THE TRADITION OF PLANT, ANIMAL AND FOREST PROTECTION IN ANCIENT INDIA

Dissertation submitted for the Degree of Master of Philosophy (M.Phil.) in Arts of the University of North Bengal

ANITA BAGCHI
Department of History

1996

University of North Bengal
Raja Rammohunpur, Dist. Darjeeling
Pin - 734430.

PROF. P. K. BHATTACHARYYA
M. A. (CAL.), PH.D. (CAL.), F. R. N. S. (LOND.)
JADUNATH SARKAR PROFESSOR OF HISTORY,
SECRETARY, AKSHAYA KUMAR MAITREYA MUSEUM
Incorporating RAJA RAJARAM MUSEUM COLLECTION,
Formerly DEAN OF THE FACULTY COUNCIL FOR POST
GRADUATE STUDIES IN ARTS, COMMERCE & LAW
UNIVERSITY OF NORTH BENGAL

P.O. NORTH BENGAL UNIVERSITY
RAJA RAMMOHUNPUR, DT. DARJEELING
WEST BENGAL, INDIA, PIN—734430
Telephone : Bagdogra—479

Ref. No.....

Dated..... .....*199*...

This is to certify that Smt. Anita Bagchi, M.A., Lecturer in History, University of North Bengal has completed her M.Phil. Dissertation on **The Tradition of Plant, Animal and Forest Protection in Ancient India** under my supervision. She has consulted original source material in preparing her dissertation.

I am glad to forward this work for submission to the University of North Bengal as M.Phil. Dissertation.

Pranab Kumar Bhattacharyya
8/12/97

(P. K. Bhattacharyya)

Dr. P. K. Bhattacharyya,
Jadunath Sarkar Professor of History
North Bengal University, Darjeeling

ACKNOWLEDGEMENT

I express my deepest regards and gratefulness to my teacher Dr. P.K.Bhattacharyya, Sir Jadunath Sarkar Professor of History, University of North Bengal for constant encouragement and supervision during the course of this work and in the preparation of this dissertation.

I extend my gratitude to Dr. C.R.Acharya, formerly Principal, Balurghat Mahila Mahavidyalay, The University Grants Commission, New Delhi and the authorities of North Bengal University for awarding me a Teacher Fellowship which enabled me to undertake this research work.

Thanks are extended to the Head of the Department of History, University of North Bengal for providing me with necessary facilities.

I convey my sincere regards to Prof. T.K.Roy Choudhury, Dr. M.M.Mukherjee, Dr. M.Bhattacharya, all are my teachers in the Department of History, University of North Bengal.

I took much help from the Libraries of Asiatic Society, Calcutta, Visva-Bharati, Santiniketan, Balurghat Mahila Mahavidyalay and University of North Bengal. I am really grateful to the Librarians and authorities of these libraries.

Mr. V.K.Yadav, IFS, former D.F.O., Wildlife Division II, Jalpaiguri has obliged me by way of allowing my access to his personal collection of literature.

Anita Bagchi
8/12.97

Anita Bagchi

CONTENTS

		Page nos.
1.	INTRODUCTION	1
2.	DOMESTICATION AND PROTECTION OF PLANTS	14
	2.1 The Beginning of Agriculture	14
	2.2 Utilization of Plant Resources and Simultaneous Study of Indian Flora by the Aryans.	22
	2.3 Protection of Plants by Growing Healthy Plants through Scientific Methods.	31
	2.3.1 Collection, Selection and Treatment of Seeds for Good Germination and for Vigorous Seedlings.	33
	2.3.2 Schedules for Seed Sowing	35
	2.3.3 Watering	36
	2.3.4 Manuring	38
	2.4 Plantation of Trees : A Sacred Act	39
	2.5 Protection of Plants from Diseases	40
	2.6 Social and Scriptural Injunctions for Conservation of Plants.	48
	2.7 Protection/Conservation of Plants by *Puṇya* Entisement.	54
	2.8 References	58
3.	DOMESTICATION AND PROTECTION OF ANIMALS IN ANCIENT INDIA.	63
	3.1 Elephants	66
	3.2 Horses	68
	3.3 Animal Husbandry	72

Contd...

3.4 Penal Measures and Scriptural Injunctions for Protection of Animals. 75
3.5 References 79
4. **Protection of Forests in Ancient India** **83**
4.1 The Beginning of Deforestation 83
4.1.1 Advent of the Aryans and Introduction of Iron. 84
4.2 Emergence of Different Professional Castes Based on Forest Products. 86
4.3 Spirit of Enquiry 88
4.4 Extent of Forests 90
4.4.1 Forest Division 92
4.5 The Ātavika Rājyas 99
4.6 Development of Imperial Control on Forests. 100
4.7 Superintendent of Elephant Forests 106
4.8 Reserve Forests : *The Abhayāraṇyas* 107
4.9 Game Laws 108
4.10 An Overview of Post-Mourya Period 114
4.11 References 117
5. **Conclusion** **121**
6. **Bibliography** **122**

List of Abbreviations

ACHSI	-	A Concise History of Science in India.
Ag.	-	Agnipurāṇa
AI	-	Ancient India, Bulletin of the Archaeological Survey of India, New Delhi.
AŚ	-	Abhijñāna Śakuntalam
CII	-	Corpus Inscriptionum Indicarum.
CS	-	Carakasaṁhitā.
IJHS	-	Indian Journal of History of Science.
INSA	-	Indian National Science Academy.
KA	-	Kauṭiliya Arthaśāstra.
Kām	-	Kāmandaki Nītisāra.
Kṛ	-	Kṛṣiparāśara
Mān	-	Mānasollāsa
MS	-	Manusaṁhitā.
Ṛg.	-	Ṛgveda.
Śu.	-	Śūkranīti
UNESCO	-	United Nations Educational Scientific and Cultural Organisation.

Vāp	-	Vāmana Purāṇa.
Vp	-	Vāyu Purāṇa.
VD	-	Viṣnudharmottara Purāṇa.
VS	-	Viṣnusaṁhitā.

1. INTRODUCTION

The history of human civilization is intimately associated with plants, beasts and birds. The plant kingdom and the animals always have played a vital role in human life. The pre-historic period was much more longer than the historic period of the human society. During this period when human beings were exclusively food gatherer population began to come to a close with the domestication of plants and animals. This coincided with the receding of the fourth glaciation about 10,000 years ago.

Historians have argued that climatic changes at the receding of glaciers, 10,000 years B.P. led to a creeping back of the forest cover and in time to a food crisis. This crisis very likely led the hunter-gatherer people to domesticate animals and cultivate plants.[1] Some archaeologists believe that wood was used along with stone during the Old Stone Age. But the oldest evidence of use of wood is from the Upper Palaeolithic Era as has been discussed by Hawkes and Woolley.[2]

During the Neolithic or the polished Stone Age, man acquired the skill of grinding and polishing stone implements. 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 power as one of the three most momentous invention in human history. Apart from the discovery of agriculture and animal husbandry the Neolithic people had other achievements like wood-working, manufacture of pottery and textiles.

The Neolithic revolution brought a major change in the technique of food production and gave man a control over his environment and saved himself from uncertainty of hunting and gathering wild berries and roots.

The crisis about which our attention was drawn above, was not equally acute everywhere. It was the *Middle East* where the crisis was most serious and attempts towards the domestication of animals and cultivation of plants received momentous success in this area. The plants like wheat, barley and lentils, and animals such as cattle, sheep and goats were first domesticated here.

The origin of plant domestication could be traced to the early attempts of the food gathering people at settling down in congenial environments and gradually utilising the plant and animal resources which were found easily accessible to them. Undoubtedly, wild plants, their roots, fruits, tubers and seeds were among the principal plant resources, used as food by early man.

For many years man had to struggle with stone weapons only in his untiring efforts for food gathering and defence. But still the Stone Age is a long chapter of stagnation because stone as a material for tools had its obvious limitations. "The advent of metal was a real break-through in man's technological progress."[3] The mastery of the metal was a big boost to the development of the human society.

The term 'Chalcolithic period' is applied to the time when people used stone implements along with those of copper or bronze. With the cultural advancement stone was steadily leaving room for metal implements which increased gradually in proportion.

In India, some tools in the copper-hoard of the Harappans helped largely to clear off the jungles of the Indus area and ushered in an era of successful agriculture and that the "entire civilization flowered forth as a result of surplus agricultural economy" cannot be doubted.[4] Knowledge of metal had a far-reaching socio-economic importance. Previously it was thought that Indus area had heavy rainfall and thick forest.[5] But later researches showed that the Harappan civilization flowered in relatively drier tracts. The Indus had soft and pliable alluvial plains and a gallery of forests. In contrast, the Doab was impenetrable thick forest within the monsoonal belt.[6,7] The Chalcolithic people equipped with copper tools very likely favoured a dry milieu as their habitat. So, it appears that the ecological conditions along with the primitive tools were the necessary pre-conditions for adopting domestication of plants and animals.

It can be taken without argument that man became careful observer of nature for the sake of his own necessity and existence. In course of time he came to know about the growth characteristics of plants, their effects on the human body and the process of their rearing as well as reproduction. The empirical knowledge of man in fact became the main stepping stone in his march towards a civilised life aided by various success of scientific importance.

Plants bearing fruits and flowers as well as the medicinal herbs originally remained mixed up in the wild and preserved in the great store-house of nature and since man wanted all of them to serve his own purpose, he found no other alternative but to bring them out of the wild vegetation and sort them out as far as possible and replant the species according to his need. But this did not happen in a day. It was the outcome of long experience acquired from experiments through a process of trials and errors.

All the cereals have arisen from wild grasses and wild ancestors of a number of them are known.[8] A fascinating history of cultivated plants has been built up by the discovery of carbonised seeds and impression on potsherds from archaeological sites. Sculpture and painting depicting agricultural operations also provide evidence of agriculture in the past. The excavations at Harappa and Mohenjodaro have given clear evidence of brisk agriculture. Among the agricultural products barley, wheat, cotton, may be specially mentioned. Millet, melon and dates were among the principal fruits.

During the Neolithic period along with cultivation of cereals, the domestication of animals was also carried on. A good deal of attention was paid to animal husbandry in course of time, which included breeding, feeding and amintenance of domestic animals. Most of the domestic animals served the purpose of men in two ways. Domestic animals like sheep, goats and cattle were easily movable sources of food and their dung served the purpose of fertiliser. People could get both flesh and milk from goats and cattle. The hair of sheep and goats protected them from cold. The animals also came into use for carrying loads in later days. So, we find that the domesticated animals on the one hand supplied food to satisfy the hunger of man, clothing and wearing to protect human body from being weather beaten, helped cultivation to produce cereals and on the other brought mobility in the economic life of the people by being utilised as the beast of burden.

Changes in climate and advent of aridity are regarded as important compelling factors for domestication of wild animals. With the decline of food and water supplies the wild animals roamed hungrily in search of food and drink round the scattered human settlements. Some very recent events of coming down of the

elephants from Dalma Hills and leopards and elephants from Dooars area to the plains of Darjeeling districts are mentionable incidents in this respect . Such type of incidents brought the wild animals into closer to human being and paved the way for their domestication.

So the study of flora and fauna which formed the immediate environment came to occupy a prominent and foremost place in human life. The ancient Indian also were similarly interested in this job. This is evident from the rich compositions on plant life, animal life and various sanskrit literature. The epics and purāṇas contain descriptions of many trees, plants and flowers. The picture of wild life and animal kingdom in India was in no way different from that in other part of the world. The earliest reference in India is from the Indus site. "The dramatic entry of India on the stage of oriental history with the excavation of Harappa and Mohenjodaro" has in fact thoroughly revolutionised the mode of periodising the history of ancient India and removed the obligatory limitation of accepting the vedic literature as sole source of our information regarding the earliest chapter of our history."

The rich yield of plant and animal remains, comes from the sites of Mohenjodaro and Harappa. This earliest evidence of the use of cereals, woods and other plants and the remains of animals unearthed from the prehistoric sites gives concrete proof of the knowledge of the Indus people in this regard. We can have some idea as to the impact of animal life on the pre-historic Indian culture from the glyptic art which are represented on the seals, paintings on pottery and animal figurines and toys.

Coming down to the age of the Vedas agriculture became an important and noble vocation. Importance of agriculture is stressed in the Ṛgveda. The literary records like *Saṁhitās*, the *Brāhmaṇas*, the *Āraṇyakas* and the *Upaniṣads* abound in several matters of scientific interest learning on plants though in a scattered nature. The increasing acquaintance with the plant life further reflected in the appreciation of the medicinal properties of the herbs and plants in the *Atharva Veda*.

The *Taittirīya Saṁhitā* and *Vājasaneyi Saṁhitā* describe the different parts of the plant body.

In the post Vedic Age, we have again to depend on varied types of Sanskrit literature and commentaries which bear eloquent testimony to the knowledge and awareness of the people of the age regarding plants and animals. The *Arthaśāstra*, the *Bṛhatasaṁhitā* and a number of *Purāṇas* give the impression that the ancient Indians had developed a tradition of protection of the living world around them.

The scientific spirit of enquiry about the plant kingdom grew among the people of ancient India and as a result of this we have got from them the medical treatises of Caraka and Susruta.

Diseases of plants and their treatment have been dealt with in *Bṛhatsaṁhitā*, *Agnipurāṇa* and *Upavana-Vinoda*. Ancient Indian's wisdom about plant science has been proved to be of high order by the discovery of a manuscript of the *Vṛkṣāyurveda* attributed to Parāśara. This is a full-fledged treatise on plant science. A very valued treatise called *Kṛṣiparāśara* may be taken to be as clearly indicative of the then existing knowledge and practices relating to

successful agriculture. In addition to the chapters on matters relating to cultivation there is also discussion on the issue of protection of crops from diseases and the care of the animals.

In the Kāmasūtra of *Vātsyāyana, Vṛkṣāyurveda* is mentioned as one of the sixty-four arts. The *Vṛkṣāyurveda of Surapāla* which is believed to be a composition of about 10th century A.D. (?) gives an account of the treatment of plant diseases.

The earliest evidence of man's contact with animals is furnished by cave-paintings of neolithic men in India (Fig. 1). In this context, Bhattacharya refers to the residential cave floor of about 50,000 years old as revealed from the recent excavations at Bhimbetka in the Raisen District of Madhya Pradesh.[11]

The Indians of the past were curious enough about the animal world. The animal remains and the animal depicts on potteries, seals and toys found in Harappa and Mohenjodaro are the clear evidences of keen interest of the Indus people for animal world as has been mentioned earlier. With the advent of the Aryans, a new chapter began in the history of India. The Aryans were the keen observers of the living-world. Their observations on habits and habitats of several animals have been kept preserved in the Vedic and other Sanskrit literature. The vedic people were essentially agriculturists and agricultural practice was regarded as dignified/vocation. A *Ṛgvedic* hymn says "plants, I hail thee ! Divine Mother of mankind (*Ṛgveda* X. 97.4)". Naturally, the animals receiving special importance were cow, goat, sheep, buffalo etc. The horse and elephants were honoured for their economic and military importance. The cow especially became the most adored animal in course of time. A typical example of this is the advice *deva - go-brāhmaṇa-guru Vṛddha-Siddhācāryan arcayet* - one should worship the gods, cows,

Brahmins, preceptors, spiritual adepts and teachers (Caraka Saṁhitā 1.8.18). In course of time, the social thinkers of ancient India absorbed themselves into the problem of the diseases of the beasts. They also began to think over the protection of the animals from the cruel and aggressive attempts of man on their lives.

The fruit of such thinking appears in many sanskrit treatises and literature of the part. In the *Ṛgveda* we find references to both plants and animals. In the *Brāhmaṇas*, two classes of animals are mentioned : some were rural i.e. domesticated and some were wild which lived in the forest.

We get zoological information from *Pāṇini*, the *Dharmāśāstras*, *Śusrūta Saṁhitā*, *Caraka Saṁhitā*, *Matsya Purāṇa*, *Vāyupurāṇa*, *Agni-Purāṇa* etc. Various information relating to elephant life have been discussed in the *Arthaśāstra*, *Bṛhatsaṁhitā*, *the Śukrānīti and the Nītisāra of Kāmandaka*. *Hastyāyurveda* has treated the diseases of elephant and *Mātaṅgalīlā* contains various information regarding elephants. The *Asvaśāstra* bears many information regarding horses and their diseases and remedies.

So we see that with the invention of the technique of plant cultivation and animal domestication, the ancient people started a hopeful journey towards the higher pursuit of knowledge that ushered in the age of gradual advancement. But the danger to the animal did not lie only with the natural diseases. People became another source of danger to them. The man threw his covetous eyes on the wild life and tried to profit themselves by hunting the dumb animals.

But here too, the ancient Indian thinkers did not sit with their eyes closed. Many scriptural injunctions and state prohibitions for not making any damage or injury to trees and animals were imposed on the people. We have ample evidences of animal and nature-protection in the *Artha'śāstra, Manusmṛti, Śukranīti* and *Kāmandaka Nītisāra*. In the Edicts of Aśoka, we find serious attempts for protection of life. Buddhist and Jain literature created an atmosphere of universal non-violence. In fact, India bears an age old glorious tradition of conservation of the living world. But in this context, some discussion should be made on the question of forest administration and management in ancient India as because the forest is the abode of wild animals and it harbours a great variety of plant species. From the time immemorial forests have been fighting a losing battle althrough the centuries for their existence since the beginning of human settlement. In this battle man's role is that of a predator but here again, it is man himself who guided by his empirical knowledge had been trying to protect this sole shelter for his own existence by creating an air of social conservation through scriptural injunctions and state prohibition.

So, there remains little doubt that India in the past was aware enough to develop a tradition of protection of plants and animals. The information on the forestry in ancient India as a distinct science as it stands today is not explicitly available. However, the administration and management of forest department were considerably developed as is evident from the *Artha'śāstra* and some other sources.

