy-two in 468 B.C. at Pavapuri near modern Rajgir. Bimbisara was the ruler of Magadha during the lifetime of the Buddha and Mahavira.

As the cultivation of soil, according to Jainism, caused violence to living beings, the Jainas adopted the profession of trade and commerce and money-lending. Even at present, Jainas are mostly merchants and money-lenders. The Jainas adopted Prakrit language in preference to Sanskrit, and this promoted the growth of Prakrit language and its literature.

With the increase in agricultural production due to the use of iron tools, trade and commerce also flourished. About twenty cities are named in Buddhist literature. Seven of them only are reckoned by Thera Ananda as sufficiently important cities (*maha-nagara*), viz. Savatthi, Champa, Rajagaha, Saketa, Kosambi, Benares and Kusinara.

Money

Instead of barter, a cumbrous system, the need of coins was felt. Punch-marked coins became the medium of exchange. The earliest punch-marked coins belonged to the fifth century B.C. and circulated in eastern Uttar Pradesh and Bihar (Fig. 169). With the development of trade and commerce, the members of the Vaisya community, who were traders and merchants, became important. They became enthusiastic supporters of the Buddha and Mahavira.

Rural Economy

'The rural economy of India at the coming of Buddhism was based chiefly on a system of village communities of peasant proprietors. There were no landlords. The Jataka bears very clear testimony to this. The king had a right to a tithe on raw produce, collected as a yearly tax; and only to this extent could he be considered the ultimate owner of the soil. All abandoned, all forest land the king might dispose of; and under this right was included the reversion to the crown of all property left intestate

Fig. 166. The Buddha subjugates the mad elephant Nalagiri. Women, nude above the waist, watch from the balconies of houses. Amaravati, late second century, Madras Museum
(Courtesy: Archaeological Survey of India)

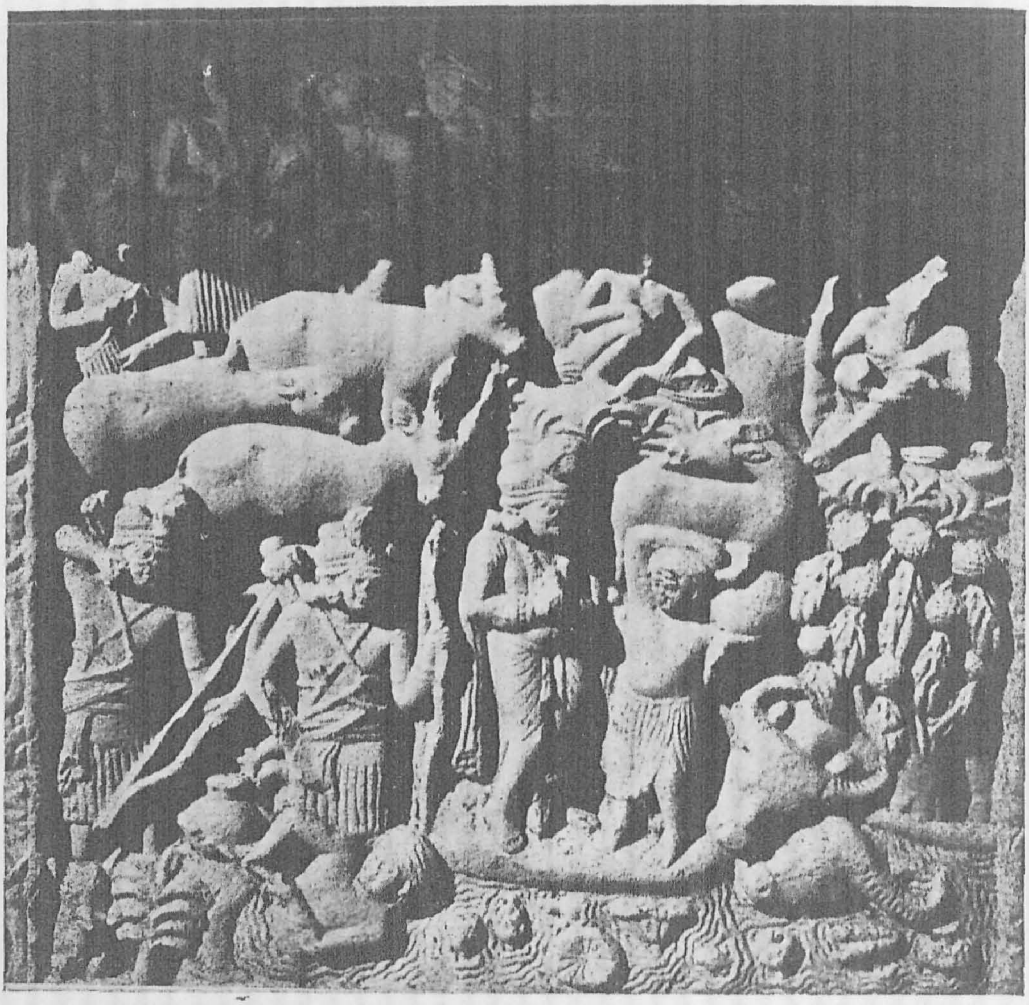

Fig. 167. Buffaloes muddying a pool. The circular hut in the background resembles the Navadatoli huts. On the left are archers carrying bows. An illustration to a Jataka story, West Gate, Sanchi.
(Courtesy: Archaeological Survey of India)

or 'ownerless'. The sovereign was moreover entitled to 'milk money', a perquisite paid by the subjects when an heir was born to him. Besides these privileges he could impose forced labour or *rajakariya* on the people, limited to the confines of his own estates. Thus the peasant proprietors enclose a deer-reserve for their king, so that they might not be summoned to leave their tillage to beat up game for him. The tithe on produce was levied in kind, measured out either by the village headman (*gama-bhojaka*), or by an official (a *mahamatta*) at the barn doors, or by survey of the crops. Some of the rice and other grain were stored in the special granaries kept filled for urgency, in war or famine. The amount levied seems to have varied from $\frac{1}{6}$ to $\frac{1}{12}$, according to the decision of the ruling power or other circumstances. And the contributions raised at one or more *gamas* (villages), rural or suburban, could be made over by a monarch to anyone he wished to endow, e.g. to a daughter on her marriage, a minister, a Brahman, a merchant. Again, the king, could remit the tithe to any person or group.

The land might, at least in the kingdom of Magadha, be given away, and in that of Kosala, be sold. In the former case, a Brahman landowner offers a thousand *karisas* of his estate as a gift; in the latter, a merchant entangles an unwilling noble in the sale of a part. And in the law-books we read that land might be let against a certain share of the produce. The holdings too in the arable land, called the *khetta*, of each village would be subject to redistribution and redivision among a family, as one generation succeeded another. It is not clear whether any member of a village community could give or sell any of the *khetta* to an outsider. It is just possible that the old tradition expressed in the *Brahmanas* when a piece of land was given as a sacrificial fee—'And the Earth said: Let no mortal give me away!'—may have survived in the villages as a communal, anti-alienizing feeling concerning any disintegration of the basis of their social and economic unity. It will be seen that conditions regarding land-holding were similar to those prevailing now in the Punjab, which is the land of peasant proprietors *par excellence*.

Village

'A *gama* might mean anything from a group of two or three houses to an indefinite number. It was the generic, inclusive term for an inhabited settlement, not possessing the fortifications of a *nagara* or the ruler's palace of a *rajadhani*. The number of inhabitants in the *gamas* of the Jataka tales varied from 30 to 1,000 families. The houses were all together, in a group, separated by narrow lanes. Immediately adjoining was the sacred grove of trees of the primeval forest left standing when the forest clearing had been made. Beyond this was the wide expanse of a cultivated field, usually a rice field.

'Around the *gama*, which appears to have been classed as of the country

(*janapada*), of the border (*paccanta*), or as suburban, lay its *khetta*, or pastures, and its woodland or uncleared jungle: primeval forest like the Andhavana of Kosala, the Sitavana of Magadha, the Pacinavamsadaya of the Sakiya Territory. Different from these were such suburban groves as the Bamboo Grove belonging to Magadha's king, the Anjanavana of Saketa, the Jetavana of Savatthi. Through those other uncleared woodlands where the folk went to gather their firewood, and litter, ran caravan routes, roads that were at times difficult because of swampy passages after rain, and dangerous on account of wild animals and brigands.

'Adjoining or merged into these wilder tracts were supplementary grazing pastures of herds of cattle and goats—herds belonging to the king or commoners. Commoners customarily entrusted their flocks to a *gopalaka*. We find him either penning his herds at night in sheds, or, more often, bringing them back every evening and counting them out to the several owners, varying the pasturage from day to day.

'The arable ground of the *gama* lay without the clustered dwellings, since these were apparently enclosed by a wall or stockade with gates *gamadvara*. Fences, snares, and field watchmen guarded the *khetta* or *gamakhetta* from intrusive beasts and birds, whereas the internal boundaries of each householder's plot were apparently made by channels dug for co-operative irrigation. These dividing ditches, rectangular and curvilinear, were likened, at least in the Magadha *khettas*, to a patchwork robe of a mendicant, called *gudri* in Punjabi. The limits of the whole *khetta* might be extended by the fresh clearing of forest land. And whereas the majority of holdings were probably small, manageable single-handed or with sons and perhaps with a hired man, estates of 1,000 *karisas* (acres?) and more occur in the Jatakas, farmed by Brahmans. In the Suttas, again the Brahman Kasibharadvajais employed 500 ploughs and hired men (*bhatika*) to guide the plough and oxen.

'We hear of no instance of a shareholder selling or mortgaging his share of the village field to an outsider; and it was impossible for him to do so, at least without the consent of the village council. We have three instances of sales of land in the books. But in one case it was the forest land cleared by the proprietor or his ancestors. A very old text apparently implies that a piece of ground was given as a sacrificial fee. But it is at once added that the earth itself said—and Mother Earth was a most dread divinity—"No mortal must give me away!"

Headman

'Instances of collectivist initiative reveal a relatively advanced sense of citizenship in the *gamas*. The peasant proprietors had a nominal head in the *bhojaka* or headman, who was paid by certain dues and fines. But all the village residents met to confer with him and each other on civic and political

matters. And carrying the upshot of their counsels into effect, they built new mote-halls and rest-houses, constructed reservoirs and parks, and took turns at a voluntary *corvee* in keeping their roads in repair. Women too considered it a civic honour to bear their own part in common work. A further glimpse into the sturdy spirit in *gama*-life is caught in the Jataka sentiment that for peasants to leave their tillage and work for impoverished kings was a mark of social decay. Relevant to this is the low social rank assigned to the hired labourer, who is apparently classed beneath the domestic slave.

Scarcity

'Scarcity owing to drought or to floods is not infrequently referred to, extending even over a whole kingdom. The times of scarcity in Buddhist records apparently refer only to brief periods over restricted areas.

Status of Farming

'The pursuit of agriculture was not associated with either social prestige or social stigma. In both Jatakas and Suttas, Brahmans are frequently found pursuing tillage, cow-herding, goat-keeping, trade, hunting, woodwork or carpentry, weaving, caravan-guarding, archery, carriage-driving, and snake-charming, but also no reflection is passed upon them for so doing.

'In the Punjab, the old tribal system was still prevalent. There the actual cultivator would still be a man of the three upper classes, whereas in Magadha he was generally Shudra. It is to this period that we must ascribe the great complexity of the caste system, and the beginning of the association of caste with craft. A number of castes arose by intermixtures of the old four divisions.

'The Kshatriya clansmen of the republics were largely cultivators of the soil. For instance, in the *Kunala* Jataka, it was the workmen in the fields of the Sakiyan and Koliya *bhojakas, amaccas* and *uparajas* who began to quarrel over the prior turn to irrigate. In the earliest Indian literature, agricultural and pastoral concepts play a great part.'[6]

Dasas and Dasis

The slave or servant (*dasa, dasi*) was an adjunct in all households able to command domestic service; but slaves do not appear to have been kept, as a rule, in great numbers. Slavery might be incurred through capture, commuted death sentences, debt, voluntary self-degradation, or judicial punishment; on the other hand, slaves might be manumitted, or might free themselves by payment. They might not, while still undischarged, be admitted into the religious community (*sangha*).

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[6]Rapson, E.J. *Cambridge History of India*, Vol. I, pp. 176-182, 370, 371 and 433

Landless Labourer

The hireling, the wage-earner, or the day-labourer was no man's chattel, yet his life was probably harder sometimes than that of the slaves. He was to a great extent employed on the larger land-holdings. He was paid either in board and lodging, or in money-wages. Manu prescribes regular wages both in money and kind for menials in the king's service.

Northern Black Polished Ware

The Buddhist period is characterized by a new type of pottery called Northern Black Polished Ware, which has a lustrous black surface. It is well fired, giving a metallic sound on being gently struck with a hammer. Its main sites are in the Punjab, Haryana and the Gangetic plain. Its centre of diffusion was the Gangetic plain. This pottery is superior to the Painted Grey Ware and is more durable.

Use of Iron for Agricultural Implements

By the sixth century B.C. the iron age was well established in Uttar Pradesh and Bihar. Spear-heads, arrow-heads, axes, daggers and knives of iron were manufactured in substantial numbers. Iron ploughshares and sickles of iron made farming more efficient.

Iron was also used for making chisels and drills—the primary tools of the carpenter—and for manufacturing nails. A larger production of iron and the manufacture of iron axes enabled the people to cut down forests and to lay roads through unexplored parts of the country. Apart from the felling of trees, skilful cutting of hard wood at Ujjain suggests the use of improved iron implements, such as saws.

With the expansion of cultivation, the usefulness of cattle was fully realized, and cattle became sacred. The Vedic practice of animal sacrifices was given up under the influence of Buddhism, and the bullocks became the companion of man in the conquest of virgin lands. Henceforth Indian farmers regarded them as helpmates and as members of their own social group.

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CHAPTER 22

THE MAGADHAN EMPIRE

FOURTH CENTURY B.C. CIVIC LIFE, ARTISANS, MERCHANTS AND MONEY

MAGADHA emerged as the most powerful State in eastern India in the sixth century B.C. Bimbisara (ruled 544 B.C. to 492 B.C.), the king of Magadha, conquered Anga. Bimbisara made Magadha the paramount power. He was succeeded by his son Ajatasatru, who ruled from 492 B.C. to 460 B.C. Ajatasatru began the construction of fortifications of Rajgir. He was succeeded by Udayin (460-444 B.C.), who made his capital at Pataliputra, the present-day Patna. In 413 B.C., the house of Bimbisara was overthrown by Nanda. Mahapadma Nanda conquered Kalinga and Kosala. The Nandas of Magadha used elephants on a large scale for their warfare.

In 325 B.C., the Nanda dynasty was overthrown by Chandragupta Maurya, whose chief adviser was Kautilya, also called Chanakya, the author of the *Arthashastra*. In 322 B.C., Chandragupta Maurya returned to Magadha from the Punjab with a large army, killed the Nanda king and occupied Pataliputra. In 305 B.C., Chandragupta defeated Seleucus, the Greek ruler of western Asia. Seleucus not only ceded to Chandragupta eastern Afghanistan, Baluchistan and the area west of the Indus but also gave him his daughter in marriage.

The sources for information on the life of the people and their agriculture in the Buddhist period are Kautilya's *Arthashastra* (fourth century B.C.), Pali texts *Mahavagya* and *Kullavagya* (third century B.C.), which describe the daily life of the Buddhist monks, and Jataka stories, which tell us about the previous incarnations of the Buddha. The sculptures of the railings and gateways of the stupas of Bharhut and Sanchi (second century B.C.) are also an important source of information on the dress, ornaments and appearance of the people of that age, and the fauna and flora of the period. Some of the Greeks who accompanied Alexander on his expedition to northern India in 326 B.C. left vivid impressions of the daily life of the Indians. In his *Anabasis of Alexander*, Arrian (Flavius Arrianus, A.D. 96 to A.D. 180) describes the life of Alexander from his accession to his death. He derived the information from the writings of Aristobulus of Cassandreia and Ptolemy, who accompanied Alexander on his campaign in the Punjab. Arrian also wrote the *Indika*, which is based on the accounts of the country given by Megasthenes and Eratosthenes. Megasthenes was sent on an embassy to Chandragupta Maurya, by Seleucus Nikator, king of Bactria. He lived in Pataliputra and wrote a book on

India, also called *Indika,* which served as a source of information to many classical writers.[1]

The People

The Greeks noted that the Indians were a tall people—'tall and slender', says Arrian, 'lightly-built to a degree far beyond any other people.' On the other hand, Diodorus, following perhaps some other source, describes them as eminently tall and massive. In the south of India complexions approximate to those of the Ethiopians and in the north to the Egyptians. But in features there is not any marked difference, and no Indian people has woolly hair, like the Negro races, 'owing to the dampness of the Indian climate'. There was discussion among the Greeks whether the darkness of skin was due to the action of the sun or to a property in the water of the African and Indian rivers. The Indians, or some races among them, were believed by the Greeks, in striking contrast with truth, to be singularly free from diseases and long-lived. The people of Sind, Onesicritus said, sometimes reached 130 years. The intellectual powers which they displayed in the arts and crafts were attributed, like their health and longevity, to the purity of the air and the rarefied quality of water, but their health was also attributed to the simplicity of their diet and their abstinence from wine.

Dress

Megasthenes noted down a variety of points which struck him in the manners and customs of the people. A noble simplicity seemed to him the predominant characteristic. Nearchus seems to have described the dress of the people in the Indus region. They wore clothes of cotton, and this linen from the trees is of a more shining white than any other linen, unless it be that the people themselves being dark make the linen appear all the whiter. The reference is obviously to tree-cotton, *Gossypium arboreum.* They have a tunic of tree-linen down to the middle of their shins, and two other pieces of stuff, one thrown about their shoulders and one twisted round their heads. And the Indians wear ear-rings of ivory, those that are very well-off.... Also they dye their beards different colours. In the summer they protect themselves with umbrellas. They wear shoes of white leather very elaborately worked; and the soles of the shoes are variegated, and high-heeled so as to make the wearer seem taller.

Megasthenes observed at Pataliputra that in dress the Indians, for all their general simplicity, indulged a love of richness and bright colours, wearing ornaments of gold and gems and flowered muslins, with umbrellas carried after them.

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[1]Majumdar, R.C. *The Classical Accounts of India,* p. 5

'Nearchus described their dress in war. 'The foot-soldiers carried a bow as long as the body....To shoot, they rested one end of it on the ground and set their left foot against it. They had to draw the string far back, since the arrows in use were six feet [1.8 metres] long. In their left hand, they carried long narrow shields of raw hide, nearly co-extensive with the body. Some had javelins instead of bows. All carried long two-handed swords with a broad blade. The horsemen had two javelins and a shield smaller than that of the foot-soldiers.' In a Sanchi relief we see two soldiers carrying bows of this type (Fig. 167).

Diet

'Their diet was distinguished from that of the Greek by the absence of wine, which they drank only in religious ceremonies; but rice-beer was generally drunk. Their staple food was pulpy rice. Each man took his food by himself when he felt inclined; for they had no fixed times for common meals. When a man would sup, a table was placed beside him and a gold dish set upon it, in which first was put the rice, boiled after the manner of the Greek *chondros* (gruel) and then on the top of it seasoned meats, done up in the Indian way. Their system of gymnastic exercise differed from that of the Greeks: it consisted principally of massage, and they used smooth rollers of ebony for shaping their bodies.

Honesty and Truthfulness of People

'Megasthenes observed the much greater part played by oral tradition and memory, as compared with written documents, than was the case in the Greek world, though it cannot be asserted that writing was unknown, as Strabo would seem to imply, since in one passage he referes to written inscriptions. In the sphere of morals, the salient characteristic of the Indian people was a high level of veracity and honesty. 'An Indian has never been convicted of lying', he wrote in one passage, and in another pointed to the rarity of law-suits as evidence of their frank dealing. 'They are not litigious. Witnesses and seals are unnecessary when a man makes a deposit; he acts in trust. Their houses are usually unguarded'. During the time that Megasthenes was on Chandragupta's camp, out of a multitude of 400,000 men there were no convictions for thefts of any sums exceeding 200 drachmas (about £8). In Sind, Onesicritus said, no legal action could be taken, except for murder and assault.

Punishment for Crime

'The laws, Nearchus said, were preserved by oral tradition. According to Megasthenes, many of them were sufficiently severe. A man convicted of giving false witness suffered mutilation. In the case of bodily harm being inflicted, not only was the principle of an eye for an eye observed, but the

Fig. 168. A bullock-cart, with a pair of bullocks in the foreground. A medallion from Bharhut, 200 B.C. Calcutta Museum
(Courtesy: Archaeological Survey of India)

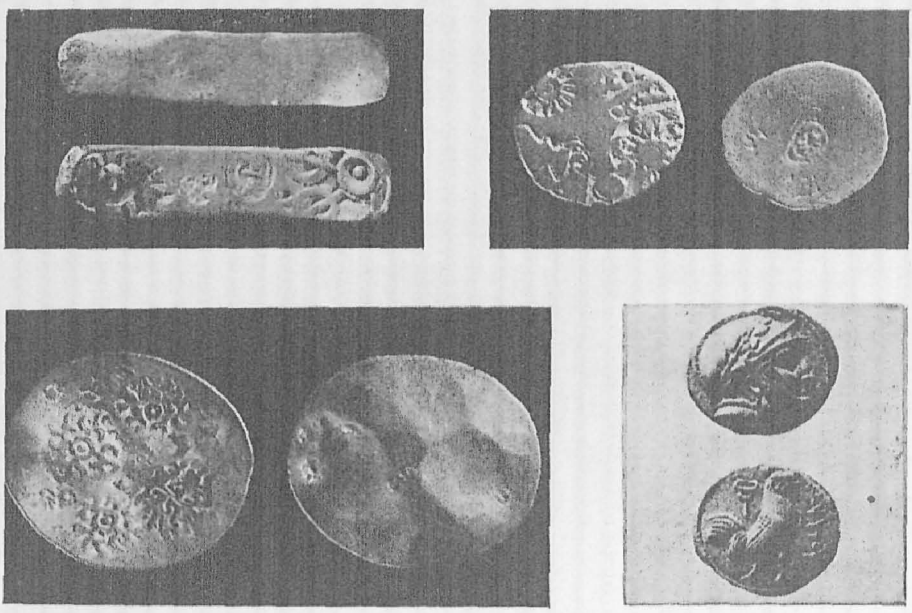


Fig. 169. Punch-marked silver coins of the Buddhist period. *Top row, left,* Bent bar variety, silver, sixth century B.C.; *right,* Punch-marked cup-shaped variety, silver, fourth century B.C.; *Bottom row, left,* Punch-marked, silver, third century B.C.; *right,* Silver coin of Sophytes, a prince of the Punjab, the obverse of the coin showing a cock with large spurs. *c.* 300 B.C.
(Courtesy: National Museum, New Delhi)

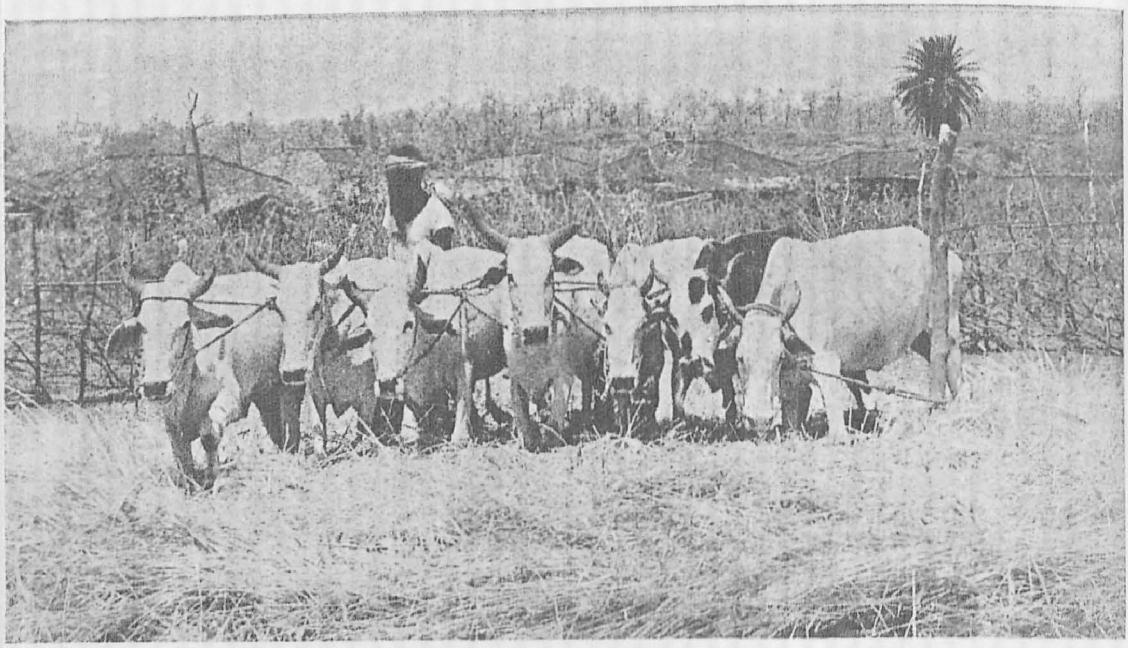
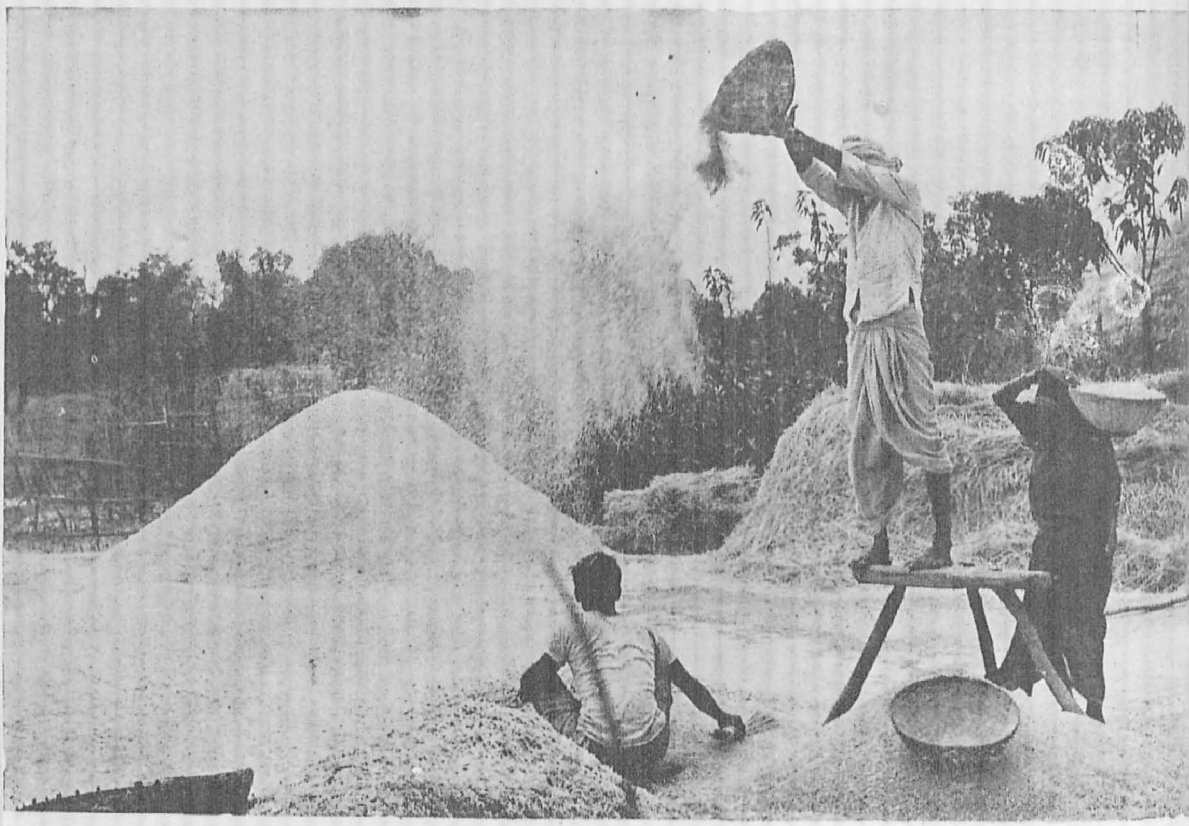


Fig. 170. The threshing of wheat near Bhopal in Madhya Pradesh. Seven bullocks are tied with a rope to a wooden post (*methi*). They walk around it for hours and thresh out the grain. This is a practice as ancient as the Buddhist period

Fig. 171. The winnowing of wheat in Madhya Pradesh



hand was cut off as well. To cause a craftsman the loss of his eye or hand was an offence punished by death.

Daily Life

'As regards daily life, the public side of it was sufficiently gay. The people were frugal in their diet, and sober, except on occasions of festivals. The chief display of luxury was in dress. The inns, hostelries, eating-houses, serais, and gaming-houses were evidently numerous; sects and crafts had their meeting-places and the latter their public dinners. The business of entertainment provided a livelihood for various classes of dancers, singers, and actors. Even the villages were visited by them. There were penalties for refusal to assist in organizing public entertainment. The king provided, in amphitheatres constructed for the occasion dramatics, boxing, and other contests of men and animals, and also spectacles with displays of pictured objects of curiosity, and the streets were lighted up for festivals. Then there were also the royal processions, when the king went forth to view his city or to hunt.

'In domestic life, the joint-family system prevailed. A boy and a girl attained majority at the age of sixteen and of twelve respectively. Adoption —legitimated by the king—was common. There were the four regular and four irregular forms of marriage, which was dissoluble by mutual consent or prolonged absence.'[2]

Pataliputra

Chandragupta's capital, Pataliputra, on the site of the modern Patna, is described by Megasthenes as a splendid city, standing on the northern bank of the Son. It was the shape of a parallelogram, roughly nine miles by two [14.5 × 3.2 kilometres], and was surrounded by a broad, deep moat, which received the drainage and was connected at its two extremities with the river. The city wall was a massive timber palisade, with drawbridges, towers and gates at regular intervals. The town itself was well planned and laid out, with inns, gaming-houses, theatres, race-courses, and meeting-halls for guilds and religious sects. There were handsome bazaars where indigenous and foreign goods were displayed for sale. The streets were crowded with a busy and many-coloured throng of men and animals. The houses were two or three storeys high, and, as they were mostly wooden, elaborate precautions were taken against an outbreak of fire. In the heart of the city was the royal palace, which stood in the midst of a walled-in park, with ornamental trees, tame peacocks and pheasants, and lakes full of sacred fish.

The palace was built of wood, exquisitely carved; the pillars were

[2]Rapson, E.J. *The Cambridge History of India*, Vol. I, pp. 370, 371 and 433

plated with gold and silver, ornamented with designs of vines and birds. The king lived in great state. "In the Indian royal palace", we are told, "there are wonders with which neither Memnonian Susa in all its glory, nor the magnificence of Ecbatana can hope to vie."[3]

Ring Wells

In the ring wells, instead of bricks, terracotta rings were used. Ring wells appeared in India in the sixth century B.C. and continued till about the second century of the Christian era. The ring wells of Ropar are dated from fifth to fourth centuries B.C. to the beginning of the Christian era. According to Y.D. Sharma, ring wells can be seen even at present in the south and in Orissa and Bengal. Their present use is for drinking water. In ancient times, they were mostly used as soakage or sullage pits. In some places, undoubtedly, they also must have been in use for drinking-water. In ancient times, they appeared often in clusters. In Ropar, there were five of them in a cluster, their depth being different from one another. When one was silted up, another was dug up close by (Fig. 69).

Artisans

'In the arts and crafts, a considerable proficiency and specialization of industry had been reached. A list of callings given in the Milindapanha, reveals three separate industries in the manufacture of bows and arrows, apart from any ornamental work on them. In the same work, there is allusion to a professional winnower of grain.

'Some trade-names, on the other hand, are comprehensive. The word *kammara* might be applied to a worker in any metal. *Vaddaki* apparently covered all kinds of woodcraft, including shipbuilding, cartmaking, and architecture, *thapati, tacchaka* (lit., planer), and *bhamakara* or turner being occupied with special modes of woodwork. A settlement of *vaddakis* is able to make both furniture and seagoing ships. Once more, the same worker in stone (*pasana-kottaka*) builds houses with the ruined material of a former *gama* and also hollows a cavity in a crystal as a cage for a mouse.'

Important handicrafts like the three named above and their branches, the workers in leather, i.e. the leather-dressers, the 'painters', and others to the number of eighteen were organized into guilds (*seni*) according to Jataka records.

Various types of workers are described by Rhys Davids as below.

The workers in wood. They were not only carpenters, and cabinet-makers, but also wheelwrights; and the builders of houses, and of ships, and of vehicles of all sorts.

The workers in metal. They made iron implements—weapons of all

[3]Rawlinson, H.G. *India —A Short Cultural History*, pp. 66-67.

kinds, ploughshares, axes, hoes, saws, and knives. But they also did finer work—made needles, for instance, of great lightness and sharpness, or gold and (less often) silver work of great delicacy and beauty.

The workers in stone. They made flights of steps, leading up into a house or down into a reservoir; faced the reservoir; laid foundations for the woodwork, of which the upper part of the houses was built; carved pillars and bas-reliefs; and even did finer work such as making a crystal bowl, or a stone coffer. Beautiful examples of these two last were found in the Sakiya Tope.

The weavers. They not only made the clothes which the people wrapped round themselves as dress, but manufactured fine muslin for export, and worked costly and dainty fabrics of silk cloth and fur into rugs, blankets, coverlets, and carpets.

Leather-workers. They made foot-covering and sandals worn by people mostly in cold weather; and also made embroidered and costly articles.

Potters. They made all sorts of pots, dishes and bowls for domestic use; and often hawked their goods about.

Ivory-workers. They made a number of small articles in ivory for ordinary use, and also costly carvings and ornaments.

Dyers. They dyed the cloth made by the weavers.

Jewellers. Some of their handiwork has survived, and is often represented in bas-reliefs. We know fairly well the shape and size of the ornaments they made.

The fishermen. They fished only in the rivers. There is no mention of sea-fishing.

The butchers. Their shops and slaughterhouses are mentioned several times.

Hunters and trappers. They are mentioned as bringing on carts animal and vegetable products of the woods, and also venison and game for sale into the city. It is doubtful whether they were formed into guilds. But their industry was certainly a very important one. The large stretches of forest, open to all, separating most of the settlements, the large demand for ivory, fur, sinews, creepers, and all the other produce of the woods, and the congeniality of the occupation, all tended to encourage the hunters. And there is no reason to suppose that the very ancient instinct of the chase was confined to the so-called savages. The kings and nobles also, whether Aryan by blood or not, seem to have taken pleasure in it, quite apart from the economic question of food-supply.

The cooks and confectioners. A numerous class, probably formed a guild.

The barbers and shampooers. They had their guilds. They dealt in perfumes, and were especially skilled in arranging the elaborate turbans worn by the wealthier classes.

The garland-makers and flower-sellers. They made garlands and sold flowers.

Sailors. They were occupied for the most part in the traffic up and down the great rivers, and also going to sea. In some of the earliest documents we hear of sea voyages out of sight of land; in the later documents, such as the Jatakas, the mention of such voyages is frequent. The earlier documents speak of voyages lasting six months made in ships.

'And later texts, of about the third century B.C., speak of voyages down the Ganges from Benares to the mouth of the river and thence across the Indian Ocean to the opposite coast of Burma; and even from Bharukaccha (the modern Broach) round Cape Comorin to the same destination. It is clear, therefore, that during the whole of this period the occupation of the sailor was neither infrequent nor unimportant.'

MERCHANTS AND TRADE

'Besides, the peasantry and the handicraftsman there were merchants who conveyed their goods either up and down the great rivers, or along the coasts in boats; or right across the country in carts travelling in caravans. These caravans, long lines of small two-wheeled carts, each drawn by two bullocks, were a distinctive feature of the times. The carts struggled along, slowly, through the forests, along the tracks from village to village kept open by the peasants. A typical bullock-cart and a pair of bullocks are seen in a Bharhut relief (Fig. 168). Smaller streams were crossed by gullies leading down to fords, the larger ones, in cart ferries. There were taxes and octroi at the border of each Mahajanapada and a heavy item in the cost was the hire of volunteer police who let themselves out in bands to protect caravans against robbers on the way. The cost of such carriage must have been great; so great that only the more costly goods could bear it.

'Silks, muslins, finer cloth and cutlery and armour, brocades, embroideries and rugs, perfumes and drugs, ivory and ivory work, jewellery and gold (seldom silver) were the main articles in which the merchants dealt.

'The activity of trade is indicated by the traffic on high roads (*rajapatha*, 'routes royales') and by-roads (*banikpatha*, 'merchant roads') the bustle at frontiers, ferries, tolls, and city-gates.'[4]

MONEY

'The most important feature of the economic development during this period was the use of coins as common currency. The system of barter, in vogue during the Vedic period, was gradually replaced by exchange in precious metals. Herodotus's statement that the satrapy in India paid 360 talents of gold dust as annual tribute to the Achaemenid king of Iran shows that even in the 6th century B.C. dust or ingots of gold and silver served as currency.

[4]Rhys Davids, *Buddhist India*, pp. 90-96

'In the sixth century B.C., we find the use of actual coins, i.e. a piece of metal of regular shape, whose weight and fineness were guaranteed by a recognized authority. They were regularly issued by rulers, individual merchants, or corporations, and the State had no monopoly in this respect. As one or more figures were marked on these coins by a punch, as symbols of the issuing authority, these coins are generally known as punch-marked coins. They, however, bore no names, and, with rare exceptions, no legends at all, and some coins with similar devices were also cast. These coins bear no inscriptions and have symbols of various types such as human and animal figures, arms, trees, solar, lunar and planetary marks (Fig. 169). These coins appear to have been in circulation from 700 B.C. to A.D. 500. The coins of this variety are found throughout the length and breadth of India. The technique of minting punch-marked coins was a simple process. The metal was possibly melted in a crucible and the molten metal was poured on to a slab to cool. Then it was beaten on an anvil into sheets. The sheets were cut into small pieces which were later punched with symbols. Thousands of these coins found in different parts of India show that they formed regular currency for a long period.'

Indo-Greek Coins

It is the Bactrian Greeks who first introduced coins with names and portraits of the rulers. The figure of the king on the obverse and of a deity or other symbols on the reverse are executed with a high degree of artistic skill. The credit for injecting art into the coinage of India goes to these Greek rulers. Not only the other foreign hordes who invaded India but even the Indian rulers adopted the system and issued coins of similar type. In a silver coin issued by Sophytes, a prince of the Punjab (*c.* 300 B.C.), we see him wearing a Greek helmet. On the reverse is an Aseel cock with large spurs (Fig. 169). Aseel is a fighting breed of poultry (Fig. 172). It is still popular with people in India who enjoy the sport of cock-fighting.

Standard

The weight of the earliest coins was based on the system laid down in Manu-Samhita. Its unit was the *rati* or *gunja berry* weighing approximately 1.83 grains or 0.118 gram. Although no actual specimen of the *suvarna* or standard gold coin of 80 *ratis* is known, the silver *purana* or *dharna* or 32 *ratis,* and of the copper *karshapana* of 80 *ratis,* as well as their various multiples and subdivisions have been discovered all over India.

Relative Value of Metals

We have no definite knowledge of the relative value of gold and silver in India before the time of the Persian Emperor Darius (518 B.C.), when it was 1:8 in his Indian Satrapy while in Persia it was 1:13. This is due

to the fact that while India had gold in abundance, her supply of silver from indigenous sources was very restricted, and it had to be largely imported from outside. But gradually the ratio in India came to be the same as in the western countries. The ratio between gold and copper did not show the same fluctuation as that between gold and silver, as both gold and copper were procurable in this country. The fluctuation in the ratio between silver and copper was, however, great and led to the variation in weight of the two coins. The approximate ratio of the two metals was 1:5.7.

In the earliest period, the copper Karshapana of 80 *ratis* (146 grains, 9.44 grams) was the standard coin. Kautilya refers to the silver Karshapanas of 32 *ratis*.[5]

'The Magadhan state functioned on a powerful cash economy. The *Arthashastra pana* was of silver. The age shows plenty of hoards of silver coins of the 3.5-gram standard, but none of gold and very few of copper. Every state servant was paid in cash. The highest pay was 48,000 *panas* per year each for the king's chief priest, high councillor, chief queen, queen mother, crown prince, and commander-in-chief. The lowest was 60 per year for the menial and drudge labour needed on such a large scale in camp and on State works; this was called *vishti*. A good deal of this labour was for porterage in bad country, roadmaking, digging irrigation canals or fortification ditches and piling up dykes. The scale of 60 pieces of silver shows the minimum then needed to keep body and soul together for a year under conditions of hard physical labour, with perhaps something left over for dependants. (This amounts to 17.5 grams of silver per month, almost exactly what was paid to the lowest Indian labour by the British East India Company in the early eighteenth century.) Carpenters and craftsmen were paid by the State at 120 *panas*. The heavy-armed soldier of the line after being trained in full got 500, which was the scale also for scribes and accountants in State service. The expert miner and the engineer received 1,000 a year. So did the best quality of spy who could disguise himself in many ways. Whereas these spies were expected actually to follow the normal pastimes of the classes whose disguise they adopted, there were no extra allowances; hence 1,000 *panas* per annum may be taken as the decent minimum for a Magadhan *grihapati's* normal standard and style of living. The lower spies got 500, which was also the scale for the registrar who reported on the village or villages in his charge. Royal messengers were paid on a fixed scale, in proportion to the distance travelled, with double rates for the long-distance couriers. There were regular pensions for those disabled in State service, and for the helpless dependants of servants and officials who died during their term. For long service,

[5]Majumdar, R.C. *Ancient India*, pp. 216-218

special bonuses were given in the form of allowances of rice or foodgrain, presents of cloth and the like. Never was anything given away which would permanently curtail State revenues.

Besides the coins, there was a very considerable use of instruments of credit. The great merchants in the few large towns gave letters of credit on one another. And there is a constant reference to promissory notes. Interest itself is mentioned very early; and the law books give the rate of interest current at a somewhat later date for loans on personal security as about eighteen per cent per annum.

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CHAPTER 23

RURAL ECONOMY AND ADMINISTRATION OF LAND IN THE MAGADHAN EMPIRE

THE Mauryan Government had a well-organized revenue administration, bureaucracy, army and police. There were Superintendents for various departments. Among them were Superintendents of Agriculture, Forest Produce, Pasture Lands, Cows, Horses and Elephants. The *Arthashastra* thus enumerates the qualifications and duties of the Superintendent of Agriculture.

'Possessed of the knowledge of the science of agriculture dealing with the plantation of bushes and trees or assisted by those who are trained in such sciences, the Superintendent of Agriculture shall in time collect the seeds of all kinds of grains, flowers, fruits, vegetables, bulbous roots, fibre-producing plants, and cotton.

He shall employ slaves, labourers, and prisoners to sow the seeds on crown lands which have been often and satisfactorily ploughed.

The work of the above men shall not suffer on account of any want in ploughs and other necessary implements or of bullocks. Nor shall there be any delay in procuring for them the assistance of blacksmiths, carpenters, borers, ropemakers, as well as those who catch snakes, and similar persons.'

All these duties were enjoined upon the Superintendents of Agriculture because the Magadhan State started the clearance of jungles on a large scale. The king was the biggest land-owner. Land farmed directly under the crown supervision was called *sita* lands. The State derived substantial income from *sita* lands, which were settled with Shudras. They gave one-fourth of the produce to the State warehouses.

FORMATION OF VILLAGES

How the villages were settled is thus described by the author of the *Arthashastra.*

'Either by inducing foreigners to immigrate or by causing the thickly-populated centres of his own kingdom to send forth the excessive population, the king may construct villages either on new sites or on old ruins.

Villages consisting each of not less than a hundred families and of not more than five hundred families of agricultural people of Shudra caste, or agricultural people, with boundaries extending as far as a krosa (2,250 yards; 2,057 metres) or two, and capable of protecting each other, shall be formed. Boundaries shall be denoted by a river, a mountain, forests, or by trees such as salmali (silk-cotton tree), sami (*Acacia suma*), and kshira-vriksha (milky trees), possiby *Manilkara hexandra.*

There shall be set up a sthaniya (a fortress) in the centre of eight hundred villages, a dronemukha in the centre of four hundred villages, a kharvatika in the centre of two hundred villages, and a sangrahana in the midst of a group of ten villages.

There shall be constructed in the extremities of the kingdom forts manned by boundary-guards, whose duty shall be to guard the entrance into the kingdom. The interior of the kingdom shall be watched by trap-keepers, archers, hunters, chandalas, and wild tribes.

Those who perform sacrifices, spiritual guides, priests, and those learned in the Vedas shall be granted Brahmadeya lands yielding sufficient produce and exempted from taxes and fines.

Superintendents, accountants, gopas, sthanikas, veterinary surgeons, physicians, horse-trainers, and messengers shall also be endowed with lands, which they shall have no right to alienate by sale or mortgage.

Lands prepared for cultivation shall be given to taxpayers only for life. Unprepared lands shall not be taken away from those who are preparing them for cultivation.

Lands may be confiscated from those who do not cultivate them, and given to others; or they may be cultivated by village labourers and traders, lest those owners who do not properly cultivate them might pay less to the government. Cultivators may be supplied with grains, cattle, and money, which they may return at their convenience.

The king shall bestow on cultivators only such favour and remission as will tend to swell the treasury, and shall avoid such favour which deplete it.

Either on the occasion of opening new settlements or on any other emergent occasion, remission of taxes shall be made.

He shall regard with fatherly kindness those who have passed the period of remission of taxes.

He shall exploit timber and elephant forests, offer facilities for cattle-breeding and commerce, construct roads for traffic both by land and water, and set up market towns.

He shall also construct reservoirs, filled with water either perennial or drawn from some other source. Or he may provide sites, roads, timber, and other necessary things to those who construct reservoirs of their own accord.

Whoever stays away from any kind of co-operative construction shall send his servants and bullocks to carry on work on his behalf, and shall have a share in the expenditure, but shall have no claim to the profit.

The king shall exercise his right of ownership with regard to fishing, ferrying and trading in vegetables, in reservoirs or lakes.

Those who do not heed the claim of their slaves (*dasa*), hirelings (*ahitaka*), and relatives shall be taught their duty.

Classification of Villages

The Mauryan Government made a two-fold classification of the villages for the purpose of fiscal administration. The villages were grouped according to the number of tax-paying inhabitants, the caste of the people, the size and the commercial and industrial value.

(i) *Villages enjoying remission of taxes.* These included certain newly founded villages and villages granted as Brahmadeyas and the like. This group included villages granted to royal servants, such as superintendents, accountants, gopas, sthanikas, veterinary surgeons, physicians, horse-trainers and messengers, without the right of alienation by sale or mortgage.

(ii) *Villages supplying soldiers or weapons of war.* Villages that paid grains, cattle, gold and raw produce as tax, and supplied free labour instead of taxes, included the purely agricultural type as well as villages of low-caste people. The Maurya Government pursued a policy of setting up villages tenanted solely by the people of the Shudra caste. Says Kautilya, 'Villages should be formed, each consisting of from 100 to 500 agricultural families of Shudra caste.' Men of low caste for such work were preferred on the ground that they were more efficient in manual labour than men of the high castes. Stringent measures were adopted to protect agricultural interests in these villages by way of forbidding impediments of different kinds. 'No ascetic other than one who was taken to the fourth stage of life, no association other than one of the same origin (i.e. of agricultural caste), no guild devoted to a different object other than a guild of the same nature shall colonize a village. On account of the isolation of the villagers, and devotion of the people to cultivation there will be growth of wealth, labour, minerals, grains and drinks.'

The seclusion of the villages belonging to the Shudra families was a Mauryan innovation. It gave a distinct stamp to the farmers as a whole. Megasthenes was thus led to believe that husbandmen formed a distinct caste. He says, 'The second caste consists of the husbandmen, who appear to be far more numerous than the others. As they were exempted from fighting and other public services, they devoted the whole of their time to tillage. Nor would an enemy, coming upon a husbandman at work on his land, do him any harm, for, farmers were regarded as public benefactors and were protected. The land thus remaining unravaged, and producing heavy crops, supplies the inhabitants with all that is requisite to make life enjoyable. The husbandmen themselves, with their wives and children, live in the country and avoid going into town.'

The Different Parts of a Village

During the Mauryan administration, an account of the different parts of a village was kept by the local officers for the purpose of assessment of taxes. They comprised cultivated plots of land, uncultivated fields,

wet lands (*kedara*), gardens, vegetable gardens, fenced plots, forests, altars, temples, irrigation works, cremation-grounds, feeding-houses, *piaos* where water was supplied to travellers, places of pilgrimage, pasture ground, roads, boundary plots, threshing floors, house sites and stables of domestic animals.

Division of Land

The division of land for various purposes, and the duties of the king towards farmers are thus described in *Arthashastra.*

'The king shall make provision for pasture grounds on uncultivable tracts.

Brahmans shall be provided with forests for soma plantation, for religious learning, and for the performance of penance, such forests being granted with safety for animate or inanimate objects, and being named after the tribal name (*gotra*) of the Brahmans resident therein.

A forest provided with only one entrance, rendered inaccessible by the construction of ditches all round, with plantations of delicious fruit trees, bushes, bowers, and thornless trees, with an expansive lake of water, full of harmless animals, and with tigers, beasts of prey deprived of their claws and teeth, male and female elephants, young elephants and bisons—shall be formed for the king's sports.

On the extreme limit of the country or in any other suitable locality, another game forest with game beasts, open to all, shall also be made.

The king shall protect farmers from the molestation of oppressive fines, forced labour and taxes, herds of cattle from thieves, tigers, poisonous creatures and cattle disease.

The king shall keep roads clear for traffic, and protect travellers from molestation by the officials, robbers, and boundary-guards. He should also protect the roads from being destroyed by herds of cattle.'

The Headman

The Jatakas refer to the headman generally under the designation 'gamabhojaka'. The Kulavaka Jataka refers to gamabhojaka who used to make money in sinful ways and who tried to harass innocent men. The appointment of the headman was either hereditary or was conferred by the village council itself. The villages of the industrial type appears to have had an elderman (*jetthaka*) as the head. The Suchi Jataka tells us that there was a '*jetthaka*' at the head of the village of 1,000 blacksmiths. It indicates extensive use of iron for fabrication of agricultural implements. The headman appears also to have been sometimes a nominee of the king even during the Jataka period. According to the Kharassara Jataka the king appointed an '*amachcha*' (minister) as the headman of a village and he collected the revenue (*bali*) from the village on behalf of the king. In the Gamani-Chanda Jatakas we are told that an officer named Chanda after

retiring in old age from service took to farming in a village. The king made a grant of this village to him as a *Brahmadeyya* (full gift). Chanda thus became the headman of the village.

The Kulavaka Jataka tells us that the members of the thirty families of a village met in the village to consider the common problems of the village community. We further learn that they kept the roads in repair, cut down trees that obstructed traffic, constructed cause-ways, dug water-reservoirs and built a hall.

Kautilya refers to the headman (*gramika*) as well as to the village-elders (*grama-vriddhah*), who constituted the local assembly. The headman co-operated with the Gopa, a royal official, in maintaining the village register, which contained a full description of the tax-paying and non-tax-paying parts of the village, a record of gifts, sales, charities and remission of taxes. The Gopa attended to the accounts of five or ten villages. Villages were divided into the following categories: villages exempted from taxation, those that supply soldiers, those that pay their taxes in the form of grains, cattle, gold or raw material, and those that supply free labour and dairy produce in lieu of taxes. Kautilya enjoins: 'When the headman of the village has to travel on account of any business of the whole village, the villagers shall by turn accompany him: those who cannot do this shall pay 1½ panas for every Yojana.' This shows that the headman was assisted by the villagers in matters relating to the whole village. The village elders, with the *gramika* at the head, looked after the local administration. So far as affairs touching land were concerned, we notice them, in the first place, taking charge of property of the infants or minors and improving it. They looked after the temple-property (*deva-dravyam*). 'In the absence of claimants to dilapidated religious buildings, villagers or charitable people may repair them. They also conducted the sale of buildings of different kinds, fields, gardens, lakes or tanks, etc. The property on sale was accurabuy; tely described, so that the buyer could know exactly what he was going to and the sale was by auction. They decided disputes concerning boundaries of land within a village as well as those between two or more villages in consultation with the elders of other village. They also punished those who made encroachments upon the boundary-areas or destroyed the boundary-marks.

The Prakrit inscriptions refer to the headman under the designations 'gramika', 'gamabhojaka', and 'gamani', and to a committee under the name 'gotthi' or 'gotti' which corresponded to the village assembly.[1]

Cultivation of Land

Fields that are left unsown may be brought under cultivation by employing those who cultivate for half the share in the produce (*ardhasitika*);

[1]Gupta, K.N. *The Land System in South India*, p. 41-45

or those who live by their own physical exertion may cultivate such fields for $\frac{1}{4}$ or $\frac{1}{5}$ of the produce grown; or they may pay to the king as much as they can without entailing any hardship upon themselves with the exception of their own private lands that are difficult to cultivate.

Farmer's Land Revenue

The wasteland probably belonged to the Crown, but in the Arthashastra, Bk. II, ch. I, we find the injunction that the king shall not take away unprepared lands from those who are preparing them for cultivation. Proprietary right thus obviously lay with those who cultivated the land. The owner was, however, responsible to the king, if he failed to sow his land or if the crops were damaged due to his own neglect or that of his servants. This meant only an economic benefit both from the standpoint of the owner of the land and of the State; and it would certainly be a mistake to try to assert anything more than that the king had no proprietary right on land with this qualification that no land was allowed to lie fallow permanently, and that he was entitled only to a defined portion of the gross produce as tax. Manu allows $\frac{1}{12}$, $\frac{1}{8}$ or $\frac{1}{6}$ part.[2] It was usually one-sixth; but made variable up to one-twelfth to ensure against over-taxation. In the time of Chandra Gupta Maurya, the rate was one-fourth with an additional water rate of one-fourth.

Crop-sharing System of Cultivation

From the Mahavagga we learn that the Buddhist Sanghas sometimes cultivated lands belonging to private persons and used to get half of the produce as their share, or sometimes let out their own lands in lieu of half the produce. 'Of the paddy seedlings belonging to the Sangha, grown upon private ground, half the produce, O Bhikku, you may have, when you have given a part to the private owner. Of seedlings belonging to private persons grown upon the land of the Sangha, you may have the use, when you have given a part to the owner.'[3]

Payment to Workers

The *Arthashastra* enjoins that provisions shall be supplied to watchmen, gardeners, slaves and labourers, in proportion to the amount of work done by them.

'They shall be paid a pana and a quarter per mensem. Artisans shall

[2] VII, 130. Medhatithi, Kullukabhatta, Gobindaraga, Nandanacharya and Raghabananda—Commentators of Manu, are all unanimous that a sixth part of the harvest is the king's share. See also Gautama X, 24-27; Vasistha, XIX, 26-27; Baudhayana, 1, 18, I, 13, 15; Vishnu, II, 22-25, 29, 30; and Apastamba, II, 26, 9.

[3] Gupta, K.N. *The Land System in South India*, p. 199

be provided with wages and provision in proportion to the amount of work done by them.

Those that are learned in the Vedas and those that are engaged in making penance may take from the fields flowers and fruits for the purpose of worshipping their gods, and rice and barley for the purpose of performing *agrayana,* a sacrificial performance at the commencement of harvest season; also, those who live by gleaning grains in fields may gather grains where grains had been accumulated and removed from.'

Social Security

The king provided social security for the aged, infirm and minors, etc. The *Arthashastra* states,

'The king shall provide the orphans, the aged, the infirm, the afflicted, and the helpless with maintenance. He shall also provide subsistence to helpless women when they are pregnant and also to the children they give birth to.

Elders among the villagers shall improve the property of bereaved minors till the latter attain their age; so also the property of gods.

When a capable person other than an apostate or mother neglects to maintain his or her child, wife, mother, father, minor brothers, sisters, or widowed girls, he or she shall be punished with a fine of twelve panas.

When, without making provision for the maintenance of his wife and sons, any person embraces asceticism, he shall be punished with the first amercement; likewise any person who converts a woman to asceticism.

Whoever has passed the age of copulation may become an ascetic after distributing the properties of his own acquisition among his sons, otherwise he will be punished.'

Farmers not to be Disturbed

As the economy depended upon the work of the farmers, they were protected from intruders. Says the *Arthashastra:*

'No ascetic other than a *vanaprastha,* no company other than the one of local birth and no guilds of any kind other than local co-operative guilds shall find entrance into the villages of the kingdom. Nor shall there be in villages buildings intended for sports and plays. Nor, in view of procuring money, free labour, commodities, grains, and liquids in plenty, shall actors, dancers, singers, drummers, buffoons and bards make any disturbance to the work of the villagers; for helpless villagers are always dependent and bent upon their fields.'[1]

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[1]Shamasastry, R. *The Arthashastra of Kautilya,* pp. 45-48

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CHAPTER 24

AGRICULTURE IN THE MAURYAN AGE

322 B.C. — 232 B.C.

THE Greeks noticed in India two annual harvests—the winter and the summer ones—and the sign of an astonishing soil fertility. They knew that rice and millets were sown in summer, and wheat and barley in winter. Aristobulus described the cultivation of rice in enclosed sheets of water. They saw trees, which the generative power of the Indian soil endowed with a strange capacity of self-propagation—the branches curving to the ground to become themselves new trunks, till a single tree became a pillared tent, under whose roof of broad leaves a troop of horsemen could find shade from the noonday heat. The reference is obviously to the banyan-tree and its pillar-like aerial roots. Among the plants, two especially interested them. One was sugarcane, 'the reeds that make honey without the agency of bees'. Megasthenes seems to have attempted a scientific explanation of its sweet juice. It was due to the water which it absorbed from the soil being so warmed by the sun's heat that the plant was virtually cooked as it grew. The other plant was the cotton plant, yielding vegetable wool. Some of it the Macedonians used uncarded as stuffing for saddles and suchlike. Spices were also associated in the Greek mind with India.[1]

In the *Arthashastra,* we find a mention of the suitability of different lands for the cultivation of different crops, viz. lands that are beaten by foam, e.g. river banks, etc., are suitable for growing pumpkin, gourd and the like. Lands that are frequently flooded with water for long are suitable for pepper, grapes and sugarcane; those in the vicinity of wells for vegetables and root crops; moist beds of lakes, etc., for green crops; and the marginal furrows between any two rows of crops are suitable for the plantation of fragrant plants, medicinal herbs, *khus-khus* roots, and the like.

The *Arthashastra* mentions the following crops: Sali (a kind of rice), vrihi (rice), kodrava (*Paspalum scrobiculatum*), tila (sesamum), priyangu, daraka(?), and varaka (*Phaseolus trilobus*) are to be sown at the commencement of the rainy season.

Mudga (*Vigna mungo*), masha (*Vigna radiata*), and saibya (?) are to be sown in the middle of the season.

Kusumbha (safflower), masura (*Lens culinaris*), kuluttha (*Dolichos biflorus*), yava (barley), godhuma (wheat), kalaya (leguminous seeds), atasi

[1]Rapson, E.J. *The Cambridge History of India,* p. 363

(linseed), and sarshapa (mustard) are to be sown last.'[2]

IMPLEMENTS OF AGRICULTURE

Srni (sickle), *khanitra* (hoe), *musala* (pestle), *udukhala* (mortar), *surpa* (winnowing-basket), *dhanyakṛt* (winnowing-fan), *chalani* (sieve), *sthivi* (granary), *methi* (the post of the threshing-floor round which cattle turn to thresh out the grains), are mentioneed as tools of agriculture.

CYCLE OF FARMING OPERATIONS

In the Kullavagga, Mahanama the Sakyan, while telling Aniruddha what is incident to a household life, gives a short list of farming operations. "First you have to get your fields ploughed. When that is done, you have to get them sown. When that is done, you have to get the water led down over them. When that is done, you have to get the water let off again. When that is done, you have to get the weeds pulled up. When that is done, you have to get crops reaped. When that is done, you have to get the crop carried away. When that is done, you have to get it arranged in bundles; when that is done, you have to get it trodden out. When that is done, you have to get the straw picked out. When that is done, you have to get all the chaff removed. When that is done, you have to get it winnowed. When that is done, you have to get the harvest garnered. When that is done, you have to do just the same the next year and the same all over again the year after."

According to the Jatakas, the agriculturists sowed different kinds of grains, planted sugarcane, cotton, different kinds of vegetables, such as pumpkins, gourds and cucumbers. To scare away birds, they made use of scarecrows; and towards the harvest time, when crops stood thick in the fields, the peasant anxious to kill the creatures that devoured crops used to dig pitfalls, set traps, fix stakes and snares. At the sight of coming rains, they would hurry to the fields with spade and basket in hands to bank the dikes, and the women of the house make haste to carry indoors rice and crops that were spread in the sun to dry, lest the harvest should get wet. Jat. No. 140 mentions a female slave dozing in her watch over rice spread out in the sun to dry, and of a goat waiting for a chance to eat it.

When crops were ripe, the threshing-floor was made ready and *methi* (the post of the threshing-floor round which cattle turn and thresh out grains) was planted with care on an auspicious day. The harvest was then threshed, winnowed and garnered after setting aside the rice of the king's tax that was measured with grain basket.[3]

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[2]Shamasastry, R. *Kautilya's Arthashastra*, p. 128

[3]Gangopadhyay, R. *Some Materials for the Study of Agriculture and Agriculturists in Ancient India*, pp. 42, 65, 106, 107

Even at present the threshing of wheat in parts of Madhya Pradesh is being carried on in the same manner as in the Buddhist period. A number of bullocks are tied with a rope to a wooden post (*methi*) fixed in the centre of the threshing-floor. They go round and round and thresh out the grain (Fig. 170). After that, the threshed wheat straw and grain are thrown from a basket by a farmer standing on a wooden stool, and is assisted by his wife. The grain falls near the stool while the dust is blown away by the wind, and the *bhoosa* falls near the heap of grain (Fig.171).

The *Arthashastra* gives the following directions for the threshing of crops. 'Grains and other crops shall be collected as often as they are harvested. No wise man shall leave anything in the fields, not even chaff. Crops, when reaped, shall be heaped up in high piles or in the form of turrets. The piles of crops shall not be kept close, nor shall their tops be small or low. The threshing-floors of different fields shall be situated close to each other. Workmen in the fields shall always have water but no fire.'[4]

Growing of Crops

According to the *Arthashastra,* rice crops and the like are the best; vegetables are of intermediate nature; and sugarcane crops are the worst, very difficult to grow, for they are subject to various pests and require much care and expenditure to reap.

The seeds of grains are to be exposed to mist and heat for seven nights; the seeds of *kosi* are treated similarly for three nights; the cuttings of sugarcane and the like are plastered at the cut ends with the mixture of honey, clarified butter, the fat of hogs, and cowdung; the seeds of bulbous roots with honey and clarified butter; cotton seeds with cowdung; and water pits at the root of trees are to be burnt and manured with the bones and dung of cows on proper occasions.

The sprouts of seeds, when grown, are to be manured with a fresh haul of minute fishes and irrigated with the milk of *snuhi* (*Euphorbia antiquorum*).

Where there is the smoke caused by burning the essence of cotton seeds and the slough of a snake, there snakes will not stay.

Irrigation

The Kama Jataka speaks of a Brahmana clearing the jungle for cultivation and making little embanked squares for water. We also hear of the rivers being dammed for the purpose of irrigation. Says the Kunala Jataka, 'The Sakiya and the Koliya tribes had the river Rohini, which flows between the cities of Kapilavasthu and Kolia, confined by a single

[4]Shamasastry, R. *The Arthashastra of Kautilya*, pp. 128-131

dam, and by means of it cultivated their crops. In the month of Jetthamula when crops began to droop, the labourers from both the cities assembled. Then the Koliyans said, "Should this water be drawn off of both sides, it will not prove sufficient for both of us. But our crops will thrive with a single watering; give us then the water."[5]

Kautilya also refers to sluice-gates of tanks and enjoins that 'persons letting out the water of tanks at any other place than their sluice-gate shall pay a fine of six panas; and persons who obstruct the flow of water from the sluice-gate of tanks shall also pay the same fine.' It is further laid down that 'the water of a lower tank, excavated later on, shall not irrigate the field already irrigated by a higher tank and the natural flow of water from a higher to a lower tank shall not be stopped, unless the lower tank has ceased to be useful for three consecutive years.'

The Junagadh rock inscription of Rudradaman records that the Sudarshana lake was constructed by Pushyagupta, the provincial governor of Chandragupta Maurya; it was subsequently provided with conduits by the Yavana king Thushaspha for Asoka Maurya. It suffered a breach (420 cubits long and 75 cubits deep) in the second century of the Christian Era, owing to heavy flood in the rivers Suvarnarekha and Palasini. It was repaired by the Parthian *amatya* Suvisakha, who was the governor of Rudradaman, the Saka ruler of that time. In western India, the successors of Rudradaman continued the tradition of constructing tanks.

Irrigation Charges

The *Arthashastra* enjoins, "Those who irrigate land by manual labour shall pay $\frac{1}{5}$th of the produce as water rate (udakabhagam); by carrying water on shoulders, $\frac{1}{4}$th of the produce; by water lifts $\frac{1}{3}$rd of the produce; and by raising water from rivers, lakes, tanks, and wells, $\frac{1}{4}$th of the produce.

The Superintendent of Agriculture shall grow wet crops, winter crops or summer crops according to the supply of workmen and water."

Plant Diseases

In the Kallavagga, we find the Buddha pointing out that when the disease called 'mildew' falls upon a field of rice, that field of rice cannot last long; neither does a field of sugarcane continue long if the disease called 'blight' falls upon it.[6]

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[5]Gupta, K.N. *The Land System in South India*, pp. 216-217

[6]Gangopadhyay, R. *Some Materials for the Study of Agriculture and Agriculturists in Ancient India*, p. 73.

PERILS OF SNAKEBITES

'As at present, the farmers in India ran the risk of being bitten by snakes. Jat. No. 354 relates the story of a farmer's family consisting of man and wife, two children—a son and a daughter—a daugther-in-law and a maid-servant of the house. They lived happily together. One day, the farmer, along with his son, was ploughing a field. The son collected dry leaves scattered over the field and set fire to them. The smoke hurt the eyes of a snake who lived in a termite-hill close by. In a rage, the snake bit the farmer's son and he fell down dead.'

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CHAPTER 25

ANIMAL HUSBANDRY IN THE MAURYAN AGE

THE term animal husbandry is used here in a broader sense. Apart from cattle, buffaloes, sheep, and goats, it includes asses, horses, mules and elephants. Animal husbandry made great progress in the Mauryan age. As Sharma states, 'With its emphasis on non-violence and the sanctity of animal life Buddhism boosted the cattle wealth of the country. The earliest Buddhist text *Suttanipata* declares the cattle to be givers of food, beauty and happiness (*annada, vannada, sukhada*), and thus pleads for their protection.'[1]

SUPERINTENDENT OF COWS

There was a Superintendent of Cows, whose duty was to supervise herds of milch cattle as well as to look after the stored milk and *ghee*. He also supervised the work of cowherds, buffalo herdsmen, milkers, churners and hunters. He took care that calves were not starved and were given adequate milk.

The herds included equal numbers of milch cows, pregnant cows, aged cows, heifers and calves. There were special herds which included crippled cattle and cows difficult to milk.

The cattle and buffaloes were classified as calves, steers, tameable ones, draught oxen, bulls that are to be trained for the yoke, bulls kept for crossing cows, cattle that are fit only for the supply of flesh, buffaloes and draught buffaloes; female calves, steers, heifers, pregnant cows, milch cattle, barren cattle (either cows or buffaloes); calves that are month or two old as well as those which are still younger.[2]

The Superintendent of Cows branded them all, including their calves over two months old, and stray cattle which had remained unclaimed for two months. Then he registered them, also noting the natural marks, colour, and distance between the horns.

THE HERDSMAN

The cattle belonged severally to the residents of the village. After the crop was cut, the cattle were let loose and roamed over the fields. When the crops were growing they were sent under the charge of a herdsman, hired by the village collectively, to the grazing grounds. The herdsman was an important personage.

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[1]Sharma, R.S. *Ancient India*, p. 64

[2]Shamasastry, R. *Kautilya's Arthashastra*, p. 143

'Knowing the general appearance of each one of his charge and the marks upon it, skilled to remove flies' eggs from their hide, to heal sores, accustomed to keep a good fire going with smoke to keep the gnats away, knowing the fords and the drinking places, clever in choosing pasture, leaving some milk in the udders, and with respect for the leaders of the herd.'

The Cow

According to the *Arthashastra*, 'The killing of the cow was a deadly sin. All that kill, eat and permit the slaughter of the cow rot in hell for as many years as there were hairs on the body of the cow so slain.' The worship of the cow is one of the first among the daily duties prescribed for kings. Thus, 'during the eighth division of the night, i.e. the very early morning, he (the king) shall receive benedictions from sacrificial priests, teachers and the high priest and having seen his physician, chief cook and astrologer, and having saluted both a cow with her calf and a bull, by circumambulating round them, he shall get into his court.'

The Buffalo

In the Mauryan age, the buffalo had become a recognized dairy animal. Among the animals to be classified by the Superintendent of Cows, before forming them into herds, were buffaloes. The rations for buffaloes are mentioned, and the outturn of butter from buffaloe's milk is compared with that from cow's milk.

In a Sanchi sculpture, which illustrates a Jataka story, two buffaloes are depicted swimming in a pool in front of a hermitage. In the background are the circular huts of the rishis, which resemble the Navdatoli huts in their design (Fig.167).

The Goat

As a milch animal, the goat is mentioned in the *Arthashastra* and seems to have become fairly important also, as the outturn of butter from her milk has been considered worthy of being reckoned in comparison with that of the cow or the buffalo.

The Sheep

The sheep were shorn of their wool once in six months.

Bulls

In the *Arthashastra*, it is prescribed that breeding bulls should be provided for the herds at the rate of four for every ten animals, whether cows or buffaloes.

The bull capital at Rampurva in Tirhut depicts a vigorous zebu bull.

Fig. 172. An Aseel cock, a fighting breed of poultry, with large spurs. Deccani, late seventeenth century. Compare with the figure on obverse of silver coin of Sophytes (Fig. 169)
(Courtesy: Prince of Wales Museum of Western India, Bombay)

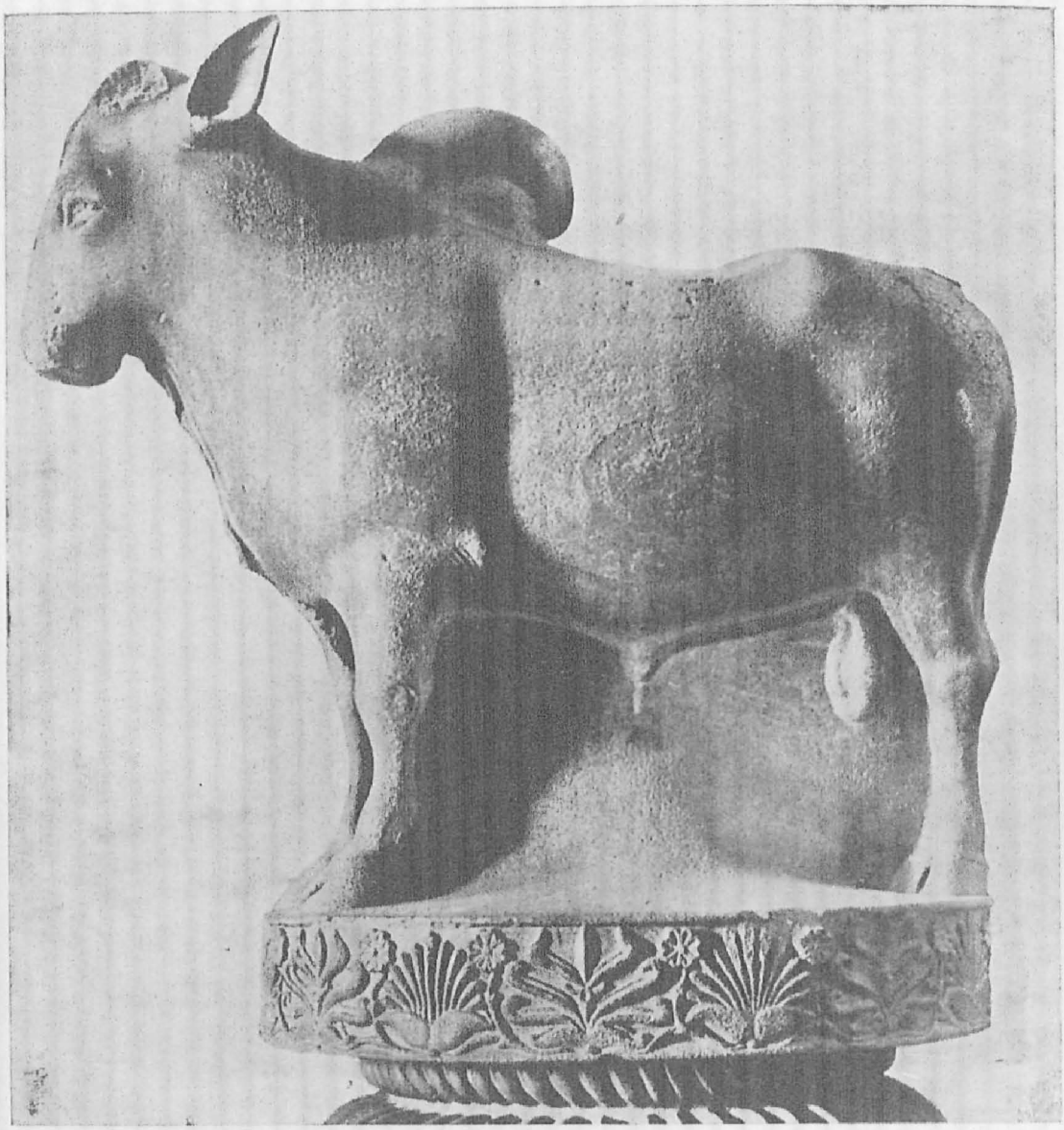
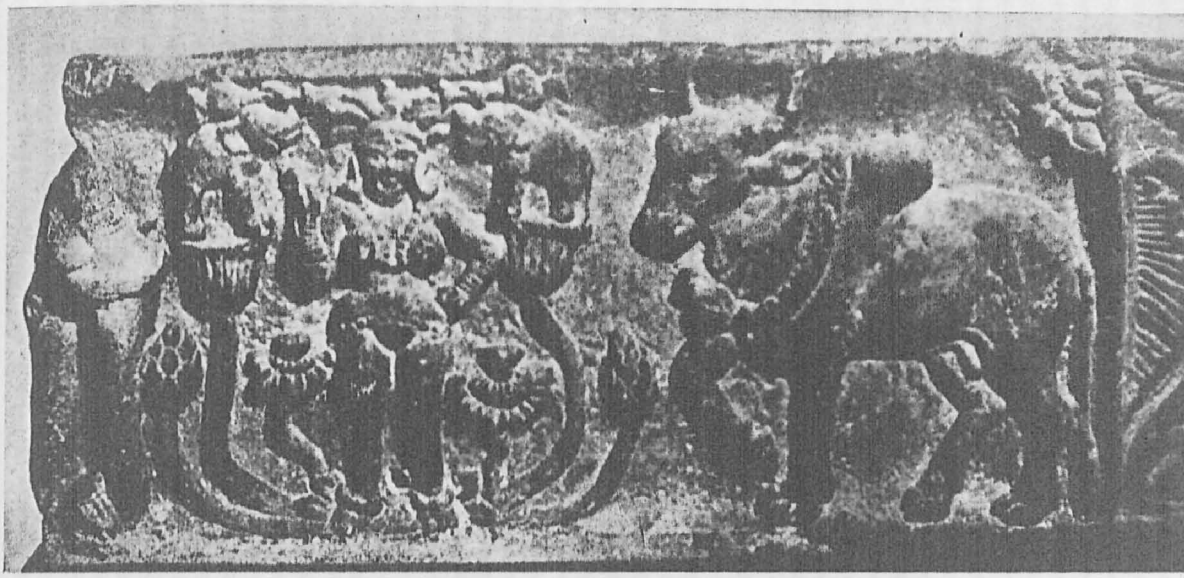


Fig. 173. Bull capital, Rampurva, Tirhut, Maurya, 240 B.C. Calcutta Museum. The bull represents the Hariana breed. It is symbolic of the importance of cattle in the economy of Mauryan India
(Courtesy: Archaeological Survey of India)



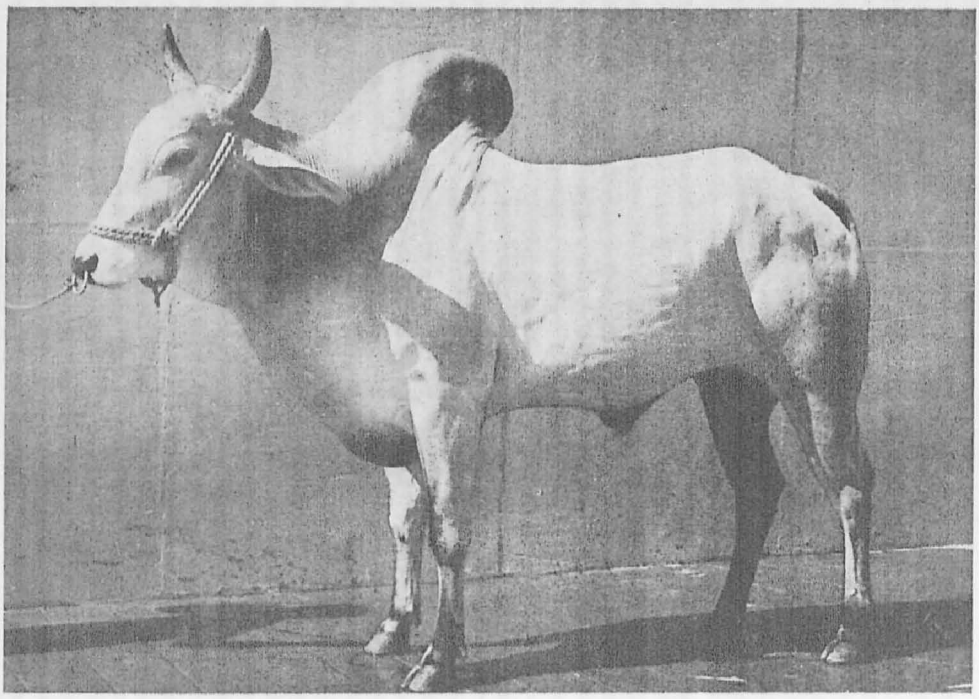


Fig. 174. *Top*, Fragment of a torana architrave showing Gajalakshmi and a Nagori bull, Kausambi, Allahabad District, Uttar Pradesh, first century B.C., Allahabad Museum *Bottom*, A Nagori bull
(Courtesy: Archaeological Survey of India)

Fig. 175. An illustration to a Jataka story. Keeping the pots hanging from the roof is a custom still followed in India. In front of the hut are two asses.
(Courtesy: Archaeological Survey of India)

It is symbolic of the importance of cattle in the economy of Mauryan India (Fig.173).

A fragment of a torana architrave from Kausambi (first century B.C.) shows Gajalakshmi and a bull. The Gajalakshmi is surrounded by lotuses and a pair of elephants. The bull, which is a symbol of male fertility, resembles the Nagori breed (Fig. 174).

Pastures

According to the *Arthashastra* it was enjoined upon kings that ample provision should be made for pastures by setting apart suitable land of sufficient extent, when forming villages. The *gopa* or village accountant was to note the boundaries of such pastures, number and register them. They were protected from thieves, tigers and other carnivores by hunters aided by their hounds. Herds were moved from one pasture to another according to the season.

Graziers

The cattle when out grazing were exposed to many dangers. They could get stuck in a quagmire or fall from a precipice. They might get drowned in a river or be struck by lightning. They might get devoured by tigers, or bitten by snakes, or dragged into water by crocodiles. They might also perish in a forest fire. It was the duty of the graziers to save them from such dangers.

The *Arthashastra* defines, among the duties of the graziers, caution in watering cows, "They shall allow their cattle to enter only into such rivers or lakes as are of equal depth all around, broad and free from mire and crocodiles". Cows should be guarded at home behind walled enclosures, if necessary, and protected when out grazing.

Graziers were enjoined to group their animals into tens of each kind, according to their colour, and take them out for grazing. They were also to attach bells to the necks of their cattle, so as to scare away snakes and tigers and as a means of knowing the whereabouts of the herds. All animals possessed brand marks, which were stamped on them at the musters.

There was capital punishment for stealing a cow or hurting one. The *Arthashastra* ordains, "Whoever hurts or causes another to hurt, or steals or causes another to steal a cow, should be slain.[3]

When a person caused a bull attached to a herd to fight with another bull, he was fined. If a bull got injured, that person was heavily fined. It is the usefulness which determines whether an animal is sacred or otherwise. Cattle had fully proved their usefulness in the Mauryan age by

[3]Shamasastry, R. *Kautilya's Arthashastra*, p. 144

the milk they provided to the people and their draught power in cultivation.

Feed and Fodder

The *Arthashastra* recognizes the difference between straw and grass and the two are separately specified in the feed to be given to cattle, as *yavasa* (meadow or green grass) and *trina* (ordinary dry straw).

The feeding of oilcake is a definite recommendation in the *Arthashastra.* Detailed rations are prescribed for cows, buffaloes, mules, camels, etc., severally. Thus:

'Bulls which are provided with nose strings and which equal horses in speed and carrying loads, are to be given half a *bhara* of meadow grass, twice the above quantity of ordinary grass (*trina*), one tula (100 palas) of oilcakes, ten adhikas of bran, five palas of salt, one kudumba of oil for rubbing over the nose, one prastha of drink (pana), one tula of flesh, one adhika of curds, one drona of barley or of cooked *urd* (*Vigna radiata*), one drona of milk; or half an adhika of sura (liquor), one prastha of oil or *ghee,* ten palas of sugar or jaggery. One pala of fruit of *sringibera* (ginger) may be substituted for milk. For cows, mules and asses, the diet was of the same commodities less by one quarter each. For buffaloes and camels it was twice the quantity. Buttermilk (*lassi*) was given as a drink to dogs and hogs. Moreover, all cattle were supplied with abundance of fodder and water. The quantity of the feed to be given was in proportion to the quantity of milk yielded by the cows or the duration of work in the case of bullocks.[4]

Milking and Milk

In the *Arthashastra,* graziers are directed to milk their animals twice a day in some seasons, viz. the rainy, autumn and the first part of winter, and only once a day, i.e. in the morning, during the whole of spring and summer. This was done because there was plenty of grass in the pastures in the rainy season and early winter, and in summer the pastures dried up.

The difference between the cow's milk and the buffalo's milk was well recognized in respect of their outturn of butter (fat content). 'One drona of cow's milk when churned will yield one prastha of butter; the same quantity of buffalo milk will yield one-seventh prastha more; and the same quantity of goats and sheep milk will produce one-half more,' states the *Arthashastra.*

Ghee

It was in the form of ghee that the butter-fat in the milk was largely made use of. *Ghee* was included even in the rations of cattle. Elephants

[4]Shamasastry, R. *Kautilya's Arthashastra*, p. 145

were given *ghee* as part of the ration at the rate of three prasthas per day, along with many other articles.

Ghee was the best form in which butter-fat could be preserved for long periods. This knowledge has been made use of not only in domestic life but also in storing supplies in forts against a siege. Huge stone cisterns were used as receptacles for storing *ghee.* Lumps of *gur* were placed as a preservative at the bottom of cisterns while storing *ghee* in them. This practice prevails even now in some rural families in India.[5]

The best *ghee* was made from butter which was melted the same day. This was the kind of *ghee* used by kings and wealthy people.

Asses

In the Mauryan age, asses were used as beasts of burden. In a Bharhut sculpture which illustrates a Jataka story two asses are shown in front of a cottage (Fig. 175).

Horses

Horses were used for riding and for war. In war, they were yoked to chariots. The chariots were of various types, viz. festal chariots, battle chariots, and travelling-chariots. Horses were also yoked to carriages.

The royal horses were under the charge of a Superintendent of Horses, who registered the breed, age, colour and their place of origin. The *Arthashastra* states, 'The breed of Kambhoja, Sindhu, Aratta, and Vanayu countries are the best; those of Bahlika, Papeya, Sauvira, and Taitala are of middle quality; and the rest ordinary.'

Steeds, stallions and colts were kept separately in the stables. As regards the construction of stables, the *Arthashastra* gives the following directions. 'The superintendent shall have a stable constructed as spacious as required by the number of horses to be kept therein, twice as broad as the length of a horse, with four doors facing the four quarters, with its central floor suited for the rolling of horses, with projected front provided with wooden seats at the entrance, and containing monkeys, peacocks, red spotted deer, mongoose, chakora, parrots, and myna birds; the room for every horse shall be four times as broad or long as the length of a horse, with its central floor paved with smoothened wooden planks, with separate compartments for fodder, with passages for the removal of urine and dung, and with a door facing either the north or the east.'

Horses were given regular training for warfare, viz. circular movement, slow movement, jumping, galloping, and several forms of riding.

Horses are also mentioned in the Jatakas.

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[5] Aiyer, A.K.Y.N. *Dairying in Ancient India*

'Sindh horses are milk-white and thorough-bred. They are white as lilies, swift as the wind and well trained. Thorough-bred horses are fed on parched rice, drippings, minced meat and grass and red rice-powder. Thorough-bred Sindh horses sheathed in mail were used for war purposes. The Valaha and Sindhu are the horses of superior breed.'[6]

Horse-dealers figure prominently among the Gandhara trades and we learn from the Vayupurana that the Gandhara horses were considered the best of all. Horse-dealers from northern districts used to bring horses to Benares for sale. Sindh horses were available in Benares and were used on ceremonials by the king.

Mules

Mules are mentioned in the *Arthashastra.*

Elephants

Magadha was the first State in India which used elephants on a large scale in warfare. For traversing jungles and marshy areas, elephants are very useful. Moreover, they had their use in storming fortresses and breaking open massive doors. According to Greek sources, the Nandas maintained 6,000 elephants and Chandragupta Maurya had 9,000 elephants. On account of its usefulness in warfare, the elephant was a protected animal, and special forests were reserved for it. The *Arthashastra* states, 'The victory of kings in battles depends mainly upon elephants; for elephants, being of large bodily frame, are capable not only to destroy the arrayed army of an enemy, his fortifications and encampments, but also to undertake works that are dangerous to life.'

War elephants and riding elephants were kept inside the fort, whereas those with bad temper were kept outside. Only twenty-year-old male elephants were captured. Female elephants and young elephants were not captured.

As regards the quality of elephants the *Arthashastra* states, 'Elephants bred in countries such as Kalinga, Anga, Karusa, and the East are the best; those of the Dasarna and western countries are of middle quality; and those of Saurashtra and Panchajana countries are of low quality. The might and energy of all can, however, be improved by suitable training.'

In the extreme limit of the country, elephant forests, separated from wild tracts, shall be formed.

The Superintendent of Elephant Forests with his retinue of forest guards shall not only maintain the forests, but also acquaint himself with all passages for entrance into, or exit from, such of them as are mountainous or boggy or contain rivers or lakes.

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[6]Gode, P.K. *Studies in Indian Cultural History*, Vol. I, p. 229

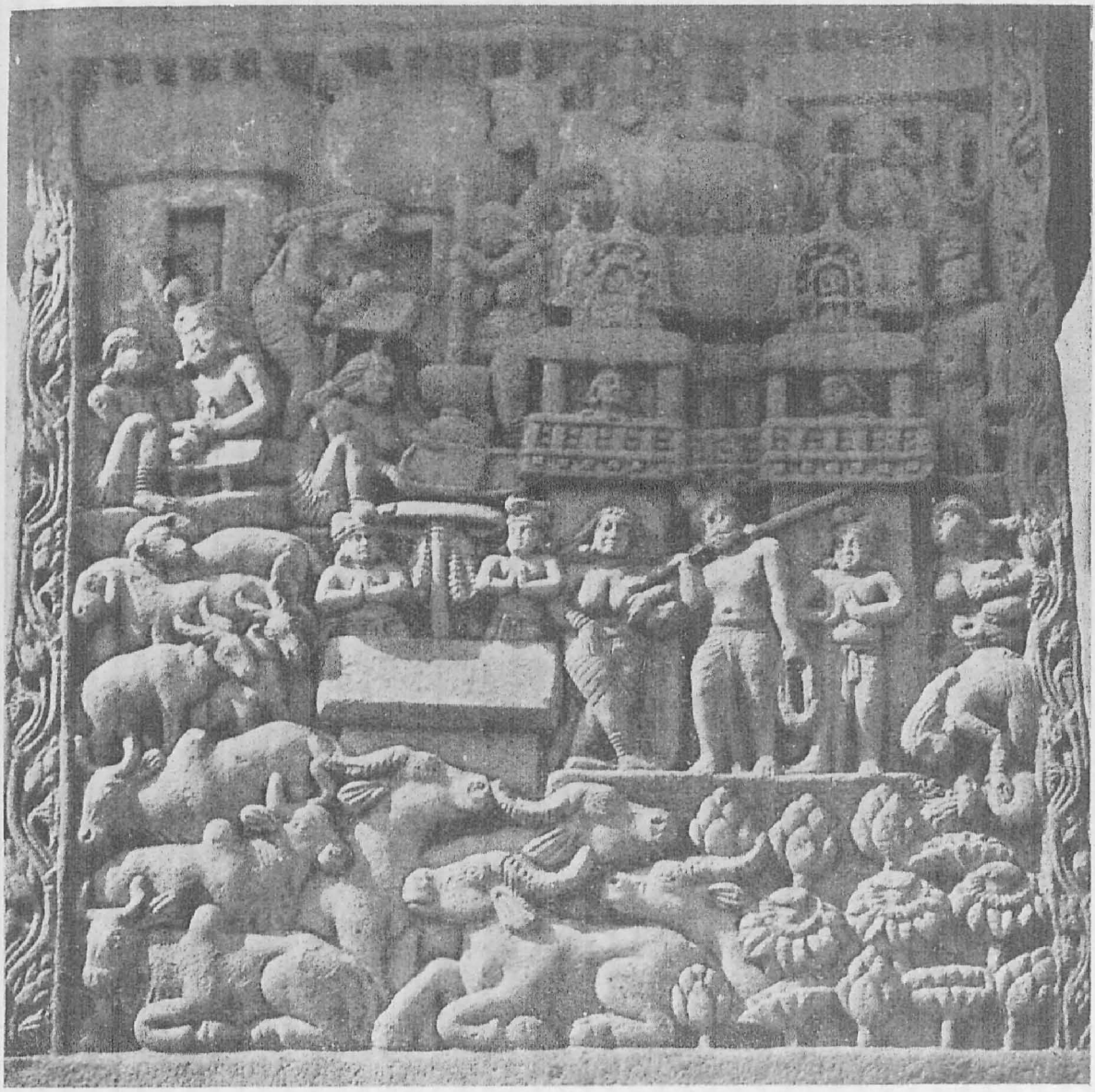

Fig. 176. Life in an Indian village in the Buddhist period, about 200 B.C. In the foreground are buffaloes, zebu bulls, goats and sheep. In front of the hut women are busy with domestic chores, such as grinding spices, dehusking paddy, and winnowing with a *chaaj*. Sanchi 200 B.C. (Courtesy: Archaeological Survey of India)

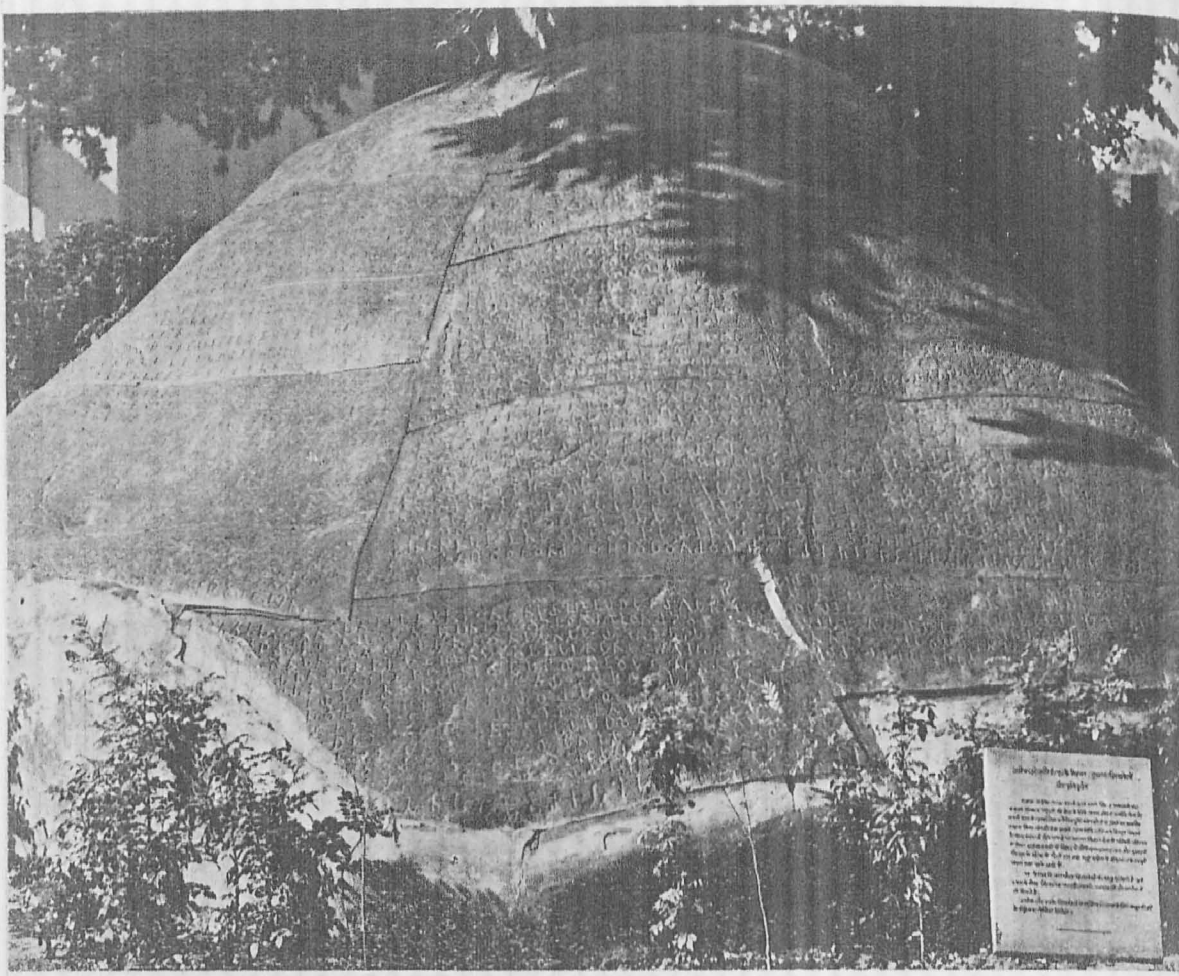

Fig. 177. A replica of the Girnar edict of Asoka, in front of the National Museum, New Delhi. In the edict Asoka states that he planted trees along roadsides
(Courtesy: National Museum, New Delhi)

Whoever kills an elephant shall be put to death.

Whoever brings in the pair of tusks of an elephant, dead from natural causes, shall receive a reward of four-and-a-half panas.

How elephants were captured is described as follows: 'Guards of elephant forests, assisted by those who rear elephants, those who enchain the legs of elephants, those who guard the boundaries, those who live in forests, as well as by those who nurse elephants, shall, with the help of five or seven female elephants to help in tethering wild ones, trace the whereabouts of herds of elephants by following the course of urine and dung left by elephants, and along forest tracts covered over with branches of Bhallataki (*Semecarpus anacardium*), and by observing the spots where elephants slept or sat before or left dung, or where they had just destroyed the banks of rivers or lakes. They shall also precisely ascertain whether any mark is due to the movements of elephants in herds, of an elephant roaming single, of a stray elephant, of a leader of herds, of a tusker, of a rogue elephant, of an elephant in rut, of a young elephant, or of an elephant that has escaped from the cage.

'Experts in catching elephants shall follow the instructions given to them by the elephant doctor (*anikastha*), and catch such elephants as are possessed of auspicious characteristics and good character.'

The captured elephants were given military training of seven kinds, viz. drill, turning, advancing, trampling down and killing, fighting with other elephants, attacking forts and cities and warfare. The elephants under training were provided with collars and were made to work in company with trained elephants.[7]

Veterinary Services

Veterinary service was considered essential to the community and veterinary doctors were assigned free endowments of land, in the same way as the village accountants, physicians and horse-trainers. Medicinal herbs were collected from places where they were growing naturally. They were also grown in fields like other crops.

Slaughterhouses were regulated by a Superintendent of Slaughterhouses. This arrangement afforded opportunities to the veterinarians to study and make observations on the internal organs of the animals.

During the reign of Asoka, veterinary hospitals were State institutions and were functioning all over the Empire. In a rock edict it is stated, "Everywhere in the dominions of His Majesty King Priyadarsi, and likewise in the neighbouring realms...everywhere on behalf of His Majesty have two kinds of hospitals been established, hospitals for men and hospitals for beasts. Healing herbs medicinal for man and medicinal

[7]Shamasastry, R. *The Arthashastra of Kautilya*, pp. 49, 151, 153

for beasts, wherever they were lacking, have been imported and planted..." Thus it is evident that provision was made for the care and treatment of sick cattle, horses and elephants.

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CHAPTER 26

ASOKA PROMOTES ARBORICULTURE AND HORTICULTURE

274 B.C. — 237 B.C.

ASOKA succeeded Bindusara on the Mauryan throne in about 274 B.C. During the early part of his reign, he conquered Kalinga (Orissa) and Ganjam. In this war the Kalingas suffered heavy casualties and 150,000 were taken prisoners. Asoka had a feeling of remorse when he saw the horrors of war, and the slaughter of men in thousands. After the Kalinga war, he became a Buddhist and abjured violence.

The extent of Asoka's empire can be judged from his rock and pillar edicts. The Kandahar rock edict has an inscription in Greek and Aramaic which shows that among his subjects were Greeks as well as Iranians. There are rock edicts at Mansehra and Shahbazgarhi in the North-West Frontier Province (Pakistan). Along the western coast are edicts at Girnar, Junagadh and Sopara. There is a replica of rock edict of Girnar placed in front of the building of the National Museum, New Delhi (Fig. 177). In the south are rock edicts at Siddapura and Maski. In the east are the rock edicts at Dhauli and Jaugada (Fig. 178).

In his sixth major rock edict, Asoka says: 'I have now arranged it thus. At all times—whether I am eating, or am in the women's apartments, or in my inner apartments, or at the cattle-shed, or in my carriage, or in my gardens—wherever I may be, my informants should keep me in touch with public business'.[1] This edict indicates his interest in animal husbandry and gardens. Asoka also prohibited the burning of forests for driving out game.

Asoka actively promoted arboriculture and horticulture. This was partly due to reasons of religion. The worship of the *bodhi*-tree was specially enjoined by Sakya Muni himself, who directed Ananda to obtain a branch of the tree under which he had obtained Buddhahood, and to plant it in the court of the Vihara at Sravasti, adding, 'He who worships it will receive the same reward as if he worshipped me in person.' Such being the recorded origin of the reverence paid to the *pipal*-tree of the last Buddha Sakya Sinha, it is not surprising that tree worship was generally popular. In the Divya Avadana it is related that the *Bodhi*-tree was the favourite object of Asoka's worship.