The tradition of highlighting an interpretative affinity between man and nature caught the attention of the scholars since long. This

resulted in the publication of a number of good works. Thus, G.P.Mazumdar (1927)[12] wrote *Vanaspati : Plants and Plant life as in Indian Treatises and Traditions* related to plant science of ancient India. The other notable contributions are : *An Introduction to the Vṛkṣāyurveda of Parāśara* by N.N.Sircar[13] (1950), *Flora and Fauna in Sanskrit literature*[14] by S.C. Banerjee (1980), *Interpretation of Rock Edicts and Pillar Edicts of Piyadasi* by M. Chakravarty (1906)[15], articles on the knowledge of ancient Hindus on the fishes, their sanskrit names and fisheries of India from different sources by S.L.Hora (1948a, 1948b, 1950), [16, 17, 18] and the article of C.D.Chatterjee (1964) entitled *Forestry in Ancient India.*[19]

There are good essays on agricualture by Raychoudhuri, Gopal and Subbarayappa[20] (1971), on Botany by Chowdhury (Pre-historic period)[21] and the vedic and post vedic period by Ghosh and Sen[22](1971). An article rich in zoological information by Bhaduri, Tiwari and Biswas[23](1971) is also worth mentioning in this context.

A socio-economic perspective of ecological history of India and prudent use of forest produce has been analysed by Gadgil and Guha (1993). Very recently some attempts have been made to analyse the concept of ancient Indians about nature and environment such as the articles of R.Mukherjee (1995)[24], M. Saha (1995)[25] and R.Ghosh Roy (1995)[26]. Each of these contributions deals in the plants, animals, forestry, and environment independently. None of these recent works treated these three components as inter-related factors of ecosystem.

Here in the present monograph an attempt will be made to concentrate on the study of ancient Indian tradition of protection/ conservation of plants, animals and forests on the basis of some

original sources. An assessment will also be attempted on the contributions already made by the scholars.

The work will be divided into the following Chapters :

Chapter 1. Introduction

Chapter 2. Domestication and protection of plants.

Chapter 3. Domestication and protection of animals.

Chapter 4. Forest management

Chapter 5. Conclusion.

References :

1 Gadgil, M. and Guha, R.C. *This Fissured Land : An Ecological History of India.* Oxford Univ. Press, New Delhi, 1993, p.76.

2 Hawkes, J. and Woolley, L. *History of Mankind, Cultural and Scientific Development : Vol 1, Pre history and the Beginning of Civilization.* UNESCO, London, 1963, p.156.

3 Agarwal, D. P. 'Metal Technology of the Harappa Culture : *Indian Journal of History of Science* Vol. No.2, 1970, pp. 238-252, INSA, New Delhi.

4 Deshpandce, M.N. *Indian Journal of History of Science*, INSA, Vol.6, No.1, 1971, p.6.

5 Wheeler, R.E.M. *Early India and Pakistan.* Thames and Husson, London, 1959.

6 Calder, C.C. *An outline of Field Science in India*, edited by S.L.Hora, Indian Science Congress, Calcutta, 1937.

7 Stebbing, E.P. *The Forests of India*, Vol.1, The Bodley Head, London, 1922.

8 Randhawa, M.S. ; Singh, J. ; Dey, A.K. and Mittere , V. *Evolution of Life*, Publications and Information Directorate, New Delhi, 1969, p.284.

9 Ibid., p.289.

10 Childe, V. *New Light on the Most Ancient East*. New York, Rev. ed. 1954.

11 Bhattacharyya, P.K. *Historical Geography of Madhya Pradesh from Early Records*. Delhi, 1977.

12 Mazumdar, G.P. *Vanaspati : Plants and Plant Life as in Indian Treatises and Traditions*. Calcutta, 1927.

13 Sircar, N.N., *An Introduction to the Vṛkṣāyurveda of Parāśara*. Journal of the Royal Asiatic Society of Bengal, XVI, No.1, 1950.

14 Banerjee, S.C., *Flora and Fauna in Sanskrit Literature*, Calcutta, 1980.

15 Chakravarti, M., *Animals in the Inscriptions of Piyadasi*. Memoirs of the Asiatic Society of Bengal I, pp. 361-374, 1906.

16 Hora, S.L.Sanskrit Names of Fish and their significance, Journal of the Royal Asiatic Society of Bengal, Science, XIV, N. 1, pp.1-6, 1948.

17 Hora, S.L., Knowledge of the Ancient Hindus Concerning Fish and Fisheries of India. 1. References to fish in Arthasastra (ca. 300 B.C.). *Journal of the Royal Asiatic Society of Bengal*, Science XIV, No.1, p. 7-10, 1948.

18 Hora, S.L. Knowledge of the Ancient Hindus Concerning Fish and Fisheries of India. 2. Fishery Legislation in Aśokas Pillar Edict V. (246 B.C.) *Journal of the Royal Asiatic Society of Bengal*, XVI, No.1, pp. 43-56; 1950.

19 Chatterjee, C.D. *Forestry in Ancient India*, Forest Directorate, Govt. of West Bengal, Calcutta, 1964.

20 Raychoudhuri, S.A., Gopal, L. and Subbarayappa, B.V. *Agriculture*, In ACHSI p. 350, INSA, New Delhi, 1971.

21 Chowdhury, K.A., Botany : Pre-historic Period, In *ACHSI* p.371, INSA, New Delhi, 1971.

22 Ghosh, A.K. and Sen, S. N., Botany : The Vedic and Post-Vedic Period, In *ACHSI* p. 375, INSA, New Delhi, 1971.

23 Bhaduri, J.L., Tiwari, K.K. and Biswas, B., Zoology, In *ACHSI* pp. 403-44, INSA, New Delhi, 1971.

24 Mukherjee, R. India's Concept of Environment And concern for Nature, *Journal of the Asiatic Society*, 36(2) : 1-7 (1994).

25 Saha, M. Personal Hygiene, Public Health And Environmental Science in Caraka Saṁhitā, *Journal of the Asiatic Society*, 37(1) : 46-69 (1995).

26 Ghosh Ray, R. Nature and Environment in Kauṭiliya's Arthaśāstra, *Journal of the Asiatic Society*, 36(2) : 64-72 (1994)

2. Domestication and Protection of Plants

2.1. The Beginning of Agriculture

The Quaternary is the shortest of all the geological periods which 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 before present. The vegetation came under human influence during the post glacial period when the Neolithic people commenced agriculture. The successive shifts in the plant populations in response to climatic changes gradually resulted in the present pattern of plant life. The main centre of Neolithic revolution was western Asia and it is in this region that the wild ancestors of two vital cereals wheat and barley are found.[1] A very interesting history of cultivated plants has been reconstructed by the discovery of carbonized seeds and impressions on potsherds found in the archaeological areas of Indus civilization.

In India, the recorded history of agriculture begins with the agricultural practices of the Indus people. That the entire civilization flowered forth as a result of surplus agricultural economy[2] cannot be doubted. The Harappans cultivated bread-wheat, barley, sesame, peas, melons, bananas, date palm and species of *Brassica*. In a number of Chalcolithic sites in India, both rice and wheat have been discovered. Rice has been found in Ahar in Rajasthan and Navdatoli in Madhya Pradesh. Sorghum has been recorded from Ahar and pea from Madhya Pradesh, carbonised seeds of mung, urd, lentil and bean have also been recorded from Navadatoli.

The earliest direct evidence of the use of rice in India as shown by Chowdhury is from Hastinapur, a Chalcolithic settlement (about 3,000 years ago)[3].

The Harappans, wore cotton garment and the history of cotton, a commercially important product from plant can be traced back to the Indus valley civilization. From the sites of the Mahenjodaro cotton cloth and string have been recovered. so, it goes without argument that the Indus valley civilization flourished as a result of brisk agricualture and plant utilization. The economy of the people was based on agricultural produce. Though we have scarce archaeological evidence to make an idea about their agricultural implements or about their agricultural knowledge, Kosambi's opinion is that the Indus people did not have the plough (which is depicted on Mesopotamian seals) but only a toothed harrow which may be recognised as one of their Indus script ideograms.[4]

The intensive excavations at Kalibangan, one of the important pre-Harappan sites in Rajasthan, located on the southern bank of the Ghaggar which is now dry, have laid bare a furrowed field. In the words of Lal[5] "about a hundred metres to the south of the settlement were identified the remains of an agricultural field, with some of the ploughed furrow-marks still intact. And no less interesting is the fact that the pattern of ploughing the field continues to be the same even now in that region". Sankalia's(referred by Chattopadhyay)[5] suggestion is that the furrowed field proves the existence of a plough. In this context Chakraborty's opinion is worth mentioning that the terracotta model of a plough at Banawali sets at rest all the hypothesis about the use or non-use of plough in the Harappan civilization. Probably this plough was a wooden one.[6]

Whether this type of plough was tipped with metal could not be determined. The furrowed field at Kalibangan indisputably indicate that even in the third millennium B.C. The technique of agriculture was sufficiently a developed type and "this finding" comment the Allchins,[7] "therefore, provides a dramatic suggestion that an agricualtural practice was already in use during early Indus times which has survived locally till today". It can hardly be denied that before reaching the "Mature Indus style" the pre-Harappans introduced ploughs for cultivation in their formative stage. The Indus people knew the technique of flood irrigation. They could exploit the flood water of the Indus for a successful agriculture and thus by irrigated farming and use of ploughs they produced huge agricultural surplus without which the flowering of such an urban civilization like that of the Indus could not have been possible. As Marshall[8] truely observes, "Great cities with teeming populations like Mohenjodaro and Harappa could never have come into being save in a country which was capable of producing food on a big scale, and where the presence of a great river made transport, irrigation and trade easy". The transformation of the early Indus culture into the "Mature Indus style" resulted in all probability from the tremendously productive agricualtural potentialities of the alluvial soil of the Indus.

The querns have been found in various excavated areas of the Indus. These querns have beyond doubt that the grinding of the grains were carried on a large scale.

The Allchins are prone to give emphasis on the observation of Lambrick about the way of their production and their method of utilization of the flood water of the Indus. The Indus people took the opportunity of the yearly innundation of the river by sowing the cereals like wheat and barley i.e., the rabi crops just at the end of

flood. The area which went under flood water acquired much fertility and gave return on a large scale. The rabi crops were reaped in March and April.

Cotton and sesame were sown at the beginning of inundation and harvested in the autumn as autumn or Kharif crops. The alluvial soil of the Indus yielded large return in lieu of minimum human effort. The vast granaries of the Indus settlement were filled with these huge produce.

"As a matter of fact", comments Chattopadhyaya[6], "the agricualtural products that filled the granaries of the Harappan cities did not presuppose a great deal of skill or improved implements. These presupposed, on the contrary, an understanding and control of annual innundation of the rivers."

The Indus people so can be credited with the knowledge they gathered for exploiting the flood water at its optimum level feasible at that time. The secret of the success in creating a vast agricultural surplus lies in their perfect utilization of the environment created by annual innundation, conducive to agriculture.

The existence of irrigation canals in the Harappan sites indicates their deep interest in improving agricultural technique.

The oldest evidences of the use of wood in the Indian region have been recorded from Harappa proper and from the sites of Harappan culture in Gujrat. For the manufacture of coffin they used rose-wood. It was a particular genus of tall tree. Deodar wood was

also used for coffin. Both are good for their scent. Further, use of wood is also evident from wooden mortar. The selection of a particular type of wood for a specific purpose indicates that the Harappans were well aware of the different qualities of timber species. Among the old wood, the most interesting is the discovery of wooden tools and implements found at Burzahom in Kashmir valley and Chirand in Bihar. Both the sites belonged to Neolithic culture.[3] A thorough analysis of the wood remains proves that the people of that period, gathered sufficient knowledge about different utilities and properties of wood and used them accordingly.

There are other plant remains found at Hastinapur, a Chalcolithic site. Chowdhury and Ghosh[8] have identified these woods as *Dalbergia sissoo Roxb. and Holarrhena antidysenterica* Wall. These were used as fire woods.

The Indus settlement was built up of huge brick construction. The quality of the bricks used in different types of construction is really amazing. Mackay's[9] observation here, is very clear. He says, "well burnt bricks and those of Mohenjodaro are of excellent quality, are practically indestructible and can be used over and over again, provided that a moderate amount of care is taken in removing them from the old walls".

These bricks were exceptionally well baked and ranged from straw colour to bright red. What a perfect technique for burning the bricks had to be attained, and how huge amount of wood were to be fired for this purpose can be easily imagined.

The informations regarding the Kiln are very scanty, still it may not be an untenable inference that there was evidently no difficulty

about fuel. The earthen potteries and vessels were also to be burnt with wood.

Flood defence probably became a vital problem to the people of the Indus site. The mud bricks were easily soluble and would have been destroyed by heavy rain and flood. To quote here the observation of the Allchins[6] will not be out of context that "a vital necessity of settlement in the Indus plain itself would have been flood defence, and here it seems that burnt bricks must have played an important role" in the defence.

Though the mud bricks were generally used by the pre-Harappan people, the process of baking the brick by fire had already set in. The sites of Kalibangan and Banawali of the formative period of the Harappan culture may be cited as instances. Burnt bricks were used to safeguard the cities from the natural calamities of heavy rain and flood.

The conjecture that the Indus valley could not have produced sufficient timber for this task of burning the bricks has been set aside by the Allchins. They give emphasis on the opinion of Lambrick that presently the timber grown along the reverine tracts in the Sind is sufficient for burning all the bricks made in the province. In the Harappan times the timber could not have been less abundant. Thus, the plentiful of wood facilitated their process of burning the bricks . It would not be logical to think that an urban settlement with huge construction of bricks could have flourished by importing innumerable ready-made burnt bricks from contemporary settlement of far off countries like Mesopotamia. It is equally illogical to believe that certain part of a territory having no timber and plant resources

of its own could project itself as nucleus of a civilization like that of the Indus.

The picture of the animals of prehistoric India built up from their actual remains and representations on potteries and as figurines claim that the Indus people were well acquainted with the wild animals like tiger, elephant, rhinoceros, and buffalo. The existence of such animals is possible only in thick forest covers. thus, it strengthens the idea that the Indus people had their own timber resource for burning the bricks.

The observation of Mughal in 1972 can help us to have an idea of the extent of the civilization flourished at the dawn of Indian history - "Starting from the borders of Afghanistan, in northern Baluchistan (at Periano Ghundai), and the Iranian border on the Makran coast (at Sulkegan-Dor) it extended east and south east and covered the entire Makran coast, the Greater Indus valley and Gujrat. The remains of the Indus culture have also been found near Delhi in the Ganges-Yamuna Doab".[10]

The Allchins in 1983 estimated the area covered by the Harappan culture to be a little less than half a million square miles. Further references are not essential to stir up the imagination of modern people of this day for making an idea about the extent of this urban development.

Such a vast stretch of human settlement with brick works required almost an astronomical number of bricks. Initial foundation an subsequent expansion of such an advanced civiilzation can be thought of on those days, only when two resources are available :

good soil for agriculture and adequate timber for using as fuel and firing the bricks.

Fertile soil must contain minerals, compost organic fertilizer and soil water.

All these are contributed by a good forest cover in the nearby. Further, the retention of ground water also depends on forest tracts. Forest tracts maintain a good humid climate favourable for adequate rainfall. Rainwater while flowing through the forest-bed faces obstruction allowing seepage into the ground. This provides soil moisture for agriculture as well as ground water for domestic purposes.

Being animal, human life is associated with vegetation. An area devoid of vegetation is subject to soil erosion causing repetitive flood. A flood prone area cannot be chosen for human settlement. The destruction of Indus civilization because of recurrent flood as emphasised by some historians might have been due to rampant depletion of forests by the Indus people.

Thus, it is imperative that the existence of timber source in the nearby area of the civilization cannot be mooted. According to Wheeler.[11], widespread deforestation of the surrounding region was caused by the Harappan people to meer the demands of firewood for brick and pottery production, for domestic fuel and for smelting metal. That the Indus people reached a considerable height of knowledge about agriculture and botany in proved beyond doubt. They used to live in villages, cities and towns, wore clothes, cultivated crops other fruits and cotton, worshipped trees, glazed their pottery

with the juice of plants and painted them with plant designs. It is justified to believe that they knew quite a lot about the characteristics of plants which grew in their surroundings.

But as archaelogy alone provides us with the surest information about their achievements, we are not in a position to comment on their perception on nature's balance contributed by the plants. In the absence of any written document and as the scripts are not yet deciphered, the Indus people fail to bear any message to the posterity, regarding their awareness of nature.

2.2 Utilization of Plant Resources and Simultaneous Study of Indian Flora by the Aryans.

The Aryans migrated to India from the west. They poured into this country in batches and opened a new vista in the history of India. The dates of the Indus culture are a matter of dispute. It has been ascertained that the Aryan migrated to this country occurred between 2300 and 1750 B.C. It seems relatively certain that the decline of the Harappan civilization began in about 1750 B.C. and that this decline was in some way connected with the coming of the Aryans from the North-west. That the Aryans were careful observer of nature, is proved from their rich literature. They began to study the flora and fauna of this new country from the dawn of civilization.

The Vedic Aryans were mainly an agricultural people. In the Vedic period agriculture became an important vocation for people. The vedic people attached great importance to agricultural practices which is evinced from several hymns in the *Ṛgveda*.[12] A vedic hymn says, 'with the master of the field, our friend, we triumph; may he bestow upon us cattle, horses, nourishment, for by such (gifts) he makes us happy .... May the herbs (of the field be sweet for us; may the heavens, the waters, the firmament be kind to us; p may the Lord of the field be gracious to us .... May the oxen (draw) happily; the men (labour) happily; the plough furrow happily .... Auspicious Sita (furrow), be present, we glorify thee: that though mayst be propitious to us; that thou mayst yield us abundant fruit .... May the ploughshares break upon land happily; may the plough man go happily with the oxen; may parjanya (water the earth) with sweet showers happily ..... (R.V., IV, 57.1-3).

The Aryans had good many reasons to acquire working knowledge of plants and plant life.

After coming to the land of 'Saptasindhavas' the Aryans engaged themselves to the task of studying the details of the Indian plants and athereby finding out properly their utility. There are sufficient indications to show that the vedic people acquired a great deal of knowledge about agriculture, the general life history of plants, their medicinal properties and also Arbori-Horticulture. At that early stage, knowledge of rudimentary plant physiology became necessary for successful cultivation.