For the first time in Indian history we hear of a monarch who encouraged arboriculture and adopted it as a State policy. Asoka encouraged the

[1]Sastri, K.A. Nilakanta and Srinivasachari, G., *Advanced History of India*, p. 102

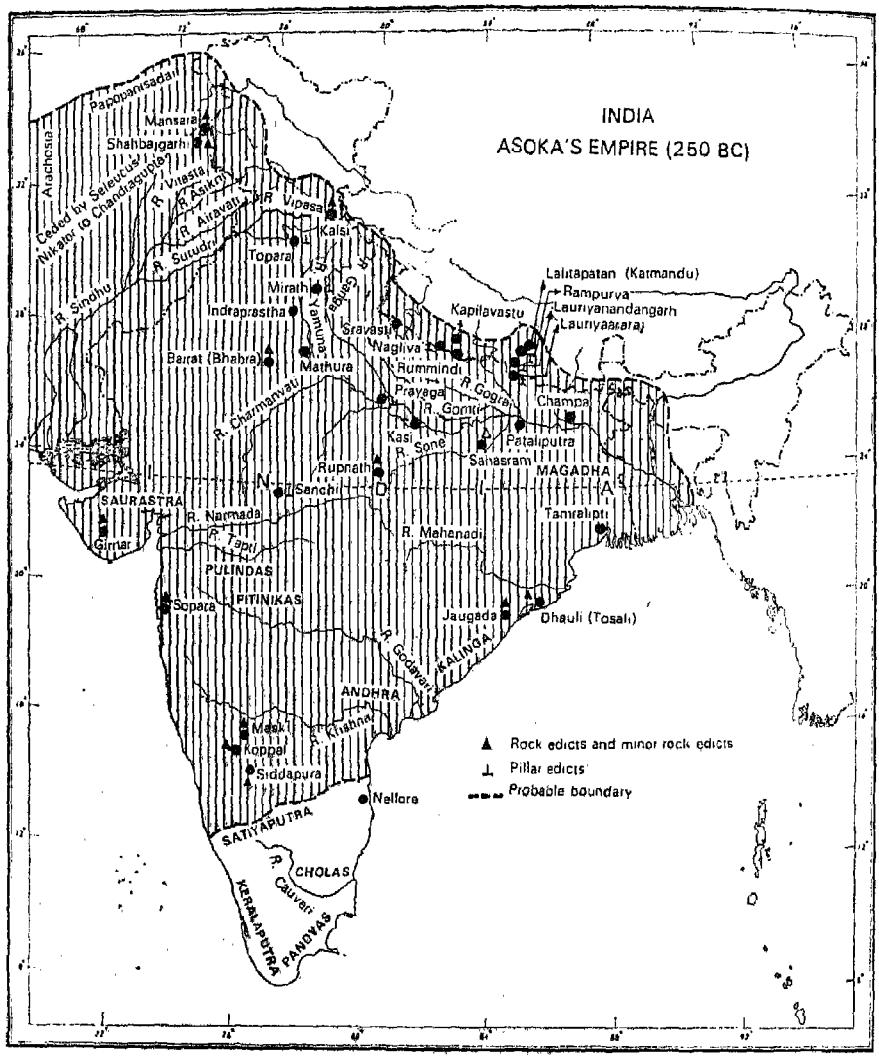

Fig. 178. A map showing Asoka's Empire, 250 B.C.

planting of trees in gardens and along roads in the form of avenues. Rest-houses were made; many watering-stations also were made for the comfort of cattle and men. One of the Asoka pillars bears the following inscription: 'On the roads I have had banyan trees planted, which will give shade to beasts and men. I have had mango groves planted and have had wells dug

and rest houses built every nine miles....And I have had many watering places made everywhere for the use of beasts and men. But this benefit is important, and indeed the world has enjoyed attention in many ways from former kings as well from me. But I have done these things in order that my people might conform to Dhamma.'[2]

In Chapter XXXIV of the *Arthashastra* mention is made of a Superintendent of Pasture Lands. He supervised the construction of tanks, wells, buildings for shelter and flower gardens and fruit gardens. There is every likelihood that this type of administrative arrangement for planting gardens continued under Asoka.

Sanchi provides us with a glimpse of arboriculture in the reign of Asoka. Sanchi is about eight kilometres from Bhilsa, the modern successor of the ancient town of Vidisa. Vidisa was the junction of two great trade routes, one of which ran west to east from the busy sea-ports of the western coast of India through Ujjain, Kausambi and Benares to Pataliputra and the other south to north-west from Pratisthana, the Andhra capital, to Sravasti. Vidisa was the home of Devi, the wife of Asoka. Sanchi became an important Buddhist centre in the third century B.C. The famous stupa in which the remains of the Buddha were enshrined was built by Asoka in 225 B.C.

As Sir John Marshall remarks: "Asoka himself founded the Sangharama and built this stupa where not only because Vidisa was one of the greatest cities of his empire, but because he wished to honour it as the birth-place of the beautiful Devi and a spot invested with specially happy memories for himself."[3] The stupa was made of bricks, and about the middle of the second century B.C., during the reign of Sunga king Agnimitra, it was encased in stone and the procession path was paved with stones. The stupa was surrounded by a balustrade which reminds one of the wooden palisades and enclosures. The balustrade was pierced by four gate-ways or *toranas*, which are richly carved. The *toranas* of *stupa* numbers 1 and 3, which are covered with sculpture reliefs, showing the Buddha's life and previous incarnations, were added in the Andhra period from 72 to 25 B.C. The stones of the procession path, balustrade, and the gateways are gifts from devotees whose names are written in Brahmi characters. Each gateway is composed of two square pillars surmounted by capitals supported by a structure of three architraves with volute ends.

Fruit-Plants

A number of fruit-plants are shown in sculptures from Bharhut. They include plantain (*Musa paradisiaca*), mango (*Mangifera indica*), jack-fruit (*Artocarpus heterophyllus*) and grapevines (Fig. 179). Mango seems to be the favourite fruit and, apart from trees, the fruit-bearing branches are

[2]Thapar, R. *A History of India*, p. 88
[3]Marshall, *The Monuments of Sanchi*

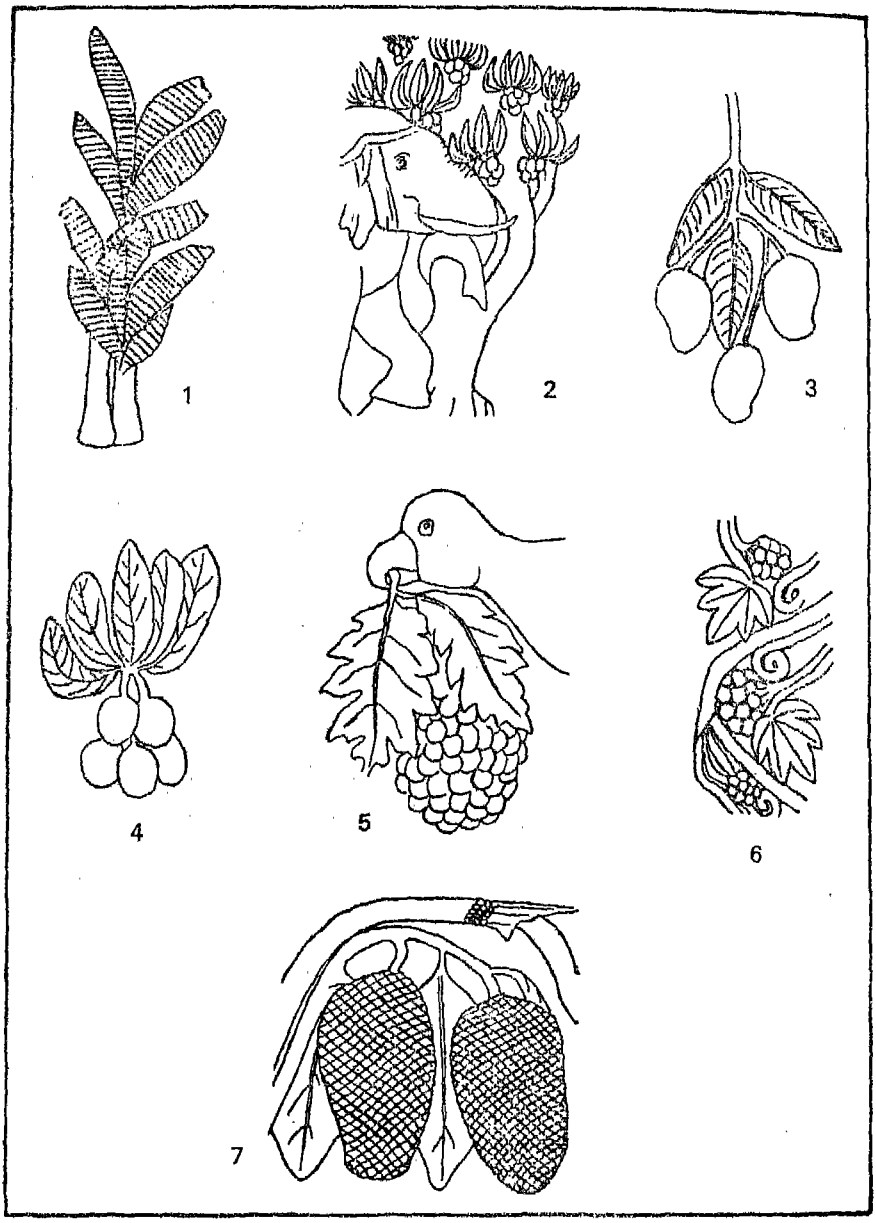

Fig. 179. Fruit-plants shown in sculptures from Bharhut, second century B.C. and Sanchi, first century B.C. 1, Plantain (*Musa paradisiaca*), Sanchi; 2, Mango (*Mangifera indica*), Sanchi; 3, Mango bunch with leaves, Sanchi; 4, Mango fruits and leaves, Bharhut; 5, A parrot carrying a bunch of grapes (*Vitis vinifera*), Sanchi; 6, A grapevine bearing bunches, Bharhut; 7, Jackfruit (*Artocarpus heterophyllus*), Bharhut
(After R.V. Sitholey)

also depicted both at Bharhut and Sanchi. The Yakshi standing under a fruiting mango-tree which decorates a gateway to Stupa I at Sanchi is a masterpiece of Indian sculpture (Fig. 181). 'Swaying gracefully from a branch of a mango-tree, the *vrikshaka* is singularly beautiful', says Marshall. 'Holding with both hands to the arching bough of a mango-tree, the *salabhanjika* "curves the woodbine of her body" in an attitude which brings out her breasts "like urns of gold". Her locks spread out over her back and are brought up on the crown of her head into a curious top-knot, which may be compared to the coiffure of the female servants and jungle-dwellers. Her transparent *dhoti* is only betrayed by the pleated folds falling at the sides and drawn up at the back between the legs. Her big earrings are broken, but the bangles, which load her forearms almost up to the elbow and her legs almost to the knees and her bead necklace and her girdle of trinkets lend themselves to detailed study. The type presents a pleasing compromise between the court lady and the woman of the woods.'[4]

The mango (*Mangifera indica*) frequently occurs among the sculptures of Bharhut. In the relief showing presentation of the Jetavana monastery, a mango-tree is shown. According to the Buddhist legend, the Buddha, when he was living in Magadha, received a visit from Anathapindaka, a rich merchant, who offered the Park of Jetavana to him. It had limpid pools, luxuriant verdure and countless flowers. In this park, the Buddha gave discourses to the people.

Grapes (*Vitis vinifera*) are also depicted both in Sanchi and Bharhut. In a sculpture from Sanchi, a parrot is shown carrying a bunch of grapes in its beak (Fig. 179). On a fragment of a railing post from Bharhut, now in the Allahabad Museum, a grapevine is carved, and both the leaves and bunches of grapes are shown (Fig.182). The grapevine was growing wild in Kashmir, North-West Frontier Province and northern Punjab (Vavilov, 1949-50).

Palms

Different types of palms are depicted in Bharhut and Sanchi. Palmyra palm (*Borassus flabellifer*) is shown on a medallion from Bharhut. It is a common tree in southern and eastern India, and the accuracy with which it is carved shows that the sculptors were acquainted with it. Wild date-palm (*Phoenix sylvestris*) is shown in a Sanchi sculpture. A palm, with a man standing below, is depicted at Besnagar (Fig. 180).

Buddhism spread rapidly in India under the patronage of Asoka. In due course, it reached Ceylon, Burma, Thailand, Sumatra, Java, Viet Nam, China, Korea, Japan, Central Asia, Mongolia and Afghanistan. It had a humanizing influence on the barbarous tribes in Afghanistan, Central Asia

[4]Marshall and Foucher, *The Monuments of Sanchi*, p. 44

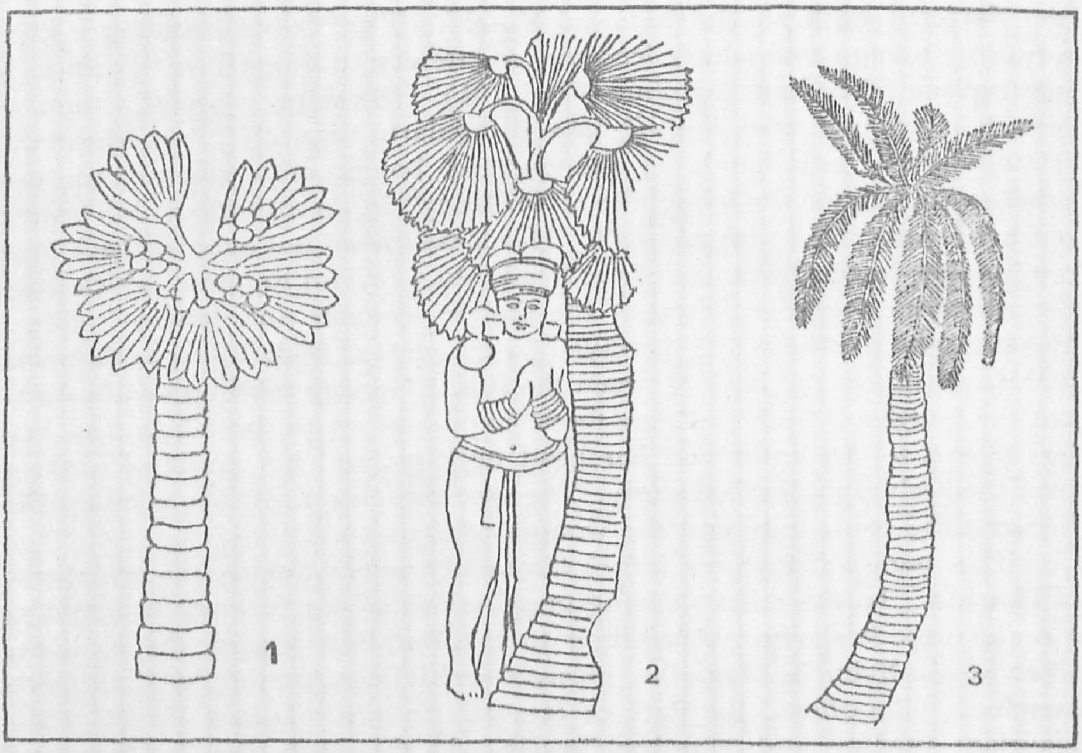

Fig. 180. Palms depicted in Buddhist sculptures. 1, Palmyra-palm (*Borassus flabellifer*), Bharhut, second century B.C.; 2, A palm, with a man standing below, Besnagar; 3, Wild date-palm (*Phoenix sylvestris*), Sanchi
(After R.V. Sitholey)

and Mongolia. It gave them a new philosophy of life and developed their moral character. It inspired the great art of Ajanta, whose influence reached Khotan in Central Asia, and Tun Huang in China. It inspired the world's greatest monument at Borobudur in Java, which is still admired for its noble sculpture. Above all, it propagated agriculture and love for trees and gardens.

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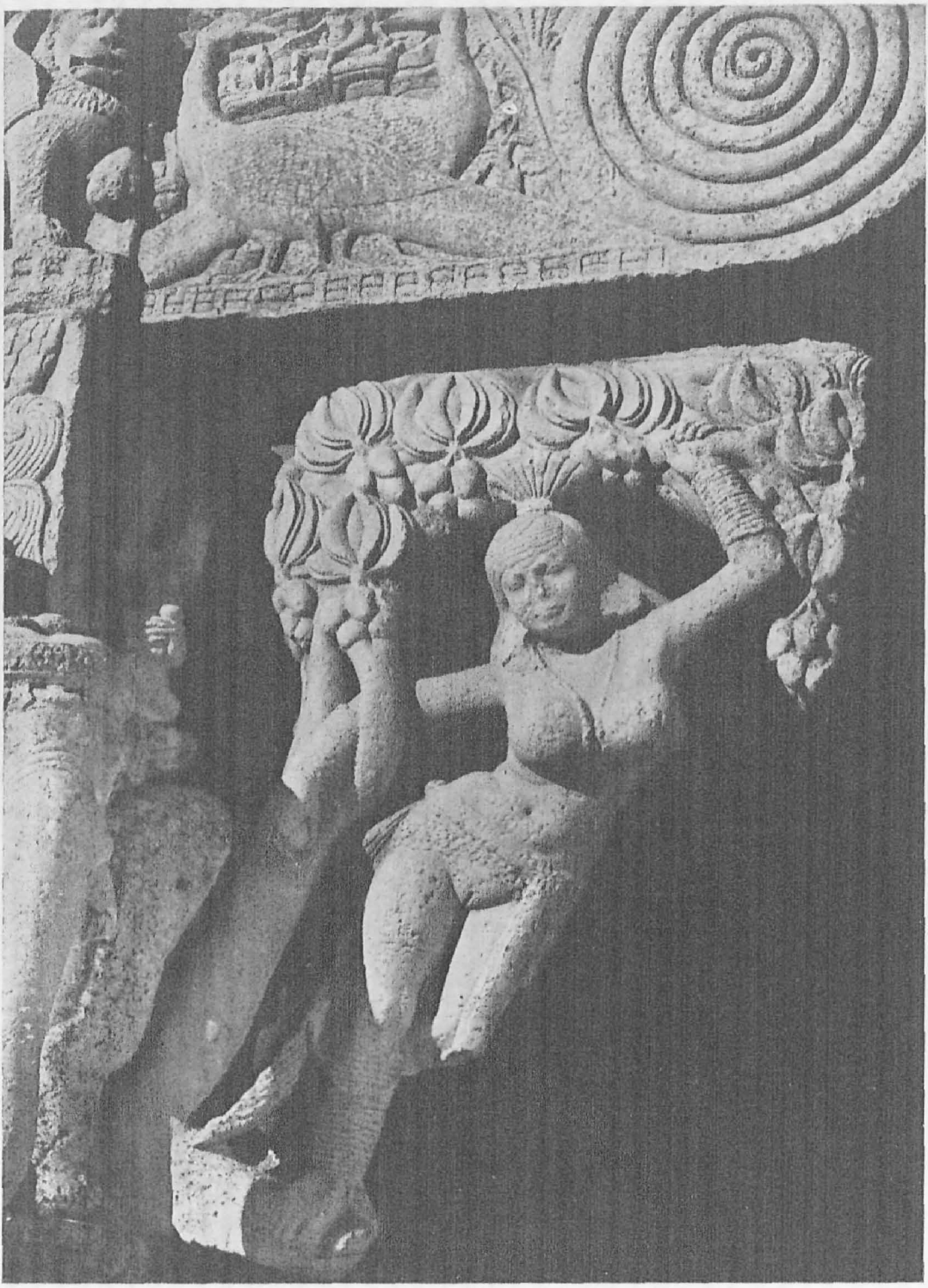

Fig. 181. A Yakshi under a mango-tree. Stupa I, Sanchi, first century B.C.
(Courtesy: Archaeological Survery of India)

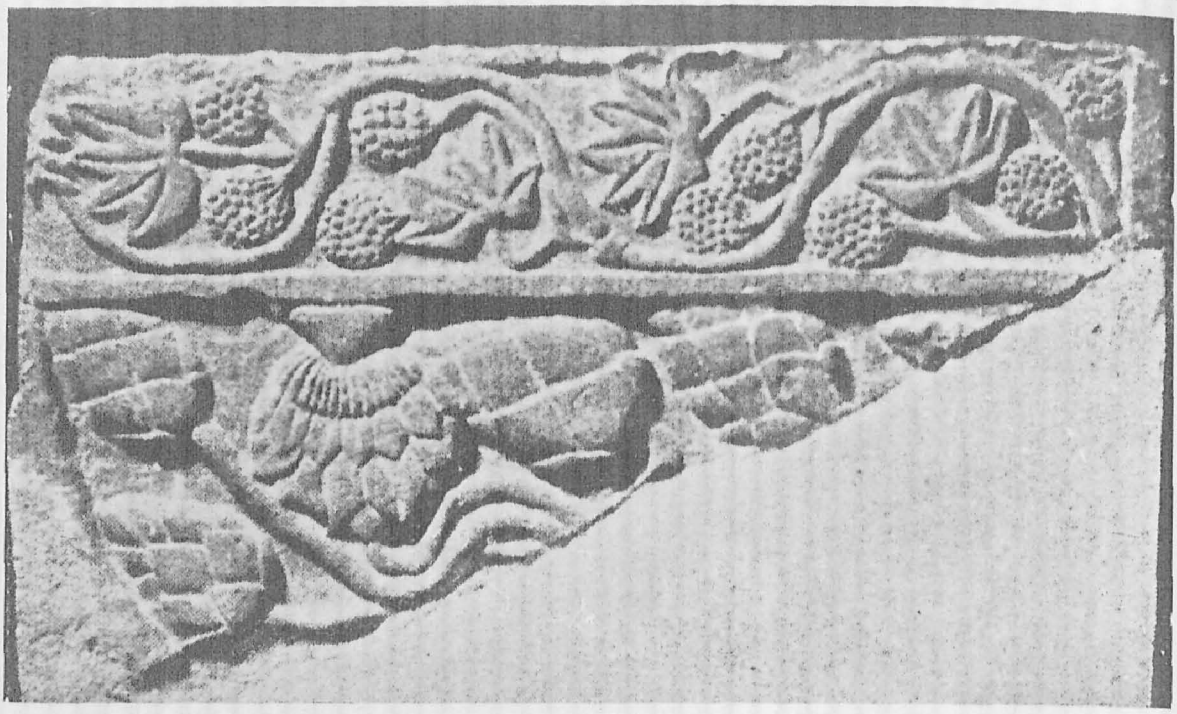

Fig. 182. A grapevine carved on a fragment of a railing post, Bharhut, Satna District, Madhya Pradesh, second century B.C.
(Courtesy: Allahabad Museum)

CHAPTER 27

FROM SUNGAS TO THE ŚĀTAVĀHANĀS AND KUSHANS

200 B.C. — A.D. 300

BRICK-WELLS AND IMPROVED AGRICULTURAL IMPLEMENTS OF IRON CULTIVATION OF RICE AND COCONUT PALMS

Asoka died in 232 B.C. and was followed by a number of weak successors. After the Mauryans, the Sungas ruled India. The Sunga Dynasty was founded by Pushyamitra, the Commander-in-Chief of the last Maurya ruler Brihadratha. He moved the capital from Pataliputra to Malwa. Kalinga became independent under Kharavela who invaded Magadha and captured Pataliputra. The Andhras (the Śātavāhanās) occupied the north of the peninsula. The southern half of the peninsula was ruled by the Cholas, Pandyas and Cheras. Northern India was ruled by the Indo-Greek kings.

The Sungas ruled from 184 B.C. to 72 B.C. The last Sunga ruler was Devabhuti. He was assassinated by Vasudeva, his minister, who founded the Kanva Dynasty. There were four Kanva kings who ruled from 72 B.C. to 27 B.C. Susarman, the last Kanva ruler, was overthrown by the Andhras.

When the Sunga power waned, the Kshatriya tribes of the Punjab, Haryana and northern Rajasthan who were living between the Ravi and the Jumna became independent and set up Republics. Panini describes them as professional warriors. Of these, Yaudheyas inhabited the country between the Sutlej and the Jumna, and the Arjunayanas lived south-west of Mathura. These tribes were the ancestors of the Rajputs.

Indo-Greeks—Coinage and Sculpture

In 250 B.C., Diodotus, the governor of the Greek colony of Bactria, set himself as an independent ruler. In 190 B.C., Demetrius invaded north-western India and conquered Taxila. In 175 B.C., Eucratides, the ruler of Bactria, defeated Demetrius and conquered the Punjab. He laid the foundation of the City of Sirkap near Taxila. The greatest of the Indo-Greek kings of the Punjab was Menander (180 B.C.-160 B.C.), who became a Buddhist. His capital was at Sagala, the present-day Sialkot. The Pali work *Milindapanha* (Questions of Milinda) is in the form of a dialogue between Milinda (Menander) and the Buddhist monk Nagasena (Nagarjuna), in which problems of the Buddhist religion are discussed. The dominion of Menander comprised the central parts of Afghanistan, North-West Frontier Province, the Punjab, Sind, Rajasthan and Kathiawar and probably western Uttar Pradesh. Coins of Menander are found in large numbers from Afghanistan to the western districts of Uttar Pradesh.

Menander died in 130 B.C., mourned by the masses, and many cities desired to get a share of his ashes.

It is the Bactrian Greeks who first introduced coins with names and portraits of the rulers. The figure of the king on the obverse and of a deity or other symbols on the reverse are executed with a high degree of artistic skill. The credit for injecting art into the coinage of India goes to these Greek rulers. Their coins are infinitely superior in design to the punch-marked coins which existed in India in the Mauryan peroid. The foreign hordes who invaded India, and the Indian rulers adopted the system and issued coins of similar type, though the execution is inferior.[1]

The Indo-Greeks also encouraged sculpture. The northern region called Gandhara, comprised Afghanistan, North-West Frontier Province and the Potwar plateau of the Punjab. Through the medium of sculpture, the chief events of the life of the Buddha were depicted by the sculptors. The Gandhara sculpture is Graeco-Roman in style, and it derived its inspiration from Buddhism. Financial support for the construction of stupas and monasteries was provided by wealthy merchants, and they also commissioned sculptors for carving statues of the Buddha and Bodhisattvas. A number of stupas and monasteries dot the hillsides of Peshawar, Swat, and the Kabul Valley. The sculptors adapted the 'face of Apollo' to represent the Buddha. Later on, about the second century of the Christian Era, the real Indian Buddha image evolved at Mathura. The Indian sculptors of Mathura and Amaravati, however, adopted Graeco-Roman drapery from the Gandhara sculpture for their statues of the Buddha. Thus the Buddha image is the product of a true cultural fusion between two streams of art, viz. Indian and Graeco-Roman.

THE ŚĀTAVĀHAN S (ANDHRAS) : THE FIRST CENTURY B.C. TO THE SECOND CENTURY OF THE CHRISTIAN ERA

During the first century B.C. to the second century of the Christian Era, when northern India was ruled by the Indo-Greeks, followed by the Kushans, the Deccan was ruled by the Brahman Dynasty of Śātavāhanās (Andhras). The coins and inscriptions of the Śātavāhanās are concentrated in the region around Paithan in the Aurangabad District of Maharashtra. Gradually, the Śātavāhanās extended their power over Karnataka and Andhra.

The first Śātovāhanās ruler was Simuka. The third ruler Satakarni I conquered western Malwa. Satakarni II conquered eastern Malwa from the Sungas. The seventh king Hala (A.D. 20-24) is remembered as the author of the *Sattasai*. Gautamiputra Satakarni (A.D. 80-104) extended the empire to western Rajasthan and Vidarbha. Sri Yajna Satakarni

[1]Majumdar, R.C. *Ancient India*, p. 119

Fig. 183. Coins and seals with animal and bird motifs from the second century to the tenth century : *Top row*, *left*; Vasudeva, Kushan, gold, second century ; *right*, Chandragupta I, Gupta, gold, fourth century; *Second row*; *left*, Kumaragupta I, Gupta, peacock type, gold, fifth century; *centre*, a bull, seal, fourth century, Sanghol, Punjab; *right*, Samudragupta, Gupta, gold, fourth century; *Third row*, *left*, a bull, seal, Gupta period, fifth century, Sanghol; *right*, an elephant trampling a lion, seal, Gupta, sixth century; *Bottom row*, *left*, Sashanka, King of Gauda (central Bengal), gold, seventh century; *right*, a horse and a bull, Shahi dynasty, Kabul, tenth century
(Courtesy: National Museum, New Delhi, and Department of Archaeology, Punjab Government)

Fig. 184. A man and a woman feeding a parrot. Below is a blossoming asoka (*Saraca asoca*). Kushan, first century
(Courtesy: Mathura Museum)

(A.D. 165-194) defeated the Sakas and recovered much of the lost territory.

Agriculture

Though iron hoes are known from the third century B.C. in South India, their number increased substantially in the first and second centuries of the Christian Era. This increased number indicates greater agricultural activity. The people of the Deccan cultivated cotton, and Andhra was known for its cotton cloth. According to R.S. Sharma, the art of transplanting rice seedlings was widely practised in the first two centuries in the deltas of the Krishna and the Godavari, which became the rice bowl of South India.[2] Through contact with the north, the Deccanis learnt the use of bricks and ringwells.

Brahmins as Pioneers of Progressive Agriculture

The Śātavāhanās were the first rulers to make land grants to the Brahmins. Owing to their knowledge of astrology and ability to forecast rain, the Brahmins enjoyed respect among the rural people. Besides, they were the educated class of that age, and also pioneers of culture and progressive agriculture in the South. Kosambi states, 'The brahmins acted as pioneers in undeveloped localities; they first brought plough agriculture to replace slash-and-burn cultivation, or food-gathering. New crops, knowledge of distant markets, organisation of village settlements and trade also came with them. As a result, kings or kings-to-be invited brahmins, generally from the distant Gangetic basin, to settle in un-opened localities. Almost all extant copper plates (which have been discovered all over the country by the ton) are charters which—from the fourth century onwards—record land-grants to brahmins unconnected with any temple. In addition, every village would set apart a lot or two of land plus a fixed though small share of village harvests for the cults and priests, brahmin or not. Brahmins, however, claimed and generally received exemption from all taxes; they even claimed a specially low rate of interest on loans, and other privileges.'[3]

Here a reference to the Saka sataraps of western India is necessary. The greatest of them was Nahapana. He ruled over Gujarat, Kathiawar, and northern Maharashtra. His capital was Minnagara, which has been identified as Dohad, half-way between Ujjain and Broach. About A.D. 100 Nahapana was defeated by Gautamiputra Satkarni.

Coconut Cultivation on the West Coast

The coconut (*Cocos nucifera*) is the most useful of the tropical palms.

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[2]Sharma, R.S. *Ancient India*, p. 109

[3]Kosambi, D.D. *The Culture and Civilization of Ancient India in Historical Outline*, p. 172

The nuts give copra, oil, oilcake and fibre. Its juice is converted into vinegar and toddy. Trunks of mature trees are used as timber for constructing houses, and matted leaves as thatch for roofs. According to Harlan[4] the coconut palm is a plant of the South Pacific Islands. The largest production of coconuts in the world is in the Philippines, with 3,997 million nuts from nearly a million hectares (1958). India follows, with a production of 3,540 million nuts from 0.6 million hectares (1958). Kerala is the largest producer of coconuts in India, followed by Tamil Nadu and Karnataka.

'The real cause of development of the west coast was the coconut', states Kosambi. 'Coconut tree, which forms the basis of the whole coastal economy today, seems to be an import from Malaysia. It was being propagated on the east coast about the middle of the first century B.C. and reached the west coast a century later. By A.D. 120 the Saka Ushavadata, son of Dinika and son-in-law of the reigning king Nahapana, began to give away whole plantations to brahmins, each one containing several thousand coconut trees. Ushavadata was generous to the Buddhists as well, but there were no cave monasteries on the coast within his reach. The coconut, now to be found in every Indian ceremony and ritual, was rather poorly known in many parts of India before the sixth century A.D. This provides a useful comment upon 'timeless and immutable' Indian customs. The wood, fibre, wine, and other products of this tree are also of the utmost value; the nut itself provides 'meat' for cooking and when dried an excellent food oil, used also for soap-making. The western coastal strip (where the coconut can grow well because of heavy rainfall and hot climate) could not have been profitably cleared of its dense forest, let alone settled with its present crowded population, without this tree and the heavy commodity production based upon its exploitation in full. The trade up the few passes of the sheer Deccan scarp gave a longer lease of life to caravans; they took salt and coconuts up to the plateau to exchange for cloth and metal vessels, as well as for the grain of the uplands'.[5]

Kushans

The close of the second century B.C. was a period of great turmoil in central Asia. On account of a severe drought, the tribes were fighting for their survival and there was a keen competition for the possession of pasture-lands. In such a struggle, a tribe known as the Yueh-Chi was pushed out by the Hiung-nu tribe. They, in their turn, pushed out the Sakas from Bactria where they settled.

Kushan was the name of one of the five Yueh-Chi subtribes. About A.D. 40 arose a leader among the Kushans, Kadphises I, who conquered the Kabul Valley and all the area west of the Indus. His successor Kadphises II

[4]Harlan, J.R. *Crops and Man*, p. 75

[5]Kosambi, D.D. *The Culture and Civilization of Ancient India in Historical Outline*, p. 189

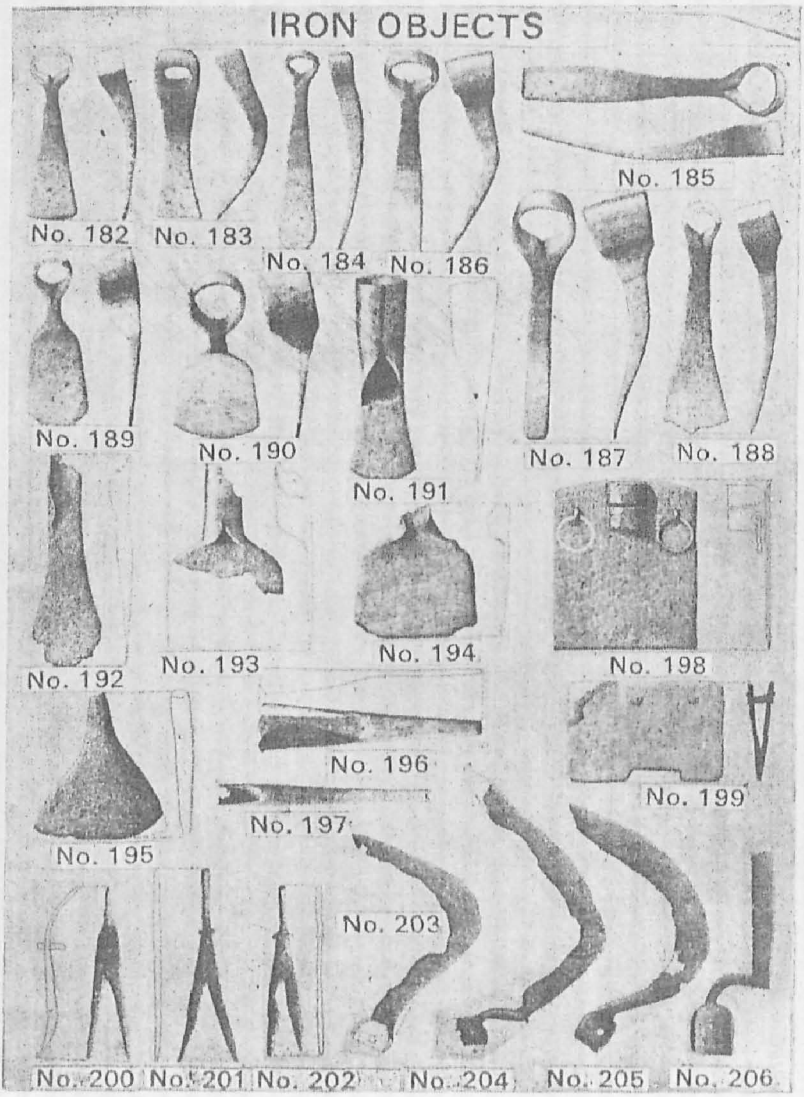

Fig. 185. Iron agricultural implements excavated from the Bhir mound, Taxila, 300 B.C. to A.D. 100; 182-190 are hoes with chisel-like blades; 191-197 are spuds with broad blades like that of *khurpa*; 198, a true spade; 200-202 are weeding-forks; 203-206 are sickles (From *Taxila*, Vol.III, by Sir John Marshall)

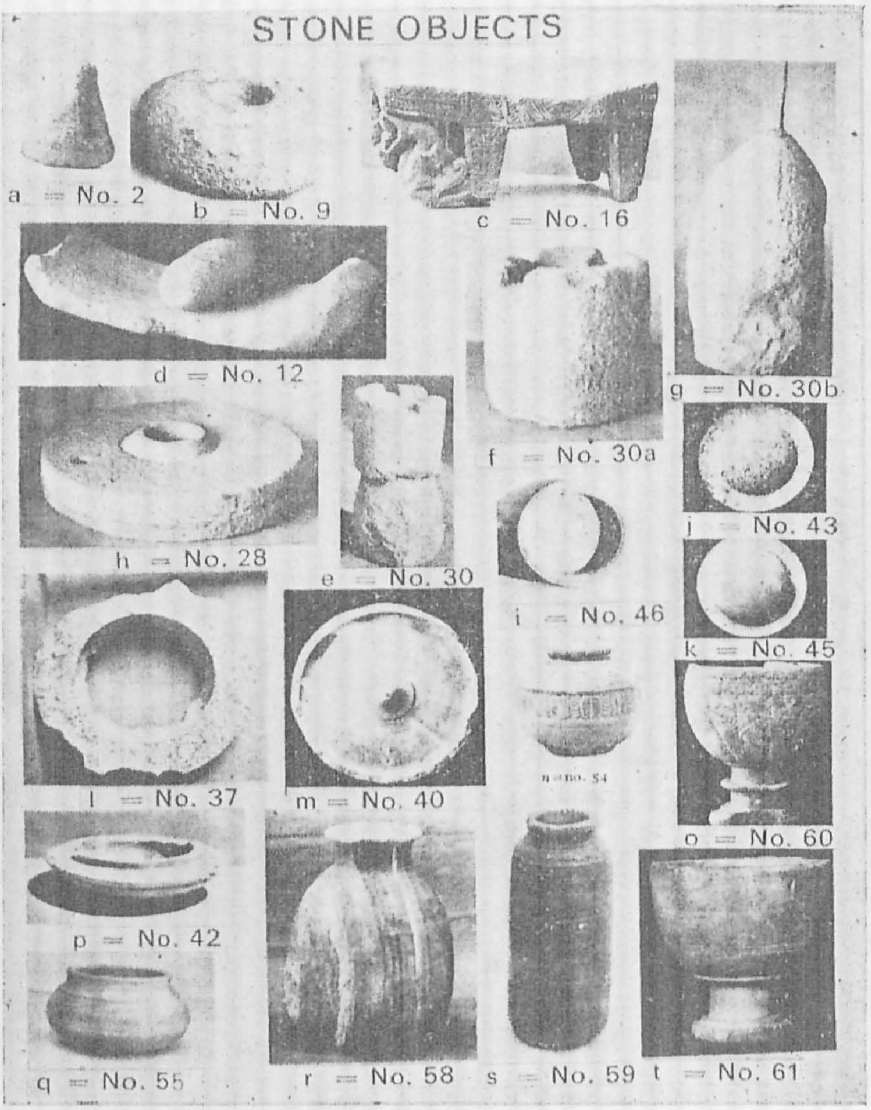

Fig. 186. Pivot stones, querns and mullers, pestles and mortars, grinding-mills from the Bhir mound and Sirkap, 300 B.C to A.D. 100
(From *Taxila*, Vol. III, by Sir John Marshall)

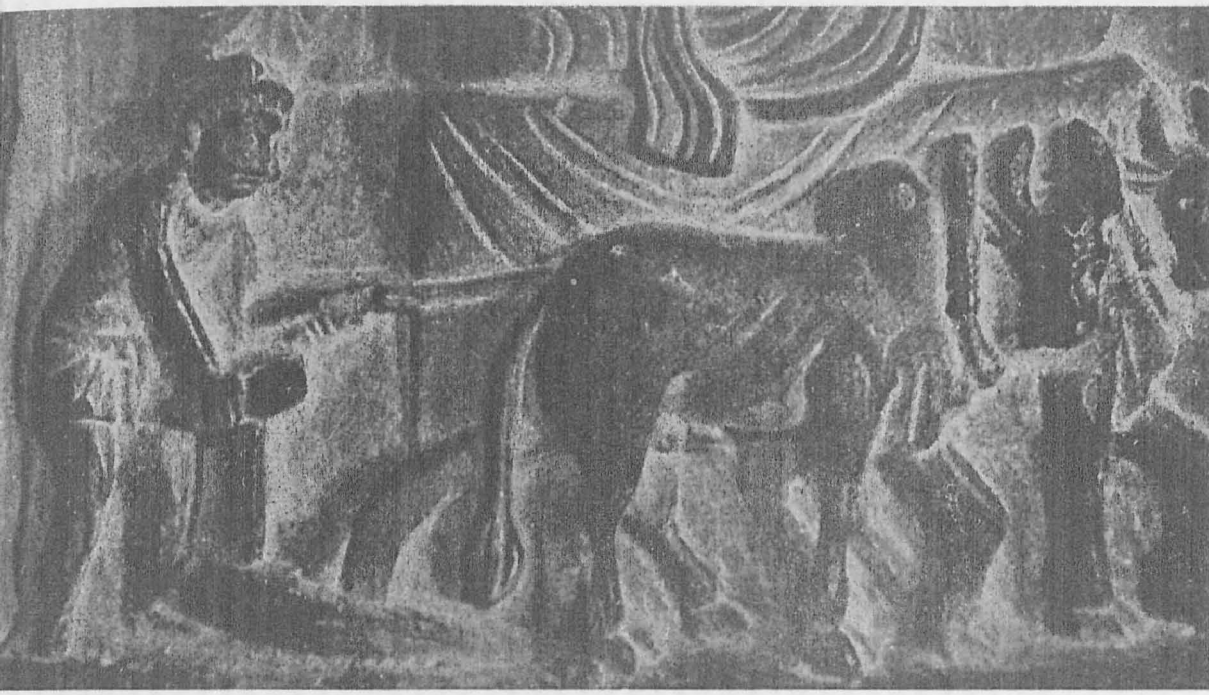

Fig. 187. A farmer ploughing. The bullocks are of the Hariana breed, and the type of plough is still in use in Maharashtra. Gandhara relief, 200 A.D.
(Courtesy: Lahore Museum)

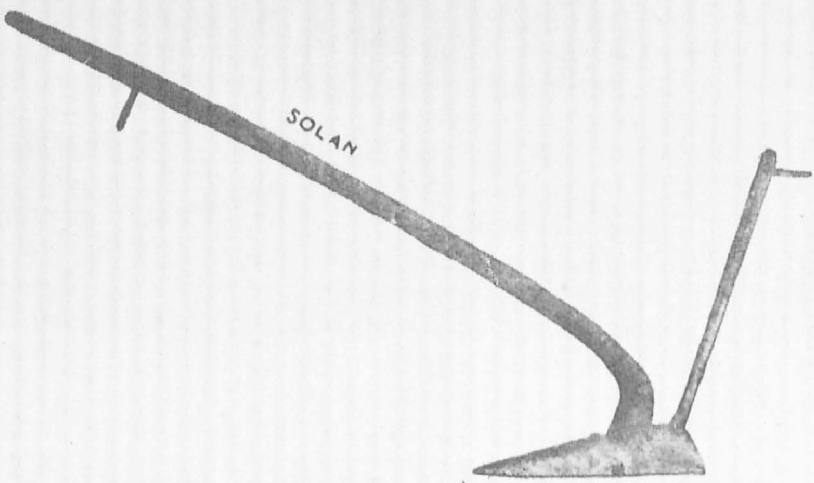

Fig. 188. Plough from Solan, Himachal Pradesh. It resembles the plough shown in the Gandhara relief above

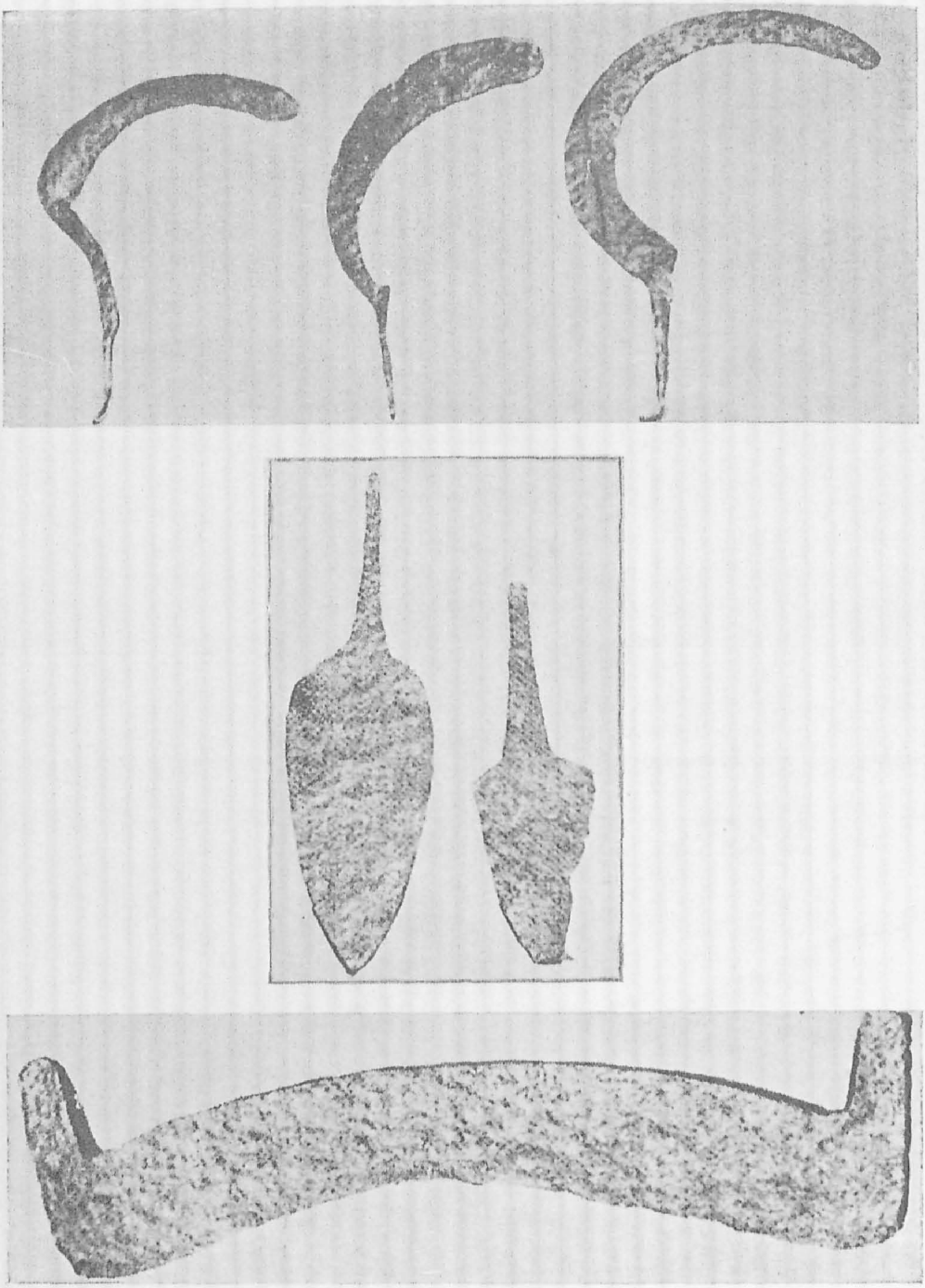

Fig. 189. Iron sickles, diameter 29.2 cm, the iron *bhakhar*, 54 cm in length, 88.9 cm in width, and iron trowels, used as *khurpis*, 200 A.D.
(Courtesy: Sanchi Museum)

advanced up to Mathura. A large number of gold and copper coins were issued in his reign, which bear the image of Shiva and his Nandi bull. The Kushans were the first rulers of India to issue gold coins on a large scale and there were no silver coins. Gold was received through trade with the Roman Empire. The Kushan Empire was situated between the Chinese and Roman Empires and controlled the Silk Route. Another source of gold was the Altai Mountains in central Asia.

Kanishka, the greatest of Kushan rulers, ascended the throne A.D. 78. The Saka Era was started by him. His capital was Purushapur (Peshawar) in Gandhara and he ruled over Kashmir, the Punjab, Sind, Malwa, and the Gangetic Valley up to Patna. He summoned the Fourth Buddhist Council at Jalandhara which prepared an encyclopaedia of Buddhist philosophy.

The successors of Kanishka were Huvishka (A.D. 107-138) and Vasudeva (A.D. 152-176). Vasudeva's coins bear the image of Shiva, holding a trident, standing near the Nandi bull (Fig. 183 *top row, left*).

YAKSHIS (TREE-GODDESSES)

SMALL POPULATION AND VAST LAND RESOURCES

Under the patronage of the Kushan rulers, a school of sculpture developed at Mathura whose favourite theme is depiction of *Yakshis*. The *Yakshis* or *vrikshakas* are auspicious emblems of vegetative fertility. The famous *salabhanjika* pose in which a woman is shown plucking flowers of a *sal* tree derives from the nativity legend of the Buddha in the Lumbini Garden, where Mayadevi, supported by the *sal*-tree, stretching her arm to catch the flowers, delivers the holy child. This seems to have provided the basis for the woman and tree motifs which are so frequently seen in the Buddhist sculptures of Bharhut, Sanchi, Amaravati and Mathura. From its association with the birth of the Buddha, the *vrikshaka* motif became a symbol of fertility and women prayed to it for gifts of children. 'The *Mahabharata* also speaks of dryads (*Vrikshaka* and *Vrikshi*) as "goddesses born in trees, to be worshipped by those desiring children".[6] In the ancient city of Sravasti, Salabhanjika festival was celebrated with great zeal when the *sal*-trees flowered. The *sal*-trees in full blossom were worshippped for offspring.

'Girls and young women are regarded as human embodiments of the maternal energy of nature', observes Zimmer. They are diminutive doubles of the great Mother of all life, vessels of fertility, life in full sap, potential sources of new offspring. By touching and kicking the tree they transfer into it their potency, and enable it to bring forth blossom and fruit. Hence, the goddess who represents the life energy and fertility of the tree is herself most aptly visualized in this magic posture of fertilization.[7]

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[6]Coomaraswamy, A. *History of Indian and Indonesian Art*, p. 64

[7]Zimmer, H. *Myth nd Symbols in Indian Art and Civilization*, p. 69

During the Kushan age, the population of India was comparatively small and there were vast areas covered with forests which could be reclaimed. Hence more people were required. This explains the popularity of *Yakshi* cult and its necessity.

The woman and the tree motif found its most elegant expression in red sandstone Mathura sculptures of the Kushan period. The leaves and flowers of *asoka* (*Saraca asoca*) (*S. indica*), were the most popular motif with the Mathura sculptors. We find numerous sculptures in the Mathura and Lucknow museums where the *asoka* is shown associated with female figures. These are not dancing-girls, but *vriksha devatas*, symbols of fertility, who were worshipped for gifts of children by childless women. On a railing pillar we see a woman standing under a flowering *asoka*-tree. A beautiful woman, with a happy face standing cross-legged on a crouching dwarf, fastens a lotus garland on her head. Behind her we see an exquisitely carved branch of *asoka*. In another Mathura sculpture, we see a couple feeding a parrot, and below the window are the leaves and flowers of *asoka*, which are so true to nature (Fig. 184).