The Vedic people knew the art of manuring the soil and cowdung was used as manure. In later period cowdung was found to give better result when dried before application. This shows that

they understood the value of natural manure of animals in the field. Of the important grains so far known of the vedic period are wheat, rice and barley. Barley is still considered by the Hindus as a sacred grain and used in various rituals, though it ceased to be a principal good food grains to the Indian people. It is interesting to note that the *Ṛgveda* makes no mention about rice and in all probability it was still a wild growth. Auboyer's[13] observation is that rice was not yet cultivated in the area where the *Rgveda* was compiled. The references to rice are found in the *Taittirīya Saṁhitā*[14] (VII, 2.10.2) and the *Atharva Veda*[15] (VI, 140, 2; VIII, 7.20 ; IX, 6.14).

The Vedic farmers knew the method of increasing the productivity of the soil by what is now known as the rotation of crops in the same plot of land. In the *Ṛgvedic* period, the rotation by fallowing land was practised. But the rotation of crops, rice in summer and pulses in the winter in the same field was recommended in the *Taittirīya Saṁhitā* (V, 1.7.3) Rotation of crops was thus familiar to the Indians. Dr. Roxburgh, the Father of Indian Botany believes, 'the Western World is to be indebted to India for this system of sowing'. In the '*Satapatha Brāhmana*[16] a detailed description of the agricultural activities are given. Among the cereals which were regularly cultivated were *yava, vrīhi, upavāka, anu, godhuma, ñivāra, priyaṅgu, syāmāka* and the pulses were mudga, māsa and masūra. The vedic farmers could understood the importance of irrigation for improving the quantity of production and protection of plants. In the dry weather of the area of Punjab water could not be retained in reservoir. So, they used to carry water through canals from catchment hilly areas. Besides, the *Ṛgveda* mentions *asmacakra* which was a wheel of stone and water was lifted with the help of this wheel. There was also a *ghatajaṇtra* or *udghātana*. From the hymn in the *Ṛgveda* it appears that the then people had to recourse to artificial water supply. In the *Atharvaveda* (IV, 15) we find the hymn which

conveys a beautiful tribute to Rain which is an indispensible factor in the prolific development of herbs and plants. "Let the mighty liberal ones cause to behold together; let the juices of the waters attach themselves to the herbs; let gushes of rain gladden the earth, let herbs of all forms be born here and there ; .... let the herbs become full of delight with the coming of the rainy season."

The Aryans were conscious of the natural enemies of the crops. The *Kauśika-Sutra* of the *Atharvaveda* enumerates the animal enemies of corn and prays to the Divine power for their destruction. The locust, the rat, the devourers of corn and the borers are mentioned and these animals and insects are very familiar enemies of the corn even now.

The vedic hymns indicate very clearly that the Aryan people of this period looked to the agricultural profession as the most venerable and by their keen observation they perfected the job with brilliant success.

As because the plants and trees were intimately associated with the life of the Aryans a spirit of enquiry spontaneously grew among them as to the effect of natural vegetation growing near their dwelling places. To the community of the Aryans, the study of plants and plant life of this new country of India became a self imposed job as because the most part of the country still remained unexplored. The growing acquaintance with plant life is further reflected in the appreciation of the herbs bearing medicinal properties. The *Ṛgveda* gives a broad classification of plants, *Vṛkṣa, oṣadhi* and *vīrudhs*. There are further subdivisions e.g. *viśākhā* (shrubs), *sasa* (herbs), *vratatī* (climbers), *pratānavatī* (creepers) and *alasālā* (spreading on the ground). There are some trees called Phalini which are luxuriant

with fruits. There are some *aphala* i.e. fruitless trees. The plants devoid of flowers are called *apuṣpā*, and the *puṣpinis* are plants with flowers. In *Ṛgveda* we find the hymns which in the words of G.P.Majumdar[17] are 'the first medical utterance of man'. It is mentioned in the Auṣadhi sūkta of the 10th *Mandala* of the *Ṛgveda*.

Some of the hymns are as follows :

1. Mother (of mankind) a hundred are your applications, a thousand fold is your growth; to you who fulfil a hundred functions make this my people free from disease.

2. "Plants" ! thus I hail you, the divine mother (of mankind). I will give to thee, Oh physician, a horse, a cow, a garment - yea, even myself (Sukta VII, 97). There are several other hyms which indicate that the Aryans were aware of the medicinal properties hidden in herbs and plants and knew the methods of their application against innumerable diseases. But a more concrete and compact knowledge can be gathered from the detailed account of the medicinal plants and their application against various maladies described in the *Atharvaveda*. The Aryans were even particular to get the best out of the medicinal herbs and plants and in order to get the best they chose the peep of dawn for their application.

The plants were used for remedies from various physical diseases like leprosy, urinary problem, fever, eye diseases, head disease, physical injury and other common problems of health. Plants were used against snake bite. The vedic physician also used plants for prolongation of life. The most important plants used were "*aparājitā, parṇa, palāśa, aśvattha, tāliśa pāthā, svādhā, khadira* and *siṁsápā*"[17] , According to G.P.Mazumdar hymns in *Atharvaveda*

indicate very interestingly that even in those years of infancy of the medical science (?) in India the vedic Aryans took note of the importance of cosmetic for the purpose of improvement of appearance. The *Atharvedic* hymns mention *Sami* as the plant, very much conducive to the health and growth of the hair.

In the vedic literature we find references describing the external as well as internal features of plants. The ancient Aryans were highly inquisitive of external morphology and stray references of which we get from the *Ṛgveda* . The *Atharvaveda* embodies the knowledge of external morphology in a hymn (VII.7) The *Vajasaneyī Saṁhitā*[18] (XXX 28) and the *Taittirīya Saṁhitā* (VIII, 3. 15.1) state the different parts of a plant body. The plants comprise of mūla (root), the tula (shoot), the *kāṇḍa* (stem), the *valśa* (twig), the *puṣpa* (flower) and the *phala* (fruit) . Besides these, a tree has *skandha* (corona), *śākhā* (branch), *parṇa* (leaf).

Osadhibhyaḥ svāhā mūlebhyaḥ svāhā tūlebhyaḥ svāhā kāṇḍebhyaḥ svāhā valśebhyaḥ svāhā puṣpebhyaḥ svāhā phalebhyaḥ svāhā/ vanaspatibhyaḥ svāhā mūlebhyaḥ svāhā tūlebhyaḥ svāhā skandhobhyaḥ svāhā śākhābhyaḥ svāhā parṇebhyaḥ svāhā puṣpebhyaḥ svāhā (Taitt, S. viii, 3, 19-20).

Pāṇini[19] in his *Aṣṭādhyāyī* mentions the different parts of a tree. Patañjali describes different parts of a plant as *mūla* (root), *skandha* (trunk), *phala* (fruit), *palāśa* (leaf). The *Viṣṇu Purāṇa*[20] mentions various parts of trees. Plants growing on other plants i.e. the pargachā was not unknown in ancient India. The weak stemmed plants or creepers were called *valli, vratatī*, or *latā*.

Mazumdar[17] observes that the ancient Indians differentiated the stem of a tree broadly into two parts, the peripheral part called the *tvac, Valkala* (rind, skin) and the inner part, the *sāra*.

In the *Vṛhat Āraṇyaka Upaniṣad* (Chap-III, 9th *Brāhmaṇa*, Lotus Library Edition)[21] the plants are regarded as animate being and analogy has been drawn between plant body and human body. The analogy runs thus : "The body of the plant is exactly like the body of man; the hairs of man corresponding to the leaves of plants and his skin corresponding to the dry exterior bark of the plants. Thus, a sort of animation was ascribed to the plants which Sir, J.C.Bose established scientifically only in recent period. So, we find that the people of ancient India made a fascinating advance in acquiring knowledge on plant life. The modern people are making conscious efforts for protection of trees and plants as they are aware of the various utility of trees and plants in human life. They are also conscious of the fact that human life would be at stake of there is no plant on the earth. The trees and plants maintain the ecological balance. So, the plants should be protected. But this thinking is not a recent and a new concept in India. This developed in the mind of the ancient Indians from their empirical knowledge, and in course of time their inquisitiveness resulted in the flourishing of plant science in India.

The *Agṇipurāṇa*[22], the *Arthaśāstra*[23,24,25] and the *Bṛhatsaṁhitā*[26] have each a distinct section dealing with plant science (*Vṛkṣāyurveda*). The meaning of the term *Vṛkṣāyurveda* is 'The knowledge of tree-life'. In the *Adhyakṣyapracārah Adhyāya* Kauṭilya says that the Director of Agriculture, himself is conversant with the practice of agriculture, water-divining and the science of rearing plants or assisted by experts in these, should collect in the proper seasons,

seeds of all kinds of grains, flowers, fruits, vegetables, bulbous roots, roots, creeper fruits, flax and cotton. (*Sītādhyakṣa kṛsitantra-gulma vṛkṣāyurvedajñastajñasakho bā sarvadhānya puṣpaphalaśāka kandamūla bāllikyakṣouma kārpāsabījāni yathā kalāṁ gṛṇhīyāt*) .

Shamasastry in his translation used the term *Kṛisitantra-gulma vṛkṣāyurveda.*[24] Mazumdar referring to the translation of Shamasastry suggests that from the construction of the sentence it is clear that *Kṛiṣitantra* and the *Gulma-Vṛkṣāyurveda* were the two disciplines of knowledge. His opinion is that these two branches of knowledge were possibly interdependent. A treatise of agriculture will be incomplete without a section dealing with plant science. That the plant science or the botanical science existed in those years is corroborated from the information embodied in the *Kāmasūtra* of *Vātsāyana*[27] . The *Kāmasūtra* regards the *Vṛkṣāyurveda* as one of the 64 kalās or arts which developed in India. A branch of knowledge is to be recognised as an art only when it stands on a long historical background and is tested against times. But Dr. R.G.Basak[25] prefers the word *Kṛṣitantra - Sulvavṛkṣāyurveda.* He translates these terms as *Kṛ ṣiśāstra* and '*Sulvaśāstra*'.

There may be some differences of opinion among the scholars regarding the interpretation of some terms of the literature, but there is little doubt that the ancient people of India went far in developing their knowledge of agricultural science as well as plant science.

The point which is noticeable in the *Arthaśāstra* is that these two sections of knowledge were complementary to each other. Agricultural knowledge cannot be complete without botanical knowledge because successful agriculture depends on the art of

plantation, cultivation, art of manuring and others, based on the science of plant life. In *Śukranīti*[28], the knowledge of plant life is regarded essential in case of *Arāmādhipati* whose position corresponds to the superintendents of botanical gardens of modern times . Śukra's advice in this regard is "the superintendent of parks and forests is he who knows of the causes of growth and development of flowers and fruits, who knows how to plant and cure the trees by administering proper soil and water at the suitable time, and who knows of their medicinal properties" (Śu.11. 317-319).

The knowledge and consciousness of the ancient people regarding plants and trees which formed their immediate environment were not concentrated only to the limit of practical necessity. That they were much more involved with the nature by heart is revealed from the relation of Śakuntalā with the natural surrounding of Tapovan, as depicted in the *Abhijñāna Śakuntalā* by Kālidāsa.[29] The parting scene of Śakuntalā from the hermitage of Kaṇva, where she had resided so long and where every creeper and plant were bound by the tie of love, stirs our imagination. Nature plays an indispensible part in human life. When Śakuntalā was proceeding for her husband's abode with a grief striken heart leaving behind her old hermitage, the nature also echoed in the same tune. Priyamvadā says, 'it is not that our friend alone is agrieved at the separation from the penance-grove. Just behold the (troubled) condition of the penance-wood whose separation from you is impending. The deer have dribbled adown the mouthful of Kuśa-grass; the pea-fouls have given up their dance, creepers with their brown leafage falling, are shedding tears, as it were.' *'Udgalita-darva-Kabalā mṛgaḥ Parityakta - narttanā mayūrāḥ apasṛta pāṇḍu-patra muñc antya śrunīva latāḥ*. The glorious life of nature and the equally glorious life of man balance themselves in the composition of this

ancient Indian poet. Indeed, this faith of life in Nature must have been so living and dynamic in the minds of the people of India, of those days that a unique creation like 'Śakuntalā could have been possible by our great poet. This perception of life in nature by the old Indians is a great achievement of the Indian cultural tradition.

2.3. Protection of Plants by Growing Healthy Plants through Scientific Methods.

The hymns of the Vedas, Upaniṣads, the Epics, the Purāṇas, the medical treatises, *Bṛhat Saṁhitā*, Amora-kośa[30] and such other works provide convincing indications that throughout the ages in the past, the people of India had remained engaged in developing a branch of knowledge about plant kingdom. Their untiring efforts for unveiling the mysteries of plant domain not by laboratory tests but by empirical knowledge resulted in the formation of a distinct science which was named by them as *Vṛkṣāyurveda*. The discovery of the manuscript of the *Vṛkṣāyurveda* of Parāśara[31] by Vaidyasastri Jogendranath Visagratna of Nabadwip, Bengal and its presentation with notes by his son N.N.Sircar in the Journal of the Royal Asiatic Society of Bengal (1950) bring to the notice of the present world lots of scientific information on plant life. Parāśara was contemporary of Agniveśa. Agniveśa and Parāśara are found mention in the Sūtrasthāna of Caraka-saṁhitā.[32] Caraka's date is uncertain, though tradition makes him the physician of the great king Kaniska. Kaniska should be ascribed to a date not earlier than the last quarter of the first century A.D.[33] If Caraka's chronology is fixed during the period of Kaniska, the date of Parāśara can be further pushed back. In this botanical treatise there is a distinct section called Bijotpatti kāṇḍa. Besides, there are other sections such as *Vanaspati Kāṇḍa*, *Vānaspatya Kāṇḍa*, *Virūda Valli Kāṇḍa*, *Gulmakṣupa Kāṇḍa* and *Cikitsita Kāṇḍa*.

The *Bījotpatti Kāṇḍa* is again sub-divided into eight chapters. The portion which is named as Cikitsita Kāṇḍa, is missing. But the information regarding diseases and treatment of plants can be gathered from a number of texts like *Bṛhatsaṁhitā*, *Agnipurāṇa* and *Upabana-Vinoda*.[34] It is evident that the ancient Indian people did know the process of germination of seeds, internal and external morphology of plants, physiology of plants and gathered knowledge about their nourishment, manuring and medical treatment.

The plants are vulnerable not only to natural diseases but also to the assault of human community. As the plants are living beaings they are bound to take birth, to grow with the passage of time and to succumb to death after the span of life is over. The span of life differs from species to species, but the death is the final end of plant life as that of any animal being. Our ancestors conceived this eternal truth about plant life.

The propagators of plant science in India took the job of developing a system of medical treatment of the plants as a distinct section of Vṛkṣāyurveda. That the science of plant life came to be regarded as a full fledged department of knowledge is evident from the *Arthaśāstra* (11.24.1) The Director of Agriculture, it is said, must possess the knowledge of science of agriculture dealing with the plantation of bushes and trees and he should have got the assistance of those who have adept in this science.

The concept that the prevention is better than cure was not unknown to our ancestors. We find that the first task of the Director of Agriculture was to collect the proper seeds to be sown in properly prepared soil in proper season (KA. 11.24.1,2).

For getting the optimum return from healthy plants, the Head of the Department of Agriculture had to keep watch over many matters relating to better success in cultivation. The *Arthaśāstra* prescribes many times ploughing of soil (KA.11. 24.2) and some treatment of seeds before sowing.

2.3.1 Collection, Selection and Treatment of Seeds for Good Germination and for Vigorous Seedlings.

According to Arthaśāstra, the seeds of rice, wheat and barley should be kept in the dew at night and in sunshine during the day time for a week. The similar treatment of seeds of pulses should be done for three to five days and nights. Honey, ghee, pig's fat cowdung etc. were recommended for treating various seeds (KA II. 24, 24). Thus, we find that the act of preparing the seeds for best germination was the matter of utmost importance, so that any unwanted crisis could be avoided in stages of continuos development.

The small chapter, *Upavana-Vinoda* as a branch of *Vṛkṣāyurveda* in the *Śārangadhara Paddhati* treats of arbori-horticulture. In this chapter some definite instructions regarding the planting, watering and protection of plants are discussed. This encyclopaedic work was compiled by Śārangadhara under the Royal instruction probably in the thirteenth century (Majumdar).

In the *Vījoptividhi* section of *Upavana-Vinoda* there are some prescribed rules for the sowing of seeds. The purpose of this section is to give the people proper guidance in the task of treating of the seeds before sowing. The instructions are :

1. First of all one should take well-mature seeds of the season, sprinkle milk and clarified butter over them, keep them for five days (in this condition) and then fumigate them with frankincense, or

2. One should besmear these seeds thus sprinkled with milk, with powder of vrhati and sesamum mixed with ghee, dry them and besmear them again with cowdung, and then fumigate with fat of some animal. If the seeds, thus prepared, are sown they sprout in a single night.

3. After besearing with cowdung the seeds sprinkled with milk, one should dry them and besmear them again many times with powders of viḍaṅga mixed with honey and sow them; and they will sprout very soon.

4. The seeds of jambū, panasa, cūṭa, sarala, lakuca should be treated with milk and sown with ghee, cowdung and viḍaṅga dust mixed herewith.

5. A person (the master of the household) after taking ablution and putting on well-washed cloths and after worshiping the gods, and making obeisance to his Guru (spiritual preceptor) and giving away earth or money to a qualified Brahmin and making obeisance again to the presiding diety of foundation (*vāstupuruṣa*) should himself sow seeds. His attendants should follow suit.

6. One should first of all sow seeds in the seed bed, spread

grass over it and sprinke milk and water, and then when the seeds germinate, remove the grass, dry the earth a little and transplant these sprouts together with this roots and earth attached thereto.

The above quoted instructions of upavanvinoda give considerable stress on the task of preparing the seeds. The seeds of treated according to the sastric guidance would sprout with full vigour.

2.3.2 Schedules for Seed Sowing

Much attention was paid to the factor of maintaining the specified distance between plant and plant so that each and every plant could suck their optimum amount of nutrients from the earth-bed and could maintain its vigour. The measured density of plants allow them to acquire maximum solar energy and air component for food production. According to *Bṛhat-Saṁhitā*, it is best to plant trees at intervals of 20 cubits, next at 16 and 12 cubits,' interval in the minimum that can be prescribed.