Apart from *asoka*, we find four other trees depicted in these sculptures. In one of these we see a woman under a *kadamba* tree (*Anthocephalus chinensis*) (*A. indicus*), holding a sword touching its ball-like flowers. The broad ovate leaves, with conspicuously marked venation and globose inflorescence, are prominent characters of the *kadamba*, and they have been faithfully carved by the sculptor.

Their third unidentified tree which we find appears to be *champak* (*Michelia champaca*) and forms a background to a beautiful female figure wearing a peculiar head-dress.

The fourth tree, with leaves like those of *asoka* and comparatively small axillary flowers, which we find in the sculpture behind the woman treading over the dwarf, resembles *Mesua ferrea*, the well-known Nagsura of Bengal and Assam. Its linear-lanceolate, acuminate, drooping opposite leaves, with short peduncles and axillary solitary flowers, resemble those of *Mesua ferrea*, rather than of any other Indian tree. *Mesua ferrea*, with its strikingly beautiful leaves and highly fragrant flowers, must have been as popular in ancient India as it is now in Bengal and Assam.

The fifth tree in Kushan sculpture is possibly *Ixora arborea* (*I. parviflora*). We find it sculptured behind a woman carrying a basket.

All these trees grow in humid tropical areas of India. Their presence at Mathura indicates that in the Kushan period this region had a higher rainfall.

Temple Gardens

The Buddhist priests planted groves of flowering trees around their monasteries. They had plenty of leisure, and they lived in peaceful

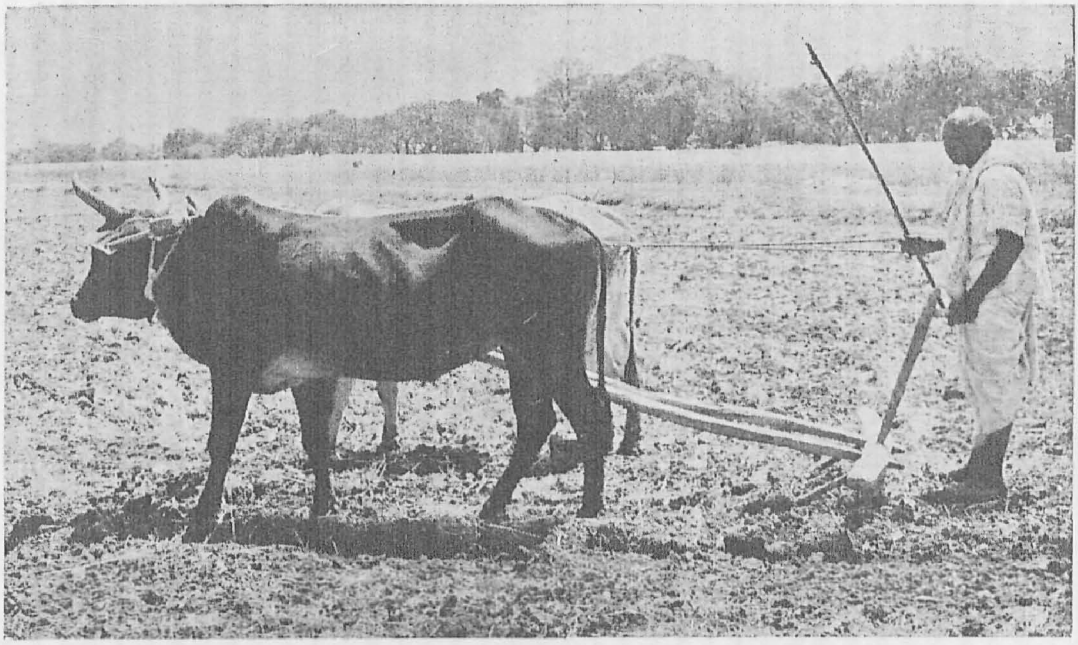

Fig. 190. *Top*, *Bhakhar* a scraper in common use in the black-cotton-soil areas of Madhya Pradesh; *Bottom*, A closer view of the *bhakhar*

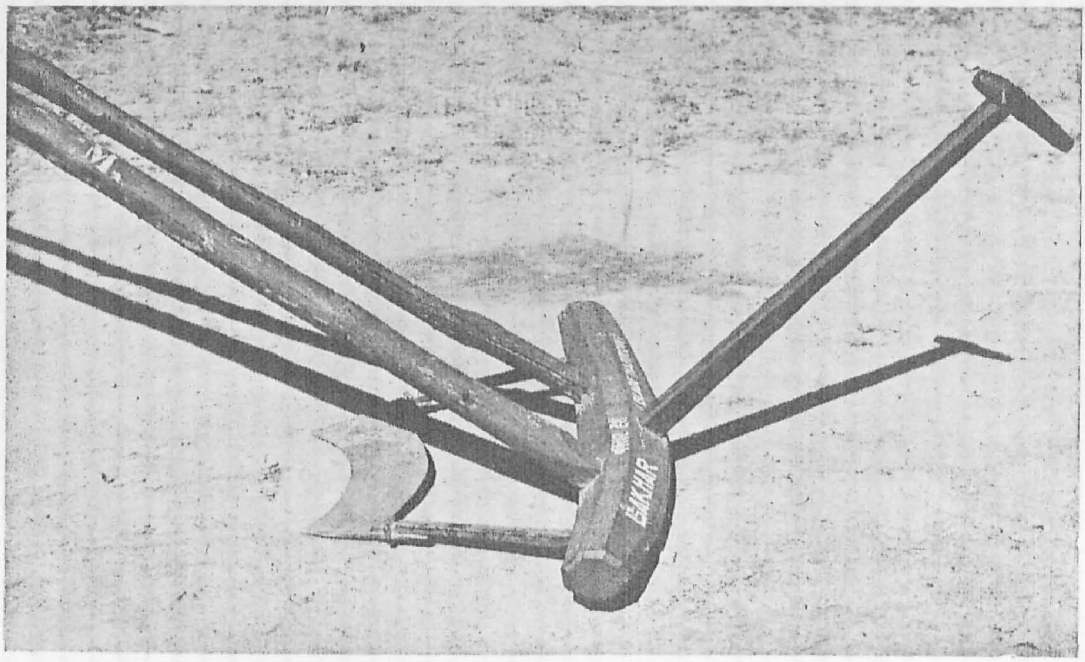

Fig. 191. Black-pepper (*Piper nigrum*) was the favourite spice of Indians till the Portuguese introduced red-pepper (*Capsicum frutescens*) from Peru, South America, in the sixteenth century. Black-pepper is grown in Kerala, trained on posts of *Erythrina variegata* var. *orientalis*

Fig. 192. Women drying berries of black-pepper in Kerala

surroundings conducive to tranquility. Such conditions are ideal for the craft of gardening. In fact, the evolution of gardening is intimately associated with Buddhist temples and monasteries.

Agriculture

Brick-wells. The use of kiln-burnt bricks became popular in the Kushan period. In the sites which have been excavated in northern India, the use of kiln-burnt bricks for floors and tiles for floors and roofs is common. The Kushan bricks from Sanghol in the Punjab are large, 32 × 20 centimetres, and 6 to 8 centimetres thick. An agricultural innovation which can be attributed to the Kushans is the construction of brick-wells, which were used for irrigation.

Horses. The Kushans used riding horses on a large scale. In sculptures of the second century of the Christian Era, riding-horses are depicted with saddles and reins, though there are no stirrups. The early stirrup was possibly a rope with a loop.

The Hariana Cattle. A Gandhara relief, now in the Lahore Museum, shows a farmer ploughing a field. The bullocks are humped and are of the Hariana breed. The plough is heavy and resembles a type of plough still used in the Solan area of Himachal Pradesh (Figs 187 and 188). Similar ploughs are also in use in the Junnar area of Maharashtra.

Agricultural Implements of Iron

Taxila, 200 B.C-A.D. *200.* Iron technology made great progress in the age of Śātavāhanās and Kushans. Indian iron and steel weapons and cutlery were exported to western Asia where they enjoyed high esteem. In India it led to the manufacture of sturdy agricultural implements. A number of iron agricultural implements were recovered from the Bhir mound at Taxila. These include a variety of hoes with length varying from 18 to 30 centimetres, seven spuds, 15.5 to 18 centimetres in length, and five sickles. One sickle had a curved blade and the other a straight blade and a curved handle. The length of the blades varied from 12.5 to 18 centimetres. True spades were also discovered which are superior in design to those currently in use in rural India (Fig. 185). The workmanship of these iron agricultural implements indicates the high level of iron technology in India during 300 B.C. to A.D. 100.

Improvement in the quality and strength of iron chisels and hammers led to improvement in the manufacture of stone objects, particularly grinding-mills (*chakkis*), which are still used in Indian homes for grinding foodgrains and spices. Now querns and mullers, and pestles and mortars could be manufactured with greater ease. Apart from these grinding devices, stone vases and cups of a variety of shapes and designs were manufactured at Taxila (Fig. 186).

Sanchi—A.D. *200.* A number of agricultural implements were discovered from Sanchi in 1920. These implements include a blade-harrow (*bhakhar*), sickles with curved blades, and iron trowels which were possibly used as hoes (Fig. 189). The *bhakhar* is even now in common use in the black cotton soil areas of Madhya Pradesh. It shows that an implement of proved utility continues unchanged over the centuries.

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CHAPTER 28

THE KINGDOMS OF SOUTH INDIA

PANDYAS, CHERAS AND CHOLAS
FIRST CENTURY OF THE CHRISTIAN ERA TO A.D. 300
CULTIVATION OF RICE, RAGI, SUGARCANE, PEPPER AND TURMERIC AND TANK IRRIGATION

THE kingdoms of South India had a history and character of their own. This was on account of the barrier of thick forests on their northern boundary which isolated them from northern India. This isolation endowed South Indian culture with a powerful originality. Broadly, they fall into two groups, viz. the Tamil group of Pandyas, Cheras, Cholas and Pallavas and the Deccan group comprising Chalukyas and Rashtrakutas.

The source of information about the economy and social life of the Tamil States is *Sangam* literature which was compiled in the period *c.* A.D. 300-600. The *Sangam* was an assembly of Tamil poets held under the patronage of a Pandya king at Madurai. Another source is *Periplus of the Erythraean Sea* (A.D. 81-96), which informs about the trade between the Roman Empire and South India. The Greeks of Egypt under the Ptolemies of the last three centuries B.C. traded regularly with India, and when Egypt became a Roman province this commerce was further developed by the Romans.

In *Sangam* literature, there are references to substantial buildings. Burnt bricks and lime were used for the construction of buildings, but it seems wood was extensively used. The use of wood should not be equated with primitiveness. Beautiful homes and palaces can be created with the use of timber, as in Kerala and Japan. The palace at Padmanabhapuram in Kerala is made of timber. It is very much like the Nijo Castle of Kyoto. From *Maturaikkanci* we learn that houses were built over the town gates. *Perumpanarrappadai* describes a port town with multi-storeyed buildings, large warehouses, and a tall lighthouse reached by climbing a ladder. *Narrinai* refers to a venerable town having shops along streets where many carts stood, while *Nedunalvadai* mentions a prosperous old town having streets broad like a river.[1]

The most important development of this period is the spread of irrigated rice cultivation. Most probably it diffused from the adjoining area of Orissa to the coastal area of Andhra Pradesh and Tamil Nadu in the Iron Age, about 300 B.C. It meant a secure food supply and probably led to

[1]Stein, B. *Essays on South India*, p. 15

a population explosion. It is no accident that the early Tamil kingdoms were located in deltaic areas of rivers.

The *Sangam* literature provides information regarding the various occupations followed by the population. Apart from farmers, there were shepherds, hunters, and fishermen. The village artisans included blacksmiths, carpenters, weavers, leather-workers and salt-makers. In the towns were merchants, shippers, customs agents and horse-importers. The people were entertained by drummers and dancers. The kings were surrounded by chieftains, warriors, scholars, poets and priests.

The Tamil States were constantly fighting among themselves and nibbling at each other's territory. It is not their petty wars which are of any significance. It is their contribution to the agriculture and the culture of India which is of tremendous importance.

Pandyas

The Pandya territory occupied the southernmost and the south-eastern part of the peninsula, roughly corresponding with the modern districts of Tinnevelly, Ramnad and Madurai. Tambaraparani and Vaigai provided fertile soil as well as water for irrigating fields. The capital was at Madurai, the Mathura of the South, which was a religious and literary centre. Its population included the Buddhist and Jain monks, who were patronized by the royal family and rich merchants. The earliest Pandya king about whom we hear is Nedunjeliyan (A.D. 215). He is described as a performer of Vedic sacrifices and as a hero of many battles.

The Cheras

The Chera country lay to the west and north of that of Pandyas and roughly corresponds with the present-day Kerala. Its recorded history begins in the middle of the second century of the Christian Era when a great battle was fought between the Chera king, Adan I, and a Chola king. The greatest Chera king was Senguttuvan (A.D. 180). After the second century of the Christian Era, the Chera power declined.

The Cholas

The Chola kingdom lay to the north-east of the Pandya kingdom, between the Pennar River and the Velur River. The delta of the Cauvery, with its moisture and fertile soil, provided an excellent economic base for the Chola kingdom. The historical period begins in the middle of the second century of the Christian Era, with the reign of Karikala (A.D. 190). He defeated the combined forces of Cheras and Pandyas. He built the new capital of Kaveripattanam on the coast. He raided Sri Lanka and captured 12,000 men. With this slave labour force, he constructed an embankment along the Cauvery, 160 kilometres long, to protect the land

from floods. He also built a number of irrigation tanks. He promoted agriculture by clearing forests.

Trade with Rome

In the first century of the Christian Era, the monsoon was discovered. This discovery facilitated trade between India and the countries under the occupation of the Romans, viz. Spain, Gaul, Dalmatia, Italy and Egypt. Roman and Greek merchants visited the ports of southern India in considerable numbers and established themselves in small colonies. They came in quest of spices and cotton cloth for which South India had become famous in the ancient world. A Pandyan king sent an embassy to Augustus Caesar (27 B.C. to A.D. 19). There were Roman warehouses in South India, and there was also a temple dedicated to Augustus at Cranganore on the Malabar coast.

Rome received fine cloth, pearls, spices, sandalwood, gems and drugs from South India. An important evidence for Roman trade with India is the great number of Roman coins found in South India. The Periplus states that gold and silver coins were profitably exchanged at Barygaza, and that in the Tamil country great quantities of coin were imported. The largest number of Roman coins has been discovered from the Coromandal coast and in the Coimbatore and Madura districts. This drain of gold coins became a source of alarm to the Roman government. Apart from gold coins it seems that Rome also exported wine. K.V. Raman recovered a dozen amphorae (two-handled wine containers) from Nattamedu in Tamil Nadu, some with resin as residue from the wine.[2]

The early literature of the Tamils provides a vivid picture of the activities of the foreign traders. A Tamil poet relates that the large beautiful ships of the Yavanas bring gold to the thriving town of Muchiri (*Muziris*) and return laden with pepper. The Periplus states that silk, tortoise shell, and betel-leaf came to Muchiri from Southeast Asia.[3] Poems describe the abodes of the prosperous Yavanas at the mouth of the Cauvery River, of Yavana mercenaries who guarded the gates of the fort of Madura and the Tamil king's tent. For the king, they brought costly vessels of silver, singing boys, and beautiful maidens for the harem.

Periplus then lists the market towns of the Dachinabades (Deccan), together with their trade and situation. Calliena (Kalyan), he says, was hostile to Greek ships landing there, and they were escorted to Barygaza. Farther south, he comes to the Damirica (Tamil country). Of Muziris (modern Cranganore), he says, "it abounds in ships sent there with cargoes from Arabia and by the Greeks." He also mentions Nelcynda of the Pand-

[2]Stein, B. *Essays on South India*, p. 29
[3]Ibid., p. 16

yan kingdom, of which the Dravidian equivalent might be Melkynda, "western kingdom", and its situation is suspected to be somewhere in the the Cochin backwaters. He says, "There are imported here in the first place a great quantity of coin, among other things, and exported fine pearls of all kinds, diamonds, sapphires and tortoise shell."[4]

AGRICULTURE

Regarding the state of agriculture in Tamil land, Sastri and Srinivasachari observe, 'Cultivable land was abundant and the necessities of life plentiful. The fertility of the lands watered by the Cauvery is a recurring theme of Tamil poets. The natural forest produce of Pari's principality included bamboo, rice, jack-fruit, the *valli* root, and honey. *Ragi*, sugarcane, pepper, turmeric and cotton were cultivated. Society was organized in castes with habits and traditions of their own; but the population of large cities and port towns tended to be cosmopolitan."[5]

During this period we hear for the first time about the cultivation of turmeric (*Curcuma longa*) and pepper (*Piper nigrum*). Harlan considers India and Malaysia as the countries of origin of turmeric.[6] Known as *haldi* in Hindi and *manjal* in Tamil and Malayalam, turmeric is used as a condiment in every Indian home. It is mainly grown on the east coast of India in Andhra Pradesh, Orissa, and Tamil Nadu. There is a wild variety also, *Curcuma aromatica,* with fragrant stems. The Guntur, Krishna, and East and West Godavary districts in Andhra Pradesh are the main growing areas. In Tamil Nadu, Trichur, Salem and Coimbatore are important turmeric-growing areas.

The pepper plant is indigenous to the forests of Kerala. It has been cultivated in Kerala from about the second century B.C. Harlan claims South-East Asia as the place of its origin. In Indonesia also, there is extensive cultivation of pepper. In Kerala, it is grown below the Western Ghats. Pepper is a climber which is grown on standards of *Erythrina variegata* var. *orientalis* (Fig. 191). The berries are originally green and when they ripen they become orange. They are dried in the sun (Fig. 192), and their outer skin becomes black and assumes the characteristic wrinkled appearance. As a preservative of food and for flavouring meat, pepper was in great demand by the Romans.

The poets of the *Sangam* period (A.D. 300-600) counselled the kings as to how to store water, enrich the land and improve the conditions of the people. They emphasized the dignity of labour. The wet lands, as a geographical division, were called *marutham.* The people occupying that

[4]Schoff, W.H. *The Periplus of the Erythraean Sea*, p. 208
[5]Sastri, K.A.N. and Srinivasachari, G, *Advanced History of India*, p. 179
[6]Harlan, J.R. *Crops and Man*, p. 75

land division were referred to as *ulavar* or *vellalar*. In many places, *marutham* was also called *panai*. *Panai* means fertile land or rich soil. The farmers were called *kalamar*. *Kalam* means the fields.

Ilango Adigal (second century of the Christian Era) said that the farmers were responsible for the triumphs of the kings and the well-being of the poor. There were two classes of farmers—the tenants and the *vallalas* or landlords. The *vallalas* had the prerogative for marital alliance with the royal households.

The *vallalas* did not plough the land themselves, but employed labourers for this purpose. The transplanting and harvesting of paddy and the digging of root crops were done by women workers. The *vallalas* were, in fact, only managers and supervisors. This schism between the farmers and farm labourers is a prominent characteristic of South Indian agriculture even at present. During the ploughing season, you would notice a man with an umbrella (the owner of the land), standing on an embankment, while the farm workers plough the muddy field.

Rivers such as the Cauvery, the Vaigai and the Palar enriched the soil of Tamil Nadu. In dry lands, minor millets such as *samai* and *ragi*, and pulses such as lab-lab and *Cajanus* were cultivated. Eighteen varieties of cereals and millets were grown. *Thirukkural Thiruvalluvar* has a separate chapter on agriculture. 'Agriculture involved hard manual labour, yet it is peerless among all the professions. The farmers are the pivot of civilization'. Valluvar further explained in detail how the farmers were responsible for the prosperity of the kings. If they were respected and encouraged, the kings strength and reputation would endure.

The *Perumpanatruppadai*, another ancient Tamil poem of the *Sangam* Age (before the second century of the Christian Era), describes the different farming operations, viz. ploughing with bullocks, the levelling of land, the transplanting of paddy seedlings, hoeing and weeding, harvesting, transporting the sheaves to the threshing-floor, the threshing of crops by using cattle, and winnowing.

The transplanting of paddy seedlings was the most important agricultural operation. Fields were irrigated from lakes and wells. Some farmers irrigated their fields by drawing water from the ponds to the accompaniment of songs. Bullocks were used to draw water from the wells. *Thulas* were also in use.

In *Pattinappalai* of the *Sangam* Age (before the second century of the Christian Era) and *Chillapathikaram* (second century of the Christian Era), descriptions of the various agricultural operations are given. *Chillapathikaram* also speaks of sandal (*Santalum album*) growing in the Malaya mountain. This was the name by which Western Ghats were known. According to the poet's fancy the sandal-trees were covered with serpents. *Chillapathikaram* further mentions that ships sailed directly from Southeast Asia to the

Chola coast with silk, sandal, camphor and spices.[7] These spices most likely included cloves, nutmegs, cinnamon, etc., which grow in the Spice Islands and are even now imported into India.

Jivaga Chinthamani says, 'When there is plentiful rain the peasants are happy. They hail the rain with shouts of joy, and beating of drums. When there are breaches in the banks of the river, the people are informed by the beat of drum, and they rush to the spot and work together to repair the breach. The wives of the peasants encourage their husbands to work untiringly in the fields by serving liquor to them.

'The land is ploughed with the aid of bullocks and male buffaloes. The work of transplanting paddy seedlings is done by women. Sugar (jaggery) is also manufactured by the peasants. As a result of peasants' untiring work, food is produced in abundance. The peasants help others by liberally giving them grain. The surplus produce is sent by carts to be sold in different parts of the country. Carts carrying imported goods are also much in evidence. Because of this trade the peasants are enriched and live a happy life.'

In *Chillapathikaram 'Nadu Kan Kathai'*, agricultural operations are thus described.

"Field labourers, their arms blackened by exposure to sun, came running with the farm owners. Their shouts could be heard from distance. The travellers could also hear the melodies of women singing in drunken voices. Their broad shoulders and large breasts were soiled with mud. Having cast away the flowers from their hair, they were sticking the tender sprouts of rice into the water-soaked ground. These graceful women looked like bronze statues sprung from the mire of the fields. Then the hymns sung by the ploughmen were heard. They walked behind their sharp ploughs, which ripped open the soil. From afar the travellers could hear the farmers' threshing songs as their bullocks trampled the harvest to separate the grain from the straw; and the cheers of those who were listening to mud-soiled drums played by vigorous young minstrels."[8]

"There was an abundance of necessities of life and a reasonably brisk inland and maritime trade. The level of material culture was fairly high and in the spiritual sphere there was occurring a progressive integration of the new Aryan with the old pre-Aryan forms and conventions. The general impression left on the mind by this early Tamil literature is one of social harmony, general contentment and happiness."[9]

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[7]Stein, B. *Essays on South India*, p. 16

[8]Translation provided by Dr Rajammal Devadas

[9]Sastri, K.A.N. and Srinivasachari, G. *Advanced History of India*, p. 181

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CHAPTER 29

THE AGE OF THE GUPTAS

A.D. 300 — A.D. 550

RENAISSANCE IN ART, LITERATURE AND SCIENCE,
HIGH LEVEL OF IRON TECHNOLOGY AND PROGRESSIVE AGRICULTURE

THE Gupta Dynasty was founded A.D. 300. The first king is known as Gupta. His grandson was Chandragupta I (A.D. 320-335), who married a Lichchhavi princess, Kumaradevi, from Nepal. Some gold coins bear the figures of both Chandragupta I and Kumaradevi. On the reverse is goddess Durga seated on a lion.

Samudragupta (A.D. 335-380), the son and successor of Chandragupta I, was proud of his matrilineal ancestry and described himself as *Lichchhavi-dauhtra,* the son of the daughter of the Lichchhavis. This indicates that the Lichchhavis were held in high esteem in that age. Samudragupta was a warrior who greatly extended his empire. It included Bengal, Bihar, Uttar Pradesh, the Punjab, Sind, Rajasthan, Gujarat and Madhya Pradesh north of the Narmada (Fig. 193). He also invaded South India, and captured twelve kings, who were however treated generously and liberated. In his South India campaign Samudragupta reached Kanchi, the Pallava capital. This campaign brought the southerners in touch with the northerners and there was intermingling of cultures to the advantage of both. In Samudragupts's army, horses, which are fast and more easily manoeuvrable, became more important than elephants. This is a lesson which was learnt from the Kushans. He also performed an *ashvamedha* or horse sacrifice to proclaim his imperial power. A gold coin issued by him bears an effigy of a horse standing in front of an altar (Fig. 183, *second row, right*). Samudragupta partonized learning and was a musician, and in some of his coins he is shown playing a lute. A Buddhist scholar, Vasubandhu, was his minister.

Chandragupta Vikramaditya (A.D. 380-412), the next ruler, conquered Malwa, Gujarat and Saurashtra. He married his daughter Prabhavati with Rudrasena II, the Vakataka king of Deccan. In his gold coins he is represented as a warrior standing, holding a long bow. On the reverse is a goddess seated on a lion (Fig. 183, *first row, right*). It was during his rule that the Chinese Buddhist pilgrim Fa-hsien visited India.

Kumaragupta I (A.D. 414-455), who succeeded Chandragupta Vikramaditya, also won many victories and performed an *ashvamedha.* In his gold coins he is shown feeding a peacock. On the reverse Karttikeya or Kumara is shown riding a peacock (Fig. 185, *second row, left*). The Mandasor inscription of Kumaragupta and Bandhuvarman, his governor

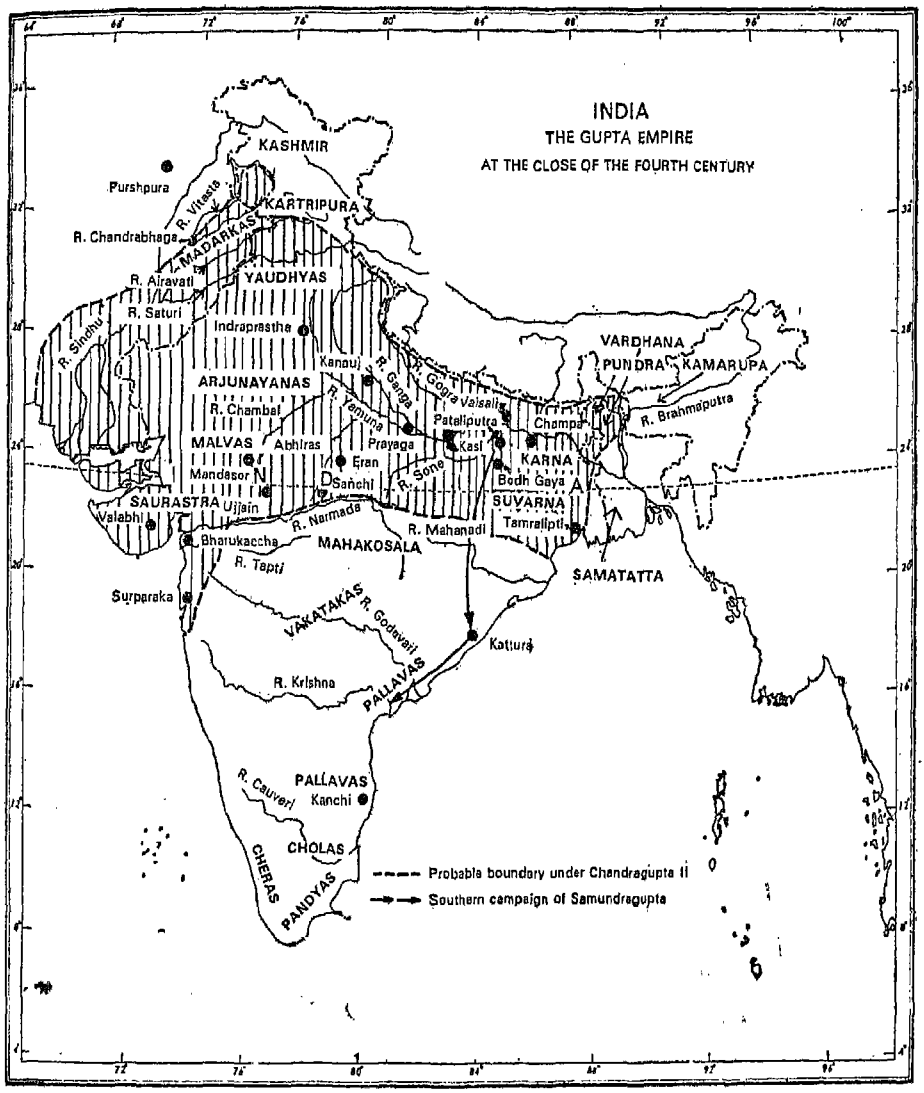

Fig. 193. Map showing the Gupta Empire at the close of the fourth century

at Dasapura, records the building of a temple in Dasapura (Mandasor) by the local guild of silk weavers in A.D. 437-438. This indicates the use of silk in that age by the richer classes.

During the reign of Kumaragupta, Nalanda became a great Buddhist University which, apart from provinces of India, attracted scholars from other countries also.

Skandagupta (A.D. 455-467) succeeded Kumaragupta I. During his reign northern India was threatened by the Huns, and he fought many battles with the Hun hordes. Huns were expert horsemen and excellent archers, and plagued northern India by their incursions.

The Gupta age was one of a great Brahmanical revival, though Buddhism also flourished. From the Bhitari inscription we learn about the installation of an image of Vishnu by Skandagupta. The Gupta coins bear the images of Hindu deities Durga and Skanda. Gupta seals bear the image of Nandi bull (Fig. 183). Nandi is a humped zebu. Apart from its religious significance, it indicates the esteem in which cattle were held in the Gupta age.

Indian Influence over East Asia

During the Gupta age, the cultural influence of India reached East Asia. In Burma, Thailand, Malaya, Cambodia, Viet Nam, Java, Sumatra, Borneo and Bali, flourishing Hindu States arose. The fifth century of the Christian Era witnessed the golden age of the Gupta Buddhist art in north Burma. The *Ramayana* and the *Mahabharata* became popular in Java. Indian missionaries were active in China. It was not a physical invasion, but a spiritual conquest.

Life in the Gupta Age

The seals and inscriptions of the Gupta age as well as the coinage of that age indicate a well-organized Government, which maintained law and order and people lived peacefully. Both trade and agriculture flourished.

Fa-hsien, the Chinese scholar, travelled in India from A.D. 401 to 410. He entered India via the Valley of the Swat and, after passing through Peshawar and Taxila, travelled through the Gangetic plain and reached Pataliputra. On his route from the frontier to Pataliputra, he found Buddhism flourishing in the Indo-Gangetic plain. At Mathura, he found twenty monasteries, with three thousand monks. The government appeared to him to be lenient. The people moved about freely without passports. Taxes were based on the richness of each locality. Soldiers and officials received their salaries regularly. Offences were punished only by fines; capital punishment was rare, and even mutilation was confined only to cases of obstinate rebellion. Public morality was high. Fa-hsien was not molested anywhere in the course of his long journey in India. In Magadha, he found many rich towns and there were lodging-houses for travellers. There were hospitals maintained by the rich. About Indians, he writes, 'They do not kill animals, and do not drink wine or eat onions or garlic, there are neither butchers' shops nor taverns in the market place.'

A Renaissance in Art, Literature and Science

If the degree of development of a culture is judged by the acsthetic level of the people, we can safely say that the Hindu culture reached its hey-day in the Gupta age. It is rightly called the Golden Age of India. The art of sculpture and Sanskrit literature reached high level of development. During the Gupta period, the Buddha image reached its perfection at Mathura and Sarnath, and people could see and feel the Divine in human form. The elegant Greek drapery was combined with the spiritual calm of India and a unique synthesis of the West and East was achieved. It also indicates that it was a period of tolerance and of coexistence between Buddhism and Hinduism.

The Laws of Manu, and the tales of *Panchatantra* were written in this period. During this period, a number of outstanding men flourished who added lustre to the annals of India. Varahamihira, the astronomer, lived at about the close of this period. Aryabhata (b. A.D. 476), the mathematician and author of the *Aryabhatiya*, flourished in this age. He explained the true causes of eclipses of the sun and the moon, and could calculate them precisely. He was the first to discover that the earth rotates on its axis and moves round the sun. The decimal place-value notation and zero was in use in India by the fifth century of the Christian Era.

Of the poets and authors of this period, Dandin, Subandhu, Banabhatta and Kalidasa deserve particular mention. Kalidasa in his *Ritusamhara*, 'The Pageant of the Seasons', gives charming descriptions of indigenous beautiful trees of India which flower from month to month. In his description of spring, he describes the mango-tree bent with clusters of coppery-red leaves, and their branches covered with light-yellow fragrant blossoms shaken by the March breezes, which kindle the flame of love in the hearts of women. He describes the *asoka*-trees, with their graceful drooping young leaves hanging, like tassels of silk, covered with coral-red blossoms which make the hearts of young women *sasoka* (sorrowful). He describes the jungles of *dhak* (*kimsuka*) resembling a blazing fire, making the earth appear like a newly-wedded bride, with red garments. He aptly compares the scarlet flowers of *dhak* with the bright-red beaks of parrots! In his description of women's toilet, he mentions that they paint their bodies with the fragrant paste of white sandal and cover their breasts with garlands of white jasmines, and perfume their hair with *champak* blossoms. In the rainy season, they decorate their heads with garlands of *kadamba*, *kesara*, *kakubha* and *ketak* flowers.

The murals in the Ajanta caves, the quintessence of the Buddhist art, which date from 200 B.C. to A.D. 600 (Caves XVI and XVII are attributed to the last quarter of the fifth century of the Christian Era), not only show the high level of the art of painting and sculpture attained in that period but also give us a glimpse of the life of the common people in those times.

Some of these paintings show wreaths of flowers in the hair of women. They wore garlands round their necks and bracelets of flowers round their arms. In fact, flowers formed an integral part of their toilet.

Seasonal Festivals

India enjoyed a long spell of peace under the rule of the Guptas. People led a happy life and celebrated seasonal festivals with much merriment. The *Salabhanjika* (Women and Tree) festival was celebrated with great zeal in the ancient city of Sravasti, which flourished in the present-day District of Gonda in Uttar Pradesh. The *sal*-tree in flower is a sight never to be forgotten. The tree gets covered with scented cream-coloured flowers in the last week of March, and they fill the forest with fragrance.

The merriest festival in ancient India was the *Suvasantaka*, the spring festival celebrated in honour of Kama Deva, the god of love. Dancing, singing and merry-making were organized in every village, and both men and women participated. Even princesses and the ladies of the aristocracy used to dance in public places, and the god Kama Deva was worshipped. *Suvasantaka* survives in the form of *Vasant panchami*, which usually falls in the first week of February, when the *sarson* flowers.

Gardens

In the Gupta age, Indians led a happy life. Vatsyayana in his *Kamasutra*, the great book of Hindu aesthetics, written about A.D. 300-400, describes how they enjoyed civic life. The book has a happy materialistic outlook with none of the other-worldly pessimism.

Four kinds of gardens are described by Vatsyayana: *Pramododyan*, for the enjoyment of kings and queens; *Udyan*, where the kings passed their time playing chess with their courtiers, enjoying the dance of danseuses and the jokes of court jesters; *brikshvatika*, where the ministers and courtiers made merry with courtesans; and *nandanvan*, dedicated to Lord Indra.

Vatsyayana recommends the building of a house close to a pond with an *udyan* (garden) outside. Lilies and lotuses were grown in the pond. Geese, ducks and swans were also kept in these ponds. In the garden attached to the house, a swing was invariably set up from the thick branches of a shady *neem* or a *pipal* and in the stifling monsoon weather when there was oppressive heat before the coming of the rains and there was not a breath of air, these swings were especially popular. The dry and hot May and June were spent in darkened rooms inside houses, and during the rains, from July to September, people mostly lived, worked and enjoyed life in the shade of trees.

A Kitchen-Garden

Describing the duties of a loyal wife and a kitchen-garden, Vatsyayana

writes: "A virtuous woman, who has affection for her husband, should act in conformity with his wishes as if he were a divine being, and with his consent should take upon herself the whole care of his family. She should keep the whole house well cleaned, and arrange flowers of various kinds in different parts of it, and make the floor smooth and polished so as to give the whole a neat and becoming appearance. She should surround the house with a garden. In the garden she should plant beds of green vegetables, bunches of the sugarcane, and clumps of the fig tree, the mustard plant, the parsley plant, the fennel plant. Clusters of various flowers such as *Trapa bispinosa,* the jasmine, *Jasminum grandiflorum,* the yellow amaranth, the wild jasmine, *Ervatamia* [*Tabernaemontana*] *coronaria,* the *nadyaworta,* the China rose and others, should likewise be planted, together with the fragrant grass *Cymbopogon* [*Andropogon*] *schoenathus,* and the fragrant root of the plant *Vetiveria zizanioides* [*Andropogon muricatus*]. She should also have seats and arbours made in the garden, in the middle of which a well, tank, or pool should be dug.[1] The gardens were kept alive with parrots, *mynas* and *chakoras* swinging in cages from the branches of trees.

Rural Economy

R.S. Sharma states that in the Gupta period, land taxes increased in number, and those on trade and commerce decreased. Probably, the king collected taxes varying from one-fourth to one-sixth of the produce. In addition to this, whenever the royal army passed through the countryside, the local people had to feed it. The peasants had to supply animals, foodgrains, furniture, etc., for the maintenance of royal officers on duty in the rural areas. In central and western India, the villagers were also subjected to forced labour called *vishti* for serving the royal army and officials.

The village headman managed the village affairs with the assistance of the elders. With the administration of a village or a small town leading local elements were associated. No land transactions could be effected without their consent.

A striking development of the Gupta period, according to Sharma, was the emergence of the Brahman landlords at the cost of local peasants. Land grants made to the Brahmans brought virgin lands under cultivation. But these landlords were imposed from above on the local tribal peasants, who were reduced to a lower status. In central and western India, the peasants were also subjected to forced labour. The Brahmans were granted land free from tax for ever, and they were authorized to collect from the peasants all the taxes which could have otherwise gone to the emperor. Royal agents were not permitted to enter the villages granted to the Brah-

[1] *The Kamasutra of Vatsyayana* translated by Sir Richard Burton and F.F. Arbuthnot, p. 197
[2] Sharma, R.S, *Ancient India,* pp. 130, 131, 132

mans. The Brahman land-owners were also empowered to punish criminals.[2]

Agriculture

Our sources of information about the life of the people and their agriculture and horticulture in the Gupta age are Vatsyayana's *Kamasutra*, Varahamihira's *Bṛhatsamhita*, and Amarsimha's *Amarakosha*. Vatsyayana's *Kamasutra* is not only a text on sexology, but also provides information on gardens. Winternitz suggests its date as the fourth century of the Christian Era.

Varahamihira was an astronomer, astrologer, and encyclopaedist. He flourished in the period A.D. 505-587. His *Bṛhatsamhita* provides information on agriculture, botany and zoology, apart from astronomy, medicine, metallurgy and geography. It describes specific characteristics of animals and the treatment of plant diseases. The *Bṛhatsamhita*, and the *Puranas*, particularly the *Agnipurana*, incidentally deal with the selection of land, manuring, cultivation, collection and the treatment of seeds, sowing, planting, reaping and grafting.

The *Amarakosha* of Amarasimha, a scholar in the court of Chandragupta II, contains information on soil, irrigation and agricultural implements.

Soil Classification and Land Use

The *Amarakosha* describes 12 types of land in its chapter on *Bhumivarga*, depending upon the fertility of the soil, irrigation and physical characteristics. These are: *urvara* (fertile), *usara* (barren), *maru* (desert), *aprahata* (fallow), *sadvala* (grassy), *pankila* (muddy), *jalaprayamanupa* (watery), *kaccha* (land contiguous to water), *sarkara* (land full of pebbles and pieces of limestone), *sarkaravati* (sandy), *nadimatṛka* (land watered from a river), and *devamatṛka* (rain-fed). In the *Vaisyavarga* are mentioned different kinds of soils and their suitability for the cultivation of specific crops, e.g., *ksetram*—rice and corn; *yavya*—barley; *tailinam*—sesamum; *maudginam*—green-gram, etc. There are also different names for lands ploughed once, two times and three times, and at several stages.

Use of Manure

The *Bṛhatsamhita* prescribes that seeds which have been properly treated are to be sown with the addition of pork or venison into the soil (where previously the sesame crop was raised, dug up and trodden) and sprinkled daily with water mixed with milk (*ksira*). It says further, 'To promote inflorescence and fructification, a mixture of one *adhaka* (64 *palas*) of barley powder, one *tola* of beef thrown into one *drona* (256 *palas*) of water and standing over seven nights should be poured round the roots of the plant.' To ensure sprouting, and to promote the luxuriant growth of the stem and

the foliage, the seed should be soaked in an infusion made of paddy powder, *urad*, sesame and barley mixed with decomposing flesh, and the whole mass steamed with the addition of turmeric. For the growth of *kapittha* (*Feronia limonia*), the seeds should be soaked for a short time in a decoction of *asphota* (jasmine), *amalaki* (*Emblica officinalis*), *dhava* (*Grislea tomentosa*), *vasaka* (*Justicia adhatoda*), *vetula* (*Calamus rotang*), *suryavalli* (*Gynandropsis gynandra*), *syama* (*Echites fructescens*) and *atimuktaka* (*Aganosma dichotoma*) boiled in milk. The soaked seeds should be dried in the sun and the process is to be repeated for a month. A circular hole is to be made in the ground (1 cubit in diameter and 2 cubits in depth), and the milky decoction poured into it. When it dries up, it is burnt and pasted over with ashes mixed with *ghee* and honey. Three inches of soil should now be thrown into it along with the powder of bean, sesame and barley, and then again three inches of soil. Finally, washings of fish are to be sprinkled and the mud beaten to a thick consistency. Now the treated seeds should be placed in the hole.

According to the *Agnipurana*, a tree becomes laden with flowers and fruits by manuring the soil with powdered barley, sesamum and the offal of a goat mixed together, and soaked in washings of beef for seven consecutive nights. A good growth of these is secured by sprinkling the washings of fish on them.

Advanced Iron Technology and Manufacture of Agricultural Tools

The iron-pillar standing near the Qutab Minar in Delhi was erected by Kumaragupta I, A.D. 415, in honour of his father. In spite of the lapse of so many centuries, the iron of this pillar has not rusted. 'This pillar measures 7.21 metres (23 feet 8 inches) from the top of the bell capital to the bottom of the base; and the diameter diminishes from 41.6 cm (16.4 inches) below to 36.6 cm (12.05 inches) above. The material is pure, rustless, malleable iron. It was made by some sort of welding process, and the weight is estimated to exceed six tonnes. V. Ball in his *Economic Geology of India*, p. 338, 1st ed., 1881, remarked: 'It is not many years since the production of such a pillar would have been an impossibility in the largest foundries of the world, and even now there are comparatively few where a similar mass of metal could be turned out.'[3] Its size and contents indicate that iron technology had reached a high level in Gupta rule. The iron ore from southern Bihar and central India was exploited for the manufacture of iron. From iron, weapons as well as agricultural tools were manufactured on a large scale. It is these agricultural tools and their use in the cultivation of land which provided the base for the prosperity of the people, and ushered in the so-called Golden Age. This also shows that

[3]Garratt, G.T. (Ed.), *The Legacy of India*, 1967, p. 338

Golden Ages are the products of iron tools and a progressive agriculture.

Agricultural Implements and Accessories

The *Amarakosha* lists a number of agricultural implements, such as plough (*langala, hala*), pin of yoke (*yugakilaka*), shaft of the plough (*langala-danda*), goad (*prajana, todana*), harrow (*kotisa*), spade or hoe (*khanitra*), sickle (*datra, lavitra*), tie for fastening the yoke to the plough (*yotra*), post for threshing grain on the floor (*medhi*), winnowing-basket (*surpa*) and sieve (*chhalani*).

Irrigation

There is enough evidence to indicate that due recognition was given to irrigation. Land known as *nadi-matṛka* depended on irrigation from river water. Water in tanks and pools was used for irrigation in the central and southern parts of India.

The *Naradasmṛti* states that the erection of a dyke in the middle of another man's fields was not prohibited in view of the fact that it would be advantageous for irrigation, whereas the loss is trifling. It states further that a man with the permission of the owner can restore a decayed dyke, although without the owner's consent he cannot use it. Narada classifies the dykes into *kheya* (which is dug into the soil to drain off excess water) and *bandhya* (which is constructed to prevent the water from flowing out)'.

Crops

A number of crops were grown during this period, such as rice, wheat, barley, peas, lentil, pulses, spices and vegetables. Kalidasa in his *Raghuvamsa* refers to paddy being grown in the fields of Bengal. The varieties of rice grown included *sali, kamala, nivara, uncha*-paddy and *syamaka*-paddy, red rice, yellow rice and hog's rice.... *Sali*-paddy was grown by transplanting seedlings. This means that the tachnique of transplanting was known to the cultivators. Wheat was grown in the Punjab, Uttar Pradesh, Bihar, central India and Rajasthan as a winter crop. Of the vegetables grown, the *Amarakosha* mentions cucumber, onion, pumpkin and gourd. Sugarcane was grown in fields close to rice fields, and harvested in winter. Cotton was grown mainly in Saurashtra or Kathiawar. The cultivation of silk-cotton, flax and hemp was also known. Pepper and cardamom were grown principally in the southern parts of India, particularly in the valleys of the Nilgiris. The other spices grown included mustard, cloves, ginger and turmeric. Saffron, betel-nut, tamarind, sesamum, linseed, *priyangu*, aloe, indigo were also grown. Of the number of fruits grown, mango was the most popular. Coconut was extensively cultivated in the coastal areas of Bengal, Orissa and Madras.[4]

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[4] *A Concise History of Science in India*, pp. 358, 359, 360, 361 and 362

The *Bṛhatsamhita* mentions the names of some plants and method of their propagaion. 'Kathal (Jack-fruit tree), Asoka, Kadali (plantain), Jambu, Lakoocha, Dadima, Drakshya, Palivata, Vijapura (Matulanga), Atimukhtaka—these are the plants to be propagated by means of cuttings besmeared with cowdung.'

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CHAPTER 30

THE KANAUJ EMPIRE OF HARSHAVARDHANA

A.D. 606 — A.D. 647

LIFE OF THE PEOPLE OF INDIA AND THEIR AGRICULTURE, AS DESCRIBED IN HIUEN TSANG'S *SI-YU-KI* AND BANA'S *HARSHACHARITA*

OUT of the ruins of the Gupta Empire arose four kingdoms in India at the close of the sixth century of the Christian Era. These kingdoms included the Maitrakas of Valabhi, the Chalukyas of Badami, the Pushpabhutis of Thanesar and Maukharis of Kanauj. Thanesar is an ancient site on the Sarasvati in Haryana, well known as the scene of the Mahabharata, the battle between the Kauravas and the Pandavas. At the close of the sixth century, Prabhakaravardhana was the ruler of Thanesar. He successfully fought the Huns and the Kushan king of Gandhara.

Prabhakaravardhana had two sons, Rajyavardhana and Harshavardhana, and a daughter Rajyashri. Rajyashri was married to Grahavarman, the Maukhari ruler of Kanauj. Grahavarman was slain by the king of Malwa and his queen Rajyashri was made a prisoner. Rajyavardhana defeated the king of Malwa, but was treacherously murdered by Raja Shashanka of Bengal, who was an ally of the king of Malwa. It was owing to these circumstances that Harshavardhana became the ruler of Thanesar. A great meeting of the nobles of Kanauj invited him to accept the throne of Kanauj. He accepted the request and moved his capital from Thanesar to Kanauj.

Harsha spent the early years of his reign in campaigning the country with an army of five thousand elephants, twenty thousand horses and fifty thousand infantry. Pedigree horses were imported for Harsha's cavalry from Vanayu (Waziristan), Aratta (Vahika or Punjab), Kamboja (Pamir region), Bharadvaja (northern Gadhwal), Sindhu-desa (Sindh *Doab*), and Parasika (Sassanian Iran). Bana mentions horses of six different colours in the King's stables. The *tanagana* type of horses, famous for their smooth and steady gait, are believed to have been obtained from northern Gadhwal. Their riders, the *khakkatas,* have been identified with an ancient tribe of the central Punjab. Bana refers to horses of especially good breeds and describes their build, habits, and distinguishing features.[1] Horses were maintained by the feudal chiefs, who brought them to the battlefield along with their soldiers. These feudal chiefs were rewarded by grants of land. The elephants were not unharnessed nor the soldiers unhelmeted

[1]Devahuti, P. *Harsha, a Political Study*, p. 190

for six years, during which period Harsha conquered the Punjab, Kanyakubja, Gauda (Bengal), Mithila and Orissa. Malwa, Gujarat and Kathiawar were also included in his kingdom. His advance to the Deccan was checked, A.D. 620, by the Chalukya king, Pulakesin II. Jalandhar in the Punjab was the boundary of Harsha's empire in the north, and Ganjam in the east, and the Narmada in the south.

Sanskrit replaced Prakrit, and was the language of religion, ritual, literature and science. The *Mahabharata,* the *Ramayana,* and the *Puranas* were popular throughout the country. As K. M. Munshi observes, 'The leading role as a highly trained and purposive agency in integration was played by Brahmanas: men of learning and teachers; literary men and religious preceptors; 'svamins' who specialised in the sacrificial lore; the Pasupatacharyas, who, feared and respected by the people, wielded vast influence over kings and founded temples and monasteries, all of which became the centres of the new socio-religious movement. *Smarta* Brahmanas were not only interpreters, commentators and lawyers, but also expounders of *Dharma.* The influence of the Brahmanas was felt throughout the country. They slowly reclaimed and raised millions of backward people. Under their inspiration, communities were uplifted and the cultural and spiritual elevation of the individual secured.'[2]

Our sources of information on the life of Indians and their agriculture in the seventh century of the Christian Era are *Si-yu-ki,* the travelogue of Hiuen Tsang, and *Harshacharita,* a biography of Harsha by his court poet Banabhatta.

Hiuen Tsang (also known as Hsuan-tsang and Yuan-Chwang), the Chinese scholar, came to India in 630 during the reign of Harsha. Leaving Loyang in 628, he passed through Turfan, Samarqand and Bamiyan. He visited Kashmir and Kulu in the north. He also travelled to Buddhist pilgrimage centres, viz. Kapilavasthu, Pataliputra, Nalanda, and Bodhgaya. He paid a visit to Nasik and from there came to Mathura. He resided in Nalanda on different occasions for about two years. He remained in India for about thirteen years (A.D. 630-643). Never before was such an arduous journey performed by any traveller with such meagre resources. He came in search of Buddhist texts and it is his faith which kept him inspired and enabled him to bear the rigours of the journey through pathless deserts and wild mountains. He left India with a large number of books on Buddhism and reached China in 645. He was honoured by the Emperor of China. He left an account of his travels in a book entitled *Si-yu-ki.* He was perceptive and his observations on places, people and plants are of great value as a contemporary record.

An account of the material condition of the Indians in the seventh

[2]Majumdar, R.C. (Ed.), *The History and Culture of the Indian People*: *The Classical Age*, p. xxi

century is provided by Hiuen Tsang. The towns and villages of Gandhara lay desolate due to the ravages of the Huns. The belt of the country below the Nepal hills comprising the ancient cities of Sravasti, Kapilavastu, Ramagrama and Kusinagara lay deserted and was the haunt of robbers and wild beasts. The tract of country along the east coast comprising Kalinga, Dhanakataka and Chola was thinly populated. The last region was covered with jungle. Great forests extended over the territory to the east of Takka as well as to the south-east of Maharashtra. But the greater part of the country, particularly the Indo-Gangetic plain, undoubtedly enjoyed prosperity. This is proved by the pilgrim's reference to the luxurious dresses of the people in certain tracts and the number of rich families in other regions. Above all, the general prevalence of peace and prosperity is indicated by the rich specimens of architecture, sculpture and painting.

Nalanda University

One of the most interesting accounts of Hiuen Tsang's travels is a description of the famous seat of learning at Nalanda in Bihar, which had become an international centre of Buddhism and attracted Buddhist scholars and monks from all over Asia. 'The curriculum included grammar, mechanics, medicine, logic, and metaphysics. Science was well established. Medicine was widely studied and included 'holding the lancet, in cutting, marking, and piercing with it, in extracting darts, in cleaning wounds, in causing them to dry up, the application of ointments and in the administration of emetics, purges, and oily enemas'. Astronomy was far advanced and the diameter of the world had been calculated. In physics, Brahmagupta (A.D. 628) had already, anticipating Newton, arrived at a Law of Gravity, and the Vaisesika school at an atomic theory.'[3]

Brahmagupta, renowned mathematician and astronomer, was a native of Bhillamala, a town between Multan and Ahilwara. The main topics dealt with in his *Brahmasphuta-Siddhanta* are: mean planetary motions, true planetary motions, problems of time, space and distance, lunar and solar eclipses, the rising and setting of planets, the moon's cusps and shadows, and conjunctions of planets. The greatest exponent of Aryabhata's system of astronomy was Bhaskara I (*c.* A.D. 629), a contemporary of Brahmagupta.[4]

People and Government

With respect to the ordinary people, Hiuen Tsang observes, 'although they are naturally light-minded, yet they are upright and honourable. In money matters they are without craft, and in administering justice

[3]Edwardes, M. *A History of India—From the Earliest Times to the Present Day*, p. 84
[4]Bose, D.M. (C. Ed.). *A Concise History of Science in India*, pp. 95, 96

they are considerate. They dread the retribution of another state of existence, and make light of the things of the present world. They are not deceitful or treacherous in their conduct and are faithful to their oaths and promises, and in their rules of government there is remarkable rectitude, while in their behaviour there is much gentleness and sweetness. With respect to criminals and rebels, these are few in number and only occasionally troublesome. When the laws are broken or the power of the ruler violated, then the matter is clearly sifted and the offenders punished. There is no infliction of corporal punishment; they are simply left to live and die, and are not counted among men. When the rules of morality or justice have been violated, or a man is dishonest or wanting in filial love, his nose or ears are cut off and he is expelled from the city to wander in the jungle till he dies. For other faults besides these, a small fine is exacted in lieu of punishment. In investigating crimes, the rod is not used to extort proofs of guilt. In questioning the accused, if he answers frankly, his punishment is proportioned accordingly, but if he obstinately denies his fault, in order to probe the truth to the bottom, trial by ordeal is resorted to.

'As the administration of the government is founded on benign principles, the executive is simple. The families are not entered on registers, and the people are not subjected to forced labour. The Crown-lands are divided into four parts. The first is for carrying out the affairs of State; the second, for paying the ministers and officers of the Crown; the third, for rewarding men of genius; the fourth, for giving alms to religious communities. In this way, the taxes on the people are light, and the services required of them are moderate. Every one keeps his worldly goods in peace, and all till the soil for their subsistence. Those who cultivate the royal estates pay a sixth part of their produce as tribute. The merchants who engage in commerce travel to and fro in pursuit of their calling. Rivers and toll-bars are opened for travellers on payment of a small sum. When the public works require it, labour is exacted but paid for. The payment is in strict proportion to the work done.'

People of Magadha, Malwa, Kutchh and Saurashtra

Hiuen Tsang made the following observations on the people of Magadha, Malwa, Kutchh and Saurashtra:

Magadha and Malwa. 'The soil is rich and fertile, and produces abundant harvests. Shrubs and trees are numerous and flourishing' flowers and fruits are met with in great quantities. The soil is suitable in an especial manner for winter wheat. They mostly eat biscuits made of parched corn-flour. The disposition of the men is virtuous and docile, and they are, in general, of remarkable intelligence. Their language is elegant and clear, and their learning is wide and profound.

'Two countries in India, on the borders, are remarkable for the great learning of the people, viz. Malwa on the south-west, and Magadha on the north-east. In this they esteem virtue and respect politeness (humanity). They are of an intelligent mind and exceedingly studious; nevertheless the men of this country are given to heretical belief as well as the true faith, and so live together.'

Kutchh. 'The population is dense; the quality of gems and precious substances stored up is very great; the produce of the land is sufficient for all purposes, yet commerce is their principal occupation. The soil is salty and sandy, the fruits and flowers are not plentiful. The country produces the hu-tsian tree. The leaves of this tree are like those of the Sz'chuen pepper (Shuh tsiau); it also produces the hiun-lu perfume tree, the leaf of which is like the thang-li. The climate is warm, windy, and dusty. The disposition of the people is cold and indifferent. They esteem riches and despise virtue.'

Saurashtra. 'The soil is impregnated with salt; flowers and fruits are rare. Although the climate is equable, yet there is no cessation of tempests. The manners of the people are careless and indifferent; their disposition light and frivolous. They do not love learning and are attached both to the true faith and also to heretical doctrine.'[5]

Towns and Buildings

Hiuen Tsang made the following observation on the towns and villages of India. "The towns and villages have inner gates; the walls are wide and high; the streets and lanes are tortuous, and the roads winding. The thoroughfares are dirty and the stalls arranged on both sides of the road with appropriate signs. Butchers, fishers, dancers, executioners, and scavengers, and so on, have their abodes without the city. In coming and going these persons are bound to keep on the left side of the road till they arrive at their homes. Their houses are surrounded by low walls and form the suburbs. The earth being soft and muddy, the walls of the towns are mostly built of bricks or tiles. The towers on the walls are constructed of wood or bamboo; the houses have balconies and belvederes, which are made of wood, with a coating of lime or mortar and covered with tiles. The different buildings have the same form as those in China: rushes, or dry branches, or tiles, or boards are used for covering them. The walls are covered with lime and mud, mixed with cow's dung for purity. At different seasons they scatter flowers about. Such are some of their different customs.

"The sangharmas are constructed with extraordinary skill. A three-storeyed tower is erected at each of the four angles. The beams and the

[5]Beal, S. *Chinese Accounts of India*, Vol. II, pp. 452, 453, 456 and 459

projecting heads are carved with great skill in different shapes. The doors, windows, and the low walls are painted profusely; the monks' cells are ornamental on the inside and plain on the outside. In the very middle of the building is the hall, high and wide. There are various storeyed chambers and turrets of different height and shape without any fixed rule. The doors open towards the east; the royal throne also faces the east.

SEATS, CLOTHING ETC.

"When they sit or rest they all use mats; the royal family and the great personages and assistant officers use mats variously ornamented, but in size they are the same. The throne of the reigning sovereign is large and high, and much adorned with precious gems; it is called the Lion-throne (*simhasana*). It is covered with extremely fine drapery; the footstool is adorned with gems. The nobility use beautifully painted and enriched seats, according to their tastes.

DRESS, HABITS ETC.

"Their clothing is not cut or fashioned; they mostly affect fresh-white garments; they esteem little those of mixed colour or ornamented. The men wind their garments round their middle, then gather them under the armpits, and let them fall down across the body, hanging to the right. The robes of the women fall down to the ground; they completely cover their shoulders. They wear a little knot of hair on their crowns, and let the rest of their hair fall loose. Some of the men cut off their moustaches, and have other odd customs. On their heads the people wear caps (crowns), with flower-wreaths and jewelled necklets. Their garments are made of Kiau-she-ye (*kauseya*) and of cotton. Kau-she-ye is the product of the wild silkworm.

"In North India, where the air is cold, they wear short and close-fitting garments, like the Hu people. The dress and ornaments worn by non-believers are varied and mixed. Some wear peacocks' feathers; some wear as ornaments necklaces made of skull bones (the *Kapaladharinas*); some have no clothing, but go naked (*Nirgranthas*); some wear leaf or bark garments; some pull out their hair and cut off their moustaches; others have bushy whiskers and their hair braided on the top of their heads. The custom is not uniform, and the colour, whether red or white, not constant.

"The Kshatriyas and the Brahmans are cleanly and wholesome in their dress, and they live in a homely and frugal way. The king of the country and the great ministers wear garments and ornaments different in their character. They use flowers for decorating their hair, with gem-decked caps; they ornament themselves with bracelets and necklaces.

"There are rich merchants who deal exclusively in gold trinkets, and so on. They mostly go bare-footed; few wear sandals. They stain their

teeth red or black; they bind up their hair and pierce their ears; they ornament their noses, and have large eyes. Such is their appearance.

CLEANLINESS, ABLUTIONS ETC.

"They are very particular in their personal cleanliness, and allow no remissness in this particular. All wash themselves before eating; they never use that which has been left over (from a former meal); they do not pass the dishes. Wooden and stone vessels, when used, must be destroyed; vessels of gold, silver, copper, or iron after each meal must be rubbed and polished. After eating they cleanse their teeth with a willow stick, and wash their hands and mouth.

"Until these ablutions are finished they do not touch one another. Every time they perform the functions of nature they wash their bodies and use perfumes of sandal-wood or turmeric."[6]

COTTAGE INDUSTRIES—TEXTILES, LEATHER AND IVORY

In the *Harshacharita* we find a mention of *pulakabandha* (gaily coloured cloth) and *pushpapatta* (flowered silk), and bark used by ascetics. Ajanta frescoes reveal four distinct weaving techniques, namely gold or silver brocade, "tie-and-dye work", weaving after separate dyeing of the warp and the woof, and the spotted muslin.

From a passage in Santideva's *Siksha-samuchchaya* (a work of the seventh century of the Christian Era) we learn that Banaras retained its reputation as the producer of the best silk garments. A slight reference in the *Harshacharita* proves that the *kshauma* cloth of the Pundra country was sufficiently well known to find its way into the author's village home. Hiuen Tsang states that Mathura produced a fine striped variety of cotton cloth in his time. Indirect evidence of the advanced condition of the textile industry in Kamarupa is found in the list of presents sent by its King to Harsha. The list comprised bundle of *kshauma, jatipattika* (woven silk) and *chitrapata* (figured textiles).

'Among the industries dealing with animal products there are two deserving special mention. As regards the leather industry the *Amarakosa* has synonyms for leather-fan, leather-bottle for containing oil, leather shoes and boots. Representations of human or divine figures in leather boots or shoes are found in the contemporary sculptures and paintings. As regards ivory work, repeated references are found in the literary works of this period.'[7]

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[6] Beal, S. *Chinese Accounts of India*, Vol. II, pp. 132, 133

[7] Majumdar, A.K. (Ed.), *The History and Culture of the Indian People: The Classical Age*, pp. 592, 593, 594

AGRICULTURE

Crops. Hiuen Tsang also mentions the characteristic products of the regions visited by him. From his account, it appears that cereals like wheat, rice and millets and fruits were extensively cultivated. He specifically mentions a dozen states which were remarkable for their fertile soil, good farming and rich crops. In Poonch and Mathura, fruits were grown in orchards adjoining homesteads. Paryatra (Bairat) produced a variety of rice which was ready for harvesting in sixty days while Magadha grew another variety with large grains of extraordinary fragrance which was called 'rice for grandees.'

Shaman Hwui Li, the disciple of Hiuen Tsang, referrring to his guru's residence at Nalanda monastery, states, 'After this he went to reside in a dwelling to the north of the abode of Dharmpala Bodhisattva, where he was provided with every sort of charitable offering. Each day he received 120 *jambiras,* 20 pin-long-sten (*puga,* arecanut), 20 tan-k'an (nutmegs), an ounce (tael) of camphor and a ching (peck) of Mahasali rice. This rice is as large as the black bean and when cooked is aromatic and shining, like no other rice at all. It grows only in Magadha, and nowhere else. It is offered only to the King or to religious persons of great distinction and hence the name Kung-ta-jin-mai (i.e. rice offered to the great householder).'[8]

Fruit Plants. The Amala fruit (Ngan-mi-lo), the Madhuka fruit (Mo-tu-kia), the Bhadra fruit (po-ta-lo), the Kapittha fruit (kie-pi-ta), the Mocha fruit (Mau-che), the Narikela fruit (Na-li-ki-lo), the Panasa fruit (Panna-so). It would be difficult to enumerate all the kinds of fruits; we have briefly named those most esteemed by the people. As for the date (Tsau), the chestnut (Lih), the loquat (P'i), and the persimmon (Thi) they are not known. The pear (Li), the wild plum (Nai), the peach (T'au), the apricot (Hand or Mui), the grape (Po-tau)., etc., these all have been brought from the country of Kashmir, and are found growing on every side. Pomegranates and sweet oranges are grown everywhere.

Vegetables. In cultivating the land, those whose duty is to sow and reap, plough and harrow (weed), and plant according to the season; and after their labour they rest a while. With respect to edible herbs and plants, we may name ginger and mustard, melons and pumpkins, the Heun-lo (Kandu?) plant, and others. Onions and garlic are little grown; and few persons eat them; if any one uses them for food, they are expelled beyond the walls of the town.

The most usual food is milk, butter, cream, soft sugar, sugar-candy, the oil of the mustard-seed; and all sorts of cakes made of corn are used as food. Fish, mutton, gazelle, and deer they eat generally fresh.

[8]Gode, P.K. *Studies in Indian Cultural History,* Vol. I, p. 260

Utensils

They have many vessels made of dried clay; they seldom use red copper vessels: they eat from one vessel, mixing all sorts of condiments together, which they take up with their fingers. They have no spoons or cups, and in short no sort of chopstick.

Drinks

With respect to the different kinds of wine and liquors, there are various sorts. The juice of the grape and sugarcane, these are used by the Kshattriyas as drink; the Vaisyas use strong fermented drinks; the Sramans and Brahmans drink a sort of syrup made from the grape or sugarcane, but not of the nature of fermented wine.

Land Revenue Administration

Commenting on administration and land revenue Hiuen Tsang observes, "As the government is tolerant, administrative duties are simple. There is no registration of households, nor is there *corvee* for individuals. Royal land is divided generally into four parts... (for defraying various expenses). For this reason, tax and *corvee* are light, and the people are happy to follow the calling of their forefathers. Those who work as tenant farmers on the royal estate hold land in proportion to the number of persons in the family, and they pay a tax of one part in six."[9]

Bana's Observations on Agriculture in Harshacharita

Bana's *Harshacharita* provides a vivid picture of Indian society, manners and customs, climate, crops, ornamental plants and domestic animals. These are based on inside knowledge of a native with a keen sense of observation.

Autumn

Bana thus describes autumn, when the rains stop and paddy ripens. 'It was the beginning of autumn, when the clouds are thinned, when the *cataka* is distressed, when the *kadamba* duck gives voice—the season deadly to frogs, robbing the peacock of its pride. Then the caravans of *haṃsas* are welcomed back, the sky is like a whetted sword, the sun brilliant, the moon at her clearest, tender the array of stars. The rainbow of Indra fades, the girdling lightning is at rest, the waters run hued like lapis lazuli, the clouds rolling light as mists leave Indra unemployed. Then closes the *Nipa*, the *Kutaja* has no flower; budless is the plantain, soft the red lotus, the blue lotus exudes honey; the water-lily is a joy, the nights are cool with

[9]Beal, S. *Chinese Accounts of India*, Vol. II, p. 143

the *Cephalika,* the jasmine becomes fragrant; the ten regions are all ablaze with opening night lotuses, grey are the winds with *Saptacchada* pollen, lovely clustering *Bandhukas* form an unexpected evening glow. The horses have undergone lustration, the elephants are wild, the herds of oxen intoxicated with ferocity. The range of mud diminishes, young sand isles bud forth by the river banks. The wild rice is parched to ripeness, the pollen is formed in the *Priyangu* blossoms, the cucumber's skin is hardened, and the reed grass smiles with flowers.'

PRODUCTS OF ASSAM

Bana describes in detail the presents sent to Harsha by the heir apparent of Assam through a messenger, Hamsavega by name. The king inspected an elaborate umbrella brought by the messenger. Bana states, 'This having been first inspected by the king, the servants in due order displayed the remaining presents. Among them were famous ornaments inherited from Bhagadatta and other renowned kings, ornaments which crimsoned the heavenly spaces with the light of the finest gems: the prime of sheeny crest jewels: pearl necklaces: silken towels, pure as the autumn moon's light, rolled up in baskets of variously coloured reeds: quantities of pearl, shell, sapphire, and other drinking vessels, embossed by skilful artists: loads of Kardaranga leather bucklers with charming borders, bright gold-leaf work winding about them, and cases to preserve their colour: soft loin-clothes smooth as birch bark: pillows of *samuruka* leather, and other kinds of smooth figured textures: cane stools with the bark yellow as the ear of millet: volumes of fine writing with leaves made from aloe bark and of the hue of the ripe pink cucumber: luscious milky betel nut fruit, hanging from its sprays and green as young *harita* doves; thick bamboo tubes containing mango sap and black aloes oil, and fenced round with sheaths of *Kapotika* leaves, tawny as an angry ape's cheeks: bundles contained in sacks of woven silk and consisting of black aloe dark as pounded collyrium, *Goçirṣa* sandal stealing the fiercest inflammation away, camphor cool, pure, and white as bits of ice, scent bags of musk oxen, *Kakkola* sprays, clove flower bunches, and nutmeg clusters, all bristling with masses of ripe fruit: cups of *ullaka,* diffusing a fragrance of sweetest wine: heaps of black and white chowries: carved boxes of panels for painting, with brushes and gourds attached to hold the paints: curious pairs of *Kinnaras,* ourang-outangs, *jivanjivaka* birds, and mermen, with necks bound in golden fetters: musk deer scenting the space all round them with their perfume: female *chamara* deer, used to running about the house: parrots, *carikas,* and other birds enclosed in gold-painted bamboo cages and chattering copious wit: partridges in cages of coral: and rings of hippopotamus ivory, encrusted with rows of huge pearls from the brows of elephants.'

THE ECONOMY OF A FOREST SETTLEMENT IN CENTRAL INDIA

Harsha had marched into Central India to recover his sister, Rajyashri. Bana describes in detail the economy of a forest village in the black cotton soil region of Madhya Pradesh. Bana states, 'The next day he set out with the horse in search of his sister, and in a comparatively few days' march reached the Vindhya forest. Entering, he saw while still at some distance a forest settlement, distinguished by woodland districts turned grey by the smoke from granaries of wild grain in which heaps of burning *Ṣaṣtika* chaff sent up ablaze. Wherein were huge banyans, encircled with cowpens formed of a quantity of dry branches; tiger-traps, constructed in fury at the slaughter of young calves; zealous foresters violently seizing the axes of trespassing wood cutters; and Durga arbours built of tree clumps in the thickets. The outskirts being for the most part forest, many parcels of rice-land, threshing-ground, and tilth were being apportioned by small farmers, and that with no little vigour of language, since it was mainly spade culture and they were anxious for the support of their families. No great amount of coming and going tramped the earth owing to the difficulty of ploughing the sparsely scattered fields covered with *Kaca* grass, with their few clear spaces, their black soil stiff as black iron, the branches bursting from the tree trunks set up here and there, their growths of impenetrable *Cyamaka,* their wealth of *Alambusa,* and their *Kokilaksa* bushes not yet cleared away. Near the tillage scaffolds constructed above ground suggested incursions of wild beasts.

'In every direction at the entrance to the forests were drinking arbours made of wayside trees, which by their coolness seemed to dispel the summer heat: arbours, where the shade was dappled by fresh shoots made grey by the dust of travellers' stamping feet, where were *Nāgasphuṭa* bushes planted in the vicinity of freshly dug tanks bedecked with bunches of *Sal* flowers easily obtained from the woods, tiny huts formed of close-woven wattles, heaps of crocks dotted with meal and encircled by twisted braids of flies, stones of rose-apples *(jamun)* which travelling folk had eaten scattered over the ground about them, masses of *Dhuli-Kadamba* flowers with the pollen formed, wooden stands surmounted by an array of bristling water jars to steal away thirst, cool porous vessels with dripping bases for allaying weariness, pitchers black with moist aquatic plants for the purpose of keeping the water cold, bits of pink gravel taken from ewers to cool the air, cups having pink flowers tied by straw whisps about their necks, tree trunks bristling with bunches of juicy young mango fruit forbidden to wither by bundles of dew-besprent twigs, and successive troops of resting pilgrims drinking the water.

'In other places again blacksmiths were almost intensifying the heat by burning heaps of wood for charcoal. On every side the prospect was filled with the inhabitants of the district, who dwelt in the surrounding

country, entering woods to collect timber and enveloped in the provisions guarded for them by old men stationed in the hamlet houses of the vicinity. Their bodies they had anointed to prepare themselves for their hard sylvan toils. On their shoulders were set strong axes, and about their necks hung their breakfast bundles. They wore ragged clothes for fear of thieves. Their water they bore in jars having mouths covered with corks of leaves and attached to their necks which were encircled by triple collars of black cane. Strong oxen marched before them in couples.

'Ranging on the outskirts were hunters, who grasped snares with intricate loops formed of animals' sinews, and bore coiled traps and netted nooses fastened to a quantity of screens used in shooting wild beasts. Fowlers roamed hither and thither, loaded with cages for falcons, partridges, *kapinjalas,* and the like, while their boys loitered about with aviaries hanging from their shoulders. Troops of childish trappers wandered in eager pursuit of female sparrows caught with twigs whereon a little cast-away pulse broth was smeared. Young hunters, practising bird-catching, coaxed on a tribe of dogs frightened at partridges hidden in clumps of grass.

'There were people moving along with bundles of *Cidhu* bark, hued like an old ruddy-goose's neck, countless sacks of recently uprooted *Dhataki* flowers of the colour of red ore and of cotton plants, plentiful loads of flax and hemp bundles, quantities of honey, peacocks' tail-feathers, wreaths of compressed wax, barkless *Khadira* logs frilled with hanging *Lamajjaka* grass, large bundles of *Kuṣṭha,* and *Rodhra* yellow as a fullgrown lion's mane. Village wives hastened en route for neighbouring villages, all intent on thoughts of sale and bearing on their heads baskets filled with various gathered forest fruits.

'Here and there the preparation of unsightly fields of barren soil was being effected by numerous lines of wagons, bearing heaps of manure from old dust heaps and yoked to strong young steers, while to the creaking of their loose and noisy wheels were added the angry cries of the dust-grey ploughboys who sitting on the poles urged them on. The surrounding country was black with numerous sugarcane enclosures, showing wide carefully tended branches, buffalo skeletons fixed on stakes to scare with their sharp points the rabbits which devastated the rising buds, and high bamboo fences which the antelopes lightly leapt when startled by ox-drivers' sticks which the watchers hurled at them.

At very wide intervals were the dwellings of the forest householders, girt with orchards of emerald-bright *Snuha,* entangled with thickets of bamboo suitable for bows, and difficult of access owing to rows of thorny *Karanja.* They had garden enclosures with clumps of *Garmut, Gavedhuka, Granthiparna, Cigru, Surana, Surasa, Vangaka, Vaca,* and the castor plant, and a network of *Kasthaluka* creepers, reared upon tall planted uprights, provided a shade. Young calves were tied to *Khadira* stakes fixed in the ground

in circular jujube arbours, and crowing cocks more or less indicated the positions of the houses. At the foot of *Agasti* trees in the yards tanks and drinking vessels for birds had been constructed, and pink masses of jujube were scattered around. The walls were formed of partitions made of slips of bamboo, leaves, stalks, and reeds, while for ornament *Gorocana* pigment and *Kimcuka* flowers were used. There were piles of charcoal tied with *Valvaja* grass, numerous heaps of cotton from the seemul tree fruit, stores of *Nala* rice, waterlily roots, candied sugar, white lotus seed, bamboos, and threshed rice ready at hand; also collections of *Tamala* seeds, mats worn from being used to pound ashes and disposed upon heaps of *Kacmarya,* a wealth of withered *Rajadana* and *Madana* fruit, abundance of *Madhuka* fruit decoctions, pots of safflower in excellent cupboards, no lack of *Rajamasha,* cucumber, *Karkatika,* and gourd seeds, and collections of living pets, such as wild-cats, *maludhana* snakes, ichneumons, *calijatakas,* and the like.'

Crops of Srikantha (Thanesar Tract)

Bana thus describes the products of Srikantha region (comprising the Thanesar tract in Haryana). 'Listen. There is a certain region named Shrikantha, peopled by the good, a heaven of Indra. Owing to the number of its land lotuses the ploughs, whose shares uproot the fibres as they scar the acres, excite a tumult of bees, singing, as it were, the excellencies of the good soil. Unbroken lines of *Pundra* sugarcane enclosures seem besprinkled by the clouds. On every side its marches are packed with corn heaps, like extemporized mountains, distributed among the threshing floors. Throughout it is adorned with rice crops extending beyond their fields, where the ground bristles with cumin beds watered by the pots of the Persian wheel. Upon its lordly uplands are wheat crops variegated with *Rajamasha* patches ripe to bursting and yellow with the split bean pods. Attended by singing herdsmen mounted on buffaloes, pursued by sparrows greedy for swarms of flies, gay with the tinkle of bells bound to their necks, roaming herds of cows make white its forests, revelling on *Vaspachedya* grass and dropping milk. Thousands of spotted deer dot the districts. Regions, pale with the dust of *Ketaki* beds emitting white pollen, gleam like the approaches of Shiva's City when made grey by the sprinklings of the Pramathas. Pot-herbs and plantains blacken the soil around the villages. At every step are groups of young camels. The exits are made attractive by vine-arbours and pomegranate orchards; arbours, ablaze with *Pilu* sprays, besmeared with the juice of hand-pressed citron leaves, having flower bunches formed of spontaneously gathered saffron filaments, and travellers blissfully sleeping after drinking the juice of fresh fruit, orchards, where the fruit, ripe to bursting, seems coloured by the beaks of the parrots attacking the seeds, and the flowers are tinged

by the cheeks of climbing monkey tribes. There are lovely groves where travelling folks plunder the date-trees, monkeys lick sweet-scented date juice, and partridges tear the *Aruka* to pieces with their beaks. Not barren are the sylvan hollows of forest pools, refuge of myriad travellers, encircled with avenues of tall *Arjuna* trees and turbid at the edges through the descent of herds of kine. Troops of camels and flocks of sheep form in hordes under the guardianship of camel boys. Wandering droves of mares, besmeared with the sap of crushed saffron beds, where they roll, with snorting nostrils and uplifted heads drinking in the air, as it were to beget speed in the young lying in their wombs.

'In such a country is a certain district called *Sthanvicvara,* blessed, like the world's first youth, with sweet fragrance of lovely flowers in diverse pleasances; bedecked, like the road to Dharma's gynaeceum, with many myriads of buffaloes stained from rolling in saffron; surpassing Tripura, as it were, in having all its people unacquainted with the devastating might of Shiva's arrow; bright, like a replica of the moon world, with rows of white houses plastered with stucco.'

Animals Used for Transport and Warfare

Harsha gives an order to his army to get ready and march towards Central India. Bana thus describes how the order was carried out. Incidentally we get an idea of domestic animals used for transport and warfare. 'Wicked elephants were loaded with a cargo of utensils hurriedly tossed upon them by travel-practised domestics. Amid the laughter of the crowd helpless corpulent bawds lagged as they were with difficulty dragged along with hands and legs sprawling sideways. Many huge and savage elephants trumpeted as the free play of their limbs was checked by the tightening of the girth-bands of their gaudy housings. A jangling of bells taking place in the elephant troop inflamed all ears with fever. Camels, as sacks were set on their backs, bellowed at the outrage. The carriages of the high-born nobles' wives were thronged with roguish emissaries sent by princes of rank. Elephant riders, deceived as to the time of starting, searched for new servants. Highly honoured footmen led the fine horses of the king's favourites. An array of gay gallants employed thick unguents to draw circular lines of camphor on their persons. To the saddles of marshals were fastened martingales with wooden figures of deer, bells, and reeds attached. Apes were placed among troops of horses whose grooms were entangled in a network of coiled reins. Stablemen dragged along half-eaten shoots to be eaten at the morning manoeuvres. Loud grew the uproar of foragers shouting to one another. Much crashing of stables resounded as the young rearing horses swerved in the confusion of starting. Women, hastening at the call of riders whose elephants were in readiness, presented unguents for the animals' heads. The low people of the neigh-

bourhood, running up as the elephants and horses started, looted heaps of abandoned grain. Donkeys ridden by throngs of boys accompanied the march. Crowds of carts with creaking wheels occupied the trampled roads. Oxen were laden with utensils momentarily put upon them. Stout steers, driven on in advance, lagged out of greed for fodder lying near them. Despairing merchants saw the oxen bearing their wealth flee before the onset of the tumult. A troop of seraglio elephants advanced where the press of people gave way before the glare of their runners' torches. Horsemen shouted to dogs tied behind them. Old people sang the praises of tall Tangana horses which by the steady motion of their quick footfalls provided a comfortable seat. Deckhan riders disconsolately contended with fallen mules.'[10]

Land Revenue

Regarding the incidence of land revenue, Devahuti observes, 'It was an ancient practice to measure villages for purposes of land-tax in plough measures, i.e. the area that could be turned over with a plough pulled by a given number of oxen. Tax was then fixed on each plough measure. Inscriptions sometimes append numerical adjectives after the names of villages (*Sakambhara sapada-laksha*). Apparently, the numbers denote plough measures in the territory and the tax from it in a silver *panas*. Bana's reference to the area of village in terms of *siras* indicates that the land unit was also known by this name among others. The *sira* of Harsha's time was probably equal to the *Kulya-vapa* of the Gupta days. Sankara's commentary on the *Harshacharita* describes *sira* as *hala* (plough). The latter term was employed for land units in Andhra in the third century A.D. Manu's commentators state that as much land as could be cultivated by twelve oxen (double of a 'middling plough') was called *kula*. Bana's reference also suggests that an average village measured 1,000 plough units, which according to a late text, the *Sukraniti-sara*, comprised one square *praja-patya krosa*, or approximately 1,333 acres [450 hectares].

Land-tax was calculated per plough unit (one and a third acres at one silver *karsha-pana* a month). As a benedictory beginning to his march of conquest Harsha donated to brahmans a hundred villages, each delimited by a thousand ploughs and therefore capable of yielding tax of a thousand silver *panas* a month.[11]

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[10]Cowell, E. B. and Thomas, F. W. (trans.). *The Harshacharita of Bana*, pp. 70, 71, 213-215 225-229, 79-82 and 200-201.

[11]Devahuti, D. *Harsha, a Political Study*, p. 203

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CHAPTER 31

THE KINGDOMS OF SOUTH INDIA

THE CHALUKYAS AND RASHTRAKUTAS OF THE DECCAN
THE PALLAVAS, PANDYAS, HOYSALAS AND KAKATIYAS
A.D. 535 — A.D. 1300
PEOPLE, CROPS AND CATTLE

THE Narmada is the conventional boundary between the north and south India. The southern states are subdivided into two groups, viz. the kingdoms of the Deccan Plateau and the Tamil group of Kingdoms.

THE CHALUKYAS

The kingdoms of the Deccan Plateau were confined to the present-day territory of the Maharashtra State with the rivers Krishna and Tungabhadra as their southern boundary. The region of Karnataka was more closely connected with the Decccan kingdoms than with the Tamil States. Inscriptions on stone or copper plates, written in Sanskrit and Kannada, are our main source of information regarding the history of the Deccan kingdoms.

Pulakesin I (*c.* A.D. 535 to 566) was the founder of the Chalukya Dynasty. His capital was Badami (Vatapi) in the Bijapur District, where he built a hill fortress, A.D. 543. His successor Kirtivarman I (A.D. 566-597) beautified Vatapi with temples and other buildings. The next king Mangalesha (A.D. 597) completed the carving of Vaishnava cave temple of Badami started by his father. The rock-cut sculptures of Vishnu in Badami caves are monumental in proportion. Some sculptures with genre themes are also of interest. On a bracket, a loving couple is shown standing below the branches of a mango laden with fruit (Fig. 194, *right*). A similar type of couple can be seen in a seventh-century temple at Pattadakal (Fig. 194, *left*). These sculptures indicate that mango was a favourite fruit of Indians in the south too.

The Durga and Ladkhan temples at Aiholli, well known for their beautiful Shaivite sculpture, were built in the sixth century. The slab on which the Flying Gandharvas are sculpted was in the Durga temple. Now it is in the National Museum, New Delhi, and is a masterpiece of Indian sculpture.

Pulakesin II (A.D. 609-642) successfully resisted Harsha, and about A.D. 620 the Narmada was recognized as the boundary between the northern kingdom of Harsha and the southern kingdom of Chalukyas. Pulakesin II sent an embassy to the court of the Persian king, Khusrau II, A.D. 620. He carried on warfare with the Pallava king Narasimha and this

feud was carried on by his successors. Another group of temples was constructed at Pattadakal, 16 kilometres from Badami. Out of these, Papanath (A.D. 680) and Virupaksha temples have some exquisite sculptures. Kirtivarman II, who succeeded to the throne in 744, was overthrown by Dantidurga, the founder of the Rashtrakuta Dynasty.

The Rashtrakutas

The Rashtrakutas belonged to Lattalura (modern Latur), a town in the Usmanabad District of Andhra Pradesh. The founder of the dynasty was Dantidurga, an official of the Chalukyas of Badami. Realizing the weakness of his overlord, Kirtivarman II, Dantidurga made himself the master of Maharashtra and also annexed Gujarat and parts of Madhya Pradesh. In A.D. 753, he proclaimed himself the paramount ruler of the Deccan. In A.D. 756, he was succeeded by his uncle Krishna I, who defeated the Gangas of Karnataka. The monolithic Kailasha temple at Ellora was excavated under his patronage. It was cut out of rock from top downwards, and the precision of its architecture and the beauty of its sculptures remain unrivalled. Krishna I died in A.D. 773, and was succeeded by his son Govinda. Amoghavarsha I (A.D. 814-880) was the builder of the Manyakheta City. He built a palace at Manyakheta which was famous for its fine workmanship. The next kings were Krishna II, Indra III, and Krishna III. The last invaded the Chola territory and defeated the Chola king at Takkolam (A.D. 949).

The Pallavas

Simhavarman (A.D. 550-558) was the founder of the Pallava Dynasty, which had its capital at Kanchi (Conjevaram). His son Mahendravarman I (*c.* A.D. 600-630) was a poet, musician and great builder of temples. He introduced the rock-cut temple architecture in Tamil country. One of his titles was *Vichitrachitta,* a tribute to the imaginative quality of his mind. Reliefs of Mahendravarman I and his two queens are found on the walls of a rock-cut temple at Mamalapuram, and it seems he pioneered the carving of these temples.

Narasimhavarman Mahamalla (A.D. 630-668), a wrestler and warrior, succeeded Mahendravarman I. One of Narasimhavarman's achievements was a successful naval expedition to Ceylon to reinstate the Sinhalese prince Manaverma. Narasimhavarman beautified the port of Mamallapuram. It was during his reign about A.D. 640 that Hiuen Tsang travelled in the south. He found Jainism flourishing in the Pallava and Pandya kingdoms. Hiuen Tsang states, 'Kanchi was about six miles [9.6 kilometres] in circumference. There were more than one hundred Buddhist monasteries housing over 10,000 Theravadin monks. The majority of the eighty non-Buddhist temples belonged to Digambara Jains. Though

Buddhism was declining in South India, its position in Tonda-mandalam was conspicuous. The people (of Ta-to-p 'i-t' u or Tonda-mandalam) esteemed great learning.... Not far from the south of the capital was a large monastery which was a rendezvous for the most eminent men of the country.'[1]

Parmeshvara-Varman was succeeded by his son Narasimhavarman II Rajasimha (*c.* A.D. 699-722). He built the Kailashnatha temple at Kanchi and the Shore temple at Mahabalipuram. The next king was Nandi-Varman II Pallavamalla (A.D. 730-800). He built the Muktesh-wara and Vaikuntha-perumal temples at Kanchi. He was a scholar who patronized learning. Saint Tirumangal Alvar flourished during his reign.

Sittannavasal. In the sixth or seventh century, a rock-cut Jain sanctuary was built at Sittannavasal near Pudukottai. It is a square hall with a vestibule before it, and is noted especially for its frescoes, which are stylistically akin to those in the caves of Ajanta. The most remarkable of these frescoes, on the ceiling of the vestibule, depicts animals drinking from a lotus pool.

Mamallapuram (Mahabalipuram). Mamallapuram, or "the Seven Pagodas", is on the coast of the Bay of Bengal. Early in the Christian Era, it was an important port which maintained trade relations with the Roman Empire, as is proved by the Roman coins found here. The city is cited in the *Periplus of the Erythraean Sea* and Ptolemy's *Geography.* The existing monuments date from the Pallava period, with the earliest going back to the first half of the seventh century. Not far from the shore are five monolithic temples (*rathas*), bearing the name of the five Pandavas, heroes of the epic *Mahabharata.* Each of these temples, cut from a single block of granite, has an individual form: a square plan with pyramidal covering, supporting small-scale models of buildings, as in the Dharmaraja Ratha and the Arjuna Ratha; a square plan, with a roof imitating that of a thatched cottage, as in the Draupadi Ratha; a rectangular plan with one storey adorned with niches, as in the Bhima Ratha; and an apsidal plan as in the Buddhist *chaitya* (Sahadeva Ratha). Large monolithic animals—lions, elephants, and oxen—are found among these temples.

About the same time, caverns were cut in the rock. The principal ones are those of the Trimurti, which has three cells, each containing an image of a god; the cave of Durga, in which are carved Vishnu on the serpent Sheshanag and Durga combating the demon Maheshasura; and the most important is that of Varaha (whose peristyle is adorned with pillars supported by kneeling lions), which is decorated with four bas-reliefs of the goddesses Lakshmi and Durga, and the Varaha and Trivikrama incarnations of Vishnu.

[1]Majumdar, R.C. *The History and Culture of the Indian People : The Classical Age*, p. 261

The most distinguished relief is the one carved into the living rock that depicts the descent of the Ganga to the earth; the water which gushes from a natural fissure in the rock represents the Ganga. Many details—ascetics at prayer, pilgrims, animals of all kinds heading towards the sacred water—constitute the charm of this splendid composition. Along each side of the current of the Ganga are grouped ascetics, *nagas* and animals. The animals commonly depicted are deer and lions which must have abounded in the jungles of South India (Fig.195). It is to be noted that tigers are not depicted.

The Pandyas

The genealogy and chronology of the Pandyas, who ruled the extreme south, is very confused. The Pandyas of the post-Sangam age ruled from the seventh to tenth centuries. R. Sathianathaier thus fixes their chronology. 'Kadungon, A.D. 590-620; Maravarman Avanisulamani, A.D. 620-645; Sendan, A.D. 645-670; Arikesari Maravarman, A.D. 670-710; Kochchadaiyan Ranadhira, A.D. 710-740; and Maravarman Rajasimha, A.D. 740-765.[2] Hiuen Tsang describes the Malakuta or Pandya country as follows: 'It was a depot for sea-pearls; its people were 'black... harsh and impetuous, of mixed religions, indifferent to culture and only good at trade.' There were many Buddhist monasteries in ruins but only a few monks. The destruction of the ancient cultural tradition of Madura may be attributed to the Kalabhra occupation of the country.' Maravarman Rajasimha I was also a very powerful ruler. The Velvikudi grant mentions Rajasimha's renovation of the palaces and fortifications of Kudal (Madura), Vanji (the Chera capital) and Koli (Uraiyur).[3]

The Hoysalas

The Hoysalas who belonged to the clan of Yadavas were the feudatories of the Chalukyas. They ruled the central Mysore country, which served as a buffer between the Chalukya and Chola empires. The Hoysala Dynasty was established by Vishnuvardhana (A.D. 1111-1191), who is also known by the name of Bittiga. Originally a Jaina, he became a Vaishnava under the influence of Ramanuja. The Hoysala capital was Dvarasamudra (modern Halebid). The temples at Belur and Halebid with their elaborate carvings and bracket figures of damsels with bulging bosoms were constructed under the patronage of Bittiga.

The Kakatiyas

The Kakatiyas were feudatories of the western Chalukyas. Prola II

[2]Majumdar, R.C. (Ed.), *The History and Culture of the Indian People : The Classical Age*, p. 267, 268

[3]Sastri, K.A.N. *The Pandyan Kingdom*, p. 41

was the first independent Kakatiya ruler, and his territory comprised districts between the Godavari and the Krishna, and Warangal was his capital. Ganapati was the Kakatiya (A.D. 1199-1263) who led expeditions against Kalinga and western Andhra. Partap Rudra (A.D. 1295-1326) conquered Adoni and Raichur from the Yadavas. He was an efficient administrator and divided his territory into 77 Nayakships. Malik Kafur extinguished the Kakatiya kingdom in A.D. 1310, and Partap Rudra died as a prisoner of the Muslims.

The People

Hiuen Tsang made very perceptive observations on the people in different States of South India, which are true even now after the lapse of so many centuries. He travelled from Bihar to Orissa, Andhra, Dravida, and Maharashtra.

About Kalinga and its people he writes, 'The forests and jungle are continuous for many hundred li. It produces the great tawny wild elephants, which are much prized by neighbouring provinces. The climate is burning; the disposition of the people vehement and impetuous. Though the men are mostly tough and uncivilised, they still keep their word and are trustworthy. The language is light and tripping, and their pronunciation distinct and correct.'

On Andhra and on the people of Andhra, he commented, 'The soil is rich and fertile; it is regularly cultivated, and produces abundance of cereals. The temperature is hot, and the manners of the people fierce and impulsive. The language and arrangement of sentences differ from Mid-India.'

About Dravida, he states, 'The soil is fertile and regularly cultivated, and produces abundance of grain. There are also many flowers and fruits. It produces precious gems and other articles. The climate is hot, the character of the people courageous. They are deeply attached to the principles of honesty and truth, and highly esteem learning; in respect of their language and written characters, they differ but little from those of Mid-India.'

Hiuen Tsang visited Pulakesin at Nasik, A.D. 641-642. Describing the king he says, 'His ideas are large and profound, and he extends widely his sympathy and benefactions.' About Maharashtra, he commented, 'The soil is rich and fertile; it is regularly cultivated and very productive. The climate is hot; the disposition of the people is honest and simple; they are tall of stature, and of a stern, vindictive character. To their benefactors they are grateful; to their enemies relentless. If they are insulted, they will risk their life to avenge themselves. If they are asked to help one in distress, they will forget themselves in their haste to render assistance. If they are going to seek revenge, they first give their enemy

warning; then, each being armed, they attack each other with lances (spears). When one turns to flee, the other pursues him, but they do not kill a man down (a person who submits). If a general loses a battle, they do not inflict punishment, but present him with woman's clothes, and so he is driven to seek death for himself. The country provides for a band of champions to the number of several hundred. Each time they are about to engage in conflict they intoxicate themselves with wine, and then one man with lance in hand will meet ten thousand and challenge them in fight. If one of these champions meets a man and kills him, the laws of the country do not punish him. Every time they go forth they beat drums before them. Moreover, they inebriate many hundred head of elephants, and taking them out to fight, they themselves first drink their wine, and then, rushing forward in mass, they trample everything down, so that no enemy can stand before them.'[4]

Society

'The independent landholder, artisan or trader commanded greater esteem in society than officials of the State, states Sastri. In the enjoyment of the social amenities, there was a wide gap between the wealthy section of the nobles and the rest of the population. In spite of their poverty the brahmanas commanded the goodwill of the kings and respect of the people by their character and learning. Women enjoyed freedom in their movements and were held in great honour. Often a courtesan was a formidable rival to the wedded wife in the families of kings and nobles.

'A select body of troops who shared a meal with the king at the time of his accession and were sworn to defend him with their lives on all occasions were known by different names in different courts—*Sahavasis* under the Chalukyas, *Velaikkarar* under the Cholas, *Garudas* under the Hoysalas, and *Apattudavigal* under the Pandyas.'

Education

'The village teacher got a share of the village land besides other presents on festive and ceremonial occasions from the parents of the children. Skill in the crafts was passed from father to son. The building of a large temple or a palace not only gave employment to men of proved ability but also provided opportunity of discovering fresh talent. Artisans had an innate sense of beauty and some of them were very skilful. The literary quality of the inscriptions on temple walls and on copper plates attests that the level of the general education was fairly high. Adult education was carried on by means of oral expositions of the epics and *Puranas*. The singing of the devotional songs in temples by well-trained choirs of singers

[4]Beal, S. *Chinese Accounts of India*, Vol. II, pp. 413, 421, 450, 453, 459

promoted religious fervour and aesthetic sense among the people. The *mathas, pallis* and *viharas* played a large part in education. The basic value of Sanskrit learning was realized and generous endowments were made to institutions to impart Sanskrit learning. The Brahmapuri at Belgaum, the Ghatika of Kanchi, and the college at Bahur are examples from the age of the Chalukyas of Badami and Pallavas of Kanchi. A minister of Krishna III endowed in A.D. 945 a college at Salatgi in Karnataka to which pupils came from different *janapadas*. There was a *ghatika* at Nagai (A.D. 1058) which had a provision for 200 Veda students and 50 students of Shastras. The institution had six teachers and a library. At Ennayiram in South Arcot, Chola Rajendra I endowed a college to take in two hundred and seventy junior students and seventy seniors with a teaching staff of fourteen persons. At Tirumukkudal (Chingleput District) there was a hostel for students and a hospital as revealed in the records of Virarajendra (A.D. 1067). At Tiruvaduturai there was a medical school and here the students were taught *Ashtangahridaya* and *Charakasamhita*. There was a school for the study of Panini's grammar at Tiruvorriyur. The Yadavas of Devagiri very much encouraged the study of law and astronomy.'[5]

The Temple—the Seat of Religion and Education

The temple played a pivotal role in the social and cultural life of the people. It was usually located in the centre of the habitation. Its pillared *mandapams* were crowded with pilgrims on the occasion of festivals. The pilgrims had a dip in the sacred tank which adjoined the temple. Leading to the *sanctum sanctorum* were many shops in which garlands and flowers were sold to devotees. In the evening the deity, Vishnu or Shiva, was worshipped with the lighting of oil-lamps amidst great religious fervour. The *deva-dasis*, the dancing-girls, also displayed their art to the accompaniment of an orchestra of drums and flutes. The temple was not only a place of worship, but also a school, where children of the villagers came to receive education in Sanskrit from the learned priests. It also provided employment to a large number of masons and stone-carvers, who carved the images which decorated the *mandapams* and *gopurams*. In times of civil unrest or war, the temple served as a citadel fortress in which people took shelter.

Coinage

The Gupta coins show the influence of the Greek and Kushan coinage. The earliest Gupta gold coins follow the Kushan standard of about 121 grains and were known as *dinara* (from Latin *denarius*). Skandagupta's coins were struck on two standards, one following a local standard of 132

[5]Sastri, K.A.N. and Srinivasachari, G. *Advanced History of India*, 1970, pp. 303, 304

grains, and the other, probably the *suvarna* standard of 146.4 grains. In South India, foreign influence is hardly noticeable. Here, gold and copper were almost exclusively used, though silver was not altogether unknown. Roman coins—gold, silver and probably also copper—have been found in the south in such a large number that it is probable that they were actually used as currency in South India.

Trade Between India and China

The T'ang period witnessed a great development of the sea-borne trade between India and China. An account written about A.D. 749 refers to the numerous merchantmen belonging to the Polomen, i.e. Brahmanas of India, and other countries, on the River of Canton. The same account refers to three Brahmana monasteries at Canton where Brahmanas were residing. It is evident that Hindu merchants sailed in large number to this Chinese port, and had built temples there for worship during their stay. According to *Harshacharita,* Chinese cuirasses were used by the chiefs of Harsha's army. The discovery of coins of the T'ang Dynasty in South India may also be regarded as an interesting relic of the commercial relations between India and China during this period.

The foreign ships in Canton are said to be 18 to 21 metres deep. Another Chinese work says that the foreign ships visiting Canton "were very large, and so high out of the water that ladders, several tens of feet in length, had to be used to get aboard."[6] Such a ship is depicted in an eighth-century relief of Borobuddur in Java (Fig. 196).

In another Borobuddur relief a man is shown ploughing (Fig. 203, *top*). The wooden plough he is handling resembles a plough still in use in Jorhat, Assam (Fig. 203, *bottom*).

Exports

Cardamom (*Elettaria cardamomum),* produced in southern India, was highly prized in the Middle East. Costus-root (*Saussurea lappa*) was, like cinnamon and cardamom, processed in Syria and was used as incense.

Then came the different kinds of nard, of which spikenard was the most costly (*nalada* in Sanskrit), but which included *Cymbopogon schoenanthus* and *Vetiveria zizanioides* (*Andropogon muricatus*). Their roots and their leaves were used in perfumery, in cooking and in medicine; the oil extracted from the plants was so precious that it was kept in small jars of alabaster or onyx. Southern India had the competition of Ethiopia and southern Arabia in the preparation of this aromatic essence. Mention should also be made of cloves (*Syzygium aromaticum*); sesame (*Sesamum indicum*); indigo

[6] Majumdar, A.K. (Ed.), *The History and Culture of the Indian People: The Classical Age* Bombay, 1970, pp. 626, 627

(which was used not only for paints and dyes but also for the preparation of medicines), varieties of barberry (*Berberis floribunda, B. aristata, B. lycium*); opium and rhubarb were exported. Sugar was exported in small quantities, as were rice (*vṛhi* in Sanskrit, *arisi* in Tamil), millet and oats. These commodities were in demand by Indian expeditions abroad. *Ghee* (clarified butter) was exported to East Africa. Fruits, such as coconuts, bananas, melons, peaches and apricots, and vegetables, such as cucumber and onion, reached the Mediterranean ports from India.