Same is the suggestion in the *Agnipurāna*. It is best to plant trees at intervals of 20 cubits, an interval of 16 cubits is next, and worst is the interval of 12 cubits. Closely planted trees become fruitless (*uttamaṁ bimśatirhastā madhyamaṁ soḍasāntaram Sthānāt sthānāntaram kāryyam vṛkṣānāṁdvādasabaram biphalāḥ syurghanā vṛkṣaḥ* chap. 282, 8-9*)*. Śukrācārya gives a slightly different advice : the king should have the domestic plant planted in villages and the wild trees in the forests - the good ones at a distance of

twenty cubits from one another, the middling at a distance of fifteen cubits and the ordinary ones at a distance of ten cubits and the youngest at a distance of five cubits (Śu. Chap. IV, 91-93).

In the section of *Upavana Vinoda* called, *'Ropona vidham'* (the process of planting) some rules are given. These rules are laid down because if the trees are not planted according to these guidance, the growth of the plants would be hampered. The plants if planted irregularly, they lose their beauty and vigour. It is said that (i) one should plant trees at an interval of 10 cubits in the lower level of the garden, and at 20 cubits in the higher and at 16 cubits in the middle, but if the surface of the garden be plane, one should plant grass like plants at an interval of 2 cubits, trees at 4 and gulmas at 3 cubits apart.

(2) Trees if thickly sown are hindered in their growth and if sown very sparsely they are in danger of falling down even consequence of mild winds; hence for lean plants in the laying out a garden, planting after the method described above is wise. From the above verses, the natural inference is that ancients had a pretty good knowledge of the fact that the plant can get the essential nutrient from the soil if each plant has a comfortable peripheral space.

2.3.3. Watering

For the vigorous growth of trees and plants, proper watering was necessary. *Bṛhatsaṁhitā's* instruction is that after the trees are planted, one should water them in the morning and evening during the summer, at the end of the day in the cold season and during the rainy season, watering should be done only when the earth is dried due to want of rain.

Śukra's opinion is that 'the trees are to be watered in the morning and evening in summer, every alternate day in winter, in the fifth part of the day (i.e., afternoon) in spring, never in the rainy season' (Śu.Chap. IV 105-106).

Upavana-Vinoda also gives an instruction for watering of plants. The trees which are newly planted should be watered regularly in the morning and evening and should be systematically protected from bad effects created by cold and strong wind.

The rules for watering the plants as advised in this work are:

1. One should water the plants every alternate day in autumn and in winter, everyday in spring and twice a day during the summer, i.e. once in the morning and once in the afternoon.

2. During the rainy and autumn seasons when it does not rain one should fill the circular ditch under the tree with water.

3. One should go on applying water till the earth attached to the roots of the tree becomes wet; one should not measure the quantity of water applied to this purpose.

4. Trees suffer from indigestion if the water in the ditches is not dried up, hence one should not pour fresh water in it till that is the case.

5. A person versed in the laws should not hesitate, in the interest of trees, to extirpate the weeds, creepers and shrubs

which grow beside them. Though these rules were framed with a view to making the people aware of the necessary preliminaries for successful arbori-horticulture, yet these rules are equally applicable for the purpose of rearing and caring of almost all the trees in general.

2.3.4 Manuring

The use of fertiliser was quite familiar to the ancient people. Lots of instructions have been given in *Bṛhatsaṁhitā* and *Agnipurāṇa*. In *Agnipurāṇa* it is said that to increase the production of flowers and fruits one should sprinkle ghee with cold milk, also a mixture of sesame, excreta of goats and sheep, barley powder and beef, thrown into water, and standing over for 7 nights should be poured round the roots of the plant. (*Ghṛtasītapayaḥsekaḥ phalapuṣpāyasarvadā. Ābikājasakṛecūrṇaṁ yava cūrṇaṁ tilāni ca Gomāṁsamudakañcaiva saptarātraṁ nidhāpayet utsekaḥ sarvavṛkṣānāṁ phalapuṣpādi vṛ ddhidaḥ* (Ag. 282. 11-12).

Instruction for manuring in the *Bṛhatsaṁhitā* is as follows : "To promote influence and fructification a mixture of one adhaka (64 palas of sesame, two adhakas of excreta of goats or sheep, one prastha (16 palas) of barley powder, one tula (100 palas) of beef, thrown into one droṇa (256 palas) of water and standing over, for 7 nights, should be poured round the roots of the plant. The measure is for all kinds of plants."

For nourishment *Śukrāniti* also suggests the use of exereta of goats, sheep and cows, water as well as meat. All these combinations after a definite span of time decompose into an ideal compost fertilizer

suitable for healthy growth of plants of all kinds.

2.4 Plantation of Trees : A Scared Act

The job of plantation of trees were regarded as sacred job. Both the Bṛhatsaṁhitā and the Agnipurāṇa advise to perform the job with sacred body and mind. In *Bṛhatsaṁhitā* (Br.S. Chap. 54, vol.11) it is said "one should plant the tree after oneself being pure and after worshipping the tree with a bath and anointment, and the result will be that the tree will be graved with luxuriant growth of leaves". What an attitude of reverence was borne by the ancient Indians towards the trees and plants and what sort of eagerness they had, can be easily visualised from these lines quoted above :

We notice the same attitude in the verses of Agnipurāṇa : " one should perform the work (of plantation) after worshipping *varuṇa*, *viṣṇu* and *parjjanya* ---- the rain God."

From the foregoing references it is abundantly clear that by means of botanical knowledge the growth and healthiness of trees and plants could be ascertained to a great extent. The treatment of seeds according to sastric method leads to the growth of flowering trees.

All the aspects of knowledge as stated above are crucial for the maintenance of sound vigour of plants. Modern agricultural science really concerns all these aspects. The ancient Indian people acquired these knowledge from their empirical judgement which they applied in agricultural practices so that the vigorous plants could resist the environmental adversities and pathogens.

2.5 Protection of Plants from Diseases by Proper Treatments.

Plant diseases and their treatment received careful attention of the ancient Indians. Inspite of all prophylactic measures, the green world is subject to the attack of varieties of diseases. The science of the treatment of plants which in the opinion of Majumdar[35] does not exist in the occidental countries, developed as an important section of *Vrksāyurveda* in ancient India. In Brhatsamhitā and in Agnipurana separate chapters are given dealing with the diseases and their remedies by means of medical applicances. Gunaratna in his commentary has drawn an analogy between a human body and a plant body". Just as the human body is subject to jaundice, dropsy shofa (?) emaciation and defects (dwarfness) of finger, nose etc., so also plants suffer from similar diseases such as inception of disease, displacement of dislocation of flower, fruit, leaves bark.

And just, as by the application of the appropriate remedies unnatural growth, deterioration, wounds, fractures, etc. can be cured, so also in plants by application of proper drugs as prescribed in *Vrksāyurveda*".

According to Varāhamihir, plant diseases are caused by the extreme climatic conditions cold climate i.e. fall in temperature, wind i.e. dryness and high temperature generally affect the plants adversely. The weather-beaten plants generally fall prey to various types of diseases. The detection of a diseased plant can be done when the leaves of the plant become yellow, the buds are under developed and the growth arrested and the branches become dry, and the exudation of the sap occurs.

Kaśyapa's account quoted by Majumdar[35] is "those plants that have yellow leaves, that are fruitless and denuded of leaves and these caused by coldness, excessive heat, too much rain, dry wind and by the intermingling of roots of different plants are to be known as diseased, and are to be treated accordingly".

The texts like *Bṛhatsaṁhitā* *Agnipurāṇa* and others not only give the symptoms of a diseased plant but also prescribe both preventive and curative treatment to make them free from ailments. Varāhamihir says "as a sort of general prophylactic mud kneaded with ghee and viḍaṅga should be applied to the roots, after which milk diluted with water should be poured".

In Agnipurāṇa, almost the same treatment is prescribed : "Viḍaṅga mixed with rice, fish and flesh - and all these mixed together constitute a remedy invigorating to the plants and curative of their diseases. (*Matsyāmbhasa tu sekena bṛddhirbhabati sākhinaḥ। Viḍaṅgatandulopetaṁ matsyaṁ māṁsaṁ hi dohadaṁ। Sarbbe ṣāṁbiśeṣeṇa vṛkṣānāṁ rogamarddanaṁ*) (Ag Adhyaya 282 - 13).

A remedy is prescribed in the Agnipurāṇa for barrenness; "Viḍaṅgaghṛta paṁkāktān secayecchītabāriṇā ॥ Phalanāśe kulatthaisca māsairmudgairyabaistilaiḥ Ghṛtasīta-payaḥsekaḥ phala-puṣpāya Sarvadā (Ag. 282.10) । "Viḍanga and ghee kneaded with mud and sprinkled with cold water together with Kulattha, Māsa, Mungo, Yava and Tila should be used in a case of barrenness.

Varāhamihir also prescribes treatment of barrenness of trees with a decoction prepared from the extracts of same ingredients.

Śukra suggests that in cases of miscarriage of fruits, the tree should be treated with cold water after being cooked together with kuluttha, Māsa (seeds), Mudga (pulse) yava (barley) and Tila (oilseed). This would lead to the growth of flowers and fruits (Śu. IV. 107-108).

The *Vṛkṣāyurveda* of Śurapāla is believed to have been composed by about the tenth century.[36] (The manuscript is available in the Bodleian Library Oxford). The exact translations of the relevant portion is given below from the *Concise History of Science in India*. There is also a reference of one Sureśvara or Śurapāla from Bengal, who was a court physician of Bhīmpāla in the eleventh century A.D. His father and grandfather are said to have been court physicians of Rampala and Gobinda Chandra respectively. This Śurapāla wrote *Śabdapradipa* and *Vṛkṣāyurveda* on medical botanical terms, and *Lohapaddhati* or *Lohasarvasva* on the medical use and preparation of iron.[37] It is very difficult to establish whether these two Śurapālas were two different persons or the two names are of same person.

This *Vṛkṣāyurveda* of Śurapāla classified the diseases of all trees into two groups. (i) there are some diseases which develops from the body i.e. internal, and there are some ailments caused by external factor. The bodily diseases are said to develop from winds (Vāta), Phelgm (Kapha) and Bile (Pitta) while the entrances ailments are caused by vermin, frost etc. The treatment prescribed by Śurapāla for caring the plants from various types of ailments are as follows :

One should cure the diseases of wind disorders by the application of flesh, lymph, fat and ghee. Nutrient provided by these substances removes all wind troubles.

Liberal fumigations with oils in which soapberry, cows-horn, horse's hair, black pepper, ghee and porpoise have been boiled and the lymph of a hog added, quickly remove the diseases due to wind.

The trees are cured of bilious diseases by being watered with the decoctions of liquorice, honey and madhuka and with milk mixed with honey. All kinds of trees are relieved of bilious diseases if they are watered with the decoction (?) of the tree myrobalans in which ghee and honey have been mixed.

The problems of animal enemies of corn is a persistent problem of agriculture. Some remedial measures to safeguard the plants from the attacks of the insects have been devised in the Vṛkṣāyurveda of Śurapāla.

Insects are destroyed by the administration of water containing milk, carcass, vacā and cowdung, and by the plaster prepared from white mustard, musta grass, vacā, kustha and ativia.

Fumigation of the tree with with fumes of white mustard, ramatha (?), viḍaṅga, vacā, black pepper, beef, ambu (a kind of Andropogan), horn of bufallo an flesh of a mixed with the powder of lodhra, at once destroys the colonies of insects infesting the trees.

Plastering with viḍaṅga mixed with ghee, irrigation with diluted milk for seven days and a poultice of beef, white mustard and sesamum are effective in destroying insects like Kandara (?) Injury caused by insects is healed by a plaster of viḍaṅga, sesamum, cow's

urine, ghee and white mustard and by watering with milk.

The broken trees are (healed and) restored to health if their fractures are filled with fertile soil, plastered with (the powder of) the barks of plakṣa and undumbara mixed with ghee, honey, wine and milk and then tightly tied with ropes and sprinkled with bufallo's milk and, finally, watered copiously at the roots.

The trees, whose branches have fallen off would grow branches so abundantly that they would obstruct the view of the sky, if the broken ends of these branches are plastered with honey and ghee and they are watered with diluted milk and fumigated.

Trees damaged by fire would cover the sky with foliage, if they are plastered all over with the paste of the lotus - plants and fed with carcass water.

Trees struck by lighting would bear beautiful leaves, if they are plustered with vidara, sugar, red, arsenic and sesamum and watered with diluted milk.

There is a distinct section called 'Druma Rakṣā' in which rules for the protection of trees are categorically mentioned. One should carefully protect trees against (destructive influence of) dew, strong wind, smoke, fire and spiders.

Trees blessed with flowers should be placed in the middle of the row of trees; and the fruits of those which produce good fruits

should be kept covered, and all trees should be well protected with walls having ditches around them.

3. One should take up the ashes of trees struck by lightning, throw the same round other trees and this will ensure the latter against cold. These have the power to allay (extinguish) even the burning fire.

4. Throwing boiled Śāli rice of white variety mixed with curd and rock salt round trees ensures their protection against poisonous (harmful) rain injuries to them.

5. If one apprehends danger from mice, locusts, ants, etc. one should utter the following formula (mantra) 108 times, and write it down on the leaf of a tree.

Oṃ Svasti kiṣkindhāsthita prakataparā kramāntar-hitārkamaṇḍalopajivitasya caśrīhan umānājñapayati mūṣaka paṭaṅgapipīlikā śalabha karabhānvakakīṭagandhikā ni vahairṇasthā tavyam. Ājñāmatikramamāṇasya śarīranigraha Samāvartayati. Tasya vānarasiṃhasya kramamānasya sāgaram. Kakṣāntaragato vāyurjimūtaiva nardati. Huṃ phat namaḥ.

6. And after writing down the (above) formula on the leaf and reciting it one should burry it in the ground under the tree. This will lead to the destruction of locusts, mice and ants of the field.

In the *Vṛkṣāyurveda* of Śurapāla, there was a scientific attempts for controlling the insect pests. The application of

incantations for controlling the insect pests in *Upavana-Vinoda* though appears to be unscientific, it reveals the inherent desire of man for plant protection. The existence of both scientific and unscientific approaches to pest control might have been delimited by time and space.

In *Upavana-Vinoda*, the diseases of trees and their remedies have been discussed. Here, also trees are compared with human beings. As human body is vulnerable to diseases through the affections of vāta (wind), pitta (bile) and kapha (phlegm), the trees also are affected by diseases caused by the disorder of wind, phlegm and bile. So, the trees are to be treated without any delay after making correct detection of diseases. An operative measure is advised in case of damage in the body parts of trees caused by insects, fire, storm, thunder etc.

1. Thus, it is said, in *Tarucikitsā* section, when a tree is consumed by insects, burnt by fire, broken by storm, struck by thunderbolt, - one should cut away the affected parts ; but in case of diseases the operation is to be of different nature.

2. Tall, thin, short, sleepless or partly conscious trees are of windy humour. They do not bear flowers and fruits.

3. Trees of billious temper cannot bear the rays of the sun, are of yellow colour, and shed their branches over and over again, and bear premature fruits.

4. Trees of phlegmatic temper have their branches and leaves very glossy, flowers and fruits well shaped and of good appearance, trunks symmetrical, and all parts covered with creepers.

Some treatments are prescribed to save the trees from the ailments.

1. Substances of pungent, bitter of caustic tastes are destructive of the windy humour of trees ; and those having bitter, hot, salty and acid juice are destructive of the bile, and those with graceful, sweet, acid or salty juice are destructive of the phelgm.

2. The affectations of windy humour is alleviated through the application of the graceful things like clarified butter mixed with flesh juice. The affectation through the bile is alleviated through the application of things that are cold and graceful mixed with water, and the affectation through phelgm is mollified through the application of acid things mixed with hot water, or through pungent and bitter things.

3. Rudeness of appearance, tubercles (nodules over the body) both of large and small size are due to windy humour which may be overcome by the application of Lodhra flower, cowdung, fats and kunapa water.

4. One should do well to realise that worms (kṛmayo) are at roots of plants affected with tubercles, or of plants for the paleness of buds and flowers of which no other particular cause can be assigned; and one should do well to root out these worms with care.

If now fresh urine of cows, clarified butter, Vidaṅga, mustard and sesamum are mixed together and applied to the trunk, then fumigated and watered with milk and water, they (these plants) grow.

2.6 Social and Scriptural Injunctions for Conservation of Plants.

The human civilisation is entirely dependent upon the contributions of nature. The indebtedness of human civilization to plants and herbs is beyond estimation. Since Man settled down and started a pastoral life, he became very much dependent on the plant world. The beautiful nature supplied all the necessaries of life. The march of human society created an ever increasing demand over soil and plants. People of ancient India showed their height of knowledge by introducing various injunctions and prohibitions against any unnecessary spoil of animal life and destruction of plant life. The purpose of these scriptural injunctions and social prohibitions was to create a congenial atmosphere to the world of animate being at large.

The continuous exploitation of nature actually drives the human civilization towards a total environmental collapse. As the economy of people was totally dependent on plant resources and agriculture in early period,any profiligacy in using the nature's wealth could be perilous to the very existence of man himself.

To avoid any such fatal situation, the ancient Indian thinkers seriously took the job of creating an environment of social consciousness for the conservation of plants by implementing state prohibitions and social injunctions.

In the vedic hymns, we notice the inquisitiveness of the Aryans for trees and plants. Different herbs and plants have been mentioned by Ṛgveda and Atharva veda. Many of the hymns clearly express the inherent desire for rich growth of plant. Many hymns addressed to the Divine power, pray for luxuriant growth; protection of plants from animal enemies was simultaneously sought. But by the 4th century B.C. the art of agriculture and plantation became more organised and scientific. Attempts were made to save the plants from the assault of the people by implementing prohibition. In Kauṭilya's *Arthaśāstra* and other subsequent texts, clear cut provision of punishment for such misdeeds are mentioned.

By the time of Gautama Buddha some two thousand and five hundred years before, agriculture and pastoralism had covered a wider area of northern India. Buddhism and Jainsm had played significant role in designing social conventions which promoted the conservation practice of nature. These religions extended their compassionate attitude towards all living creatures, imposed ban on killing of animals and suggested planting and protecting of trees. A widespread perception of the need of protecting the plants and trees reached perfection in that age. The first known attempts to protect trees from the greed of people are recorded in *Arthaśāstra*. By the 4th century B.C. the art of agriculture and plantation became more organised and scientific.

In *Arthaśāstra* we notice that there was a Department of Agriculture. The main qualification of the Director of Agriculture was his knowledge in *Vṛkṣāyurveda*.

The Forest Department, was in the charge of the Director of forest produce i.e. *Kūpyādhyakṣa*. This Director had to perform many

duties for the improvement of productivity of forests. But here one thing is worth mentioning that this Director had to take punishment measure in case of cutting or causing damage to the trees. He imposed fine on the misdoers (KA. 11.17.3).

Kauṭilya in the section 13 (physical injury) gives diverse forms of punishment for doing crimes to the animals and plants. He categorically mentions : "For cut ting the shoots of trees in city parks that bear flowers or fruit or yield shade (the fine shall be) six paṇas, for cutting small branches twelve paṇas, for cutting stout branches twenty-four paṇas, for destroying trunks the lowest fine for violence, for uprooting (the tree) the middle (fine)" (KA 111.19.28).

Kauṭilya further states that "in the case of bushes and creepers bearing flowers or fruits or yielding shade the fines shall be half, also in the case of trees in holy places, penance groves and cremation grounds". (KA 111.19.29). In some cases he increases the rate of fine and mentions that in the case of trees at the boundaries, in sanctuaries and of trees that are prominent , these same fines doubled shall be imposed, also (in the case of trees) in royal parks.

It is amazing that about 2000 years back this Indian thinker could assess the importance of trees and plants for maintaining the ecological balance. This balance can be upset by rampant destruction of trees. Human society always thrives at the cost of vegetal world. So any profilagacy in the exploitation of nature's contribution was strictly disallowed. The Mauryan state craft regarded this act of protection of plants and trees as an arena of Govt. activity.

There is no doubt that the factor of economic benefit derived from the plants and herbs was a matter of serious consideration. A

collapse in green domain would destroy the means of subsistence of the people. But Kauṭilya's view was not confined to mere resource gain.

There is also an indication of approach to protection/ conservation of plants and thereby wild animals. Even he advocated for capital punishment in case of large scale destruction. His instruction in this respect is, "he shall cause to be burnt in fire one who sets on fire a pasture a field a thresing ground, a house, a produce forest or an elephant forest (KA. iv. 11.20).

Trees came to be regarded as so important that their felling or depletion without reason and prior permission was looked upon as punishable offence. Various degrees of punishment are prescribed in the Laws of Manu[38] . "According to the usefulness of the several (kinds of)trees a fine must be inflicted for injuring them; that is the settled rule (MS. viii. 285).

Manu advises for state protection of the following 'old gardens, forests ....., natural and artificial groves (MS. ix. 265). Manu classifies the offences ..... injuring (living) plants ..... (MS. xi. 64) and cutting down green trees for firewood, ... (MS. xi. 65) as *upapātakas*. This classification implies a special importance to the living plants. Manu further laid down minor penal measures for restraining man from destroying plants. These were : 1. 'For cutting fruit trees, shrubs, creepers, lianes or flowering plant, one hundred Rikas must be muttered." (MS. XI. 143).

2. "If a man destroyed for no good purpose plants produced by cultivation, or such as spontaneously spring up in the forest, he

shall attend a cow during one day, subsisting on milk alone." (MS.XI.145).

In *Viṣṇu Saṁhitā*,[39] there are serious attempts to introduce to laws to restrain people from doing any harm to plant and herbs. In the chapter dealing with crime and penalties, punishment measures have been prescribed to check such misdoings. It is clearly stated that (1) the hewer of fruit bearing trees shall be punished with the highest fine (VS. v.54), (2) the hewer of flower trees with an intermediate fine (VS. v.55), (3) the hewer of creepers and groves (shall be fined) a hundred *karsha paṇas* (VS. V.56), (4) the destroyer of grass (shall be fined) one *karsha paṇam* (VS. V.57). In an ecosystem all kinds of plants contribute to the maintenance of ecological balance. The punitive measure even for spoiling the greasses appears to be an instance of ecological consciousness of those days. A person may be guilty of upapātakas in case of cutting trees, shrubs, creepers, climbing plants or cereals (VS. xxxvii. 24). Persons guilty of upapātakas are advised to practise *cāndrāyana* or to celebrate a cow-sacrifice by way of expiation (VS. xxxvii. 35).

In *Agnipurāṇa*[22] penal measure is devised for damaging trees: *prarohisākhinaṁ śākhā skandha Sarbbaupajībyadrumāṇāntu vidāraṇe biṁśaterdviguṇā damāḥ* In case of cutting the twigs trunk and roots of banyan and mango tree, the fine shall be twenty *paṇas*, forty *paṇas* and eighty *panas* respectively (Ag. 258.25).

In *Agnipurāṇa* also, it is categorically stated that a man shall cause to be burnt in the fire being bestowed with grass, if found guilty of burning crop field, threshing ground, dwelling houses, forest and villages (*Kṣetra-beśma, Vana-grāma - bibitākhaladāhakāḥ (rājapatnyabhigāmī) dagdhabyāstu kanṭāgniṇa* (Ag. 258.67). The

above references are sufficient to indicate that the śāstrakāras and puranic writers all had taken the task of creating an environment where all kinds of plants and trees would be looked upon with high esteem.

An ideal house should have *plākṣa* tree in the north, Nyagrodha trees in the east, undumbara in the south, Aśvattha tree in the west and garden in the left hand side. (*Agnipurāṇa* 247.24-25). One thing to be noticed in this context is that there is no provision of cutting or uprooting the trees in any circumstances even if the trees were not planted properly according to sastric instruction. The *Gobhila Grihya sūtra* states that to have an *Aśvatha* tree on the east side of the site, *plakṣa* and Nyagrodha tree on the south and west sides respectively and udumbara on the north side, should be avoided because the trees bring danger from fire, early death, hostility and eye-diseases respectively. But even under such situation, there is no permission of spoiling these trees to death. This is categorically mentioned that in such a situation the trees should be removed and replanted in other places.

The plants mentioned above are not of immediate economic value, yet their destruction was prohibited. The provision for replantation certainly hints at the ancient Indians knowledge of environmental awareness, by the way of protection of all sorts of plants.

That the planting, grafting and preservation of plants constitute an art (Śu. IV. 144) was proclaimed by Śukracārya.[28] He also suggests that the king or the state authority would be entrusted with the responsibility of plantation of domestic plants in villages and wild

trees in the forests. (Śu. IV. 91-93). Thorn bearing trees such as Khadira are known as wild and advised to be planted in forest land.

2.7. Protection/Conservation of Plants by *Punya* Entisement

The social thinkers of the early medieval period along with the imposition of social and scriptural bans on destruction of the trees, plants and herbs of all kinds, also tried to create an air of eagerness for acquiring *punya* by means of doing new plantation of trees.

In the medieval environment acquisition of *punya* was a social compulsion.

The medieval writers inspired the people to plant new trees by giving them the hope of attaining happiness as result of acquiring *punya.*

In *Viṣṇu saṁhitā*[39] it is stated that trees sown by a man become his sons in the next world (XCI.3); the giver of a tree gladdens the gods with its flowers (X CI.4); the Atithis, with its fruits (X ci. 5), those with its shadow who chance to sit under it (X ci.6) ; and the pitrs with the rain water which tricles down from its leaves (Xic. 7). It further entises the people by saying that the offering of flowers to the God, adorns him with the boon of physical charm. The ultimate motive behind the propagation of such punya rituals might have been to inspire the people to protect and conserve plants. Probably the common people of the said period were not saicneitically conscious of the importance and significance of plants in nature's balance. The social thinkers of ancient India might have an idea to utilise the sentiment of the common people by developing a concept

of acquisition of puṇya and with this view in mind they probably proclaimed the act of planting trees as puṇya ritual.

In the *Tarumahimā* section of *Upavana vinoda*[34] there is a detailed account of acquisition of various grades of puṇyas by means of plantation, and a description of the glory of trees. These are : 1. (It is) better to have a tree (planted) by the wayside where many rest under its shade than to have many sons born who are devoid of wealth and virtue.

2. We read in the *śāstras* that (excavation of) a pond is equivalent (in virtues) to (sinking of) ten wells, a lake is equivalent to ten ponds, and a son is equivalent to ten such lakes and a tree is as good as ten sons.

3. He, who for pleasure makes him a good garden full of fruit and flower trees, is destined to go to the abode of *Śiva* and resides there for as many as three ages.

4. One should plant trees with full knowledge of these particular, in as much as, from trees proceed virtues, material prosperity, fulfilment of desires and salvation - all these four sovereign things.

5. A man is sure to reside in *vaikuṇṭha* (the abode of *Visnu*) for as many thousand years as there are Basil plants planted in his house.

6. *Lakṣmī* (the goddess of wealth) lives for generations in the house of a man who plants the vilva trees, peculiarly favourite with '*Śiva*'.

7. He, who plants *Aśvattha* trees after proper methods, no matter where, goes to the abode of *Viṣṇu*.

8. He, who plants the *Āmalaka* trees, reaps the fruit of constant asceticism, the giving of earth and of many sacrifices (*Yajña*).

9. He, who plants after a proper method two Banyan trees, goes to the abode of '*Śiva*, and is waited on by the seraphim.

10. The virtuous man who plants three *Nimba* trees attains to the abode of the sun and stays there for three thousand years.

11. There can be no doubt of the fact that the man who plants four *plakṣa* trees enjoy the fruits of a *Rājasūya* sacrifice.

12. He, who plants five *Āmra* trees by the wayside or in the garden, secures the salvation of fourteen generations past and future, backward and forward.

13. He, who plants six *Śirīsa* trees by the wayside, attains to the abode of *Garuḍa* and spends his days therein as much pleasure as the gods do.

14. The man who plants either seven or even one *Pataśa* tree, gets at the abode of *Brahma* and is waited upon there by the best of gods.

15. He, who plants eight *udumbara* trees himself or gets them planted by others, reaches the abode of the Moon and enjoy intensity of pleasure there.

16. He, who plants a *Madhūka* tree, becomes free from all diseases and by him all the gods, especially the goddess *Pārvati* is pleased or gratified.

17. He who plants a tree along with any of these trees ; *Kṣirika, Kadali, Drākṣā, Piyāla, Panasa*, etc. ensures himself against all diseases for seven lives (births) to come.

18. He, who plants a Jambū tree, either with knowledge or in ignorance, enjoys the fruits of virtue in his own house every day.

19. He, who plants trees capable of bearing fruits and flowers besides those that have already been mentioned enjoys the fruits of the gift of one thousand cows of gold.

20. He, who plants *Aśvattha*, pichumanda, Nyagrodha, one each, ten tamarind trees, and Kapittha, Vilva and *Āmalaka*, three each, and five mango trees, is never fated to see hell.

Thus, there is clear evidence of attempts of the social thinkers to inspire the people to take the act of planting trees to be a holy work and the performance of these, might have led them to the world of eternal happiness. Indians always believe in the existence of a life beyond death. By performing the puṇya rituals, they can knock the door of *Śiva loka* or *Viṣṇu loka* i.e. the abode of gods. The common people though dependent upon the supplies of nature, are not always conversant with the role of plant and trees in maintaining the ecological balance. They generally do not pay interest in the preservation/conservation of plants. So, attempts were made by the thinkers of ancient society to invent such means by which the ultimate

objective of protecting the green world could be acquired. A series of rules were laid down in *smrtis* and *purānas* in order to restrain people from wanton destruction of plants and trees.

Along with these penal measures mentioned above, the old thinkers tried to entise the people with the hope of eternal happiness of heavenly abode like Visnu loka or *Śiva loka* as a reward of planting of trees.

2.8. References

1 Randhawa, M.S. ; Singh, J. ; Dey, A.K. and Mittere, V. *Evolution of Life.* Publication and Information Directorate, Hilliside Road, New Delhi, 1969.

2 Deshpande, M.N. In IJHS V.6, No.1, 1971. 6.

3 Chowdhury, K.A. and Ghosh, S.S. *Plant remains from Hastinapur* 1950-1952. A.I. 10, 11, 121, 137, 1954, 1955.

4 Kosambi, D.D. *Introduction to the Study of Indian History*, Bombay, 1956.

5 Lal, B.B. *Essays in Indian Proto-History* (Ed. by D.P.Agarwal and D.K.Chakraborty). New Delhi, 1979.

6 Chattopadhyay, D.P., *History of Science and Technology in Ancient India - the Beginning*. Firma KLM Pvt. Ltd., Calcutta, 1986.

7 Allchin, B. and Allchin, R. *The Rise of Civilization in India and Pakistan*. New Delhi, 1983.

8 Marshall, J. *Mohenjadaro and the Indus Civilization* - being an official account of archaeological excavations carried out by the Govt. of India between the years 1922 and 1927, 3 volumes, London, 1931.

9 Mackay, E.J.H. In *Mohenjo-daro and Indus Civilization* (ed. by J. Marshall). Arthus Probsthain, London, Vol. I, p. 262, 1931.

10 Mughal, M.R. In *Possehl's Ancient Cities of the Indus*, New Delhi, 1979.

11 Wheeler, M. *The Indus Civilization, the Cambridge History of India - supplementary volume*. Cambridge University Press, Cambridge, 1960.

12 Wilson, H.H. *Ṛgveda* . english trans. 6 Vols. London, 1850.

13 Auboyer, J. *Daily Life in Anacient India* (from C. 200 B.C. to A.D. 700). English trans. by Taylor, S.W., Bombay, 1965.

14 Keith, A.B. *Tattirīya Saṁhitā* (English trans.). Harvard Oriental Series No. 18, 19, 1914.

15 Bloomfield, M. *Hymns of the Atharvaveda*. Oxford , 1897.

16 Weber, A. (Ed.) 1885, translated by Eggling. *Satapatha Brāhmana*. The Sacred Books of the East. Oxford, 1882-1900. Vols. XII, XXVI, XLI, XLIII, XLIV.

17 Majumdar, G.P. *The History of Botany and Allied Sciences* (Agriculture, Medicine, Arbori-Horticulture) *in Ancient India* (C. 2000 B.C. to 100 A.D.). AJHS, UNESCO, Paris, 1951.

18 Griffith, R.T.H. (English trans.) *Vājasaneyī Saṁhitā*. 1899.

19 Panini, *Aṣṭādhyāyī*.

20 Dutt, M.N. *Viṣṇupurāṇa* (English trans.) Calcutta, 1894.

21 Radhakrishnan, S. *Thirteen Principal Upanisads*, London, 1953.

22 Dutt, M.N. *Agnipurāṇa* (English trans). Calcutta, 1901.

23 Kangle, R.P. *The Kauṭiliya Arthaśāstra*, Part II. University of Bombay, 1972.

24 Shamasastry, R. *Arthaśāstra* (Eng. Trans.), 4th Edn., Mysore, 1951

25 Basak, R.G. *The Arthaśāstra of Kauṭilya* (with Beng. Trans.) Vol.I, Calcutta, 1964.

26 Sastri, S. and Bhat, M.R. (Eds. and trans.). *Bṛhatsaṁhitā*, 2 vols. Bangalore, 1947.

27Tarkaratna, P. and Bandopadhyay, M. (Bengali trans.). *Vātsyāyana's Kāmasūtra*. Sanskrit Pustak Bhandar, Calcutta, Bengali San 1398.

28 Sarkar, B.K. *The Śukranīti* (English trans.). Oriental Books Reprint Corporation, New Delhi, 1975.

29 Bose, R.M. *Abhijñāna Śakuntalam of Kālidāsa* (English trans.). Modern Book Agency Pvt. Ltd., Calcutta, 1963.

30 Colebrooke, H.T. *Amarakośa* (English trans.). Serampore, 1808.

31 Sircar, N.N. *An Introduction to the Vṛkṣāyurveda* of Parāśara. The Journal of the Royal Asiatic Society of Bengal, letters. Vo. 16, No. 1950.

32 Sen, U.N. and Sen, D.N. *Caraka* (Bengali trans.). Calcutta, Bengali San, 1316.

33 Sircar, D.C. The Kusanas. In *The History and Culture of the Indian People* ; Vol. II. *The Age of Imperial Unity*. (Ed. R.C.Majumdar) Bharatiya Vidya Bhavan, Bombay, p. 143, 1990.

34 Majumdar, G.P. *Upavana Vinoda/Śārangadhara* (ed. and trans.) Foreword by B.N.Seal. Indian Research Institute, Calcutta, 1935.

35 Majumdar, G.P. *Vanaspati - Plants and Plant Life as in Indian Treatises and Traditions.* Calcutta University, 1927.

36 Raychaudhuri, S.P. ; Gopal, L. and Subbarayappa, B.V. Agriculture. In *A Concise History of Science in India* (eds. D. M. Bose, S.N.Sen and B.V.Subbarayappa). Indian National Science Academy, New Delhi, 1971.

37 Mehendale, M.A. and Pusalker, A.D. Language and Literature : A. Sanskrit. In *The History and Culture of the Ancient Indian People,* Vol. V. *The Struggle for Empire* (Ed. R.C.Majumdar) Bharatiya Vidya Bhavan, Bombay, p. 328, 1989.

38 Max Muller, F. (ed.) translated by M. Buhler, *The Laws of Manu. In the Sacred Book of the East,* Vol. XXV. Motilal Banarasidass, Delhi, 1984 (First published by the Oxford University Press, 1886).

39 Dutt, M.N. *The Dharam'Sastra : Hindu Religious Codes,* Vol. IV. Cosmos Publication, New Delhi, 1908 (Reprinted 1979).

3. Domestication and Protection of Animals

Human beings have been co-existing with the beasts and birds since the beginning of human origin. During the period when human society from the hunting stage turned towards agricultural and pastoral life, the domestication of animals was also carried on. This could be feasible only when people became conversant with the habits and habitats of animals. The time sequence of domestication of wild animals during that period was goat and sheep at the first step, cattle and pigs at the second step followed by drought and transport animals like the horse, ass and llama.[1].

The earliest concrete evidence of familiarity with the animals in India is furnished by the haematite drawings(Fig.1) on the rocky walls of the Vindhya Hills in Mirzapur district of Uttar Pradesh.