Other merchandise sent abroad consisted of animals: talking parrots, tame monkeys, pheasants, snakes and elephants, all of which found places in the private zoos of Western kings and emperors. Since sea-travel affected them adversely, they were usually transported overland by caravans.

Slaves, too, constituted a profitable item of trade. The major part of it was under the control of the Arabs, who furnished Greek women to the Indians and Indian women to the Greeks, the greater the distance of their supposed place of origin the higher being the price to the buyer. Most of the women brought to India in this way were dancers or musicians, or else were imported specially to act as military guards in the royal harems.[7]

Imports

China sent musk, tung-oil, amber, cinnabar, raw and woven silk, hemp matting and cloth, ceramics, lacquered and copper objects, wooden combs, paper, parasols, iron cooking-vessels, sieves, needles and saddles. From the Khmer country, many valuable products were imported to supplement India's own output, particularly sandalwood, teak and aloes, cardamom, beeswax, kapok and kingfishers' feathers. Sumatra and Java furnished gold and musk. The Malay Peninsula exported silver and tin (called 'white lead' in those times) from its well-developed mines; it also sold the finest nutmeg, logwood and ivory.

During the entire period covered by the expansion of Rome, products of Mediterranean origin continued to come into India. These included red coral from Sicily, Sardinia and Corsica, the Balearic Islands, Spain and North Africa; copper, tin, antimony, realgar, silver vessels and lamps, bronze containers; yellow amber, which came also from the Baltic and was usually exchanged for precious stones; Egyptian emeralds; glassware from Alexandria, Tyre and Sidon.'[8]

Manasollasa of Someshvara

Here a reference may be made to the Sanskrit encyclopaedia, the *Manasollasa*, composed by Someshvara (*c.* A.D. 1127), the Chalukya king. It deals with subjects like drawing, painting, casting of metal images, ico-

[7,8] Auboyer, J. *Daily Life in Ancient India*, pp. 84—86

nography, cookery, cock-fighting, hunting, fishing and gardening. It also deals with the blending of perfumes, which were used for royal baths as well as for the ritual of worship. Its fourteenth chapter deals with zoology of fishes. Thirty-four varieties of fishes are named, and their habitat and food are described. Someshvara also describes lines, hooks and baits. '*Manasollasa* is rich in factual and deductive knowledge which in some respect remains unsurpassed even now', comments Hora.[9]

'While describing the horses being made ready for the royal polo, Someshvara refers to "*Padadharai*", or stirrups of gold, hanging down on both the sides of the horse. The use of the stirrup in the game of polo as played at the Chalukya court about A.D. 1130 is important as it proves the currency of the stirrup in Indian horsemanship more than 800 years ago.

Crops

With the expansion in irrigation, rice cultivation was extended over a larger area. Millets continued to be cultivated in the rain-fed areas of the Deccan and Mysore plateaus. There is, however, scant mention of crops in history. Perhaps people took them for granted. There were possibly no food shortages as population was sparse.

The names of crops are mentioned in relation to the land revenue payable to the government and the rent payable to the land-owner. These are paddy, gingelly, millets and sugarcane. The fruits mentioned are mango, coconut, plantain and jack-fruit. The vegetables are ginger, pumpkin and yams.

We come across a specific mention of an arecanut garden. A stone-slab inscription, A.D. 1028, at Hosur in the Gadag Taluka of the Dharwar District of the reign of Jagadekamalladeva I records the grant of an arecanut garden and house sites by Aycha-gavunda to the *basadi* constructed by him in memory of his wife.[10]

Cattle

Hallikar cattle. The predominant breed of cattle in south India is the Hallikar. In the well-known sculpture in the so-called Gopis Cave at Mahabalipuram, Krishna is shown milking a cow (Fig. 197). This sculpture relates to the Pallava period of the seventh century. The cow with long horns pointing backwards is of the Hallikar breed. This shows that the Hallikar is an ancient breed of cattle. In the Halebid temple is also the famous sculpture of Krishna holding the mountain Govardhana. The cattle shelter ing below the mountain resemble those of the Hallikar breed (Fig. 199).

[9]Hora, S.L. Knowledge of the Ancient Hindus concerning Fish and Fisheries of India—*Matsyavinoda* or a chapter on Angling in *Manasollasa* by king Someshvara (A.D. 1127), *JASB Lett.*, 17, 1951

[10]Gode, P.K. *Studies in Indian Cultural History*, Vol. I, p. 116

The Hallikar cattle are grey to dark grey in colour. Their horns emerge near each other from the top of the poll and are carried backwards, each in a straight line for nearly half their length and then with a gentle and graceful sweep bend forwards, usually lightly reclining inwards towards their points, which are usually black-tipped and sharp. When the animal is feeding with its head downwards, the horns almost touch the neck in front of the hump. The eyes are small, clear and intelligent and in some cases bloodshot. The ears are small, tapering to a point and are carried firmly in a horizontal position. The neck is long, thin for the size of the cattle, and sinewy. The dewlap is thin and moderately developed. The hump is also moderately developed, and in the bulls it is around eight inches (20 centimetres) high. The sheath is very small and close to the body. The forequarters are well developed and the legs are strong and set apart, permitting good chest development. The hooves are strong, small, tightly set and black. The back is straight and strong.[11]

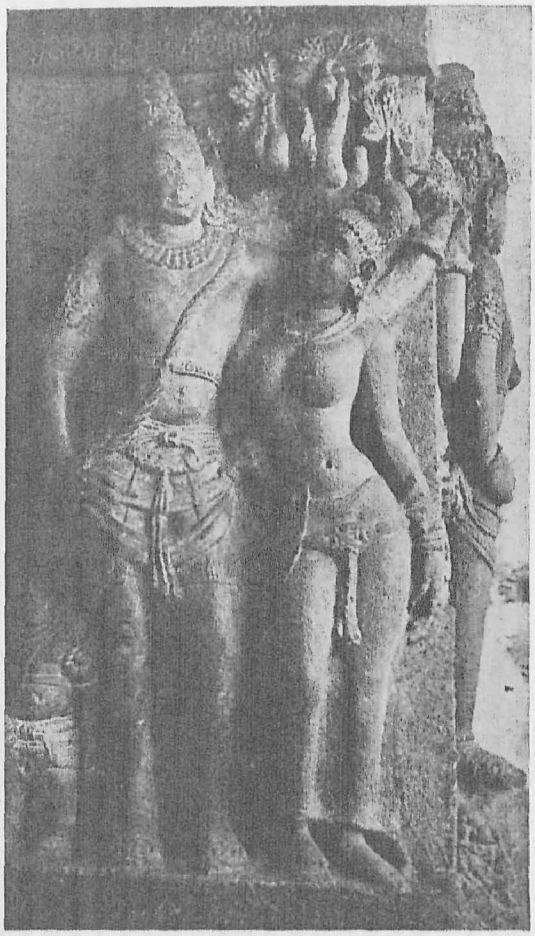
The Hallikar is a draft breed. The bullocks are strong, spirited, quick and steady in the fields and on the road. The cows are poor milkers. This breed is found in the Tumkur, Hassan and Mysore districts of Karnataka. Young cattle are kept in large herds almost in a semiwild state. They are extremely unruly and it is only after many months of patient training that they develop into bullocks. A herd of the Hallikars is shown in Fig. 198. The pointed horns of the Hallikars, sloping backwards, lend character to this photograph.

Ongole cattle. The Ongole breed of cattle, found in the Nellore and Guntur districts of Andhra Pradesh is valued by the farmers of South India. The bullocks are muscular, long-limbed, large and heavy. They are white, with dark-grey markings on the head, neck and hump. There are black points on the knee, pasterns of fore- and hindlegs. The forehead is broad between the eyes and the horns are stumpy. The bullocks are powerful and are suitable for heavy ploughing and for draft. The cows are good milkers. A large sculpture of the Nandi Bull at Mysore is modelled after the Ongole breed (Fig. 200). An Ongole bull from the Guntur District of Andhra Pradesh is shown in Fig. 201 for comparison. But for its stumpy horns, it resembles the Hariana breed. Possibly, it derives from the Hariana breed as a result of a mutation.

Horse Trade with Arabia from A.D. 800 to A.D. 1300

One of the greatest gifts of Arabia to the world is the Arabian horse. It is spirited and intelligent, is very strong and is able to stand galloping for hours, and lives up to the ripe old age of thirty-five years or so. Its development by the Bedouins of Arabia is a great achievement in animal-

[11] Joshi, N.R. *Zebu Cattle of India and Pakistan*, p. 209



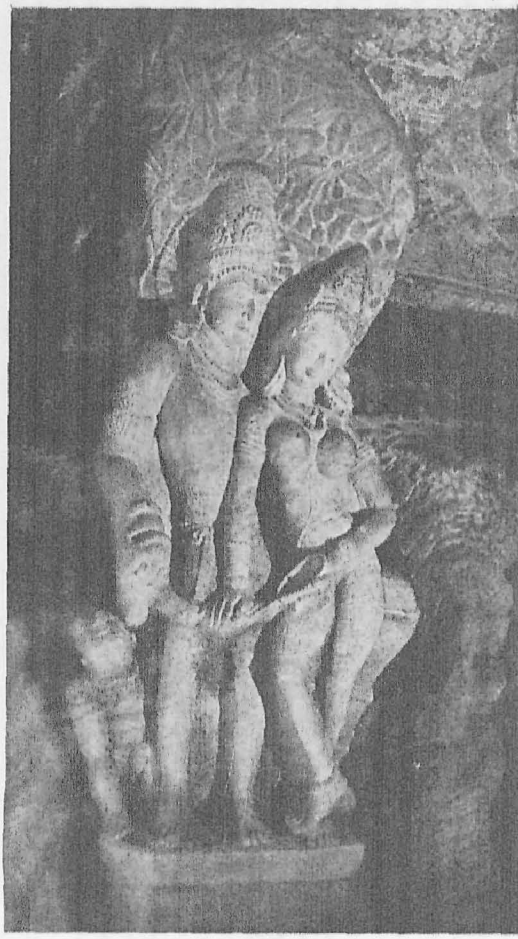


Fig. 194. Mango, a favourite fruit of the Indians. The couples shown standing below the branches of fruit-bearing mangoes are (*right*) from Badami (A.D. 578) and (*left*) from Pattadakal, Bijapur District, Karnataka, seventh century

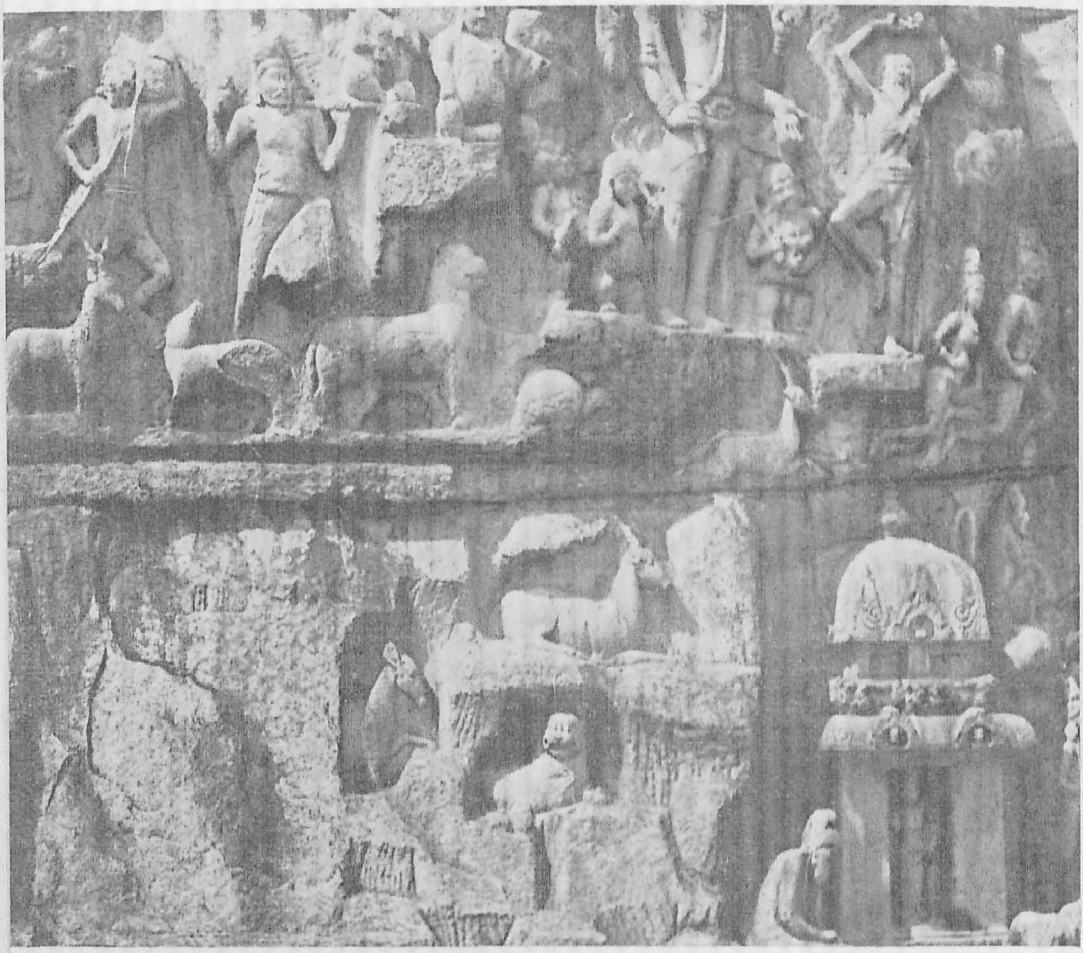


Fig. 195. Relief showing the descent of Ganga, Mahabalipuram, Tamil Nadu, Pallava, seventh century. A number of animals, including deer and lions, are shown

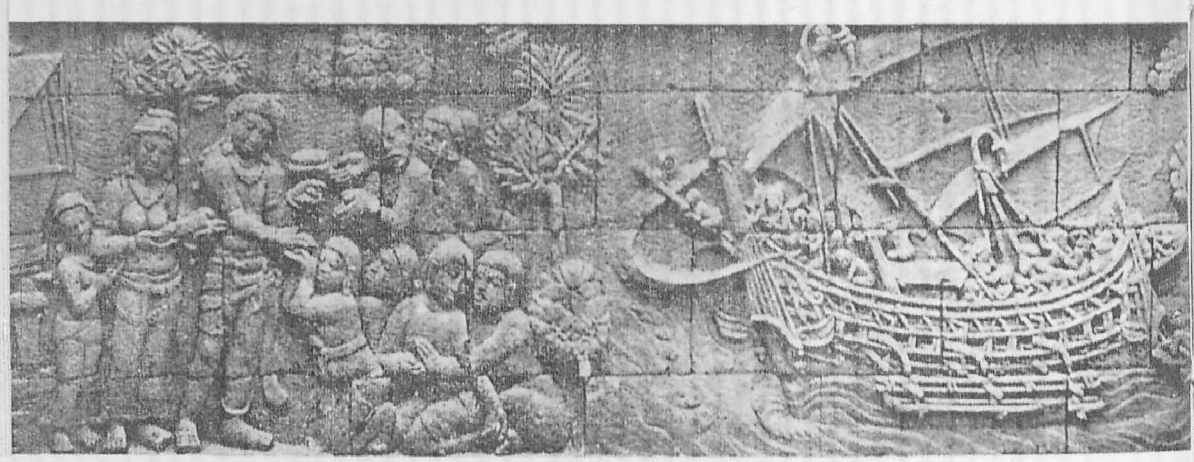


Fig. 196. A ship with sails. South Indians sailed in such vessels from India to Java during the Chola period. Borobuddur, Java, eighth century

Fig. 197. Krishna milking a cow. Mahabalipuram, Pallava, seventh century. The cow is of the Hallikar breed

Fig. 198. A herd of Hallikar cattle in Karnataka

Fig. 199. Krishna holding the mountain Govardhana. Hoysaleshwara Temple, Halebid, Karnataka. Hoysala, twelfth century. The cattle sheltering under the mountain are of the Hallikar breed

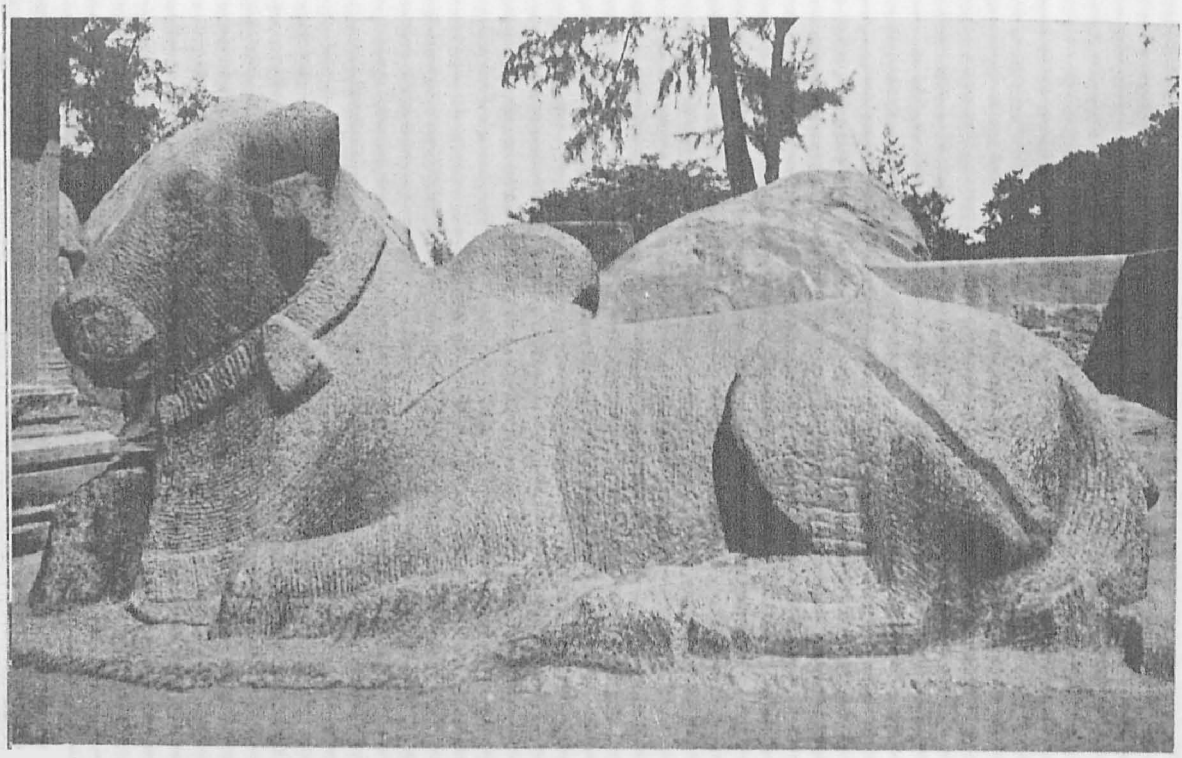


Fig. 200. Sculpture of the Nandi Bull, Mysore. It is based on the Ongole breed of Andhra Pradesh

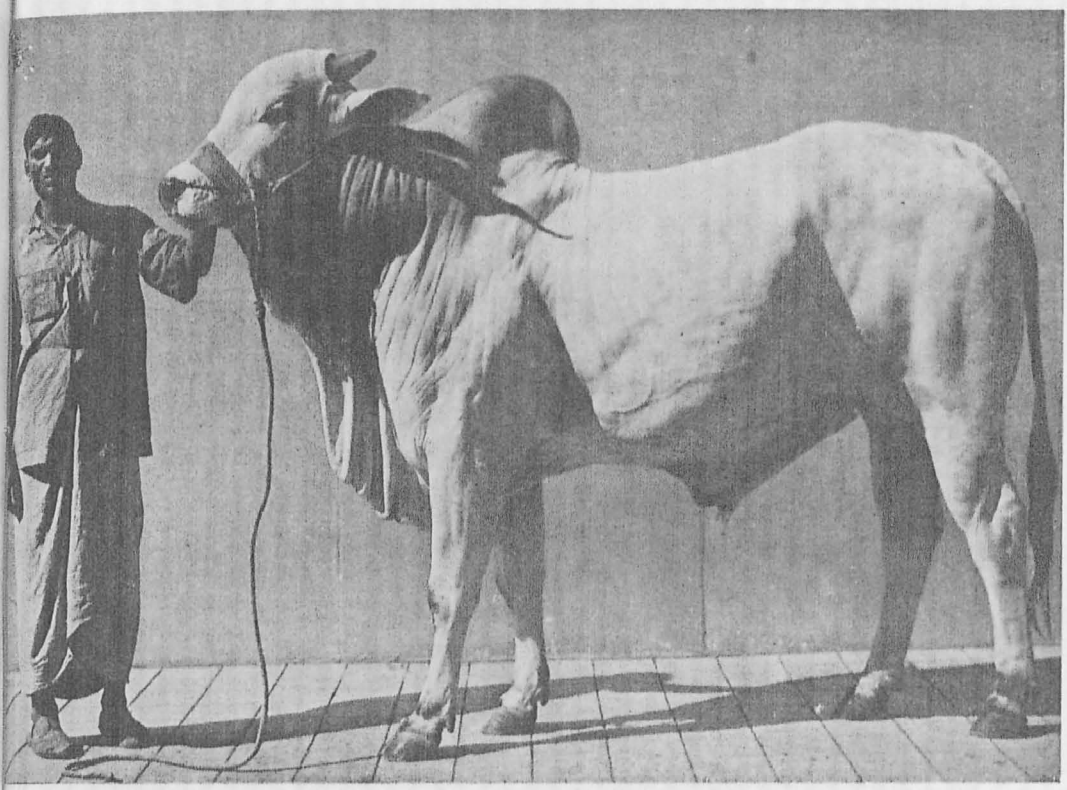


Fig. 201. An Ongole bull from the Guntur District of Andhra Pradesh, with energetic body, white skin, large dewlap and stumpy horns

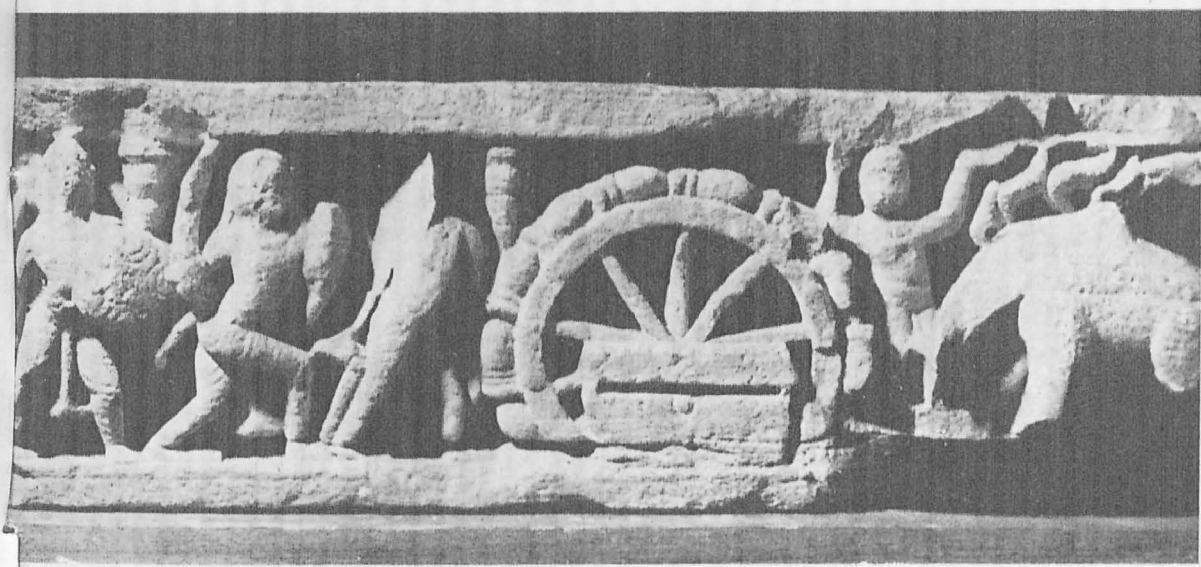


Fig. 202. A panel depicting a Persian wheel from Mandor, Rajasthan, eleventh century. This is the earliest record of a Persian wheel in India. It is pre-Islamic and proves that it is an Indian wheel and not an import from Iran
(Courtesy: Jodhpur Museum)

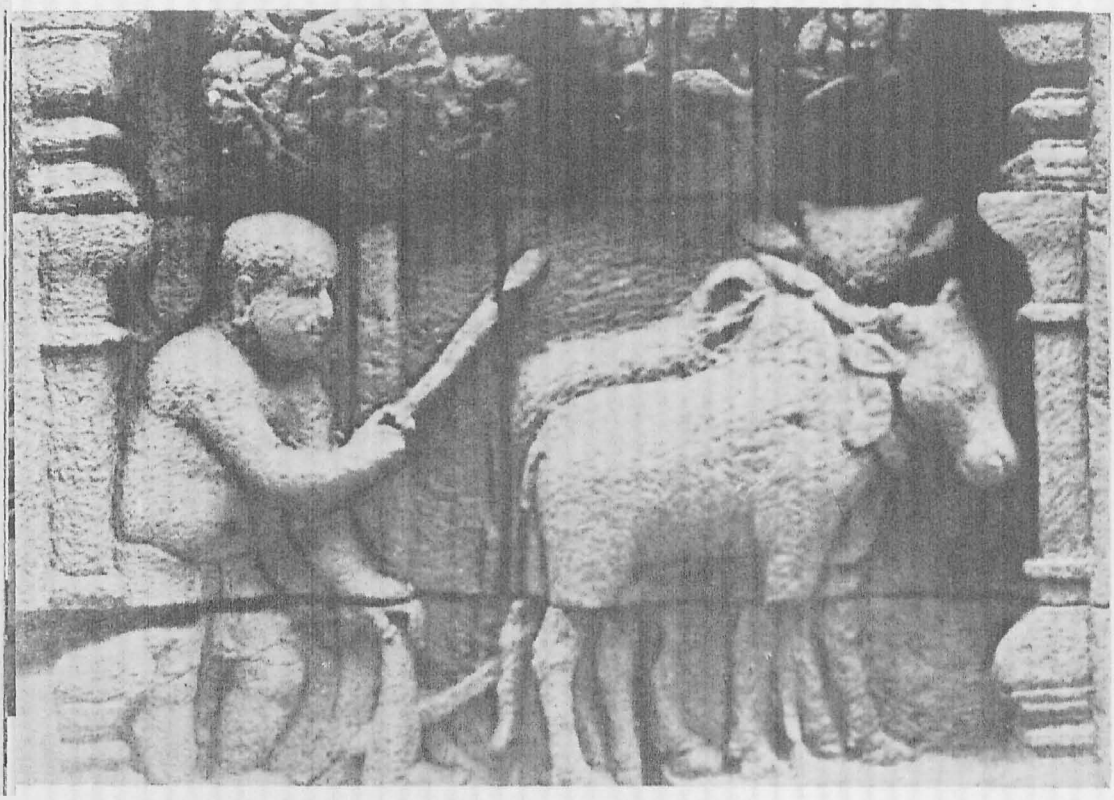
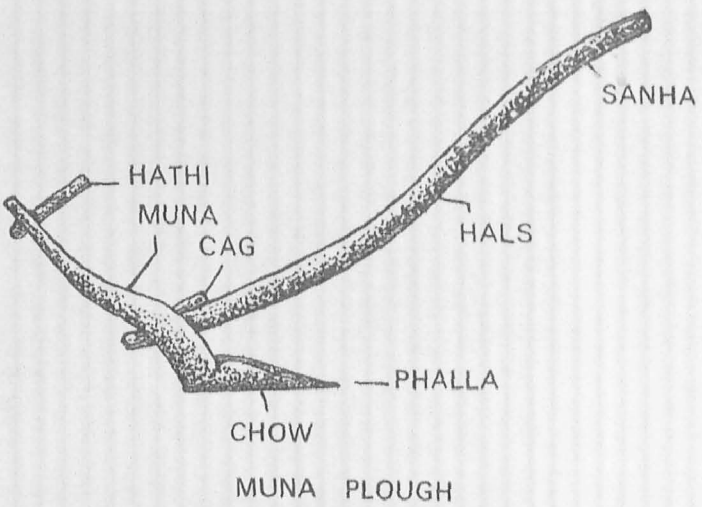


Fig. 203. *Top*, A ploughman. The plough is similar to the Indian *desi* plough. Borobuddur Java, eighth century; *Bottom*, The plough from Jorhat, Assam, resembles the plough shown in the Borobuddur sculpture above



MUNA PLOUGH

breeding. The success of the Arab armies in Sind was partly due to their horses. This factor created great interest in these horses among the Hindu rulers of India. Arabian, Turkish and other foreign breeds of horses were imported into India from A.D. 800 to 1300. This trade appears to have attained a phenomenal proportion in the twelfth and thirteenth centuries. The Indian authorities of this period agree in assigning the first rank in their classified list of horses to the foreign breeds (specially those of "Vanayu" or Arabia and Persia) and the lowest rank to the indigenous breeds, such as those of Trigartta, Gurjara, Avanti, Saurashtra and Pariyatra.

The following account of the horse-trade about A.D. 1290 at the Malabar Port of Kayal was recorded by S.K. Aiyangar.

'Kayal was a port at the mouth of Tamaraparani in the Gulf of Manar not far from the far-famed Korkai. There was a prominent trade-settlement at Kayal—about A.D. 1290, where an agency was established by an Arab Chieftain, Maliku-Islam Jamal-ud-din, ruler of Kis. According to Wassaf, about this time ten thousand horses were imported into Kayal and other ports of India of which one thousand and four hundred were of Jamal-ud-din's own breed. The average cost of each horse was 220 *dinars* of 'red gold'. The cost of even those that died on the way was paid by the Pandya King for whom they were imported. The Arab agent had his headquarters at Kayal. It indicates that he was the agent-general for the import trade of the Arab horses in this part of the country. The trade of this region in those days was very great, both in volume and value. In the words of Wassaf "Ma'bar extends in length from Kulam to Nilawar (Nellore) nearly three hundred parasangs along the sea-coast, and in the language of the country the king is called Dewar, which signifies the lord of empire. The curiosities of Chin and Machin, and the products of Hind and Sind laden on large ships (which they call junks) sailing like mountains with the wings of winds on the surface of the water, always arrived there. The wealth of the islands of the Persian Gulf in particular and in part the beauty and adornments of other countries, from 'Irak and Khurasan as far as Rum and Europe are derived from Ma'bar, which is so situated as to be the Key of Hind.'[12]

Marco Polo says, A.D. 1300, that Arabian horses were "greatly in demand in southern India and were shipped there from Aden and Hurmuz. He claims that every year 2,000 horses were imported by the five rajas and that each horse cost 500 *dinars*. The Mongol historian Rashid-ud-din (A.D. 1318) confirms this import of a great number of horses from the Persian Gulf to the Malabar.[13]

The necessity for this extravagant demand from the Indians for the

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[12]Gode, P.K. *Studies in Indian Literary History*, Vol. III, pp. 179, 180

[13]Jairazbhoy, R.A. *Foreign Influence in Ancient India*, p. 171

horses from the West is traced by the foreign observers chiefly to the Indians' ignorance of the art of managing the animals. According to Wassaf, the Indians were so ignorant of training horses that even the best animals under their management were soon disabled for active work. Marco Polo, while lamenting the waste of a great part of the wealth of the country in the purchase of horses, gives three reasons for the same. Firstly, no horses were bred in the country. Secondly, the Indians had no farriers, and the foreign merchants prevented any farrier from going to that country for fear of losing their highly profitable trade. Thirdly, and lastly, the Indians, in their ignorance of the treatment of horses, fed them with boiled rice and boiled meat and various other cooked food.[14]

[14]Majumdar, R.C. *History and Culture of the Indian People*, Vol. IV, p. 523

CHAPTER 32

THE KINGDOMS OF SOUTH INDIA

THE CHOLAS

A.D. 985 — A.D. 1205

THEIR IRRIGATION SYSTEMS

THE Cholas ushered in the most glorious phase in the history of South India in the tenth century. They unified the warring States of South India, and improved their agriculture by building up new types of irrigation systems. The prosperity which resulted from irrigated agriculture ultimately led to efflorescence in art. Magnificent temples were built, and beautiful images were cast in bronze and carved in stone.

The Chola King Rajaraja I (A.D. 985-1013) was a dynamic leader. He subjugated the Pandyas and Cheras of Kerala. He sent a naval expedition to Sri Lanka and conquered the northern half of the island, which became a Chola province. He conquered the bulk of the Mysore country, and the Eastern Chalukya kingdom of Vengi became his protectorate. The Western Chalukya kingdom was next subjugated.

Rajendra Chola (A.D. 1014-1044) succeeded his father Rajaraja I, A.D. 1014. He completed the conquest of Sri Lanka. The Pandya and Kerala territories were integrated into a separate viceroyalty with headquarters at Madura. He defeated the King of Kalinga. As an act of devotion to Shiva, he built the Brihadisvara Temple at Tanjavur. In one of the niches of the temple he is shown sitting at the feet of Shiva, who is winding a garland around his head. The art of temple-building and metal and stone sculpture attained a high level during his reign.

The next Chola ruler of importance is Kulottunga I (A.D. 1070-1118). The extent of his territory is shown in Fig. 204. To promote trade, an embassy of seventy-two merchants was sent to China in A.D. 1077. The Chola kingdom also maintained diplomatic relations with the rulers of Burma and Kambojas in Indo-China.

Vikrama Chola (A.D. 1118) remodelled the Temple of Nataraja at Chidambaram and also improved the Ranganatha Temple of Srirangam. Kulottunga II (A.D. 1135-1173) reconstructed the famous Chidambaram Temple, in which dance poses based on Bharata's *Natyashastra* are shown. Kulottunga III (A.D. 1178-1205) was the last ruler of the Chola Dynasty.

IRRIGATION

(*i*) *Anicuts.* Irrigation systems by building *anicuts* across rivers, and the chains of tanks in the courses of small streams are the proud achievements of southern India. As already stated, the Chola king Karikala (*c.* A.D.

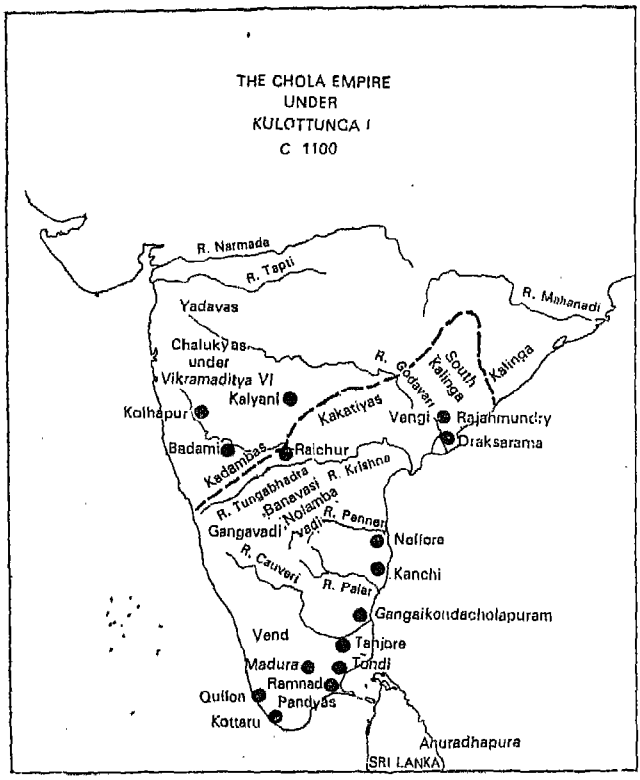

Fig. 204. Map showing the Chola Empire under Kulottunga I, *c.* 1100

190) and his successors constructed the irrigation canals Vennara and Arasil, which take off from the Cauvery.

The Cauvery and its tributaries support an extensive system of irrigation by means of channels drawn from dams, called the *anicuts* (Kanarese *ane katte*, dam, dyke or embankment), which retain the upper waters at a high level and permit only the overflow to pass downstream. These works are of great antiquity. Tradition attributes to the Chola kings the construction of the famous *anicuts* across the River Cauvery in the Tanjore District. The most famous of the Chola public works is the Great *Anicut* below the island of Srirangam, consisting of a massive dam of unhewn stone, 329 metres long and from 12 to 18 metres broad. The large Talkad *Anicut*, the lowest one down on the Cauvery, was constructed in the tenth century. The most recent, with a few exceptions, are not less than three centuries old. "The dreams which revealed to favoured mortals the plans of these ingenious works", says Wilks, "have each their appropriate legend, which is related with reverence and received with implicit belief." The

channels, thence drawn, meander over the adjoining tracts of country on each bank, following all the sinuosities of the ground, the total length running in Karnataka being upwards of 1,915 kilometres.

(*ii*) *Chain-tanks in Andhra Pradesh and Karnataka.* The topography of Telangana and Karnataka is well suited for the construction of storage reservoirs. Telangana, where most of the irrigation tanks are located, is known as "The Land of Thousand Tanks'. A special feature of the tanks in these tracts is their construction in series, by bunding the same valley at several points. The surplus water escaping over the waste-weir from one tank feeds the tank lower down and so on. Not only does the surplus water escape into it but the surplus irrigation water from the fields under the upper tank seeps through the subsoil and flows into the lower tank. Owing to the porous nature of the soil and the sloping terrain, often large quantities of water are drained into the lower reservoir in this manner. This improves the tank duty. During the dry crop season, when the waste-weirs do not surplus, the effect is quite marked.

The main advantage of the series of tank irrigation is that the benefits of irrigation are distributed over the entire watershed. In a big storage tank the catchment area does not derive any benefit and the entire irrigation is localized downstream of the tank.

The disadvantage of the series of tanks is the breaching of the entire system during heavy rains. If due to excessive floods any tank in the chain breaches, the tank lower down is unable to bear the strain of the rushing waters from above and it also breaches. This process continues and the entire system downstream is destroyed.

Tanks in Tamil Nadu

The Pallava King Mahendravarman I excavated the first tank in the Tamil country in early seventh century. His great-grandson is credited with the construction of the Paramesvara-tataka late in the seventh century. The land irrigated by the tank was divided into twenty-five parts, five of which were meant for public purposes. The Tiraiyaneri Tank referred to in an inscription of Nandivarman Pallava (eighth century A.D.) was probably built by an earlier king. Another inscription of Nandivarman refers to water-levers (*jalayantra*). The tank at Uttaramallur, called Vayiramega-tataka, was constructed by one of the Pallava kings. King Dantivikramavarman (ninth century) excavated a tank at Gudimallam in North Arcot. King Kampavarman of the Ganga-Pallava line constructed one at Ukkal. The tank Kanakavallieri at Solapuram dated from the ninth century. The Kaveripak Tank, the most extensive in the district, with a bund about 6.4 kilometres long stretching from north to south, was dug about the latter half of the ninth century. To this period also belong the Chitrameghatataka in Arcot as well as the sluices of the tank at Tundalam.

In the tenth century, a number of tanks were excavated, e.g. the Cholavaridhi by Parantaka I, the tanks at Sodiyambakkam and Takkolam in Arcot, the feeding-channel of the tank at Vinnamangalam, the tanks at Tanagunda (Karnataka) and Chikballapur (Kolar), the tank referred to in the inscription of Rajakesarivarman and Parantaka I, as well as the Uyyakkondan channel attributed to Rajaraja I or one of his ancestors. An inscription of Rajendra Chola I refers to a tank called Madhurantakappereri. The 'Big Tank' at Bahur near Pondicherry mentioned in an inscription of Rajaraja Chola I (A.D. 985-1013) belongs to this period. In the eleventh century, the tank at Arikesarimangalam was excavated, as referred to in an inscription of Rajaraja I. In the twelfth century, the tank at Anamkonda, attributed to the Kakatiya minister Beta, and the tank at Sindhuvalli in Karnataka, were excavated during the reign of Kulottunga.[1]

Tank System in Karnataka

There are no natural lakes in Karnataka, but the streams which gather from the hillsides and fertilize the valleys are, at every favourable point, embanked in such a manner as to form a series or chain of reservoirs, called tanks, the outflow from one at a higher level supplying the next at a lower level, and so on, all down the course of the stream. These tanks, varying in size from small ponds to extensive lakes, are dispersed throughout the country and number 38,080. One of the largest tanks is Sulekera, 64 kilometres in circumference. Other large ones are the Ayyankere, Madagakere, Masur-Madagakere, Vyasa-samudra, Ramasagara, and Moti Talab.

Major Sankey, one of the first Engineers of the Mysore State, who devoted his attention to the systematic repairs of tanks, stated that "to such an extent has the principle of storage been followed that it would now require some ingenuity to discover a site within this great area suitable for a new tank. While restorations are of course feasible, any absolutely new work of this description would, within this area, be almost certainly found to cut off the supply of another, lower down the same basin, and to interfere with vested interests."[2]

Although there are many isolated tanks in particular localities, the vast majority are constructed on a connected system of streams and their feeders which are abundant in the undulating plateau of Karnataka. In fact, most of these tanks have been classified according to the main valleys. sub-valleys, etc. As an instance of the chain of tanks may be mentioned the Palar system, which has one thousand tanks in the valley, the last one being the large Ramasagara Tank.

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[1]Gupta, K.M. *The Land System in South India*, pp. 219, 200, 221
[2]Rao, C.H. *Mysore Gazetteer*, Vol. III, 1929, p. 157

Maintenance of Tanks

The village assembly and especially its executive committee, the Tank Supervision Committee (*eri-variyam*), looked after the maintenance of the irrigation works of a village, by repairing breaches and dams, removing silt and regulating the distribution of water-supply.

CHAPTER 33

VILLAGES OF SOUTH INDIA DURING THE CHOLA RULE

TENTH CENTURY TO TWELFTH CENTURY
TENURE, LAND REVENUE AND RENT
ECONOMIC CONDITION OF THE RURAL PEOPLE

THE villages of South India were known under different names according to their character. Thus a rescript from king Uttama-Choladeva, of the early twelfth century is addressed to the inhabitants of the Brahmadeya villages, i.e. the villages granted to the Brahmanas; the Devadana villages, i.e. the villages attached to some gods or goddesses or temples; Pallichchanda villages, i.e. the villages attached to Jaina religious foundation; Kani (or Gani) murruttu villages, i.e. the villages meant for the support of astrologers; and Vettapperru villages, probably villages connected in some way with the supply of labour, i.e. service-tenure villages. Again, a village tenanted by Brahmanas only, or rather the proprietary right of which belongs to the Brahmanas only, was known as an *agrahara* or *mangalam*, as distinguished from *kudi* (an ordinary village) or *ur* or Vellalan (i.e. Sudra) village. An ordinary village (*kudi*) when made over to a Brahmana as a gift underwent a change in name as well as in other respects.

A Brahmadeya was sometimes changed into a Vellan-Vagai village, i.e. into an ordinary cultivators' village. Thus an inscription of the reign of Rajendra Choladeva I records that Palaiyanur, a Brahmadeya village of the assembly of Singalantaka-Chaturvedimangalam, is to be withdrawn from the latter and become Vellan-Vagai village, but, unlike the other Vellan-Vagais, should pay a standing fixed tax in money and kind, and become a Devadana of the temple of Palaiyanur-Tiruvalangadu.

A system of naming the villages according to the caste of their inhabitants was in vogue in later times. Thus in the Madura District, a village inhabited by the Telugu and Kanarese people was called an *ur*; a small Kalla village, *patti* or *kurichi;* a fortified village, *kottei* (*kottai*); a Brahmana village, *mangalam* or *agraharam;* and an oridinary village, *kudi*. In Chingleput the villages were known as *nattams*, a name subsequently applied to Sudra villages.

VILLAGES ON SAMUDAYAM, PALABHOGAM AND EKABHOGAM TENURES

The threefold classification of the villages according to the forms of the privileges enjoyed by the inhabitants, and which were believed to have existed from time immemorial, is as follows: These three modes of enjoyment of privileges were known as *samudayam* (lit. common propery) or

pasungarai or *sumohi*, *palabhogam* or *achandrarkam* (lit. permanent property) or *arudik-karai*, and *ekabhogam* or *ejaman* or *yajaman gramam* (lit. sole enjoyment villages). *Samudayam* is regarded as the earliest form of enjoyment. It was of two kinds, namely the absolute *samudaya* and *karaiyidu*. Under the former, the whole of the cultivated area of a village, together with the common waste-land and the common fallow land, belonged to the whole body of the *mirasidars* or owners. The lands were cultivated either by the whole body jointly or separately by each member, but the entire produce in both cases was shared by the members of the community according to their respective shares. The ownership was communal, so far as the arable and waste-lands were concerned. The house-sites (*nattam*), along with the gardens or backyards only, belonged to the members severally. In this form, thus, there was no separate allotment of land to individuals; and the property was a right to a certain share or *pangu* or a number of shares in the produce. Each member of the community contributed his share of labour. Under the form known as *karaiyidu* (lit. field-division), 'lands were temporarily in separate shares by the co-sharers forming the members of the community and were subject to redistribution at stated intervals.' These intervals were of 8, 12, 27 or 30 years. In both the *samudaya* forms, there was the joint liability of the co-sharers for the government revenue. The share of the government called the *melvaram* as well as the local dues and cesses were deducted from the gross produce before distribution. The co-sharers could alienate their shares by way of mortgage, sale or otherwise. In the absolute *samudaya* form, sale or mortgage meant the sale of the right to an undivided share in the common enjoyment: in the *karaiyidu* form the land was liable to redistribution at the end of the stated interval. In the case of sales, the members of the community had a right of pre-emption, the owners of the neighbouring lands having the first claim. Under the *palabhoga* tenure, all the cultivated lands, *warapat* (i.e. lands yielding a share of the produce) and *tirwapat* (i.e. lands paying a fixed money-tax), were permanently distributed, but all the other rights and privileges were held in common as also the wastelands reclaimed since the general division. The cultivated lands were held in severalty with individual ownership and individual liability for the payment of the government revenue. The *ekabhogam* or *yajamana-gramam* system differed from the other joint village types chiefly in that the proprietor distributed the cultivable lands among a number of joint-holders farming in common and levied cesses on their produce. He usually held a *manyam* or tax-free estate and conducted the village assembly. He was not a public officer like the headman of the villages of North India, and he could alienate his land and the attached privileges at his will. No sales could be made without his permission, nor any stranger could settle in the village without his permission. The possession of shares in the *samudaya* form of villages in Arcot and Chingleput carried with it peculiar hereditary

rights in the village lands and waste and their produce. The owners took cesses in kind, such as the *kani-merai* collected by their labourers before threshing the gross produce of paddy, the *kuppattum* taken by them after threshing, and the *svamibhogam* or *tunduvaram* levied only on their tenant's produce. They often received, in addition to these shares, *manyams* or honorary estates which they held either wholly or in part free of taxes together with the right to the services of the Paraiyans or serfs living either in the suburb attached to each joint-village or scattered over the wastelands.

An *ekabhoga* is defined as 'a plot of land granted to a single Brahman for his sole enjoyment and having on it his mansion and the houses of his dependents and farmers.' A Chola inscription tells us that queen Tribhuvana-Mahadeviyar made a *devadana* grant of a piece of land belonging to a Brahman village, after paying the *purvacharam* (lit. former usage) to the Brahman owners.

Some of the inscriptions refer to committees of the village assembly, which were elected for arranging distribution of lands in the village. This system shows that it was on account of the existence of the *karaiyidu* tenure that such distribution of the village lands was needed. An inscription of about the twelfth century records that Tondaimanar Samantanarayana, having purchased a village, divided it into 108 shares, out of which he gave 106 to the Brahmans and two shares to a temple.

The Different Parts of a Village

The lands attached to a village were carefully classified for the purpose of taxation, and every detail was entered into the village register (*pottagam*).

All land was carefully surveyed and classified into the tax-bearing and non-taxable lands. The taxable lands were graded according to their natural fertility and the nature of the crops raised. Immunities in favour of the individuals and institutions were common and carefully recorded. The village was assessed as a whole for the land tax, and the work of collection sometimes involved harsh processes. The right of cultivating the lands of defaulters of revenue was sold by the village assemblies to realize the arrears payable to the State. The people made a common cause in resisting arbitrary and unusual imposts. Revenue was payable in cash or in kind.

The most remarkable feature of the administration of the time was the self-government of the villagers. The village assemblies were autonomous institutions which functioned with unexampled vigour and efficiency. A highly developed committee system (*variyams*) for the executive of the assemblies came into existence. The *sabha* of Uttaramerur is a good example of a large number of similar attempts throughout South India to evolve arrangements suited to local conditions in the light of experience. Justice was administered by the village courts, caste *panchayats*, and the king's courts

(*dharmasanas*). For the purpose of revenue administration, the village was divided into four parts—cultivated lands yielding a share of the produce; lands paying a fixed money tax; waste or uncultivated lands, which were divided into cultivable waste, and immemorial waste; and *poramboke*, viz. lands set apart for various communal purposes, e.g. village-site, temple-site and crematorium. The cultivated land was classified into wetlands and drylands.

The Constitution of Villages

Broadly speaking, we come across the following types of villages in the South in accordance with the inscriptions in southern India: the joint villages, in which the controlling power was exercised by the community of the Brahmanas, besides whom there were people of the lower castes mostly Vellalans; joint villages belonging to Vellalan or farmers with subordinates of the same or lower castes; and villages assigned to single individuals. So far as local affairs, and especially transactions relating to land, were concerned, these villages acted on most republican lines through the assemblies known as *Sabhai, Maha-sabhai, Perunguri-sabhai, Parudai* or *Paradai* or *Mula-parudai* in the case of the Brahmana villages, and *ur* in the case of the Vellalan villages. Though the king occasionally interfered in the affairs of the villages, they seem to have had no headman of the type familiar in North India who acted as an intermediary between the community of the village and the government. Some of the inscriptions speak of a *kilan* or *kilavan*, who appears like a headman, but who really seems to be a senior burgess of a Brahmadeya. His functions are not like those of the village headman of the North. A record of Kaviripakkam mentions a gentleman, named Arumbakilan, who was a *kangani* or government supervisor, along with the so-called 'administrator of the town' (*Ur-alkinra*), acting jointly with the executive committee of the township in affairs which affected the interests of both the crown and the burgesses.