The animal remains[2] excavated from the Indus site fall under three categories : domestic, semi-domestic and wild beasts.

The commonest domestic animals were the humped cattle, buffalo, sheep, goat and pig. The elephant and ass were quite familiar. Perhaps they did not know the use of horses and remains of horses are not found in the earlier stratifications. The horse became very much popular with the Aryan peoples. The animal remains excavated from the prehistoric sites give clear evidence of close association of the people with the animal world. The animal representations on pottery, seals, figurines and toy also give some idea about their extent of mental involvement with these living creatres (Figs. 2-5).

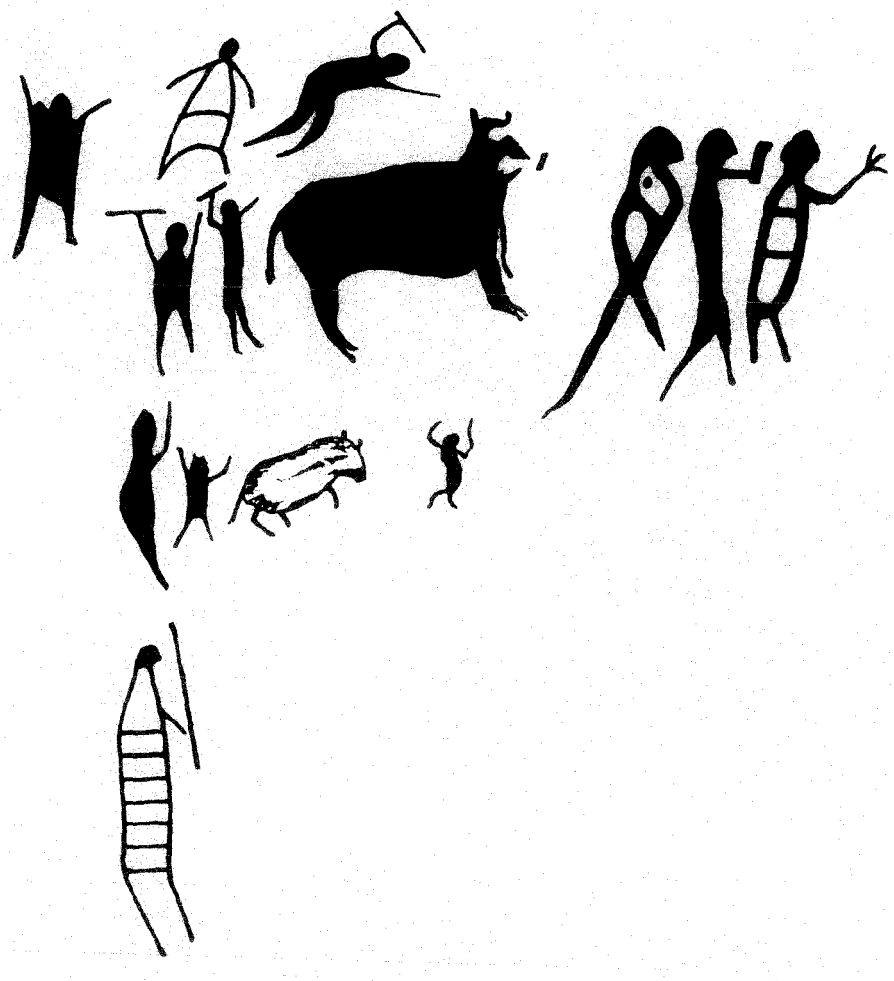


Fig. 1. Neolithic haematite drawings showing stag, boar and hunters (Adopted from 'ACHSI', INSA, New Delhi, 1971)

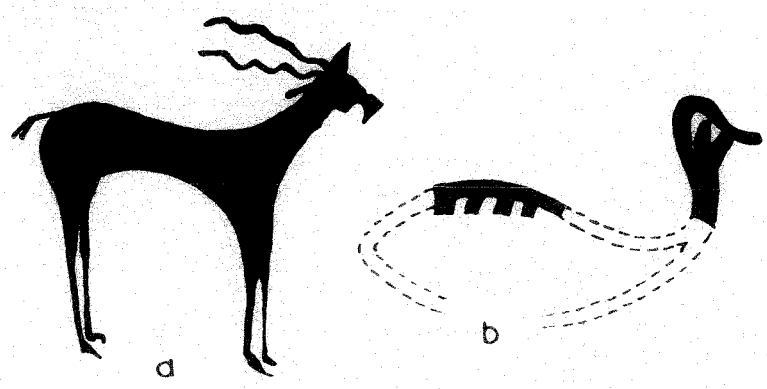
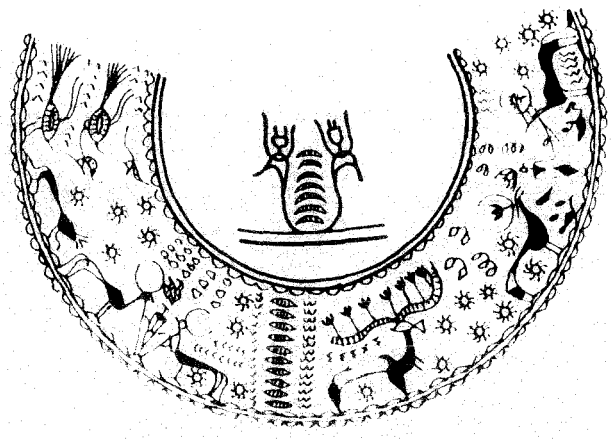
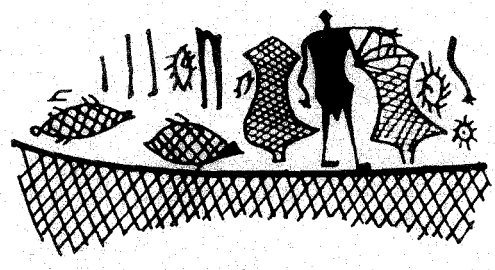


Fig. 2 Animal paintings on pottery of Kalibangan, Rajasthan (a) Blackbuck, (b) Duck (Adopted from 'ACHSI,' INSA, New Delhi, 1971).



a



b

Fig. 3. Sketch of animals on Harappa wares. (a) Peacock with other animals, (b) Fisherman with net and pole. (Adopted from 'ACHSI', INSA, New Delhi, 1971).

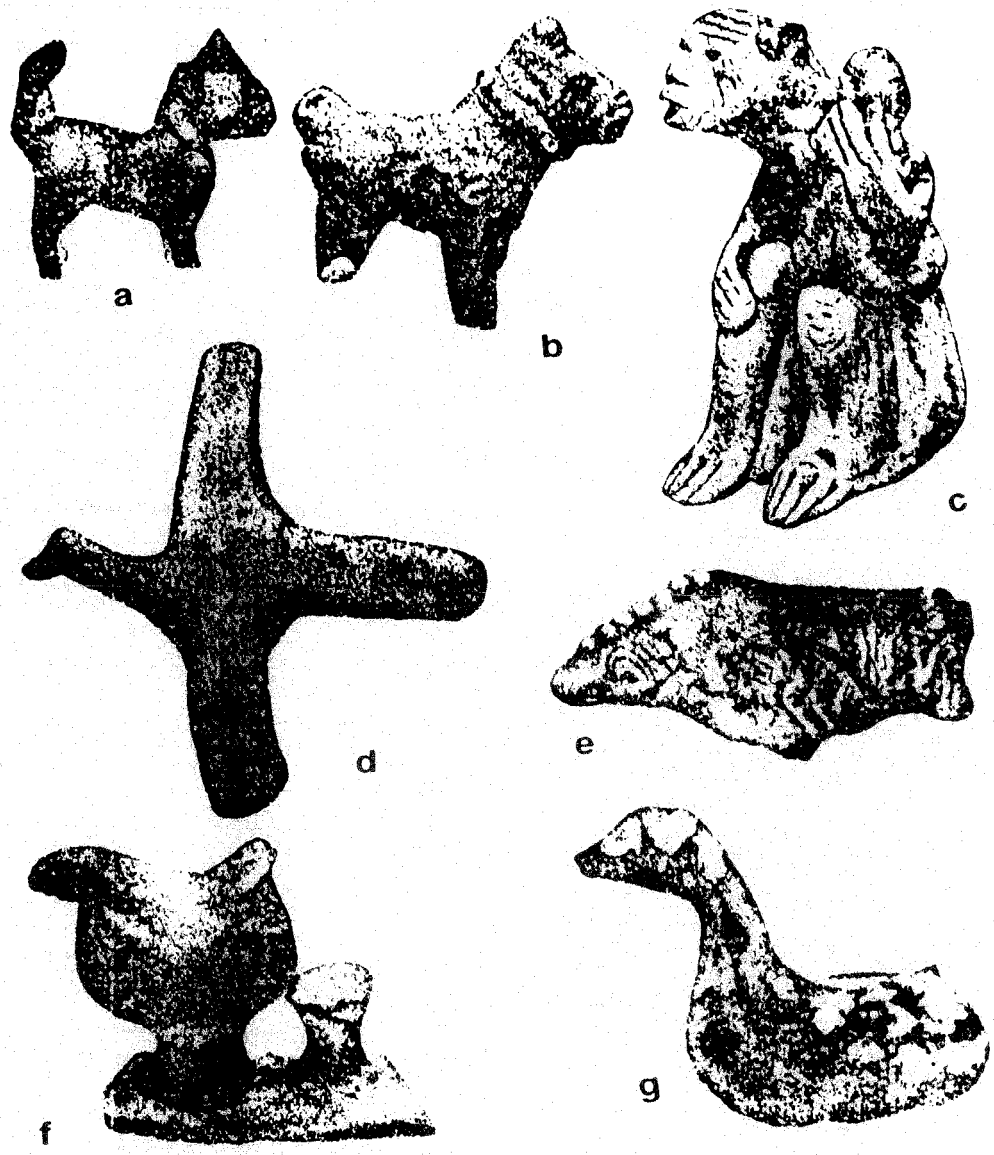


Fig.4. Animal representations of Mohenjodaro in the form of figurines and toy arts. a. dog, b. mastiff, c. monkey, d. dove, e. pig, f. domestic fowl, g. goose (Adopted from *ACHSI*, INSA, New Delhi, 1971).

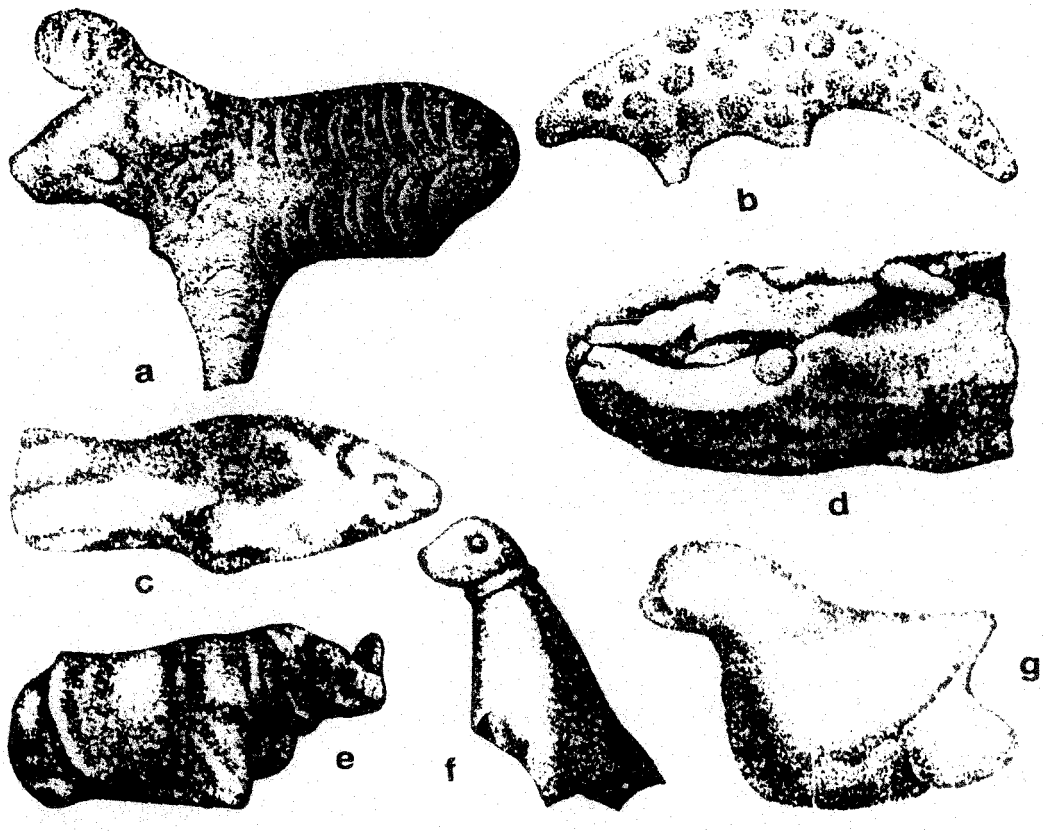


Fig. 5. Animal representations in the toy arts of Harappa. a. ram, b. pangolin, c. fish, d. crocodile, e. rhinoceros, f. parakeet, g. pigeon (Adopted from *ACHSI,* INSA, New Delhi, 1971).

Large number of seals with engravings of animals have been unearthed from Harappa and Mohenjodaro (Fig.6). Some of the animals depicted, appear to be mythical having fabulous external morphology, but others are vividly reproduced. Among the animals, the most popular animals regularly reproduced on seals are various types of bulls. The next popular one on the seal is elephant figure. Quite interesting is the non-representation of cows on the seals. But the regular presence of bulls on the seals proves beyond doubt the abundance of cows as a natural phenomenon. The accuracy and perfection of the Harappan artists in depicting the figures of animals stir our imagination and clearly indicate that the artists had a deep interest on and close acquaintance with the animals. Such perfection can be reached only by clear and close observation.

The definite evidence of fishing is furnished by the discovery of several fishhooks from these sites. The present climatic conditions in the Punjab and Sind are hardly congenial for the the type of beasts which were abundant in prehistoric times. The engraved figures of wild animals like elephant, tiger, rhinoceros bear eloquent testimony to the abundance of these animals in prehistoric times. This further, provide evidence in favour of the existence of thick forested area in that region. The huge amount of bricks used in Harappan sites also indicate the presence of wood tracts which also might have been the shelter of wild beasts including tiger, elephant, rhinoceros, or the buffalo.

One of the most celebrated finds from Mohenjodaro is a seal bearing the image of a horned three-faced male deity, seated in a yogic position and surrounded by the animals like, elephant, tiger, buffalo, rhinoceros and deer. This is evidently a prototype, of the great god Śhiva, the lord of the beasts (*Paśupati*) (Fig.7).

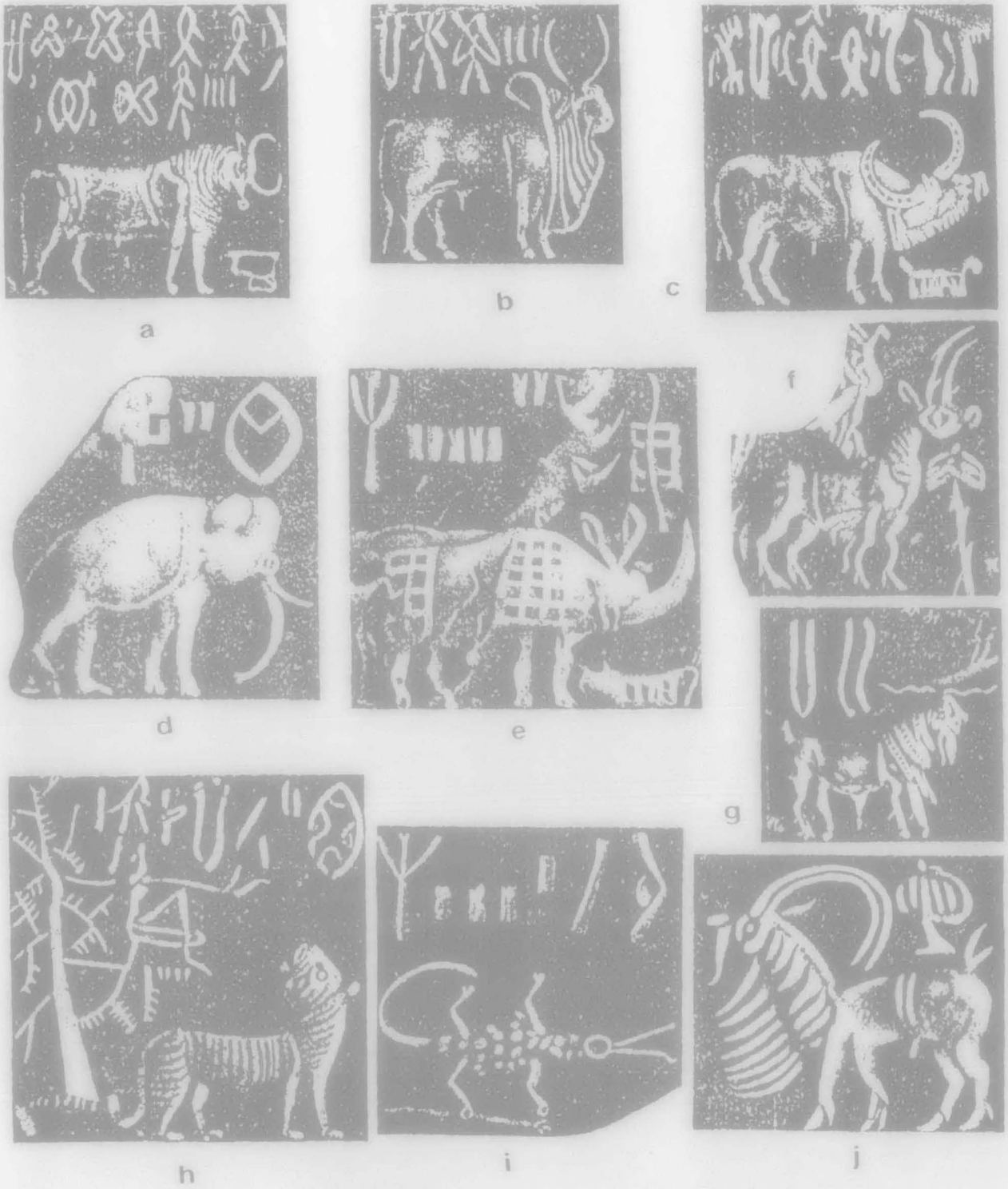


Fig.6. Animal representations on the seals of Mohenjodaro. a. a short horned bill, b. Indian humped bull, c. buffalow, d. elephant, e. rhinoceros, f. chinkara, g. domestic goat, h. tiger, i. gharial, j. wild goat (Adopted from *ACHSI*, INSA, New Delhi, 1971)

Fig.7. A Seal from Mohenjodaro bearing the image of a horned and three-faced male deity, surrounded by animals, appears to be a prototype of *Siva Pasupati* (Adopted from *The History and Culture of the Indian People,* Vol. I, Bharatiya Vidya Bhaban, Mumbai, 1991).