Besides these officials, the village body politic, according to the South Indian inscriptions, contained an astrologer, a *vetti* who swept public buildings and kept them in order, a constable, a potter, a smith, a carpenter, a tanner and, sometimes, a physician. The assembies and their executive committees, called the *variyam*, were intimately connected with the land-system.

Cultivation of Land Conducted under the Supervision of the Village Assemblies

In the villages, where the ownership of the cultivated land was joint, cultivation was looked after by the assemblies. The share of the assembly as landlords was two-thirds of the produce and that of the tillers of the soil one-third (cf. Brihaspati). A record of the reign of Parantaka I, dated the

early part of the tenth century, tells us that the assembly had a piece of land 'cultivated on the terms of two to one obtaining in this village', that is, on 'a system of contract by which two shares of the produce were assigned to the landlord and one to the cultivator or vice versa. Probably, this division of the produce was effected after the deduction of the *melvaram* or the government revenue. This inscription indicates that there was no hard-and-fast rule about the exact sharing of the produce. It depended on the local customs as well as on the fertility of the soil. On the evidence of a record of the time of the Ganga-Pallava King Dantivikramavarman (*c.* ninth century), we learn that the assembly used to resume the land when the cultivators failed to pay the due taxes. From an inscription of Rajendra Chola I it appears that the assembly sometimes made over the right of collecting the taxes from the cultivators to private individuals. With regard to the temple lands, the village assembly looked after them in return for a sum of money. Thus in return for an annual payment of 18 Ilakkasu by the local temple, the village assembly of Narasimhamangalam agreed to look after the temple lands and to discharge certain other functions.

Melvaram (Land Revenue)

When the temple lands were under the direct management of the Devakanmis or temple trustees, they used to fix the rate of *melvaram* that the cultivators, or the individual to whom the land was made over, had to pay. Thus a record of the Pandya King Jatavarman Sundara-Pandya (1270-1310) tells us that the Maheshvaras, Shri-rudras, Devakanmis and the temple accountants granted certain temple lands as *kanippidipadu* to an individual on the condition that he would enjoy them, after repairing the tanks in disuse and bringing under cultivation such of the lands as were covered with jungle, and that, so long as he would enjoy them under these circumstances, he would have to pay a *melvaram* at the following rate:

One-third for Pasan.

One-fifth for crops, such as *tinai* (a kind of grain), *yaragu, ellu* (gingelly), *payaru* (a kind of gram), *kuruvai* (a kind of paddy), *karambu* (sugarcane), *kolundu* (a kind of scented leaf), *karunai* (yams), *manjal* (saffron), *inji* (ginger), *sengalunir* (? red coconut), *valai* (plantain), *valudalai, pusani* (pumpkin).

One-fifth from trees like mango, jack-fruit, *nattai*, lime, *kulaviruli, nelli* and *iluppai.*

One-seventh for coconut and areca palms.

One-seventh for dry crops (according to yield).

A progressive rate of tax was levied on land brought under cultivation by clearing jungles: one-tenth first year; one-ninth second year; one-eighth third year; one-seventh fourth year; and one-third for the subsequent periods, permanently (cf. Brihaspati). A record of the Pandya King

Maravarman-Vira-Pandya (*c.* 1303) fixes the *melvaram* of a Devadana at one-third for the pasanam (harvest?), one-fifth for the garden crops Mavadai and Maravadai, and one-seventh for dry crops. An inscription of the fifteenth century records an agreement arrived at by the temple-manager and the tenants of the temple land as to the *melvaram* on areca, coconut, mangi and other trees grown on the 'Tiruvidaiyattam' lands of the temple. It was formerly three-fourths, but it was now reduced to two-thirds, so that one-third now went to the share of the tenants. In the case of sesamum, green-gram and sugarcane, the rates obtaining in the neighbouring villages were adopted, and in cases where betel, plantain and other quick-yielding crops were reared side by side in the newly planted areca and coconut groves, the *melvaram* was fixed at three-fourths of the old rates.

Rent

An inscription of the early part of the fourteenth century fixes the following apportionment of the produce of the soil between the landlord and the tenant in an Ekabhoga Brahmadeya village: as to *kadamai* (i.e. taxes paid in kind), in cases of *kar* paddy (paddy in wet fields), for both the crops of the year, the landlord is to get one-twentieth; that the dues, *palli, pad-kaval, perum-padikaval, sudu* (sheaves of corn) given to servants, *araivadai* and *alkuli* should be charged on the whole village in common (i.e. on the whole body of the cultivators) and that the remainder should be distributed in the ratio of 1:4 between the landlord and the tenant; the straw and the green grass (*payaru*), generally sown just before or after the harvest, have to be equally divided between them. As to the *kudimai* right, i.e. payment in money, the rate is as follows: as to *kar*, half a *panam* for the first crop and one-fourth for the second for every plot of land. As to the threshing expenses, which are to be borne equally by the landlord and the tenant, one *tuni* or one *padakku* for the first crop per plot and half of it for the second crop. In the case of dry crops, such as turmeric, castor-seeds, cotton and gingelly, the seed-grain is to be supplied by the landlord, and the yield is to be divided equally. The supply of labour, the storing of grain in the landlord's granary and the work of repairing ridges in the fields devolved on the landlord exclusively.

Royal Fee for Shifting Cultivation

Shifting cultivation was in vogue among the hill tribes of South India. A record of the Chola King Rajendradeva II, dated A.D. 1072 tells us that a cloth (? *pudavari*) was to be given to the government for every 1,500 *kuli* of land on which shifting cultivation was carried on by the hill tribes.[1]

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[1]Gupta, K.M. *The Land System in South India*, pp. 61 to 65 and 208 to 213

ECONOMIC CONDITION OF THE PEOPLE

C.H. Rao has given an excellent account of the economic condition and village administration in the Chola period, based on the study of inscriptions. He states, 'the Tanjore inscriptions throw light on the economic condition of the people of the Chola country about the beginning of the 11th century. The land assessment (*kanikkadan*) was roughly one hundred *kalam* of paddy for each *veli* of land. Paddy was sold at the rate of two *kalam* for each *kasu* and three ewes could be purchased for one *kasu*. The rate of interest was apparently 12½ per cent. It was actually ⅛ *kasu* per year for each *kasu* of three *kuruni* of paddy for each *kasu* per year. For Sivayogins who had to attend the temple on certain festive occasions and who may be taken to represent the average middle-class men of the time, the allotment made for each meal is one *kuruni* and two *nari* of paddy. Assuming that a middle-class man took two meals a day, the consumption for each man would be 2¼ *kuruni* of paddy per day. The parasol-carrier may be taken as the type of the lowest class of manual labourers and each of them got 40 *kalam* of paddy per year and this would yield 1⅛ *kuruni* of paddy for each day. It is worthy of note that chillies are not mentioned and coconuts seem to have been unknown at least in the vicinity of Tanjore, if not in the Chola country.

VILLAGE ADMINISTRATION

The following portions of villages were communal and as such free from assessment: the village site, the village tank and its banks; the portion occupied by the artisans and the pariahs; the burning-ground; the irrigation channels; temples; the shrines of Aiyan, Kadugal, Durgaiyar and Kala-Pidariyar; the temple of Settai (Jyeshtha), the shrines of the Pidaris Tiruvaludaiyal, Kuduraivattam-udaiyal, Punnaitturainangai and Poduvagai-urudaiyal; ponds in the middle of fields; flower-gardens; streams; the portion occupied by toddy-drawers; the portion ocupied by washermen; the water-pond used by pariahs; the portion occupied by the polluting castes; highroads; rivers; the sacred courts (i.e. temples); the cremation-ground of the pariahs, the stone fence (for cattle); the stables (*kottagram*); the village threshing-floor; grazing-ground for calves; wells and cisterns.

THE VILLAGE SABHA AND ITS COMMITTEES

A large number of villages in the Chola country had *sabhas* or regularly constituted village corporations which watched jealously over the internal affairs of the village. The Uttaramallur inscriptions of Parantaka I lay down rules for the selection of the members to the village committees, which were apparently controlled by the village assemblies. During the reign of Rajaraja I, certain changes appear to have been introduced in these rules. In the 11th year of his reign (or A.D. 996) it was laid down that

only those who were capable of reciting the *Mantrabrahmana* (Hymns of Brahmanas) could be elected members of the Village Supervision Committee (*urvariyam*) and take part in the deliberations of the village assembly. Those who were guilty of misappropriation of property and of other heinous crimes were debarred from election. It was further ruled that anyone chosen in contravention of these rules would be accorded the same punishment as was usually meted out to transgressors of royal orders. An inscription of Rajaraja dated in his 16th year (A.D. 1001) indicates that the members of a village assembly were called together by the blowing of a trumpet, and that the herald was entitled to get a fee (2 *soru*) from the village. The members appear to have met together and transacted business even during night, though in the generality of cases it is found that business was conducted during daytime. We may presume that the same rules were in force in other village *sabhas*. There were also villages where the villagers managed the business of the village without having been constituted into a regular corporation. Wherever the village assemblies existed, their transactions must have been quite lively as there were periodical changes of members on these bodies. They seem to have been entrusted with civil and magisterial powers. In fact, each village seems to have been a self-contained body jealously watching over its own interests as well as over those of its members. The village assemblies generally managed temples and were trustees of public charities. A number of village assemblies are said to have received money on interest from the Rajarajesvara temple at Tanjore. In all probability, the money thus borrowed was used in bringing wastelands under cultivation. From the produce of these lands, the interest on the money borrowed was paid. Village assemblies could alienate lands whenever the liabilities incurred by them could not be otherwise discharged.

Limits on Powers of Taxation of the Village Sabha

These village assemblies appear to have been invested with the power of taxation. This is inferable from many inscriptions, a few of which may be referred to here. From an inscription dated, A.D. 996, in the 12th regnal year, we see a *vyavastai* issued which says that the assembly of a village should not levy any tax other than the *siddhaya*, *dandaya* and *panchavara*. They should not levy any *sillirai* (or miscellaneous) taxes not mentioned in the rates already fixed. It would seem as though they could not levy tax which was not included in the royal schedule. In an inscription of his 9th year, the great assembly Uttiramerur was convened to put an end to inequality in taxation. Though the inscription is incomplete, it may be inferred that resentment was felt at some partiality shown to some particular communities in the matter of taxation. Accordingly, the assembly enacted that the employees of the royal house-hold, Brahmans, Merchants and Vellalas (agriculturists) should individually be responsible for the payment of the

fines imposed upon their respective classes. From another inscription, we get to know how the defaulters were dealt with. The assembly concerned, apparently, sent out its order to the *Adhikari* of the place where the defaulters were, and he was requested to execute the order there. The property of the defaulter was, accordingly, sold away for any price it could fetch and the proceeds were credited to the *talam* (temple treasury) concerned, after obtaining a receipt. If necessary, the *Adhikari*, in his turn, sent out the order to the *sabha* of the village or to all the people of the place (*ur*) in order that they might openly bid for the land. The price for which the latter bid was called *urvilai*. Where no bidders came forward and it was knocked down to the temple itself, it was called *ajnayakrayam* (i.e. upset price).

Restrictions on Exactions

Well-defined restrictions were evidently laid on any exactions or pretended claims of the members of the different committees. The members of the Annual Tank or Village Supervision were not entitled to any kind of payment in rice or paddy as *amanji* (without payment or cash). If anyone claimed such payment, he was to be fined 25 *kalanju* of gold. The fine was to be collected by the *Deva Kanmis* or managers of the temple. Even after paying this fine, the defaulters were liable to a fine to the Dharmasana (the court of justice). The accountant of the committee who allowed unlawful collection was also asked to pay *vetti* (a fine). Anybody who said "nay" to this order and anybody who instigated others into saying so were to pay a fine of 15 *kalanju* to the Dharmasana and they were thereafter to obey the same order. Anybody who ran away without paying the taxes due was pursued to the village or hamlet concerned and there the order was executed. The case of one Kilakkil Avanipa Bhatta is in point. He was thus deprived of *bhattsvam* in a particular village.

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CHAPTER 34

RAJPUT KINGDOMS OF NORTHERN INDIA

PRATIHARAS, GAHADVALAS, CHAUHANS, PRAMARAS AND CHANDELLAS
THE PALA AND SENA DYNASTIES OF BENGAL
EIGHTH CENTURY TO ELEVENTH CENTURY
OBSERVATIONS OF ALBERUNI ON INDIA AND INDIANS
INDUSTRY, TRADE AND AGRICULTURE

THE Rajputs are the descendants of the Huns, and Gurjara tribes of Central Asia, who were ennobled and assimilated in the Hindu society. From the eighth to eleventh centuries, four Rajput clans, viz. Pawar (Pramara), Parihar (Pratihara), Chauhan and Solanki became prominent in northern India.

THE PRATIHARAS

The Pratihara Rajputs were of the Gurjara stock. The Pratihara Dynasty was founded by Nagabhatta I in 650. Nagabhatta II (A.D. 800-833) conquered Kanauj and made it his capital. The most distinguished Pratihara was Bhoja (A.D. 840-890), who became a legendary figure in Indian history. He ruled over a vast territory bounded by the Sutlej to the north-west, the Hakra to the west, the Narmada to the south, and Bihar and Bengal to the east.

Mahendrapala I (A.D. 890-908), the successor of Bhoja, preserved the vast empire he inherited from his father. In 961, the Pratiharas lost Gujarat to the Chalukyas of Anhilvara.

The Pratihara Empire was the last great Hindu empire in northern India. According to Majumdar, the chief credit of the Pratihara kingdom lies in the successful resistance to the Moslem invasions from the west. While Islamic armies made rapid progress in the Middle East, Africa and Europe, the Pratiharas stopped their advance beyond the boundaries of Sindh, their first conquest in India, for nearly three centuries.

THE PRAMARAS

The Pramara Dynasty of Dhar was founded by Krishnaraja early in the tenth century. Of the Pramaras, the most distinguished was Bhoja (A.D. 1018-1060), a warrior, a scholar and a patron of learning. He wrote a number of books on astronomy, architecture and poetics. He founded a Sanskrit college. One of his achievements was the creation of the Bhojpur lake to the south-east of Bhopal, which covered an area of 647 square kilometres. Irrigation from this lake insured Malwa against famines.

The Chandellas

The Chandellas were a clan of aboriginal chiefs related to the Gonds, who were ennobled as Kshatriyas, who ruled Bundelkhand. Their principal towns were Chhatarpur, Mahoba, Kalanjara and Khajuraho. Their most remarkable ruler was Dhanga (A.D. 954-1002), under whose patronage the famous temples of Khajuraho, so well known for their sculptures, were erected. His son Ganda joined the confederacy of Anandapal against Mahmud of Ghazna.

The last Chandella ruler was Paramaradideva (Parmal), who ruled from A.D. 1165 to 1203. He defeated Prithviraj Chauhan in 1182. In 1203 he was defeated by Kutb-ud-din, who captured the Fort of Kalanjara.

The Solankis

The Solanki Dynasty was founded by Mularaj (A.D. 974-995), with Anhilvara as its capital. Mularaj conquered Saurashtra. His son Chamundaraja defeated Sindhuraja, the Pawar ruler of Dhar. Bhimadeva I (A.D. 1022) reconstructed the temple of Somanath, which had been earlier destroyed by Mahmud of Ghazna. Bhimadeva II (A.D. 1199-1238) fought Kutb-ud-din and drove him back to Ajmer in 1196. In 1197, Anhilvara fell to Moslems.

The Gahadvalas and Chauhans

In 1090, Chandradev, the third king of Gahadvala clan, took Kanauj from the Pratiharas. Govindachandra (A.D. 1104-1155), the grandson of Chandradev, was the greatest king of Gahadvala Dynasty, and under him Kanauj regained its importance. Govindachandra's grandson was Jaichand, so well known in history. His daughter Sunjogata was carried off by Rai Pithora Chauhan (Prithviraj) of Ajmer. It was the resultant feud between the Gahadvalas and Chauhans which resulted in the weakening of the Rajputs. Prithviraj was defeated by Shihab-ud-din at Tarain, a place between Thanesar and Karnal.

Palas and Senas of Bengal

Here a reference to the Pala and Sena dynasties of Bengal, Gauda or Vanga, as it was known in the past, is pertinent. The Pala Dynasty was founded by Gopala about A.D. 760. He extended his power to Magadha, and the rulers of northern Orissa were his vassals. The next ruler was Dharmapala (A.D. 776-810), a devout Buddhist who founded the monasteries of Vikramashila and Paharpur. The third Pala monarch was Devapala (A.D. 810-850). Monghyr was his capital. He had close contact with the Srivijay Empire of Sumatra and there was a lively trade between Bengal and the islands of Java and Sumatra. The next ruler was Mahipala I (A.D. 970-1030). It was during his reign that a Buddhist mission headed

by Dharmapala was sent to Tibet. Ramapala (A.D. 1080-1123) built many temples and established the famous Buddhist monastery of Jagadalla. The rural area was prosperous and mansions of merchant princes studded the high banks of the rivers and waterways of Bengal. We read of fine clothes made of cotton that were transparent as dew, and lovely pieces of cloth, blue-tinted like a cloud (*meghadambara*), and with rainbow colours of peacock plumes (*mayura pekham*). The last Pala ruler was Indradyamnapala.

Richly ornamented sculpture in black stone on Buddhist themes is characteristic of the Pala period. The painting of this period is characterized by mellowness and fluid grace. The Pala kings excavated numerous lakes and tanks which preserve their memory.

The Senas were Brahma-Kshatriyas from Karnataka. They settled in northern Orissa and gradually extended their kingdom to Bengal. Vallalasena (A.D. 1108-1119) reorganized the caste-system and introduced *kulinism* among the Brahmanas, Vaidyas and Kayasthas.

Lakshmansena (A.D. 1178-1205) was the last ruler of Bengal. He was a scholar and patron of learning. Jayadeva, the author of the *Gita Govinda*, the Sanskrit poem, was his court poet.

The People

A reliable source of information on India and Indians in the early eleventh century is Alberuni's *Kitab-ul-Hind*. Born in the territory of Khiva, in 973, in central Asia, he travelled in India from 1017 to 1030 as a political hostage of Sultan Mahmud of Ghazna. He studied the works of Hindu astronomers and mathematicians as well as the *Pouranas*. He was a master of astrology, both according to the Greek and Hindu systems. The net result of his study and observations is a veritable encyclopaedia of Hindu religion, philosophy and science—the *Kitab-ul-Hind*.

Alberuni observes that the Hindu scholars were complacent, proud and self-satisfied. They believed that there was no country but theirs, and no science like theirs!

Alberuni thus described the physical appearance of the Hindus, their dress and habits.

'They do not cut any of the hair of the body. Originally they went naked in consequence of the heat, and by not cutting the hair of the head they intended to prevent sunstroke.

'They divide the moustache into single plaits in order to preserve it. As regards their not cutting the hair of the genitals, they try to make people believe that the cutting of it incites to lust and increases carnal desire. Therefore, such of them as feel a strong desire for cohabitation never cut the hair of the genitals.

'They let the nails grow long, glorying in their idleness, since they do not use them for any business or work, but only while living a *doice far*

hiente life, they scratch their heads with them and examine the hair for lice.

'The Hindus eat singly, one by one, on a tablecloth of dung. They do not make use of the remainder of a meal, and the plates from which they have eaten are thrown away if they are earthen.

'They have red teeth in consequence of chewing arecanuts with betel-leaves and lime.

'They drink wine before having eaten anything, then they take their meal. They sip the stall of cows, but they do not eat their meat.

'They beat the cymbals with a stick.

'They use turbans for trousers. Those who want little dress are content to dress in a rag of two fingers' breadth, which they bind over their loins with two cords; but those who like much dress wear trousers lined with so much cotton as would suffice to make a number of counter-panes and saddle-rugs. These trousers have no (visible) openings, and they are so huge that the feet are not visible. The string by which the trousers are fastened is at the back.

'Their *sidar* (a piece of dress covering the head and the upper part of breast and neck) is similar to the trousers, being also fastened at the back by buttons.

'The lappets of the *kurtakas* (short shirts from the shoulders to the middle of the body with sleeves, a female dress) have slashes both on the right and left sides.

'In washing they begin with the feet, and then wash the face. They wash themselves before cohabiting with their wives.

'On festive days they besmear their bodies with dung instead of perfumes.

'The men wear articles of female dress; they use cosmetics, wear ear-rings, arm-rings, golden seal-rings on the ring-finger as well as on the toes of the feet.

'They ride without a saddle, but if they put on a saddle, they mount the horse from its right side. In travelling they like to have somebody riding behind them.

'They fasten the *kuthara*, i.e. the dagger, at the waist on the right side.

'They wear a girdle called *yajnopavita*, passing from the left shoulder to the right side of the waist.

'In all consultations and emergencies they take the advice of the women.

'When a child is born people show particular attention to the man, not to the woman.

'Of two children they give the preference to the younger, particularly in the eastern parts of the country; for they maintain that the elder owes his birth to predominant lust, whilst the younger owed his origin to mature reflection and a calm proceeding.

'In shaking hands they grasp the hand of a man from the convex side.

'They do not ask permission to enter a house, but when they leave it they ask permission to do so.

'In their meetings they sit cross-legged.

'They spit out and blow their noses without any respect for the elder ones present, and they crack their lice before them. They consider the *crepitus ventris* as a good omen, sneezing as a bad omen.

'They use black tablets for the children in the schools, and write upon them along the long side, not the broad side, writing with a white material from the left to the right.

'They write the title of a book at the end of it, not at the beginning.'

Alberuni also observed that the Hindus had a predilection for versification. This was due to the fact that there was more reliance on memory than on a written record. He states, 'Grammar is followed by another science, called *chandas*, i.e. the metrical form of poetry, corresponding to our metrics—a science indispensable to them, since all their books are in verse. By composing their books in metres they intend to facilitate their being learned by heart, and to prevent people in all questions of a science ever referring to a *written* text, save in a case of bare necessity. For they think that the mind of man sympathises with everything in which there is symmetry and order, and has an aversion to everything in which there is no order. Therefore, most Hindus are passionately fond of their verses, and always desirous of reciting them, even if they do not understand the meaning of the words, and the audience will snap their fingers in token of joy and applause. They do not want prose compositions, although it is much easier to understand them.'

Books

About the writing material of the Hindus and their books, Alberuni states, 'The Hindus are not in the habit of writing on hides like the Greeks in ancient times. Socrates, on being asked why he did not compose books, gave this reply: "I do not transfer knowledge from the living hearts of men to the *dead* hides of sheep." Muslims, too, used in the early times of Islam to write on hides, e.g. the treaty between the Prophet and the Jews of Khaibar and his letter to Kisra. The copies of the Koran were written on the hides of gazelles, as are still now-a-days the copies of the Thora. Written on this material, the orders of the Khalifs went out into all the world until shortly before our time. Papyrus has this advantage over vellum, that you can neither rub out nor change anything on it, because thereby it would be destroyed. It was in China that paper was first manufactured. Chinese prisoners introduced the fabrication of paper into Samarkand, and thereupon it was made in various places, so as to meet the existing want.

'The Hindus have in the south of their country a slender tree like the date and cocoa-nut palms, bearing edible fruits and leaves of the length of

one yard, and as broad as three fingers one put beside the other. They call these leaves *tari* (*tala* or *tar*, *Borassus flabellifer*), and write on them. They bind a book of these leaves together by a cord on which they are arranged, the cord going through all the leaves by a hole in the middle of each.

'In Central and Northern India people use the bark of the *tuz*-tree, one kind of which is used as a cover for bows. It is called *bhurja*. They take a piece one yard long and as broad as the outstretched fingers of the hand, or somewhat less, and prepare it in various ways. They oil and polish it so as to make it hard and smooth, and then they write on it. The proper order of the single leaves is marked by numbers. The whole book is wrapped up in a piece of cloth and fastened between two tablets of the same size. Such a book is called *puthi* (cf. *pusta, pustaka*). Their letters, and whatever else they have to write, they write on the bark of the *tuz*-tree.'[1]

Industrial and Mercantile Guilds

Our main source of information on industry and trade in the ninth century is Medhatithi. We learn from him that both industrial and mercantile guilds functioned in his time. He defines the guild (*shreni*) as consisting of people following common professions, such as tradesmen, artisans, money-lenders, coach-drivers, and so forth. Besides the *shreni* and the *sangha*, there were associations of labourers. Illustrating Manu's law on the subject, Medhatithi lays down the rule that among architects, masons, carpenters, and the like, the wages shall be distributed on the principle that he who does the most difficult part of the job shall receive more, and he who does the easier part shall get less.

In the inscriptions of this period we have concrete examples of different classes of guilds and their constitution and functions. Among the guilds specially mentioned are those of weavers, potters, gardeners, and artisans. Mention is made of single as well as multiple headmen (*mahattaras*) who evidently formed the executive of these bodies. The guilds collectively made endowments for pious objects or received them on trust to provide for such objects out of the accruing interest. In each case, they arranged for distributing the task among themselves, evidently in accordance with the old *Smriti* rule giving legal authority to the agreement of guilds.

Interest

The old legal rate of interest, laid down in Vasishtha at 15 per cent per annum, had ceased to be binding, and the usage had outgrown even the somewhat flexible rules of the later *Smriti* texts. But Medhatithi generally upholds the older law relating to usury against later interpretations.

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[1]Sachau, E.C. *Alberuni's India*, pp. 136, 137, 174, 179-183

As regards Manu's higher scale of rates (2 , 3, 4, and 5 per cent per month) to be paid respectively by Brahmanas, Kshatriyas, Vaishyas, and Shudras, Medhatithi says that these alternatives are allowable to a money-lender who cannot maintain his family at the 1¼ per cent rate, or to one who has only a small capital or in the case of the borrower not being a specially righteous person.

Wages

The *Smriti* law relating to wages can be gleaned from Medhatithi. The wages which were paid in cash or in kind were fixed by contract according to the nature of the work to be done, the contract sometimes extending over a period of six months or even a year. A wilful breach of the contract rendered the labourer liable to forfeiture of his wages as well as to payment of compensation to his employer.

Textile Industry and Metal-working

One of the oldest Indian industries is the textile. The records of this period mention a great variety and different qualities of textiles such as woollen and hempen yarns, garments made of silk and of Ranku deer's hair, and of sheep's and goat's wool. The professions of the weaver, the tailor, and the dyer (in three different colours, viz. red, blue, and yellow), are mentioned in contemporary literature. Medhatithi says that wives left unprovided for by their husbands are to live by such unobjectionable occupations as spinning (*kartana*) and lace-making (*jalika-karana*), and widows forced to live by their own labour are to subsist by the same occupations.

The working of metals was pursued with as much success as in the preceding epoch. The list of metals found in contemporary literature includes copper, bell-metal (or brass), iron, lead, tin, silver and gold. From the synonyms given in the *Abhidhanaratnamala*, we learn that Saurashtra was famous for its bell-metal, whereas Vanga was well known for its tin industry. Five centres for manufacturing swords are mentioned in *Agni Purana*, along with the distinctive qualities of their products. These are Khatikhattara and Rishika (unidentified), Surparaka (Sopara), Vanga (East Bengal), and Anga (Monghyr and Bhagalpur Districts). Ibn Haukal mentions the City of Debal in Sindh as famous for the manufacture of swords.

Trade

Scattered references indicate that India's trade with the outside world was carried on both by land and sea. Enterprising Arab merchants from southern Arabia had built up by this time extensive trade relations with India, and with the countries of the Far East as far as China. According

to Mas'udi, ships from India, along with those from Basra, Siraf and Oman, from Djawaga and Champa, ascended the Khanfu River to reach Khanfu (Canton) at a distance of seven days' journey from its junction with the sea. In *Trikandasesha* is a list of names (*hoda, tarandhu,* and *vahana*) for vessels plying on the high seas. More important are the reminiscences of voyages by daring Indian merchants to the rich lands of South-East Asia, which are found in the contemporary ballads of Bengal.

It is chiefly from the accounts of the early Arab geographers that we get a list of the principal Indian sea-ports. On the coast of Sindh, near the mouths of the Sindhu, lay Debal, a large mart and port. On the Gujarat coast were Kambay, Thana, and Sopara, and farther south lay Sindan (modern Sanjan, 142 kilometres north of Bombay), from which pepper was exported. On the Malabar coast lay the important port of Kaulam Malaya (modern Quilon), where the ships sailing from Muscat took in fresh water before crossing the Bay of Bengal.

Agriculture

Persian wheel. An evidence in a Hindu sculpture of the use of a Persian wheel is in a panel from Mandor, near Jodhpur in Rajasthan (Fig. 202). This panel depicts a Persian wheel and is ascribed to the eleventh century. A wheel with a chain of terracotta buckets is clearly shown. On one side of the wheel, an animal is depicted drinking water from a trough, and on the other side are soldiers carrying swords and shields. Irfan Habib[3] is of the view that the device shown is merely a *noria* or wheel carrying pots, worked manually, as no gearing mechanism is shown. This sculpture shows a Persian wheel in profile, and the gearing mechanism would be on the other side. Hence there is no valid reason for doubting that it depicts a Persian wheel. That this sculpture is pre-Islamic proves that the so-called Persian wheel is an Indian wheel, and is not an import from Iran.

Crops. A number of cereals as well as edible vegetables and plants are mentioned in Sanskrit lexicons. In the description of the king's dietary in the *Manasollasa,* reference is made to eight varieties of rice, distinguished by their colour, odour, size, and period of growth, and seven different kinds of beans. The cereals were classified under three heads, viz. those in pods (*samidhanya*), the awned grains (*sukadhanya*), and rice of different varieties.

For cereals, Magadha is mentioned for its richness in rice, whereas the rice of the Kalinga country is included in the list of varieties suitable for the king's dietary. Grapes are mentioned by Kalhana as a product of Kashmir. From Idrisi we learn that date- and coconut-palms grow at Sandan (Sindhudurga in the Ratnagiri District) and that coconut-palms

[3]Habib, Irfan. Jatts of Punjab and Sind, in *Punjab Past and Present—Essays in Honour of Dr Ganda Singh,* pp. 97, 98

grow in abundance at Saymur (Sirur in South Canara). Ginger and cinnamon were produced in large quantities in the Pandya kingdom according to Marco Polo. Camphor grew on the mountain-slopes between Quilon and Madura, according to Yaqut. Marco Polo observes that "Bengala" (Bengal) produced spikenard and other spices, ginger, sugar, and other articles. According to Idrisi, cardamom grew on the hill-slopes at Fandarina (Pandalayani in Malabar). According to Ibn Sa'id, Malabar was the country of pepper. It was grown at Sandan, Fandarina, Jurbatan and Quilon (all in Malabar), according to Idrisi, Yaqut, and Qazwini. Bamboo grew at Kuli (in the Gulf of Cambay), Tana (Thana in the Salsette Island), Sandan and Saymur. Sandalwood was a product of the Malaya hill (the southern part of the Western Ghats), whereas Kashmir produced yellow sandal which was used as an unguent by kings in the rainy season. Saffron is mentioned by Kalhana as one of the products of Kashmir. Cotton-trees of a very great height and almost twenty years old grew in Gujarat. Marco Polo states that cotton grew in Bengal. Indigo was produced in great quantities in Gujarat and at Quilon. "Brazil wood" (*sappan*) of very fine quality as well as teak grew at Kulam (Quilon).

Exports of Agricultural and Forest Products

'Ibn Khordadbah, writing towards the end of the ninth century, mentions Indian exports consisting of aloe-wood, sandalwood, camphor, nutmeg, clovepink, cubele, coconut, vegetable stuffs, and cotton. Costus, rattan, camphor-water, indigo, and bamboos were exported from Sindh. It appears that costus from the Himalayas and indigo from Gujarat, as well as camphor and rattan, probably from Malay and Sumatra, were brought to the ports of Sindh for export. According to *Kavyamimamsa*, pine- and deodar-trees, grapes, saffron, and jujube (*ber*) were the products of Uttarapatha (North-West India), while birch-bark (*bhojapatra*) is mentioned as a product of the Himalayas. According to Ibn Rosteh, teak was exported from the Rashtrakuta kingdom of Western India, where it was extensively grown. Pepper was exported from Sindan, and *sandal* from Cambay. *Kavyamimamsa* mentions among products of Western India varieties of bamboos, palm-trees, bdellium, and date-trees. The characteristic products of Malaya Hill (Western Ghats below the Cauvery) in South India consisted of sandalwood, pepper, cardamom and various perfume-bearing plants. From the extensive reference to the use of sandalwood which is found in the literature of this period we can infer that a large trade in this article was carried on by South India with the rest of the country. As regards Eastern India, the land to the east of Banaras grew, according to *Kavyamimamsa*, different species of fragrant plants and trees (*lavali* creeper and *granthiparnaka*-tree) as well as aloes and grapes.

'Of the kingdom called Rahma, the Pala kingdom, we are told that

it produced Indian aloe-wood and a remarkably fine variety of cotton fabric. The textiles of Rahma, according to Ibn Khordadbah, were of velvety cotton, whereas Sulaiman declared them to be so light and fine that a robe made of that cloth could be passed through a signet ring.

'As regards animals and animal products, *Kavyamimamsa* includes skins and *chowries* made of *chamara* deer's tail among the products of Uttarapatha, and musk among those of Purvadesa. In the extreme south, the Tamraparni River in the Pandya kingdom, at the point of its junction with the sea, was still famous for its pearl fisheries.

'According to Medhatithi, precious stones and pearls in the South, horses in the West, elephants in the East, as well as saffron, silks, and woollens in Kashmir were royal monopolies, and private trading in them was punished with confiscation of the property of the offender.

'As for mineral products, antimony (*srotonjana*), rock-salt (*saindhava*), and beryl (*vaidurya*) are mentioned by Rajasekhara among the characteristic products of Uttarapatha. The rock-salt must have come from the Khewra mines in the Salt Range in the Punjab.

Imports

'The import of wine from Kapisa is hinted at by the synonym Kapisayana given for wines in *Abhidhanaratnamala*. Ibn Said, an Arab writer of a later date, mentions the import of dates from Basra into Debal in Sindh. The phrase *chinamsuka* (Chinese silk), found in the literature of this period as in former times, suggests that this fine stuff was still being brought from China.

Animal Products

'The preparation of silk from the cocoons of the silkworm and of wool from the hair of the hill sheep was widely known. Equally familiar was the use of the bushy tail of the Himalayan yak for preparing flywhisks and of musk from the musk-deer. Elephant's tusks are mentioned by Chau Ju-Kua among the products of the Chola kingdom. The manufacture of leather was greatly developed in some regions during this period. From Marco Polo we learn that Tana had a great export trade in quality leather. Cambay had a great trade in hides. Gujarat produced dressed skins of different kinds (those of goats, of domestic and wild oxen, of buffaloes and so forth) as well as "beautiful mats in red and blue leather, exquisitely inlaid with figures of birds and beasts and skilfully embroidered with gold and silver wire." It also produced leather cushions embroidered with gold. These articles were in demand in Western lands. The "sleeping mats", which were "marvellously beautiful things", and the cushions were sold for ten and six silver marks a piece respectively.

'A valuable industry dating from ancient times was that of the pearl-

fisheries at Subara (Suparem or Supara in the north of Bombay) and Fufal (Bekal, 34 miles [55 kilometres] south-south-east from Mangalore). Chau Ju-Kua includes pearls among the native products in the Chola kingdom. The great seat of the pearl-fisheries was the Pandya kingdom. Marco Polo, writing at the close of the thirteenth century, observes that pearls were fished in great quantities in the kingdom of Malabar which in fact was the place from which they were spread all over the world. The pearl-shells, he says, were found in the gulf between India and Ceylon during the season from the beginning of April to the middle of May every year. He gives a vivid description of the fishing operations conducted by the pearl-fishers. They engaged the services of fish-charmers as well as of a large number of divers and paid royalty of ten per cent for their finds to the king.[3]

[3]Majumdar, R.C. *The History and Culture of the Indian People*, Vol. IV, pp. 399 to 406, 516, 517

CHAPTER 35

OBSERVATIONS OF MEDHATITHI, PARASHARA AND KASHYAPA ON AGRICULTURE

NINTH CENTURY TO ELEVENTH CENTURY

THE sources of information on agriculture in India during the period from the ninth to eleventh centuries are the writings of Medhatithi, Parashara, Kashyapa and early Arab writers.

Medhatithi was a Kashmiri scholar who lived during the period from A.D. 825 to 900, and is known for his commentary on the *Manu-Smriti*. He stresses the need of irrigation works to make people less dependent on rains. As regards taxation, he states that taxes should be light on small holdings, and heavy on those which yield large profits. About drinking, hunting and gambling, being a man with practical common sense, he says that it is neither possible nor desirable to prohibit them.

Medhatithi's view of the relative status of different occupations is similar to that of Manu and he views agriculture as a profession with disfavour. He says that among the Vaishya's occupations, agriculture is the worst for a Brahmana, then comes trade, and next the tending of cattle and so forth.

SOIL

In *Abhidhanaratnamala*, soils were classified as fertile (*urvara*), barren (*irina*), fallow (*khila*), desert (*maru*), and excellent (*mritsa* or *mritsna*), as well as those green with grass (*sadvala*) or abounding in reeds (*nadvala*), those which were black or yellow, and those which owed their fertility to rivers or rains. The *Abhidhanaratnamala* further states that different kinds of fields were selected for different classes of crops. It includes terms for fields producing several varieties of rice (*vrihi, sali, kodrava*, and a variety ripening in 60 days), of beans (*mudga* and *masha*), of oilseeds (sesame and linseed) as well as those producing hemp, barley and vegetables.

IMPLEMENTS

Machines (*yantra*) for crushing sugarcanes are mentioned in a description of the winter season in the *Upamitibhavaprapanchakatha*. Fields irrigated with Persian wheels (*arahata*) and with leather buckets (*charsa*) are mentioned in a record of A.D. 946. Again, it appears from Medhatithi that the Vaishya (the agriculturist *par excellence*) was expected to know, among other things, what seed was to be sown thickly and what thinly, what soil was suitable for a particular kind of seed, and what harvest was expected from a special variety of seed.

CROPS

The early Arab writers of the ninth and tenth centuries refer to the fertility of the soil and the cultivation of grain and fruits in Western India. Some cities in Gujarat grew mangoes, coconuts, lemons, and rice in great quantities. One such city also grew sugarcane and teak-trees. Malabar produced pepper and bamboo.

The *Abhidhanaratnamala* mentions a large variety of cereals and other foodgrains along with their synonyms. The list comprises *sali* rice of three varieties, coarse grain (*kodrava*), mustard (*sarshapa*) of two varieties, pepper or saffron or "Italian millet" (*priyangu*), wild sesamum (*jartila*), wild rice (*nivara*), as well as pulses of four different kinds (*masura, kalaya, ralla,* and *adhaka*). A group of seventeen articles (including rice and barley) is included by the *Smritis* in the category of grain (*dhanya*). Again, Medhatithi mentions sugar-candy (*ikshukhanda*) and sugar (*sarkara*), along with sweetmeats and milk products. The excellence of *pundra* sugarcane which yielded juice even without a pressing instrument in contrast to a variety of sugarcane (*kosakara*) with its mass of flowers, is pointed out in a verse of the *Kavyamimamsa*. Similarly, the *Vishnudharmottara,* gives a list of five kinds of grains (*dhanya*), viz. barley, wheat, paddy, sesamum, and edible grains of two varieties (*kangu* or *syamaka* and *chinaka*). Among other agricultural products, camphor and *aguru* are given as examples of costly articles by Medhatithi.[1]

PARASHARA

Who is the author of *Krishi-Parashara?* Was the author of the *Krishi-Parashara* the same as the author of the well-known *Parashara-smriti,* regarded as the highest authority on agriculture in the Kali Age. Whereas there is no external evidence on the matter, the internal evidence fails to prove anything conclusively. According to Raychaudhuri, 'One may safely place the author of the *Krishi-Parashara* in the period between A.D. 950 and 1100.

The *Krishi-Parashara* deals with the then existing knowledge and practice relating to agriculture such as soil classification and land-use, manuring, rotation of crops, irrigation, tillage implements, protection of crops from pests and diseases, and agricultural meteorology. It also deals with the care of draught animals and the grazing of cattle.

KASHYAPA

Kashyapa, in Indian tradition, appears to be an appellation to different personages who belonged to different periods from the Vedic period onwards. Some among them attained pre-eminence in the fields of medi-

[1]Majumdar, R.C. *The History and Culture of the Indian People,* Vol. IV, *The Age of Imperial Kanauj,* pp. 399 to 406

cine, astrology, plant science and architecture.

Varahamihira (*c.* fifth century) in *Bṛhat Samhita* mentions Kashyapa versed in astrology among the three other *rishis,* namely Parashara, Garga and Vajra, as prognosticator of rainfall. Bhattotpala (tenth century), the commentator of the *Bṛhat Samhita,* frequently cited Kashyapa's views on various aspects of plants while commenting on the chapter entitled 'Vrikshyurveda'. If these two Kashyapas of the *Bṛhat Samhita* are the one and the same person, then the probable date of Kashyapa versed in plant science dates before the fifth century. If not, Kashyapa the plant-scientist appears to belong to a period before the tenth century. The *Krishi-sukti,* a comprehensive text on agricultual science, is attributed to Kashyapa. It is likely that he was a native of Kosala, for he shows keen insight into rice cultivation and also mentions Kosala by name when describing rice culture. He also mentions tropical crops, such as arecanut, coconut and bread-fruit.

Importance of Agriculture

Unlike Medhatithi, Kashyapa realizes the importance of agriculture and advocates its practice by the rulers, their advisers and officials so that they realize the difficulties which the farmers face. Says Kashyapa, 'Both bipeds and quadrupeds on the face of the earth would face misery if there were no cultivation. Hence, for pleasing the gods and protecting the people the king should take keen interest in agriculture. Agriculture should also be practised by priests, Brahmanas and ministers particularly.

'Having mined iron, copper, gold, silver, red ochre, etc., the king should have the various war-weapons and agricultural implements prepared by expert ironsmiths, cutters, and goldsmiths in the villages and cities. The former he should distribute among the soldiers and also keep at the army headquarters for the protection of towns, palaces and fortresses, and the latter he should distribute among the village people.'

Management

Kashyapa stresses the importance of efficient and good management in agriculture. He states, 'By continued vigilance over their paddy-fields, by holding cultivation in esteem, and doing it methodically and by the care of their cattle, the cultivators get richer rewards as well as peace of mind. Hence experienced cultivators, having cordial relations among themselves and intent on having two crops every year, should consider it their first duty to protect their cattle, servants, seeds, water-channels, reservoirs, tanks, lakes, etc., spades, sickles, etc., threshing-floors, fences and fields diligently and practising the bountiful art of cultivation according to their local custom, snug in the fulfilment of the three aims of their life, live in great happiness.'

CROPS

Apart from rice, Kashyapa mentions other crops. He says, 'Cultivation of beans and pulses like *masha* (*Vigna radiata*), *chana* (gram), *mudga* (*Vigna mungo*), *kuluttha* (*Dolichos biflorus*), *tila* (sesamum), and of seeds of pepper and *ciraka* should also be done at some places.'

MARKETING

Recognizing the importance of marketing, Kashyapa says, 'The king should collect the produce of vegetables, grains, *adhakas*, grams, sesamum, *masha*, mustard, grapes and the various seasonal fruits and stock them for the benefit of the people in shops, market-places, stalls or other places especially built for the purpose on the cross-roads and provided with a spacious yard with or without a shed.'

'All the commodities mentioned above and useful necessities such as blankets, cloth, curds, milk and other articles of food, jaggery, oil and other useful products of agriculture, the king should place in the market-places of the villages, towns, cities and particularly of the capital. There he should appoint rich vaishyas who are well-versed in trade for the sale and purchase of these commodities.'

RICE

Observations of Kashyapa on the cultivation of rice are remarkable for their accuracy. From the raising of the nursery, he describes the transplanting of seedlings, weeding, irrigation, protection against pests, threshing and storage.

'Of the cultivable commodities the varieties of rice occupy the first place, the pulses the second, and the vegetables the third', says Kashyapa. In the fourth place come *ghee*, milk, curds, etc. These four kinds of products comprise the entire food-stuff. This stuff promotes the happiness of all the gods and is the means of sustenance of man-kind. This gives nourishment, health and long-life and was created by Brahma at the beginning of creation all over the earth.

'The sages have said that the cultivation of paddy is best done in countries like Kosala where the fields are irrigated with river-water. Therefore, wise husbandmen who have decided upon reaping a harvest of different kinds of rice like Kalama and Vrihi should first irrigate their fields well by means of channels drawn from reservoirs, rivers or lakes and then till them with the help of oxen.

Transplanting seedlings. 'Then the cultivator should order the uprooting of the wisps of paddy seedlings which have already been grown closely in a separate nursery, and then, tying together each wisp, he should, on an auspicious hour, have them transplanted by servants in rows evenly in the paddy field in which the clay has become soft by tilling and has been

carefully dressed with the dung of cows or goats or with decayed vegetable matter.

'Afterwards only a small quantity of water should be allowed to remain in the field and care be taken to provide an outlet for superfluous water.

'In this manner, the paddy seedlings transplanted in rows in a well-ploughed paddy field full of water, in a village, town, forest or woodland, irrigated by a canal and provided with several outlets for draining away the surplus water, are made to take root by the Creator (i.e. Nature) after the lapse of seven or ten days and then the new shoots sprout forth and make their blessed appearance. Then the land shines forth with that fascinating bloom which is found on the plumage of parrots or on the body of a damsel in the prime of her youth.

'In this way at the expiry of the first month gradual growth of the paddy blades is discernible.

'There is an all-round growth of shoots and increase of splendour on the plants which feed on water daily and hold out a promise of rich harvest.

Weeding. 'Therefore the cultivators should systematically and assiduously weed out the wild grass and weeds and other injurious rushes like *munja* from their fields. It is best to destroy the wild grasses, rushes, weeds, etc., which affect the growth of grain and reduce the yield of crops, from their very roots. An experienced person should first fill the paddy fields with water and then gradually root out the weeds, etc., row by row. Or it is best to have the pest removed daily by the servants. When the weeds have been eliminated by the cultivators their fields shine forth lustrous and luxuriant.

'The cultivation of all the various kinds of rice like the white *Sali*, red *Sali, Kalama,* etc., which have been enumerated above is done in the same manner.

'When the ears at the top of the rows of plants gradually grow solid and full of milky-juice (or sap) and appear to be somewhat bent, then they should be protected, especially from the parrots. This caution applies equally to all countries.

Irrigation. 'Then by and by the juicy grains in the ear would become harder at the core and would finally ripen into the rice. Till then regular irrigation of the fields is advisable and beneficial; otherwise there would be the loss of crop.

'Therefore, the cultivators should continue to observe the development of sap frequently, and should regularly water their fields at the proper times for the sake of increasing the sap.

Protection against pests. 'It is extremely beneficial if the crop is protected from rats, locusts, parrots, and other pests.

'The ripe paddy, which is so beneficial to the living beings, should be honoured by those who live on it, with circumambulations, and then pre-

served by them after having determined the period of life of the grain from its appearance, the stamina of its seed and the quality of the soil from which it is produced or from actual experience.

'Therefore, the cultivators should be alert to protect their crop at the time of ripening against all sorts of depredations.

Harvesting. 'When the ears of the paddy have gradually ripened according to their respective duration of time, then water should not be let into the fields. This is the advice of the agricultural experts and should be followed in the case of all paddy-fields.

'When the ears at top of the plants become ripe then their stalks bend their head very low to the ground. Seeing them bend so, the husbandman should himself or through his servants protect them in the field for a period of twenty days. Now, when the stalks have become ripe and assumed a golden hue, the cultivators should then reap them with sickles etc. They may have the harvest mown in one day or in several days successively with the help of their dependants and servants working in co-operation.

'But reaping would be useful only if care is taken that the stalks are not damaged during the operations nor the harvest spoiled by rain or carried away by thieves.

Threshing. 'The cultivators should have the reaped plants with their ears stacked on threshing-floors with the help of their servants and attendants. It is advisable to keep the harvest lying on the threshing-floors for three to five days. By threshing the ripe stalks from which the ears become loosened, the grains drop on the threshing-floor and sparkle like heaps of bright pearls. On the second round of threshing done by having the crop trodden over by bullocks and buffaloes, the remaining quantity of the grain also drops on the floor. After having the paddy threshed in this way on the threshing-floor, the cultivators should gather the assorted stuff that is thick and substantial.

Selection of seed. 'The cultivators should carefully sift the superior grain from the inferior stuff by means of the winnowing-fans, etc., and gather the former into a heap. A wiseman should then dry them in the sun and get them cleaned of impurities. He should then, having apportioned one share to the gods, one to the king, one as a gift to a Brahmana learned in the Vedas, and one for the maintenance of the servants, keep the remaining stock of paddy in his own house.

Storage. 'He should carefully preserve the grain in suitable receptacles like *kathinya* or in well-baked clay pots or in vessels of strong glass, or in containers woven of ropes and plastered with mud, according to the custom of the locality. At some places, the farmer should dig a pit in the hard earth, provide it with descending steps and store the paddy into it, taking care that it is safe from the hazard of damp, thieves, parrots, rats and other noxious animals.'

VEGETABLES

Regarding the cultivation of vegetables, Kashyapa states, 'In spite of the various species of rice and other provisions like *adhaka*, etc., want of food is still felt all over the world. Therefore, the farmers should cultivate delicious vegetables like *jatika, rasijatika, valhika, vanavalika, patolika*, egg-plants, *savaka*, pumpkin-gourd, *kalata, kustumburu, surana sakuta*, and turmeric and ginger—both cultivated and wild—as well as various other luscious plants for the sake of cooking. In the writer's opinion these are the principal vegetables.

'The cultivators should grow vine, Indian spikenard, cardamom, etc., in their respective regions of cultivation.

'Sometimes parasitic vermin grow on the leaves of the vegetables like the egg-plant, *patolika, valte, savaka*, cucurbits, *kalatas, surana, sakuta*, turmeric, ginger, etc. In order to kill the vermin, the cultivators should sprinkle the leaves with ashes, dust or lime-water according to the local usage.

'For the sake of obtaining luscious edibles wisemen should undertake the cultivation of *patolika*, egg-plant, gourds, *jambir* (citron), *lakuca*, cardamom, vine, date-palm, etc., according to the local custom and proper season. Of these vegetables, either leaves, flowers, fruit, unripe fruit or bulbous roots are taken for use either at the beginning of efflorescence, or in the middle or end of it, as the case may be.