With the advent of the Aryans and the development of the vedic literature, prehistory passes into history in India. The *Rgveda*[3] is replete with references to beasts and birds.

In the *Atharvaveda*,[4] there is a hymn praying for the protection of cattle. The hymn states, " To the draft-oxen (do thou) first, to the milch kine (do thou) , O'Arundhati, to the non-milch cow, in order to vigour, to the four footed creatures do thou yield protection" (Atharvaveda, Book *VI*. 1.59) " No dust-raising horseman reaches them; nor unto the slaughter- house do they go, etc.".

There is further evidence in *Atharvaveda*[4] which indicates the efforts of man for maintaining good health of the cattle: " Rich in progeny, shining in good pasture, drinking clear waters at a good watering place - let not the thief master you, nor the evil plotter; let Rudra's weapon avoid you " (*Atharvaveda* IV. 7.21).

The Saṁhitās, the Brāhmanas, the *Āraṇyākas* and *Upaniṣads* contain several names of animals. In the Brāhmanas such as in *Śatapatha Brāhmana*[5] we find two broad classes of animals. That considerable zoological knowledge was possessed by the people of ancient India is attested by Pāṇini.

The two great medical works, the *Caraka Saṁhitā*[6] and *Śusruta Saṁhitā*[7] give an almost complete list of animals of various groups.

The Dharmasūtras[8] mention a number of beasts, birds and aquatic creatures. The value of accurate identification of animals was not unknown to the ancient Indian people. The nomenclature adopted by them, and their classification of the animals are adequate

testimony to the efforts in this direction. An important development during the ages of Buddha was the propagation of the creed of *ahiṁsā*. a reaction against the sacrifical ritual of the *Vedic Hidus*. In the hey day of Buddhism and Jainism these appears to have been a widespread perception of the need to moderate harvesting of plant and animal. " This extreme ethics of non-violence has had a pervasive influence on Indian society[9] " The moderate harvest of animals is equivalent to sustainable utilization for the maintenance of nature's balance. But more attention-drawing matter is the development of Āyurvedā as a comprehensive sciece of life. This branch of knowledge does not deal with the medical science merely for man, this also deals with the welfare and treatment of other living creatures. " A Knowledge of the level of veterinary science in ancient India is obtained from specialized and individual treatises dealing with cows, horses and elephants".[10]

3.1. Elephants

In ancient India elephants were constantly used for military purposes as well as for carrying loads. So the care of elephant became an important matter to the ancient people. *Hastyāyurveda* of *Pālākapya* and *Mātangalīlā* of Nīlkantha[12] are the two mentionable works in this branch of science.

The *Hastyāyurveda*[11] is written in prose and verse. It is probably compilation work. This work is divided into four sections:

(1) *Mahārogasthāna*, (2) *Kṣudrarogasthāna*, (3) *Śalyasthāna* and (4) *Uttarasthāna*.

In the first section, there is a discussion on the fatal diseases of elephants and their treatment for remedies.

In the second section, there is discussion regarding common disesases and their treatments. The section Śalyasthāna, deals with the surgical treatment of elephants. Finally, the last section deals with the food and drink of elephants.

The *Mātāngalīlā*[12] has twelve chapters. These chapters contain information about origin, good and bad signs, ascertainment of longevity, different stages of life and other informations about the elephants. The elephant was an inseparable part of military set up in the days of the Mauryas. There was a department exclusively for the elephants under the Maurya administration as evinced from the *Arthaśāstra*[13]. The Head of the Department was designated as Superintendent elehants. The Superintendent had a number of subordinate staff for looking after different matters relating to elephant supervision.

There were regular posts of physician, cook and stall-guard so that the elephants could get proper medical treatment, appropriately cooked food and sufficient protection.

There is categorical instruction for penalty in *Arthaśāstra*[13] in case of uncleanliness of the stall, non-receipt of fodder, making (elephants) sleep on bare ground, mounting by another person, riding at an improper time or on unsuitable land, leading down to water where there is no crossing and a thicket of trees (KA.II. 32. 19).

The guidance laid down for supervision of the elephants, appears to have a reflection of Indian mind bearing a deep feeling of affection for this animal.

3.2. Horses

The horse was the greatest comrade of manking and was used for many purpose. This animal was engaged in drawing the ploughs, carts and chariots. Horse was also used for hunting. In ancient India cavalry was the most important Division of military force. From the Arthaśāstra[13] we know that a notable government dignitary was the Superintendent of the horses. The Superintendent had to maintain a register of total number of horses and to keep information about their pedigree, age, colour, marks, class and source. He had to know about the diseased horses.(KA.II.30.1.2).

The stable was to be constructed in such a way that proper hygienic condition could be maintained. It is said that "he should cause a stall for each horse to be built, square with the length of a horse, with a flooring of smooth planks, with a receptacle for fodder, with outlets for urine and dung (and) facing the east or the north (KA.II.30.5). The superintendent also had take proper care of the mare after her delivery. For a mare that has borne a foal, a drink of a *prastha* of *ghee* (shall be provided) for three nights. After that, a *prastha* of barley-meal and an invigorating drink of fat and medicines (shall be given) for ten nights. Thereafter, half-cooked barley of beans, green fodder and a diet according to the seasons (shall be given)" (KA.II.30.8-10).

A foal in its infancy should get proper diet and grow under strict supervision. " After ten nights (from birth) a foal should have a diet

fo one *kuduba* barley-meal, *ghee* one quarter and a *s* of milk, till it is six months old.

After that (it should be given) a *prastha* of barley, increased by a half (of a *prastha*) every month, till it is three years old, (then) a *drona* (of barley) till it is four years old. After that, when four or five year old, being full developed, it is fit for work". (KA.II.30. 11-13)

The above mentioned references indicate the importance of horses in a statecraft as well as the government's duty, assigned to the concerned office for the welfare of this animal.

The horses which lost their fitness due to diseases and old age or during a war, were not totally rejected. They were used for breeding with the mares of common people of the country. Even if the horses were declared unfit for war, provision was there to give food for their maintenance (KA.II.30.27). A good number of manpower was employed under the superintendent only to look after the horses. This strength of number porvide clear evidence that utmost care was taken for maintaining the health of this animal. There were probably skill-based division of labour among the employees such as holder of reins, the binder of horses, the fodder-giver, the food-cook, the stall-guard, the hair-trimmer and the specialist in poison cure. (KA.II. 30. 4.).

A stringent punitive provision has been prescribed in the *Arthaśāstra* that in case of a worsening of the disease because of withholding treatment or medicine, a fine shall be double the (cost of) cure. The rules for attendance on the horses were equally applicable to the cattle, donkeys, camels, buffaloes, goats, and sheep

(KA.II.30.49). It is no wonder that horse was highly needed animal and treatises were written dealing with both breeding and signs of horses as well as disease and the treatment of horses. In the *Hitopadeś* there is a mention of treating the burning wound of horses with the fat of monkey. The *Saṁhitā* of *Śālihotra*,[14] an ancient and famous treatise, has dealt exclusively with the horses, the extract of which are found in the *Agnipurāṇa*[15]. It is also held by some that in the twelfth century it was redacted by Kālhana under the title' *Śālihotrasārasamuccaya*[16].

Other important compilation of this work is *Aśvavaidyaka* by Jayadattasuri[14]. The *Asvaśāstra* is attributed to Nakula one of the five Pandavas of the *Mahābhārata*[17]. That it is a compilation and not an original work is mentioned in the composition itself. " It seems that the author with a view to imarting a halo of authoritativeness and antiquity, associated the work with the name of the well known Pandava whom legend makes a physician of horses".[19] Nakula's work deals with the knowledge of equine anatomy and contains pictures of twenty one horses of different varieties.

The *Aśvavaidyaka* is large volume of sixty eight chapters. The text was written after the thirteenth or even the fifteenth century A. D.

Along with many topics on horses, this text deals with the diseases and medicine of horses. Of the diseases mentioned in it, some are *vrana* (scar), *Śula* (pain), *kustha* (leprosy), *sotha* (dropsy), *Arśa* (piles) and *unmāda* (insanity). Of the various plants mentioned as curing the diseases of horses, the important and well-known ones are : *aguru, ahiphena, āmlaka, apamarga, arjuna, atasi, dhattura, erānda, guggulu, haritaki, hingu, kantakāri, karavira,*

kulattha, lasuna, nimba, patala, pippali, rasona, saptapatra, tulasi and *udumbara.*

In *Śukranīti* it is said, the man who knows of the feeling of horses and can discover and distinguish their qualities by studying their species, colour and movements, who knows to guide, train and treat them and is aware of their mettle, spirit, and diseases, who knows what is good and what is bad nourishment for them, who knows of their weight, their capacity for bearing weights, their teeth and their age, who besides is volourous, adept in military parades and is wise, should be appointed as Superintendentship of horses (Su, II. 260-263).

Thus, it is evident that the horses or elephants were regarded with high esteem and treated with sympathetic touch. One may argue that as the elephants and horses were indispensible part of military set-up, and the authority had to depend always on Cavalry and Elephant forces, they used to give proper attention to these animals.

In *Arthaśāstra*[13] this is cleary mentioned that the rules for attendance on horses would be equally applicable to the cattle donkeys, camels, buffaloes and goats and sheep. Almost the same view is noticed in the *Śukranīti* : " those men are to be masters of goat, sheep, cows, buffaloes, deer etc., who have love for these animals (Śu.II. 297-98). From these references an idea can be formed about the attitude and perception of the ancient Indian people towards the animal kingdom particularly towards the domesticated animals.

The compassionate attitude toward the living creatures of all kinds which developed in India through the ages can hardly be

explained only by utilitarian philosophy. It emerged as the result of India's age long cultural tradition of tolerance and affection for all living creatures.

3.3. *Animal Husbandry*

In ancient India a good deal of attention was paid to animal husbandry which included breeding, feeding, treatment and rearing of domestic animals.

The *Kṛṣiparāśara*[21] contains a number of rules of tending the cattle. *Kṛṣiparāśara* also gives directions as to how the shed could be kept clean (Kṛ. 89-92). According to this composition, a shed measuring five by five (?) is good for the healthy growth of cattle and the washing of rice, hot scum of the boiled rice, fish broth, cotton seeds and husk, if kept in the cowshed prove baneful to the cattle Breaking out of diseases is an obvious fact in the life of the cattle. The people of ancient period tried to safeguard the animals from these calamities by arresting the spreading of infectious diseases. In *Agnipurāṇa*[15] specific instruction for this purpose has been given. " To safeguard against the breaking out of diseases, the shed should be occasionally fumigated with vapours to *devadāru, vacā, mamsi, guggulu, hing* and mustard seeds mixed together. *Balapradā Biṣāṇāṁ Syādgrahanāśāya dhūpakah devadāru vacā mamsi guggulurhingusarsapāh grahādigadanāśāya eṣa dhūpo gavāṁ hitaḥ.* (Agni. 292.33) The use of *dhup* and *guggulu* is still in practice in our country. A considerable portion of country people believes in the germicidal efficacy of *dhup* and *guggulu* still today.

Alongwith many topics *Agnipurāṇa*[15] deals with the diseases and treatment of cows, horses and elephants. For horn diseases of

cows boiled *śṛngabera*, *balā* and *māṁsakalka* and *samākṣik* oil together, mixed with *saindhava* is prescribed for application (Agni, 292.23) Certain medical treatments have been prescribed for diseases of ear, tooth, mouth, tongue, neck, heart, rheumatism, tuberculosis, digestive disorder and different types of sores and cough (Agni, 292.24-31). In case of fracture of bone the use of *priyangu* mixed with salt is recommended (*dātabyabhagnasandhāne priyaṅgurlavaṅanvitā tailaṁ bātaharaṁ pitte madhu-yaṣṭi bipācitaṁ*, Agni. 292. 24-31).

Certain medical treatments have been advised for diseases of elephants and horses in *Agnipurāṇa*[15] (chap. 287, 288, 289).

The *Viṣṇudharmottarapurāṇa*[16] describes certain medical practices of treating the diseased cattle for curing their affected horn, ear, eyes, tooth, tongue, throat, bilious disorders etc. (Vi 2, 43. 1-27). The oil in which ginger, bata and *jatāmāṁśi* have been fried and rock salt and honey mixed should be applied to the diseased horn. The powder of the roots of wood-apple tree, *apāmārga*, *dhātakī*, *paṭala* and *kuṭaja* removes toothache. The same treatment as in *Agnipurāṇa* has been advised in *Viṣṇudharmottarapurāṇa* for the fracture of bones.

The above references abundantly prove that the people of ancient India could easily visualise the necessity of developing a system of medical treatments for all living creatures other than man. The realisation that the animal kingdom is an inseparable component of the living world and the animals play no less role in maintaining the nature's balance has its root in the ancient antiquity. The world of beasts and animals received considerable attention from the state authority also. The textual references to the practice of medical

treatment of man as well as of animal is corroborated by inscriptional evidence also. The great Emperor Aśoka with a view to doing welfare to his people and also to the animals, issued the famous Edict of Dhauli.

This Edict of the third century B. C. from Dhauli goes as : " The king with charming appearance, the beloved of the gods, in his conquered territories and in the neighouring countries thus enjoins that: medical attendance should be made available to both man and animal; the medicinal herbs, the fruit trees, the roots and tubers, are to be transplanted in these places where they are not presently available, after being collected from those places where they usually grow; wells should be dug and shadowy trees should be planted by the roadside for enjoyment both by man and animal "[22].

What a serene attitude towards all living creatures by the Saint Emperor of India ! This is that great message of India in which human being and other living creatures are standing on the same foofing as the two relative parts of a body. This simultaneous efforts for the well - being of the people and the non-human living beings bring forth to the present world, what a strong compassionate feeling the Indians had developed for the animals and how much their feeling had been active in shaping the thought process of the ancient people of India. Here Barua's[23] observation is mentionable. The arrangements made by Aśoka for two kinds of medical treatments(dve chīkichhā katā, Rock Edict II), one for men and the other for animals(manuṣa chikīchhā cha paśu-chīkichhā, R.E.II), both within his empire and outside, warrants that there must have been a regular medical department organised for the purpose with expert physicians and veterinary surgeons as imperial officers to advise him. For making such arrangements in the allied territories outsides his empire, the agency

of the Dūtas was needed. If it was so, the *Dūtas* had not only heralded religious mission but medical and hmanitarian as well. Such works can be described in Aśoka's language as 'monumental acts of piety'[23].

3.4. Penal Measures and Scriptural Injunctions for Protection of Animals

The animals were looked upon with high esteem and value in the ancient Indian society. They came to be regarded so important that a serious attempt was made by introducing penal measures against any cruel attempts on their life in the ancient texts.

In *Arthaśāstra*[13] specific penalty has been prescribed for causing injury ot animal. " For causing hurt to small animals with wood and other thing the fine shall be one *paṇa* or two *paṇas*, double that for causing bleeding. For these same offences concerning big animals, the fine shall be double and (payment of) expenses for treatment and cure". (KA.III, 19.26.27)

There is mention of an important post of supervisor to look after the slaughter of animals. He had to impose fine of twenty six paṇas and three quarter for killing or injuring fish and birds. Besides, there are provisions of other punishments for doing harm to the animals.

The supervisor of animal slaughter was to look after the sale of meat, " the calf, the bull and the milch cow among these (animals) are not to be killed. For one killing (them, there shall be) a fine of fifty *paṇas* also for (one) torturing (them) to death" (KA. II, 26. 10. 11).

Manu also suggests penal measures for injuring animals. He says, " if a blow is struck against men or animals in order to (give them) pain, (the judge) shall inflict a fine in propartion to the amount of pain (caused) " (MS. VIII, 286).[24] Here, giving pain to an animal is equated with the offence of giving pain to a human being. " For injuring small cattle the fine shall be two hundred *panas*, the fine for beautiful wild quadrupeds and birds shall amount to fifty *panas*" MS. (VIII, 297). " For donkeys, sheep and goat, the fine shall be five *mashās*; but the punishment for killing a dog or a pig shall be one *mashā*" (MS. VIII, 298).

Sometimes social thinkers tried to restrain the people from injuring or killing animals by imposing fearful provisions of degradation from one's own caste. It is said by Manu that :" killing a donkey, a house a camel, a deer, an elephant, a goat, a sheep, a fish, a snake or a buffalo, must be known to degrade (the offender) to mixed caste (*Samkari Karana*)" (MS. XI, 69).

In Visnu *Samhita*,[25] much more strict punishment is prescribed. " The slayer of an elephant, horse, or a camel shall have one hand and one foot cut off" (VS. V. 47). The slayer of any domesticated animal shall be fined a hundred *karsapanas*" (VS. V. 49) " The killer of birds and fishes shall be fined ten karsapanas" (VS. V. 52).

Even the small creatures like worms also did not escape their notice. " The killer of worms are to be fined one *karsapana*" (VS. V. 53). Physical torture on beasts was also regarded as serious crime. " If one cuts an organ of a beast, he is to be fined with hundred *panas*(VS. V. 117).