'Some of the fruits are delicious to eat, and others good in sucking their juice. Of the plantain tree in particular all the parts—roots, stem, flower, unripe fruit and ripe fruit—are delicious and agreeable to eat. It is recommended as an excellent food by the sages.

'The cultivators should preseve the art of cultivation by practising it in their homes, pleasure groves, land, field-beds, on the banks of ponds and lakes, below the water-reservoirs or near to their sluices.

'They should also grow in a proper manner the plantain, arecanut palm, *punnaga (Rothleria tinctoria)*, coconut, mango, bread-fruit, cardamom, vine and *malati* (jasmine) as well as egg-plants, *valte*, gourds, etc.'

GARDEN CROPS

Kashyapa mentions a number of garden plants. He says, 'A wise man may grow plantain, sugarcane, piper-betel and arecanut in a low land, a garden or a pleasure grove. He may also grow the plantain *(Musa paradisiaca* [*M. sapientum*], *mocha)*, bread-fruit (*panasa*) tree, *likucha (Artocarpus lakoocha)*, the *rasala* and *amra* varieties of mango, rose-apple (*jamun*) and cocoanut trees in the house-orchards, in gardens, or on high or low land.'

GARDENS

'A wise king should grow a pleasure grove or a garden in a suitable

place in the village, city and particularly in the capital', says Kashyapa. 'He should have a grove of trees planted outside or inside the town. He should also have a garden planted especially for the diversion of the ladies of his harem. He may have a grove of trees grown on the precincts of a forest.

'By growing trees like the sara (*sal*) and sandal he should provide material for house-building for his subjects.

'In his palace garden he should grow various kinds of beautiful and fruits-bearing trees such as the different species of the plantain (*rambha, mocha,* etc.) and citron (*jambira, matulunga,* etc.) and the Indian spikenard.

'He should also encourage the cultivation of the various species of grass (such as *kusa, kasa*), basil, the wood-apple and the fragrant and seasonal flowers which may be suitable for worship and household remedies.

'For religious festivals he should have a garden planted on the temple land inside or outside the village according to the availability of land or local custom.

'In his palace he should have an excellent pleasure grove attached to the gynaeceum bristling with beautiful trees and flowers like the *malati*. He may also have one such grove planted outside his capital for the diversion of the people.'

Forests

Kashyapa further enjoins that the king should encourage forestry. He says, 'their precincts and on the top and slopes of the hills he should grow forests radiant with many kinds of trees. There he should also order the preservation of the seeds of all kinds of trees.

'From these trees the people get flowers, fruits and wood for the construction of their houses.

'Therefore, the king, taking upon himself the responsibility of protecting his kingdom, should grow on vast tracts of land or with walled enclosures trees and plants like the following: viz. karanjaka (*Pongamia glabra*); bhurjaka or birch (*Betula utilis* [*B.bhojapatra*]), arjuna (*Terminalia arjuna*), kadamba (*Anthocephalus chinensis* [*A.cadamba*]), sigru (*Moringa oleifera* [*M. pterygosperma*]), ornamental flowering trees; tinduka (*Diospyros peregrina* [*D. embryopteris*]), vata—the banyan; Plaksa (*Ficus lacor* [*F. infectoria*]), vibhitaka (*Terminalia bellerica*), Amalaka (*Emblica officinalis*) [*Phyllanthus emblica*], karnikara (*Pterospermum acerifolium*), likuca (*Artocarpus lakoocha*), nimba (*Azadirachta indica*), margosa; ashoka (*Saraca asoca*) [*Jonesia asoka*], sirisa (*Albizia lebbeck*), gampeyaka (*Michelia champaca*), vamsa-bamboo; kuta; rasola, amra (varieties of mango); madhuka (*Madhuca indica*) [*Bassia latifolia*], punnaga (*Calophyllum inophyllum*), kovidara (*Bauhinia purpurea*), paribhadra (*Erythrina variegata* var. *orientalis*) [*E. indica*].

'In this manner, he should have great forests, radiant with groves of trees, planted by the cultivators and other people on river-banks and in

various countries like Gandhara, Kunti, Panchala, Kashmira, Avanti, Sindhu, Nepala, Nishadha, Kosala, Anga, Dhurjara (Gurjara) and Saurashtra, on fertile land provided all round with tanks, canals or ponds, etc. He should have them well guarded by brave soldiers and fighters for the benefit of the people.'

The forests yielded a large variety of edible fruits—mango, pomegranate, jack, banana, date, *vilva, kapittha,* rose-apple, jujube, mascot, coconut—these being the commonest and best. Vines, dates and palms were specially grown in the Punjab and the North-West Frontier. Panini speaks of *Kapisa* as the premier vine-growing district of India.

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APPENDIX I

LANDMARKS IN THE EVOLUTION OF MAN HIS CULTURE AND AGRICULTURE

70	Million Years Ago	Prosimians, earliest primates, develop in trees.
40	,,	Monkeys and apes evolve.
20	,,	*Dryopithecus*, a giant ape in the Siwaliks, India.
15	,,	*Ramapithecus*, oldest-known primate with apparently man-like traits, evolves in India and Africa.
5	,,	*Australopithecus*, closest primate ancestor to man, appears in Africa.
3	,,	Oldest known tool fashioned by man in Africa.
1½	,,	First true man, *Homo erectus*, emerges in Indonesia and Africa.
1	,,	*Homo erectus* migrates throughout Old World tropics.
800	Thousand Years Ago	*Homo erectus* populates temperate zones.
500	,,	*Homo erectus pekinensis* learns to control and use fire.
400	,,	Man begins to make artificial shelters from branches.
90	,,	Neanderthal man emerges in Europe.
60	,,	Ritual burials in Middle East suggest belief in afterlife.
32	,,	Cro-Magnon man arises in Europe.
28	,,	Man reaches Australia.
22	,,	First artists decorate walls and ceilings of caves in France and Spain.
19	,,	Invention of needle makes sewing possible.
10	,,	Dog domesticated in Iraq.
9000	Years B.C.	Jericho settled as the first town.
8700	,,	Sheep domesticated in Middle East.
7700	,,	Goat domesticated in Iran.
7500	,,	Invention of polished stone implements. Man cultivates his first crops, wheat and barley, in Middle East.
6400	,,	Loom, basketry and hand-made pottery

		invented in Middle East.
6000	„	Cattle and pigs domesticated in Middle East.
5000	„	Cave paintings at Adamgarh, Madhya Pradesh.
4400	„	Maize cultivated in Mexico.
3500	„	First potatoes grown in South America.
3400	„	Wheel invented in Sumer.
3000	„	Bronze used to make tools in Middle East.
2900	„	Plough invented in Middle East.
		Irrigated farming in Iraq.
2800	„	Sumerians invent potter's wheel.
2700	„	Silk-moth domesticated in China.
2300	„	Harappan Chalcolithic Culture.
		Cities rise in the Indus Valley.
		Cultivation of wheat, barley, grams, peas, *sarson* and cotton.
		Poultry, buffalo and elephant domesticated in Indus Valley.
2200	„	Harappan culture spreads to East Punjab, Rajasthan and Gujarat.
		Cultivation of rice in Lothal and Rangpur, Gujarat.
1800	„	*Ragi (Eleusine coracana)* cultivated at Hallur, Karnataka.
1780	„	*Kulthi (Dolichos biflorus)* cultivated in Tekkalkota, Karnataka.
1725	„	*Jowar (Sorghum bicolor)* cultivated at Ahar, Rajasthan.
1700	„	Herdsmen of Central Asia learn to tame and ride horses.
1600	„	Aryans in North India. They bring wheeled *rathas* drawn by horses.
		Pulses *(urd, moong* and *masur)* cultivated at Navdatoli, Madhya Pradesh.
1500	„	*Tusser* silk in use at Nevasa, Maharashtra.
		Vedic Aryans in India.
		Cultivation of barley, rice and sugarcane.
		Irrigation from wells.
1400	„	Iron in use in Middle East.
1000 B.C. to 600 B.C.		Later Vedic Period.
		Second wave of Aryan migrants in India.
		The age of iron and painted grey pottery.

Invention of iron ploughshare and axe. Clearance of jungles and expansion of cultivation in Punjab, Uttar Pradesh and Bihar.

Note

While the diffusionists believe that iron technology diffused from the Hittite empire to Iran and other countries, some believe that it could have a multiple origin. D.K. Chakrabarti[1] is of the view that early iron-using centres in India could have developed in many places where iron ore was available. According to him, the iron age sites in India date from 1100 B.C. to 700 B.C. The earliest date is however much later than for Anatolia. It seems that while in North India iron technology diffused from Anatolia via Iran, in South India it may have been discovered independently.

[1]D.K. Chakrabarti, 'Distribution af iron ores and the archaeological evidence of early iron in India.' *Jour. of the Economic and Social History of the Orient*, Vol. XX, Part II

APPENDIX II

RADIOCARBON DATES OF IMPORTANT ARCHAEOLOGICAL SITES IN INDIA AND PAKISTAN

TABLE 1. ^{14}C DATES OF MICROLITHIC SITES

Site		^{14}C dates, based on half-life = 5730 years, in years B.C.
Bagor (Rajasthan)	TF-1011, & 1012	3285± 90
	TF-786	4480±200

TABLE 2. ^{14}C DATES OF NEOLITHIC SITES

Site		^{14}C dates, based on half-life = 5730 years, in years B.C.
Barudhih (Bihar)	TF-1101,	595± 90
	TF-1100	1055±210
Burzahom (Kashmir)	TF-128,	2375±120
	TF-15	1535±110
Chirand (Bihar)	TF-1035,	1270±105
	TF-1032	1755±155
Ghaligai (Pakistan)	R-379,	2422± 55
	R-377a	1608± 50
Hallur (Karnataka)	TF-580,	1710±105
	TF-573	955±1001
Kili Ghul Mohammad (Pakistan)	P-524,	3690± 85
	UW-61	3470± 83
Paiyampalli (Tamil Nadu)	TF-833,	1360±210
	TF-827	1725±110
Sangankallu (Karnataka)	TF-359,	1550±105
	TF-354	1590±110
Tekkalakota (Karnataka)	TF-266,	1780±105
	TF-239	1540±105
Utnur (Andhra Pradesh)	TF-168,	2040±115
	BM-54	2295+155

TABLE 3. ^{14}C DATES OF PRE-HARAPPAN AND HARAPPAN SITES

Site		^{14}C dates, based on half-life = 5730 years, in years B.C.
Balakot (Pakistan)	UCLA-1924D,	2386± 82
	UCLA-1923A	3406±137
Bara(Punjab)	TF-1207,	1645± 90
	TF-1205	1890± 95
Damb Sadaat (Pakistan)	P-523,	2200± 75
	P-522	2550±200
Kalibangan Pd.I (Rajasthan)	TF-240,	1765±115
	TF-155	2370±120
Kalibangan Pd.II (Rajasthan)	TF-160,	2230±105
	TF-143	1665±110
Kot Diji (Pakistan)	P-196,	2600±145
	P-195	2100±140
Lothal (Gujarat)	TF-136,	2080±135
	TF-19	1800±140
Mohenjodaro (Pakistan)	P-1177,	2155± 65
	TF-75	1755±115
Mundigak (Afghanistan)	TF-1131,	2755±105
	TF-1120	3145±110
Surkotada (Gujarat)	TF-1307,	1660±110
	PRL-85	2315±135

TABLE 4. THE ^{14}C DATES OF CHALCOLITHIC SITES

Site		^{14}C dates, based on half-life = 5730 years, in years B.C.
Ahar (Rajasthan)	V-57,	2145±100
	TF-31	1270±110
Chandoli (Maharashtra)	P-473,	1330± 70
	TF-43	1040±105
Chirand (Bihar)	TF-445,	1650±100
	TF-444	715±105
Eran (Madhya Pradesh)	TF-331,	1500± 95
	TF-326	1040±110
Inamgaon (Maharashtra)	TF-1001,	1565± 95
	PRL-78	870±115
Kayatha (Madhya Pradesh)	TF-680,	2015±110
	TF-679	1300±135
Mahishadal (West Bengal)	TF-391,	1380±105
	TF-390	855±100
Prabhas Patan (Gujarat)	TF-1287,	2455±110
	PRL-19	1235±165
Sonegaon (Maharashtra)	TF-384,	1565±110
	TF-379	1290± 95

TABLE 5. THE ^{14}C DATES OF PAINTED GREY WARE SITES

Site		^{14}C dates, based on half-life = 5730 years, in years B.C.
Hastinapur (Uttar Pradesh)	TF-91,	570±125
	TF-83	335±115
Khalua (Uttar Pradesh)	PRL-68,	485±170
	PRL-67	570±160
Noh (Rajasthan)	TF-1144,	490± 90
	UCLA-703B	820±225

TABLE 6. THE ^{14}C DATES OF NORTHERN BLACK POLISHED WARE SITES

Site		^{14}C dates, based on half-life = 5730 years, in years B.C.
Atranjikhera (Uttar Pradesh)	TF-284,	295±100
	TF-194	530± 85
Hastinapur (Uttar Pradesh)	TF-88,	340±115
	TF-80, 82	50±115
Kausambi (Uttar Pradesh)	TF-226,	220±100
	TF-221	500±105

Abbreviations

P. Pennsylvania U.C.L.A. University of California.
T.F. Tata Institute of Fundamental Research, Bombay
P.R.L. Physical Research Laboratory, Ahmedabad
B.M. British Museum.
U. Uppsala R. Rome.
U.W. University of Washington.

After D.P Agarwal, S. Kusumgar and R.K. Pant, *Radiocarbon and Indian Archaeology*.

APPENDIX III

CHRONOLOGY

ANCIENT INDIA

DEVELOPMENT OF SCIENCE, TECHNOLOGY AND AGRICULTURE AND IMPORTANT PERSONALITIES AND EVENTS

	B.C.
Gautama, the Buddha	563–483
Bimbisara, King of Magadha	543–491
Buddhist literature in Pali	
Kullavagga and *Mahavagga*	
(reference to farming operations)	
The Nandas of Magadha	422–322
Campaigns of Alexander in Punjab and Sind	327–325
Chandragupta Maurya	322
	(possibly earlier, 298)
The *Arthashastra* of Kautilya:	322–186
Mining, metal-working,	
agriculture and irrigation	
Increased and widespread use of iron;	
Use of bellows for forging iron	
Construction of the Sudarshana Lake	
Bindusara	298–273
Asoka	274–237
Sacred groves, tree-worship;	
planting of road-side avenues	
and gardens	
The Sunga dynasty	184–72
Brick-wells	
	A.D.
Kadphises I, Kushan, King of the Great Yueh-chi	*c.* 40 – *c.* 77
Kadphises II	*c.* 78 – *c.* 110
Kanishka	*c.* 120 – *c.* 160
Huvishka	*c.* 160 – *c.* 182
Vasudeva I	*c.* 182 – *c.* 220
The Kingdoms of South India	1st century to A.D. 300
Pandyas, Cheras and Cholas;	
Age of Sangam in the Tamil country	
Colonization of South-East Asia by South Indians	
Cultivation of rice, *ragi*, sugarcane,	

pepper and turmeric	
Chandragupta I	320 – *c.* 330
Samudragupta	*c.* 330 – *c.* 380
Chandragupta II	*c.* 380 – 415
Fa-hien in India	401 – 410
Kumaragupta I	*c.* 415 – 455
First Hun attack on Gupta empire	450
Skandagupta	455 – *c.* 480
Kumaragupta II	473
Metal-working; art of jewellery; iron pillar at Mehrauli	
High level of iron technology	
Kalidasa—observations on vegetation in *Kumarasambhava*	5th century
Bṛhat Samhita of Varahamihira: a number of chemical processes; plant and animal classifications.	*c.* 500
Amarakosha; classification and synonyms of plants and animals, minerals and metals	*c.* 500
Classification of rocks, references to agricultural implements	
Aryabhata I writes *Aryabhatiya*	499
Pulakesin I Chalukya, builds Badami	543 – 544
Vatsyayana's *Kamasutra*	500
Harshavardhana	600 – *c.* 647
Bhaskara I	600
Brahmagupta's *Brahmasphuta-siddhanta*	628
Travels of Hiuen Tsang in India	629 – 643
Bana's *Harshacharita*	*c.* 646
I-tsing's travels in India and the eastern islands	671 – 695
Vishnudharmottara Mahapurana	700
Arab conquest of Sind	711 – 712
Rashtrakuta Dantidurga in occupation of Ellora	742
Beginning of Pala rule in Bengal	750 – 760
Nagabhata I, founder of Gurjara Pratihara dynasty	756
Krishna I (6th in succession)	*c.* 760 – 800
Kailasha rock-cut temple at Ellora	
Use of the Persian water-wheel (*araghatta*)	
Medhatithi—commentary on *Manusmriti* and observations on Agriculture	825 – 900
Chalukya Taila II	973
Rajaraja I (the Great), Chola	985 – 1018

Construction of *anicuts* and tanks	
Krishi-Parashara and *Vrikshayurveda*	9th – 10th century
Manuals on agriculture and botany	
Kashyapa's *Krishi-sukti*,	10th century
a text on agricultural science	
Mahipala I of Bengal	978 – 1030
Mahmud of Ghazna invades Mathura and Kanauj	1018
Alberuni in India	1017 – 1030
Bhoja of Dhara	1018 – 1060
Rajendra I, Chola	1018 – 1044
Rajendra III, Chalukya	1070 – 1122
Kulottunga I, Chola	1070
Chalukya Vikramaditya VI	1076
Upavana-vinoda of Sarangadhara	1120 – 1330
Manasollasa of Somadeva:	1131
Encyclopaedic work; alchemical ideas; iron-casting; perfumery; treatment of diseases of horses and elephants	
Kulottunga III, Chola	1178
Contemporary poet Kamban	
Rajaraja III, Chola	1216 – 1256
Rajendra III, Chola	1246 – 1270
Marco Polo in South India	1293

APPENDIX IV

CULTIVATED PLANTS IN INDIA, AND THEIR PLACES OF ORIGIN

CULTIVATED plants in India belong to two categories, viz. indigenous, and those introduced from other countries, viz. Western Asia, Africa, China, Southeast Asia and Pacific Islands, the New World and Europe.

I. SELECT LIST OF INDIGENOUS CULTIVATED PLANTS OF INDIA

These are the plants which had their origin in India and have been cultivated over a long period of time. Only a select list is given below, and it is by no means exhaustive.

CEREALS

Oryza sativa Linn., Rice, *Dhan, Chaval*
Paspalum scrobiculatum Linn., Kodo-millet, *Kodon*
Panicum miliare Lam., Little-millet, *Kutki* (some consider it to be *P. sumatrense* Roth. & Schutt.)
Digitaria cruciata (Nees) A. Camus, *Raishan.*
Coix lacryma-jobi Linn., Job's Tears, *Gurlu*

PULSES

Cajanus cajan (Linn.) Millsp., Pigeonpea, *Arhar*
Dolichos biflorus Linn., Horse-gram, *Kulthi*
Vigna mungo (Linn.) Hepper (syn. *Phaseolus mungo* Linn.), Blackgram, *Urd*
V. radiata (Linn.) Wilczek (syn. *Phaseolus aureus* Roxb.), Greengram, *Moong*

ROOT CROPS

Alocasia macrorrhiza Schott, Giant Taro, *Boromon Kachu*
Colocasia esculenta (Linn.) Schott, Taro, *Kachalu, Arvi*
Dioscorea alata Linn., Greater Yam, *Khamalu*
Amorphophallus campanulatus (Roxb.) Blume ex Dcne, Elephant-foot Yam, *Zamin-kand*
Zingiber officinale Rosc., Ginger, *Adrak*

OILSEEDS

Brassica juncea (Linn.) Czern. & Coss. Indian mustard, *Sarson, Rai*

FRUITS

Artocarpus heterophyllus Lam., Jack-fruit, *Kathal*
Borassus flabellifer Linn., Palmyra-palm, *Tari*

Syzygium cuminii (Linn.) Skeels, Jambolana, *Jamun*
Feronia limonia (Linn.) Swingle, Elephant-apple, Wood-apple, *Kapittha*
Mangifera indica Linn., Mango, *Am*
Musa paradisiaca Linn., and *M. balbisiana* Colla, Plantain, Banana, *Kela*
Emblica officinalis Gaertn., Emblic, *Amla*
Phoenix sylvestris (Linn.) Roxb., Date-palm, *Khajur*
Tamarindus indica Linn., Tamarind, *Imli* (some consider it to be indigenous to tropical Africa)
Ziziphus (sphalmate *Zizyphus*) *nummularia* (Burm. f.) Wight & Arn., Wild Jujube, *Ber*

VEGETABLES

Amaranthus spp.
Cucumis sativus Linn., Cucumber, *Khira*
Solanum melongena Linn., Brinjal, Eggplant, *Baingan*
Momordica charantia Linn., Bitter-gourd, *Karela*
Raphanus caudatus Linn., Rat-tail Radish, *Sengri, Newari Muli*
Lagenaria siceraria (Mol.) Standl., Bottle-gourd, *Ghia, Kaddu, Lauki*
Luffa acutangula (Linn.) Roxb., Ridged-gourd, *Jhinga, Kali Torai*
Trichosanthes anguina Linn., Snake-gourd, *Chachinda*
Basella rubra Linn., Indian Spinach, *Poi*

SPICES

Curcuma domestica Valet. (syn. *Curcuma longa* Linn.), Turmeric, *Haldi*
Piper nigrum Linn., Black-pepper, *Kali Mirch*
Piper betle Linn., Betel-pepper, *Pan*
Piper longum Linn., Long-pepper, *Pippal*
Elettaria cardamomum (Linn.) Maton var. *minor* Watt, Cardamom, *Choti Elachi*

SUGAR PLANTS

Saccharum officinarum Linn., Sugarcane, *Ganna*

FIBRE PLANTS

Corchorus capsularis Linn., White Jute, *Pat*
Corchorus olitorius Linn., Tossa Jute, Costa
Crotalaria juncea Linn., Sannhemp, *San*
Gossypium arboreum Linn., Tree-cotton, *Kapas*
Hibiscus cannabinus Linn., Mesta, *Patsan*
Hibiscus sabdariffa Linn., Roselle, *Patwa, Lalambari*

MEDICINAL PLANTS

Cannabis sativa Linn., Hemp, *Bhang, Ganja*

II. CULTIVATED PLANTS INTRODUCED INTO INDIA FROM OTHER COUNTRIES

I. Cultivated Plants Introduced into India from Western Asia

CEREALS

Hordeum vulgare Linn. emend. Bowden, Barley, *Jau*
Triticum dicoccum Schübl., Emmer wheat, *Gehun*
T. aestivum Linn. emend. Thell., Bread-wheat, *Gehun*

PULSES

Cicer arietinum Linn., Chick-pea, *Chana*
Lens culinaris Medic. *(L. esculenta* Moench), Lentil, *Masur*
Pisum sativum Linn., Pea, *Mattar*
Vicia faba Linn., Broad-bean, *Bakla*

VEGETABLES

Allium cepa Linn., Onion, *Pyaz*
A. sativum Linn., Garlic, *Lehson*
Beta vulgaris Linn., Beet, *Chukander*
Brassica rapa (Linn.) Thell. emend. Metzger, Turnip, *Shalgam*
Brassica oleracea Linn. var. *capitata* Linn., Cabbage, *Bandh Gobi*
Daucus carota Linn., Carrot, *Gazar*
Raphanus sativus Linn., Radish, *Muli*
Trigonella foenum-graecum Linn., Fenugreek, *Methi*

SPICES

Coriandrum sativum Linn., Coriander, *Dhania*
Cuminum cyminum Linn., Cumin, *Zira*
Foeniculum vulgare Mill., Fennel, *Saunf*

FODDER CROPS

Medicago sativa Linn., Alfalfa, Lucerne, *Hol, Vilaiti Gawuth*

FIBRE CROPS

Linum usitatissimum Linn., Flax, *Alsi*

MEDICINAL PLANTS

Atropa belladonna Linn., Belladonna, *Sagangur, Angurshefa*
Digitalis purpurea Linn., Digitalis, Foxglove
Glycyrrhiza glabra Linn., Licorice, *Mulhatti*
Papaver somniferum Linn., Poppy, *Post, Afim*
Plantago psyllium Linn., Black Psyllium, *Kala Isabgol*

II. Cultivated Plants Introduced into India from Africa

CEREALS

Eleusine coracana (Linn.) Gaertn., Finger-millet, *Ragi*
Pennisetum typhoides (Burm. f.) Stapf & C.E. Hubb. [some consider it to be *P. americanum* (Linn.) Schum.], Pearlmillet, *Bajra*
Sorghum bicolor (Linn.) Moench, Sorghum, *Jowar*

PULSES

Vigna unguiculata (Linn.) Walp., Cowpea, *Lobia, Chowli*

OILSEEDS

Ricinus communis Linn., Castor, *Arind*
Sesamum indicum Linn., Sesamum, *Til*

VEGETABLES

Abelmoschus esculentus (Linn.) Moench, Okra, *Bhindi*

FODDER CROPS

Panicum maximum Jacq., Guinea-grass, *Gini-ghas*
Pennisetum purpureum Schum., Elephant-grass, Napier-grass

BEVERAGES

Coffea arabica Linn., Coffee, *Kafi*

III. Cultivated Plants Introduced into India from China

CEREALS

Panicum miliaceum Linn., Proso-millet, Hog-millet, *Chin, Morha, Anu*
Setaria italica (Linn.) Beauv., Italian millet, *Kangni*

PULSES

Glycine max (Linn.) Merrill, Soybean, *Bhat, Ramkurthi*

OILSEEDS

Aleurites fordii Hemsl., Tung-oil
Sapium sebiferum (Linn.) Roxb., Tallow-tree, *Pippalyang, Vilaiti Shisham*

FRUITS

Eriobotrya japonica (Thunb.) Lindl., Loquat, *Lokat*
Juglans regia Linn., Walnut, *Akhrut*
Litchi chinensis Sonner., Litchi, *Lichi*
Prunus armeniaca Linn., Apricot, *Khumbani*
P. persica Batsch, Peach, *Aru*

BEVERAGES

Camellia sinensis (Linn.) Kuntze, Tea, *Cha*

IV. Cultivated Plants Introduced into India from Southeast Asia and Pacific Islands

ROOT AND TUBER CROPS

Amorphophallus spp.
Dioscorea alata Linn., Greater Yam, *Khamalu, Chuprialu*

FRUITS

Artocarpus communis Forst., Breadfruit
Averrhoa bilimbi Linn., Bilimbi, *Bilimbi*
A. carambola Linn., Carambola, *Kamrakh, Karmal*
Citrus aurantifolia Swingle, Lime, *Nimbu*
C. aurantium Linn., Sour-orange, *Khatta*
C. decumanus Linn., Shaddock, Pomelo, *Chakotara*
C. limon (Linn.) Burm. f., Lemon, *Barabimbu*
C. medica Linn., Citron
C. nobilis Lour., Tangerine
C. paradisi Macfad., Grapefruit
C. sinensis (Linn.) Osbeck, Sweet-orange, *Musambi, Malta*
Durio zibethinus Murr., Durian, Civet-fruit
Garcinia mangostana Linn., Mangosteen, *Mangustan*

PALMS

Arenga pinnata (Wurumb.) Merr., Sugar-palm
Cocos nucifera Linn., Coconut, *Nariyal*
Metroxylon sagus Rottb., Sago-palm, *Sago*

CHEWING

Areca catechu Linn., Arecanut, *Supari*
Piper betle Linn., Betel-pepper, *Pan*

TOILET

Lawsonia inermis Linn., Henna, *Mehndi*

Note: Lists of cultivated plants introduced into India from Europe and the New World would be given in subsequent volumes.

APPENDIX V

SELECT LIST OF PLANTS MENTIONED IN SANSKRIT LITERATURE

(for a detailed list see *Wealth of India: Raw Materials,* Vol. 11, Cumulative Indexes. Council of Scientific and Industrial Research, New Delhi)

Name of plant in Sanskrit	Botanical name	A brief description
Aguru	*Aquilaria agallocha* Roxb.	A large evergreen tree with fragrant heart-wood
Arjuna	*Terminalia arjuna* (Roxb. ex. DC.) Wight & Arn.	A large shady tree
Aśoka	*Saraca asoca* (Roxb.) De Wilde	A herald of spring, it produces scarlet crimson bunches of flowers in early March. Said to flower on the touch of a beautiful woman's feet
Atimukta	*Jasminum* sp.	
Bandhuka	*Pentapetes phoenicea* Linn. (or *Leucas lavenduliifolia* Rees)	
Bimba	*Coccinia cordifolia* (Linn.) Cogn. (syn. *C. indica* Wight & Arn.)	A climber whose unripe fruits, smooth and bright green, often with white stripes, are used as vegetable. When ripe they become bright scarlet-red
Bel, Sriphala	*Aegle marmelos* Correa	'Bengal quince', a large round fruit
Caṇaka	*Cicer arietinum* Linn.	Chickpea, gram
Champaka	*Michelia champaca* Linn.	A large tree commonly grown in temples, with light yellow fragrant flowers
Chuta	*Mangifera indica* Linn.	Mango. Flowers in early March in north India
Devadaru	*Cedrus deodara* (Roxb.) Loud.	The Himalayan cedar
Gandharaja	*Gardenia jasminoides* Ellis	A shrub with highly fragrant white flowers

Godhūma	*Triticum*	Wheat
Gunja	*Abrus precatorius* Linn.	Seeds used as jeweller's weights
Hareṇu		A pulse
Ikṣu	*Saccharum*	Sugarcane
Kadamba	*Anthocephalus cadamba* Miq.	Ball-like flowers during the rainy season, favourite of Krishna
Kandali	*Aneilema vaginatum* R. Br.	An annual herb with blue-purple flowers during the rainy season
Karnikara	*Pterospermum acerifolium* Willd.	A large tree with broad leaves
Kaila (Plantain)	*Musa paradisiaca* Linn.	Smooth straight stem, symbol of female beauty
Kamala	*Nelumbo nucifera* Gaertn.	Day-flowering, common lotus
Karpasa, Tūla	*Gossypium arboreum* Linn.	Tree-cotton
Kaśa	*Saccharum spontaneum* Linn.	A tall grass
Kesara	*Crocus sativus* Linn.	A herald of spring
Ketaki	*Pandanus odoratissimus* Linn.	Screw-pine — a highly fragrant plant with spinous sword-like pointed leaves
Kimsuka	*Butea monosperma* (Lam.) Taub.	(*Palasa, Dhak*) Tree with beautiful crimson-red flowers, a herald of spring
Kovidara	*Bauhinia purpurea* Linn.	A small tree bearing pink flowers in November
Kulattha		A pulse
Kumuda	*Nymphaea esculenta* Roxb.	A waterlily with white flowers opening at night time, and closing during the day
Kunda	*Jasminum multiflorum* (Burm. f.) Andr.	A jasmine
Kurabaka	*Lawsonia inermis* Linn.	(*Mehndi*) Crushed leaves used for dyeing palms of hands
Kuruvinda, Maṣa	*Vigna mungo* (Linn.) Hepper	Blackgram
Kutaja	*Wrightia zeylanica* R. Br.	A small tree with white flowers

Lavanga-Lata	*Luvunga scandens* (Roxb.) Buch.-Ham. ex Weight	A herald of spring
Lodhra	*Symplocos racemosa* Roxb.	Pollen used as face powder in ancient India
Madhavi	*Hiptage benghalensis* (Linn.) Kurz	A scandent shrubby climber, herald of spring, and lover of the mango tree
Mahua	*Madhuca indica* J.F. Gmel.	A common shade tree in Cenral India. An alcoholic beverage is distilled from its flowers
Malati	*Jasminum flexile* Vahl	A twining shrub with fragrant white flowers
Mandara	*Erythrina variegata* Linn.	Small tree with red flowers in leafless condition in early March
Masa, Kuruvinda	*Vigna mungo* (Linn.) Hepper	Blackgram
Masūra	*Lens culinaris* Medic.	Lentil
Mudga		A pulse
Naga-Kesara	*Mesua ferrea* Linn.	A forest tree of Eastern India with white flowers with yellow interior
Nālika, Nāli	*Pennisetum typhoides* (Burm.) f. Stapf & C.E. Hubb.	Pearlmillet
Narikela	*Cocos nucifera* Linn.	The coconut palm
Navamallika	*Jasminum arborescens* Roxb.	A shrubby jasmine
Padam	*Prunus cerasoides* D. Don	Wild cherry found in the temperate Himalayas at altitudes from 900 to 1,830 metres
Parijataka	*Nyctanthes arbor-tristis* Linn.	*Har-singhar*. Drops its flowers in the morning
Patala	*Stereospermum suaveolens* DC.	Trumpet-flower, herald of spring
Pipal	*Ficus religiosa* Linn.	A large tree with glossy, dark-green, poplar-like leaves
Pital		A yellow flower not identified
Priyangu	*Setaria italica* (Linn.) P. Beauv.	Millet

Punnaga	*Calophyllum inophyllum* Linn.	A tree with glabrous leaves, and fragrant white flowers
Sala, Sarja	*Shorea robusta* Gaertn. f.	A tall timber tree, one of the trees associated with the birth of the Buddha
Saptachchhada	*Alstonia scholaris* R. Br.	A handsome shade tree
Sarṣapa	*Brassica juncea* Linn.	Leaf mustard, *Rai*
Semal, Salmali	*Bombax ceiba* Linn.	Silk-cotton tree. Beautiful cup-like red flowers in early March
Sirisha	*Albizia lebbeck* (Linn.) Benth.	Fragrant flowers during the early rainy-season
Sriphala, *Bel*	*Aegle marmelos* Correa	Honey-apple, 'Bengal quince', a large round fruit
Tala	*Borassus flabellifer* Linn.	Palmyra—round purple fruits, symbol of female charm
Tamala	*Garcinia xanthochymus* Hook.f., or *Cinnamomum tamala* (Buch.-Ham.) Nees & Eberm.	Straight stem, dark fragrant leaves, symbol of Krishna
Tambula, *pan*	*Piper betle* Linn.	Betel. A climber; leaves used for chewing
Tila	*Sesamum indicum* Linn.	Sesame
Tūla, Kārpāsa	*Gossypium arboreum* Linn.	Tree-cotton
Utpala	*Nymphaea caerulea* Sav.; *N. stellata* Willd.	The blue waterlily
Vakula	*Mimusops elengi* Linn.	(*Moulsari*) A dwarf tree, bears highly fragrant flowers during the rainy season
Vrīhi	*Oryza sativa* Linn.	Rice
Yava	*Hordeum vulgare* Linn. emend. Bowden	Barley
Yavanāla	*Sorghum bicolor* (Linn.) Moench	Sorghum
Yuthika	*Jasminum auriculatum* Vahl	A jasmine with fragrant white flowers tinged with purple

APPENDIX VI

PRINCIPAL CROPS OF INDIA AND THEIR SANSKRIT NAMES

Sanskrit Name	*English Name*
Vrīhi, Sāli	Rice
Yava	Barley
Godhūma	Wheat
Caṇaka	Chickpea, Gram
Ikṣhu	Sugarcane
Tila	Sesame
Sarṣapa	Mustard
Tūla, Kārpasa	Tree-cotton
Hareṇu, Kulattha, Mudga, etc.	Pulses
Kuruvinda, Māṣa	Blackgram
Bhadramustā	Moth-bean, Dew-gram
Masūra	Lentil
Yāvanāla	Sorghum
Nālikā, Nālī	Pearlmillet

APPENDIX VII

PRINCIPAL DOMESTIC ANIMALS OF INDIA AND THEIR SANSKRIT NAMES

Sanskrit Name	*English Name*
Dhenu, Go	Cow
Mahiṣa	Baffalo
Sūkara	Pig
Aśva, Hari	Horse
Uṣhṭra	Camel
Hastin	Elephant
Camara	Yak
Gārdabha	Ass
Avi, Meṣha	Sheep
Aja, Chāga	Goat
Śvāna	Dog
Biḍāla	Cat

GLOSSARY

ABBEVILLIAN, a culture representing the earliest hand-axe industry in Europe, which flourished about 476 000 years ago, named after a site on river Somme in France.

ACHEULIAN, a Stone-Age culture which existed about 230 000 to 200 000 years ago, named after the site of St Acheul in France.

AHAR-BANASIAN, a pre-historic Copper-Age culture whose ruins have been found near village Ahar on Banas river in Rajasthan.

ANTHROPOIDS, most highly evolved sub-order of primates which includes monkey, ape and man. They have nails and toes, instead of claws, and grasping hands and feet.

ARCHAEOZOIC ERA, a period extending from more than 3 300 million years ago to 1 300 million years ago, when first living things evolved.

ARYANS, a people who migrated in successive waves from South Russia and Turkestan during 2nd millennium B.C. Their first invasion of India took place in about 1 500 B.C., when they overwhelmed the Indus Valley Civilization.

AUSTRALOID, probably the oldest of all the surviving races of man; they originated in Asia, but are now represented only by the aborigines of Australia and some Dravidian tribes of South India.

AUSTRALOPITHECUS ('Southern ape'), a man-like creature which appeared 4 to 5 million years ago and whose remains have been found in Ethiopia and East Africa; could make simple pebble tools.

BIPEDALISM, movement on two legs, an exclusive characteristic of man. The hands were thus free to make tools.

BHIMBETAKA, a Mesolithic site in Madhya Pradesh remarkable for its cave paintings dating from 20 000 years to Chalcolithic Era.

BRONZE AGE, the age following the Stone Age, characterized by the use of an alloy of copper and tin as the chief material for making weapons and tools. The years of its appearance differ from region to region.

BURZAHOM, a Megalithic site about 16 km NE of Srinagar, Kashmir, discovered in 1936. The earliest settlers (*c.* 2375 B.C.) were pit-dwellers, though the pits were later abandoned for mud-houses.

CAMBRIAN PERIOD, geological time of the first period of Palaeozoic Era characterized by warm seas and desert land areas.

CARBONIFEROUS PERIOD, a division of the Palaeozoic Era characterized by swamp formation and deposition of plant remains which later hardened into coal.

CENOZOIC ERA, the latest era in Geological Time, which includes the Tertiary and the Quaternary. It is characterized by the evolution of mammals, birds, plants, modern continents, and glaciation.

CHALCOLITHIC PERIOD, period between the Neolithic and the Bronze Age when both copper (*chalcos*) and stone (*lithos*) where being used. It developed between 6000 and 3000 B.C.

CHALCOLITHIC REVOLUTION, 6000–3000 B.C., marks the invention of the plough, and the wheeled cart, as also the use of oxen power. It extended from Nile river to Ganga.

CHOU-KOU-TIEN, sites near Beijing in China where the fossils of *Homo erectus* ('Peking Man') were discovered. They date from 800 000 years, and there is the evidence of the first use of fire.

CRETACEOUS PERIOD, period 135 to 65 million years ago, named after the Latin word for chalk (*creta*). The end of the period saw the emergence of mountains which resulted in the formation of the Himalayas.

CRO-MAGNON, literally 'big hole', a site in south-western France where the remains of the modern man (*Homo sapiens sapiens*) were first found. They date from 35 000 years ago.

CULTIGEN, a cultivated plant, also a domestic animal, which is not known to exist in natural, or wild, state. An organism dependent on man for its existence.

DEVONIAN PERIOD, the fourth period of Palaeozoic Era characterized by the appearance of forests and amphibians.

DRYOPITHECUS, an extinct ape-like animal that was the ancestor of both the modern apes and man. It apparently originated in Africa about 2 500 000 years ago.

EOCENE EPOCH, second oldest of the five epochs in the Tertiary Period, 53 million to 37 million years ago.

EPOCH, a unit of Geological Time, which is a division of a Period, e.g. Holocene Epoch, a division of the Quaternary Period.

ERA, the longest division of Geological Time comprising one or more periods, for example: Cenozoic Era, embracing Tertiary and Quaternary Periods, extending from 58 000 000 to 11 000 years before the present.

FERTILE CRESCENT, a well-watered and fertile area in West Asia which extends in the form of a crescent from the Euphrates and the Tigris rivers in the east to the Nile in the west. It also includes parts of Syria, Jordan and Israel. Man's earliest civilizations dating from about 8000 B.C. and also agriculture originated in this area.

GEOLOGICAL TIME SCALE, the time extending from the formation of earth to the beginnings of the historical period. The scale is conveniently divided into Eras, Periods, and Epochs.

GONDWANALAND, one of the two ancient super-continents formed by the split of the still larger super-continent, Pangaea, about 2 000 million years ago. Gondwanaland included what are now Africa, South America, Australia, India, Arabia, and Indonesia.

HARAPPAN CULTURE, 2300–1600 B.C., a chalcolithic, pre-Aryan urban culture originally identified with excavations of Harappa, in Indus Valley. Contemporary sites have since been discovered in Punjab, Rajasthan, Gujarat and western U.P. The Harappan civilization is believed to have been obliterated in the waves of Aryan invasions.

HOA BINH, plateau in the Southeast Asia forming the southwestern limit of the Red River Delta. It is still a rice-growing centre.

HOLOCENE EPOCH, younger of the two epochs in the Quaternary Period extending from the end of the last major Ice Age (10 000 years ago) to the present.

HOMINIDS, family of primates evolved from ape-like ancestors of modern man about 26 million years ago.

HOMO ERECTUS, ancestor of modern man (*Homo sapiens*) who lived in the middle of the Pleistocene, more than 500 000 years ago. He made hand-axes and pebble-tools, and knew the use of fire. Remains have been found at Chou-kou-tien (China) and Olduvai (Tanzania) among other places.

HOMO HABILIS, an early type of man-like ape whose remains have been discovered in Olduvai Gorge, Tanzania. He had a large brain, and has been linked with modern man.

HOMO SAPIENS, a species of Hominid, the direct ancestor of modern man. He probably lived 250 000 years ago.

HOMO SAPIENS SAPIENS, the 'modern man' distinguished from all other extinct sub-species of the Hominid in having a large brain, small teeth, and chin, and skill in making and using tools. He first appeared in Asia about 35 000 years ago.

ICE AGES, a series of periods characterized by extensive glaciations alternating with a period of relative warmth. The glaciers of Greenland and the Antarctica are the remnants of the most recent Ice Age.

INDUS VALLEY, site of an early, pre-Aryan, city-based culture which developed in the valley of river Indus about 2300 B.C. *See* Harappan Culture.

IRON AGE, the age when iron replaced bronze and copper as the chief material for making tools and implements. It appeared in different areas in different times. It appeared in West Asia about 3000 years ago.

JARMO, a site in Iraq, dated about 6500 B.C., excavated between 1948 and 1955. It is one of the earliest food-producing settlements discovered—the people cultivated wheat and barley, and also domesticated goats.

JURASSIC PERIOD, middle period of the Mesozoic Era, characterized by more abundant plants and animals, particularly ferns, rushes and cycads, and countless varieties of insects and snails. It extended from 190 million to 135 million years ago.

KALIBANGAN, a pre-Harappan chalcolithic site on the bank of the dry bed

of ancient Saraswati in Rajasthan. Discovered in 1971, the settlement was found fortified with mud-brick houses within the walls. The place was probably abandoned in about 1800 B.C.

LATER VEDIC PERIOD, 1000–600 B.C., marks the further penetration eastward of the Aryans, and the consolidation of their civilization in India. It is characterized by advancement in iron technology, invention of iron-axe and ploughshare, as also the consolidation of the caste system.

LOTHAL, a Harappan site, north of Gulf of Cambay, Gujarat, discovered in 1953. A large dockyard for ships from Egypt and Mesopotamia is one of the most remarkable finds.

MADRAS-ACHEUL, or MADRAS HAND-AXE INDUSTRY, palaeolithic site in South India, near Madras, marked by extensive finds of stone hand-axes which were used for digging roots and rhizomes.

MAYA CULTURE, pre-Columbian civilization of Central and South America. The people domesticated llama and alpaca for transport, though their agriculture was ploughless.

MEGALITHS, literally 'great stones', roughly hewn stone slabs of great size used by the primitive man for construction. A remarkable megalithic site is Burzahom in Kashmir.

MESOLITHIC PERIOD, a stage between Palaeolithic and Neolithic periods which began about 12 000 years ago. It is associated with many developments including taming of dogs. Cave paintings of Mirzapur, U.P., belong to this period.

MESOZOIC ERA, era of geological time from the end the Palaeozoic to the beginning of the Cenozoic, characterized by the reptilian life forms.

MIOCENE EPOCH, second youngest of the five epochs in the Tertiary Period, 26 million to 12 million years ago, characterized by the appearance of primitive apes and grazing animals. Further development of the horse took place; and cats, camels and rhinoceroses were common, as also a species of a great ape. Reduction in area occupied by forests also took place.

MITTANIS, people of Asia Minor who were contemporary of the Rig-Vedic Aryans. They frequently had Aryan names, and worshipped common deities.

NATUFIAN, Mesolithic culture of Palestine and Syria, about 9000 B.C. Natufians were hunters and food-gatherers. They had sickles for harvesting the grain, but probably did not cultivate it.

NEANDERTHAL MAN, an extinct subspecies of *Homo sapiens* named after Neanderthal Valley, West Germany, where the remains were first discovered, in 1857. He was chinless, and with receding forehead, but with a brain as large as that of a modern man. The remains have since been discovered over a wide region, and date from 400 000 to 35 000 years ago.

NEOLITHIC PERIOD, the 'New Stone Age' is the period in which agriculture and domestication of plants and animals began. It developed about 10 000 B.C. during the Holocene Epoch.

OLDUVAI GORGE, a gorge cut by a river in North Tanzania where remains of a Palaeolithic culture and the fossils of *Homo habilis* have been found. They date from two million years ago.

OLIGOCENE EPOCH, middle of the five epochs of the Tertiary Period, 37 to 26 million years ago. A more highly developed type of horse, the earliest elephant and a primitive anthropoid ape made their appearance.

ORDOVICIAN PERIOD, the second period of the Palaeozoic Era, characterized by the appearance of primitive fishes and fishlike vertebrates.

PALAEOCENE EPOCH, oldest of the five epochs in the Tertiary Period, ranging from 65 to 53 million years ago. It is characterized by the extinction of the dinosaurs and the rise of mammals. Primates became relatively abundant.

PALAEOLITHIC PERIOD, 'belonging to the Old Stone Age', earliest period of human development and the longest period of human history, it extends from about 750 000 years ago to the Mesolithic—about 15 000 years ago. The most remarkable event was the development of the true *Homo sapiens*. Its characteristic was the distinctive stone tools.

PEKING MAN, *see* CHOU-KOU-TIEN

PENDA, or JHUMING, a form of a shifting cultivation still practised by some tribals in India. A temporary site (*penda*) is ritually decided by felling the trees. After two years of cultivation, the site is abandoned for a fresh *penda*.

PERIOD, a unit of Geological Time longer than an Epoch, and shorter than an Era. For example, Quaternary Period is longer than Pleistocene Epoch, but is shorter than the Cenozoic Era.

PERMIAN PERIOD, last period of the Palaeozoic Era which began about 280 000 000 years ago and lasted about 55 000 000 years ago. While several varieties of life became extinct, the reptiles developed rapidly, and there was a radical change in vegetation.

PLEISTOCENE EPOCH, older of the two epochs of the Quaternary Period, ranging from about 2 million years ago to the end of the last major Ice Age (about 10 000 years ago). The epoch is also noted for the first appearance of modern man.

PILOCENE EPOCH, youngest of the five epochs of the Tertiary Period, 12 million to about 2 million years ago. The epoch is characterized by distinctly modern plants and animals.

PRECAMBRIAN ERA, era from the beginning of the earth's history up to 570 million years ago. Life appeared in water, and the oldest fossils of worms, sponges and algae date from this era.

PRIMATES, order of mammals that include the most advanced mammals, characterized chiefly by their adaptation to tree living. It includes monkeys, apes and man.

PROTEROZOIC ERA, a division of the Precambrian comprising the less ancient rocks of the system, lying about the Archaeozoic. The strata contains the earliest traces of living things.

PRZEWALSKI'S HORSE (*Equus przewalski*), wild horse of Asia, the only extant wild horse, which in his full-bred state is not descended from the domestic horse. It now survives only in the semi-desert plains of west Mongolia.

RAMAPITHECUS, earliest man-like creature on direct line of descent of man, whose remains were first discovered in the Siwalik hills. Believed to have lived 14 million years ago, he used his knuckles for moving, and could break bones for food.

QUATERNARY PERIOD, the second period of the Cenozoic Era, from the end of the Tertiary to the present, characterized by the appearance and the development of man. It also saw extensive disturbances of the earth's crust and the development of mountains and valleys.

SILURIAN PERIOD, the third period of the Palaeozoic Era characterized by the appearance of land plants, and possibly of the first animals to live on land.

SOAN CULTURE, a pre-historic culture associated with a site in the valley of Soan river near its junction with Indus. Use of pebble-tools for breaking nuts and for making notches in the trees for climbing were the chief characteristics.

TERTIARY PERIOD, period ranging from 65 million to about 2 million years ago. Though giant reptiles became extinct, there were amphibians like frogs, and many giant varieties of birds. World's fossil fuel is mostly derived from Tertiary rocks.

TETHYS OCEAN, the ocean which separated the northern continent, Laurasia, from the Gondwanaland during the Triassic Period. It covered northern India and West Asia, and during the Cretaceous period it was spread over a great part of Europe. The sediments were later elevated into the Alps and the Himalayas.

THREE-AGE SYSTEM, a scheme devised by a Danish archaeologist by which pre-history was divided into Stone Age, Bronze Age, and Iron Age. The Stone Age was subsequently divided into Old Stone Age (Palaeolithic period), Middle Stone Age (Mesolithic period) and the New Stone Age (Neolithic period).

TRIASSIC PERIOD, the first period of the Mesozoic Era when vertebrates developed rapidly and reptiles were dominant. The period extends from about 225 million to 190 million years ago.

VEDAS, literature of the Aryans compiled about 1000 B.C. They are of four

types: *Samhitas, Brahmanas, Aranyakas,* and *Upanishads.* The most important are the four *Samhitas* which form the basic *Vedas.* The earliest is the *Rig-Veda.*

VEDIC AGE (1500–1000 B.C.), the period in Indian history from the first invasion of the Aryans to the consolidation of their hold of the north-western India. It was a pastoral culture, with organized agriculture, but rice appears to be unknown. The later phase of the Vedic Age to about 500 B.C. is called Later Vedic Period.

ZINJANTHROPUS, a man-like creature whose fossil remains have been found from Olduvai in Tanzania. He probably existed 2 million years ago.

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