In Viṣṇu *Saṁhitā*,[25] for expiation of the sin of killing beasts, some penances have been advised. "For killing an elephant, one shall make a gift of five Nila bulls, a gift of cloth for killing a horse; a one year-old bullock after having killed an ass, or a lamb, or a goat" (VS. L. 24-28). " A krishnalam weigth of gold should be gifted away for the expiation of the sin of killing a camel. Having killed a dog, one shall fast for three days. Having killed any of these animals, such as a mouse, a cat, an ichneumon, a frog, a *dundubha* snake, or an *ajagara*, one shall fast and feed a *Brāhmaṇa* with *Krishāru* and make the gift of an iron rod. Having killed a lizard, an owl, a crow, or a fish, one shall fast for three days" (VS. L. 29-31).

Having killed any of these animals such as a swan, a heron, a crane, a madgu, a monkey, a hawk, a bhāśa or a cakravāka, one shall make the gift of a cow to a *Brāhmaṇa*. Having killed a snake, one shall make the gift of an *abhri* (a digging implement). For killing a boar, a pitcher of a clarified butter; and for a patridge a *droṇa* of sesame were to be given for expiations. If one kills a parrot, a two years-old bullock was to be given as gift and a three years old bullok for killing a *Kraunca*. For killing a carnivorous beast, a milch-cow was to be gifted as expiatory measure. A killer of herbivorous animal shall give a female calf" (VS. L. 34-41). Fasting is also prescribed for killing water-frequenting animals.

All kinds of creatures were to be given protection, according to the *smṛti* and *puranic* texts. In *Agnipurṇa*, for injuring or killing beasts, punishment is specified as

" *duḥkhe ca śoṇitotpāde śākhāṅgacchedane tathā daṇḍaḥ kṣudra paśūnāṁ syāddvipaṇa prabhṛti kramāt|| lingasya cchedane mṛtyou madhyamo mūlyameva ca /mahāpaśūnāmeteṣu sthāneṣu dviguṇādamāḥ* (Agni. 258.23, 24)

In case of physical torture of the small beasts, the fine shall be two *paṇas*; if they bleed, the fine shall be four *paṇas* and in case of cutting their limbs, the offender is to pay six *paṇas* as fine. If the genital organs are cut off and tortured to death, the penalty is madhyamasāhasadaṇḍa. Moreover, the owner of the animal would have to be compensated.The fine would be double in case of the same offence done to the big animals like cow, horse and elephants.

The school of Kāmandaka[26] outrightly rejected the practice of hunting and declared it to be a great *vyasana* for the common people (KM. 26). The king is advised not to deviate from the rules for hunting and to take it as merely a sport, not as addiction (KM. 41 and 42).

Śukrācharya[20] though accepted the advantages of hunting, still denounced it for cruelty (Su. 667-669; III, 312).

The religious phohibition and scriptural injunctions of the Hindus created an environment of strong disgust of the common people for eating all sorts of flesh. The extreme ethics of non violence as preached by Buddha and Mahāvīra has had a pervasive influence on the ancient Indian society. This led to the complete ban on the slaughter of cattle in sacrifical rituals. In course of time a strong religious sentiment developed for the cow and hence also a strong religious taboo against beef-eating. The religious reverence for the cows and the injunctions against killing of animals created immense problem for the physician in recommending specific flesh for particular ailment of patients. The revulsion deep-rooted for some sorts of flesh was so acute that the physicians had to contrive by way of prescribing the needful flesh in disguise of generally acceptable one[27].

Most of the prescribed fleshes in ailments belonged to carnivorous birds and mammals. The large herbivores like elephant, rhinoceros and horse were also recommended for medical purpose. The most of the birds are well recognised scavengers, keeping the environment clean. The top carnivorus mammals maintain the natures balance by suppressing the overgrowth of herbivorous population. It will not be holly unjustified if one claims that ancient Indians generated a feeling of apathy among the people for killing these eco-friendly animals as mentioned in *Caraka Saṁhitā*[6]. (CS. 27, 35-37).

3.5. References

1 Randhawa, M.S.; Singh, J.; Dey, A. K. and Mittre V. *Evolution of Life*, Publications and Information Directorate, New Delhi, 1969.

2 Bhaduri, J. L.; Tiwari, K. K. and Biswas, B. *Zoology*. In '*A Concise History of Science in India* (eds. D. M. Bose, S. N. Sen and B. Subbayappa) Indian National Science Academy, New Delhi, 1971.

3 Wilson, H. H. *Ṛgveda* (Eng. Trans.) 6 Vols, London, 1850.

4 Bloom field, M. *Hymns of the Atharvaveda*. Oxford, 1897.

5 Weber (Ed) 1885, Trans. by Eggling. *Satapatha Brāhmaṇa. The Sacred Books of the East*. Oxford, 1882 - 1900. XII, XVI, XLI, XL3, XL4.

6 Sen, U. N. and Sen, D. N. " *Charaka* " (Beng trans.) Calcutta, Bengali San 1316.

7 Bishagratna, K. L. *Suśruta* (Eng. Trans.) 2 vols, Calcutta 1911.

8 Apte, V. M. Social *In the Grihya Sūtras*, The popular Book Depot, Bombay, 1954.

9 Gadgil, M. and Guha R. *This Fissured Land : An Ecological History of India*, Oxford University press, New Delhi 1993.

10 Majumdar R. C. *Medicine. In " A concise History of Science in India:* INSA, New Delhi, 1971.

11 Sarma, S. *Hastyāyarveda of Palakapya*. An Anandasram Sanskrit Series, No 26. poone 1894.

12 Sastri, G. Nil Kantha, (Ed) ' *Mātangalīla Trivandrum*' 1910.

13 Kangle, R. P. " *The Kauṭiliya Arthaśāstra part II*. University of Bombay 1972.

14 Gupta, U. C. (Ed) " *Aśvavaidyaka of Jayadatta Surī*" Asiati Society, Calcutta 1887.

15 Dutta, M. N. *Agnipurāṇa* (Eng. Trans.) Calcutta 1901.

16 Sen, Gananath, *Āyuarveda Paricaya*, (in Bengali) Visvaβharati Granthalaya, Calcutta, 1944.

17 Gopalan, S. *Aśvaśāstra of Nakula.* Madras Government Oriental Service, No. 57, Tanjore, 1952.

18 Sen, Satyandranath, Halder, Gopal and Adu, Sri Keshab. *Kasiram Das Birochita Mahābharata*, (in Bengali), Saksharata Prakashan, Calcutta 1976.

19 Banerjee, Suresh Chandra. *Flora and Fauna in Sanskrit Literature*, Naya Prokash, Calcutta, 1980.

20 Sarkar, B. K. " *The Śukranīti* (Eng. Trans.), Oriental Books Peprint Corporation, New Delhi, 1975.

21 Majumdar, G. P. and Banerjee, S.C. *Kṛṣiparāśara*, Asiatic Society, Calcutta, 1960.

22 Shah, Priyabal (Ed) *Viṣṇudharmottara Purāṇa*, Gaekwad's Oriental Services, No 130, Baroda 1958.

23 Barua, B. M. *Aśoka and His Inscriptions: part I and II*, New Age Publishers Ltd. Calcutta, 1946.

24 Max Muller, F.(Ed.) translated by M. Buhler, *The Laws of Manu.* In *The Sacred Book of the East*, Vol. XXV. Motilal Banarasidass, Delhi, 1984 (First published by the Oxford university press, 1886)

25 Dutta, M. N. *The Dharam Śāstra : Hindu Religious Codes*, Vol IV, Cosmos Publication, New Delhi, 1979.

26 Mitra, R. L. (Ed). '*The Nītisāra or The Elements of polity by Kāmandaki.* Fascicules, Calcutta, 1847.

27 Chattopadhyaya, *D. P. Science and Society in Ancient India*, Research India publication, Calcutta, 1979.

4. PROTECTION OF FOREST IN ANCIENT INDIA

4.1. The Beginning of Deforestation

With the introduction of agriculture in the Neolithic period, man began to exercise considerable influence on the plant life in India as elsewhere. With the growing population and increasing demand on the forests for a clearance of land for cultivation, for smelting copper and later on iron, for baking bricks and pottery, a tremendous destructive influnce in addition to climatic and edaphic changes, reduced the indigenous forests to a great extent. The flourishing vegetation in Rajasthan and Sind was replaced by a desert about a couple of thousand years ago[1]. Excepting Rajasthan, no portion of India seems to have suffered from aridity or barrenness, Being situated within monsoon belt, almost all portions of this subcontinent could get sufficient rainfall which provided condition for the vigourous growth of forests.

The history of forests in India like any other country in the world is one of deforestation. There are many natural causes for the destruction of large tracts of forests. Mention may be made to volcanic action of great intensity, flood, fire and also to the meteoric showers[2].

But man's responsibility for the destruction of forests is the greatest. From the starting mark of human civilization, man had to depend on the supplies of nature. For pastoral and agricultural land he had to clear off the jungles and trees. He had to cut down the trees for constructing houses and for gathering fuels. With the passage of time he came to learn how to use plants, herbs and the roots of some trees as drugs for curing various diseases.

The agricultural pastoral people spread over the Indian subcontinent in many phases. With the settlement of the Chalcolithic people the systematic destruction of forest in India started. The Indus civilization extended over a vast area. In 1983 the Allchins give an approximate measurement of the area : " the area enclosed by a line joining the outer-most sites at which the material culture of this civlization has been discovered is little less than half a million square miles, considerably larger than modern Pakistan".[3] Obviously, for such a settlement the Indus people had to wipe out forest tracts for acquiring land and bulding up the towns. The present climatic conditions in the Punjab and Sind are not suitable for the type of fauna that this tract supported in pre-historic times. The picture of wild life of pre-historic India built up from the archaeological remains indicates the presence of large stretches of thick forest areas on which thrived a large variety of wild animals including the tiger, the elephant, the rhinoceros and the buffalo.

4.1.1. Advent of the Aryans and Introduction of Iron

The knowledge of metal, especially the introduction of iron, opened a new chapter in the history deforestation in India. Possibly the Ṛgvedic Aryans did not know the use of irons. The general term used for the metal is *ayas*. Probably the word '*ayas*' began to mean iron later. On the basis of the available archaeological evidences a view is coming to the fore that iron was introduced into India by about 1000-800 B. C.[4] The discovery of iron which in many areas led to the colonisation of the forested land by agricultural people made easy the continued felling of big trees in forests. The Aryans with their knowledge and mastery of iron and improved technical know how started a steady process of deforestation towards the east as far as the Gangetic valley..

This is not certain, when the Aryans first came to north - west India or the land of seven rivers or ' Sapta Sindhavas' as it is called in the Rgveda. But their occupation of the country must have taken place at least as early as 1400 B.C.[5] It seems that the new comers at first fixed up their abode in the punjab but before the close of the Ṛgvedic period, they had spread over the vast expanse of Indian territory.

The Aryans were partly pastoral and partly agricultural people. Naturally they required land for pastoral as well as agricultural purposes. This land could be obtained only by clearing up the jungles. With the march of agriculture and village settlement, a significant portion of forested land began to be converted into grassland or crop fields. Fire, stone axes and metal axes aided in this process of conversion. The burning of the 'Khāndava' forest as depicted in the Mahābhārata Ādiparva beautifully illustrates the destruction of forests by fire.[6] Cultivation imposed increasing demands on natural vegetation and a greater removal of forest produce to be used as fuel, fodder, manure, building-timber and implements. But in this connection it is noteworthy that the Aryans did not destruct forest for building towns and cities in the early phase of their civilization.

After the decline of the ' First urbanisation ' of Harappan culture, India had to pass through a long period of no remarkable building activity. Ghosh[7] has very aptly made his obsrervation. " For her next cities, her 'second urbanization" India had to wait for over a thousand years after the disappearance of the Indus cities - till the middle of the sixth century B. C., which saw simultaneously the beginnings of her historical period".

In fact, after the end of the first urbanisation, it took a period of about a thousand years or more for the reintroduction of urban settlement. This intervening period betweeen the two urbanisations is often called by the archaeologists as the Dark Age.[8]

During this intervening period, the Aryans developed human civilisation in sylvan sorroundings.

Their first settlement was flourished in the river banks and in the process of extension of their settlements the Aryans had to create open spaces inside the forests. As they avoided building construction, large scale destruction of trees was not needed alike in this period; still deforestation contineued for laying out villages for human habitation. The Aryan people used chariot made of wood, they lived in thatched cottages for which wood was indispensible material. This is not all. For communication of villages with each other, suitable paths were to be made for passing their carts and chariots. For this purpose, clearing up of extensive forest tracts were carried on. With the extension of human settlement the depletion of forest continued for creating fresh fields and pastures anew.

So, we find that from the dawn of history human community has been surviving and thriving at the cost of forest welth and this led to the depletion of vast tracts of forests throughout the ages.

4.2 Emergence of Different Professional Castes Based on Forest Produts

From the paliwork Dhammapāda[2] we get the name of some professional castes of ancient India who depended entirely on the

forest products for their subsistence. These castes were '*Nalakāras* (manufactures) of bastets and matresses),' *Usukāras* (Manufactures of arrows) *Cammakāras* (leather workers), *Tacchakas* (carpenters), *Pāśikas* and *Niṣādas* (the trappers and the hunters), and the ' *Dantakāras*' (ivory workers).

In the Jātakas,[9] the collection of timber and fire wood, medicinal plants, and herbs and the profession of carpentry are mentioned. Carpentry depended on the timber-supply from forests (J.T. 25 and 81). The transport of cart-load of logs (JT. 116 and 139) suggests a heavy demand for wood both for house - building and fuel (J. T. , 288 snf 305). The items of furniture mentioned in the tales indicate heavy demand on wood. Stick gathering (JT. 8) faggot-bearing (JT. 9) and bird-snaring (JT. 236) were also forest-based occupations.

Another forest-based profession was wicker work. A considerable number of people were living on basket making with bamboos of forest belt. (JT. 222) and osiers of swampy area (JT 48 and 98).

The skins and hides of animals were used. Apart from skins of domestic animals, the tiger skin, panther hide and deer skin were used (JT. 28, 32 and 232).

So, from various references, there is hardly any scope to deny the fact that man's role in this endeavour is that of a predator.

Some vedic and pali works throw some light on the professions of the forest dwellers.

Among such tribes may be mentioned Goat clam, Fish-clan, Horse radish clan, the Serpent clan, Bird clan, Lambakarnas[2] etc.

In later days i.e., in the age of Kauṭilya.[10] We get references to the forest people like Trappers, Śabaras, Pulindas, Caṇḍālas and other forest dwellers. These people were utilised as guards in the frontier region (KA. 11.1.6), During this period, these forest dwellers and the people who entirely depended on forest produces like yarn, bamboo, leather etc. and belonged to the lowest strata of the society were gradually being integrated functionally to the four-varna structure of the Aryan society. That these people were assigned with certain portion of land for quarter within the city area though beyond the stables of animals is evident from te *Arthaśāstra* (KA. 11. 4. 12). But still, the pāṣandas and the caṇḍālas were not allowed to reside even in these areas. Their quarters were fixed on the outskirts of the cremation ground (KA. 11.4.23)

However, there is not tint of doubt that the people who thrived entirely on the products of nature must have developed a cultural tradition and belief system of their own, favourable for conservation of nature.

4.3. Spirit of Enquiry

As because the plants and animals constituted the intimate associates of ancient people in India, a spirit of enquiry very likely grew among them as to the effect of trees and plants growing near their dwelling places. It is evident from the vedic works that the Aryans were careful observers of flora and fauna of this nearly acquired territory. In the vedic literature, we find a large numbers of terms

used for describing the different parts of plant body. To utilize the forest resources in best possible ways the Aryans classifed not only the trees, keeping in view their general usefulness but also their medicinal properties. In the Ṛgveda,[11] the trees have been classified as *Phalini* (bearing fruits), *aphalā* (not bearing fruits), 'apuṣpā' (devoid of flowers) and *puṣpini* (having flowers). In the same Veda the plant kingdom has been divided into Vṛkṣa (tree), gulma (shrub), bheṣaja (medicine) and lalā (creeper), Oṣadhi is also a vedic term for a class of tree (Ṛgv. x. 97.15). [10]

Manu's classification of plants is very clear (MS 1,46,47,48).[12] These are : Oṣadhis, Vanaspatis, Vṛkṣas, Guccha, Gulams, Tṛṇas, Pratānsnas, Vallīs.

Carakas[13] classifications run thus : Vanaspati vānaspatyas, oṣadhis, virudha (sutrasthana1, 36, 37).

The scientific spirit of enquiry about the plant kingdom inspired the people to discover that plants and trees are animate beings. The height of knowledge on the life of plants acquired by the aryans attained to such an extent that evern there is indication in the hymns of the *Ṛgveda* that the vedic Indians had some knowledge of the manufacture of food, the action of light on the process and storage of energy in the body of the plants - a great achievement indeed for our ancestors at that remote age.[14]

In this connection, it is reasonable to believe that the Aryans might have acquired some knowledge regarding Indian plants from the aboriginal forest tribes. The totemistic clans of the Ganges valley who were forest dwellers should not be deprived of their credit for

contribution to the study of nature in that most ancient age. The tribes had adapted themselves culturally to their biological and physical environment having learned by trial and error what to eat and what to avoid, and how to make prudent use of natural resources. Such dwellers naturally, are expected to have developed a cultural tradition of their own. This traditional knowledge and culture enriched the main stream of study of nature subsequently.

The vedic Indians introduced four stages of life. The system of *vānaprastha* and *Sanyāsa* i.e. the third and fourth *āśramas* which were practised by the Brāhmaṇas undoubtedly helped them in acquiring knowledge of the Indian flora and fauna. In these two āśramas a Brāhmaṇa had to live in a cottage built within or near the forest. Some Brāhmaṇa Kumāras often resided int the hermitages for acquiring knowledge under the supervision of Vedajña Brāhmanas. There could hardly be any better system for man to study the behaviour of nature in his surroundings. The forest provided them not only with a knowledge of material resources it provoked their imagination which culminated in the creation of a new series of vedic compositions, the Āraṇyakas.

4.4. Extent of Forests

Before going to the discussion about the managemnt and adminstration for forest protection, some mentions should be made regarding the idea of extent of forest tracts in ancient India.

The Aryans had spread over a vast Indian territory before the close of Ṛgvedic period.[5] In the east the Rgvedic Aryans certaily reached the holy waters of the Jamunā and the Ganges. We find the mention of the Gangā in the Ṛgveda (Xth Mandala, Nadīsūkta There

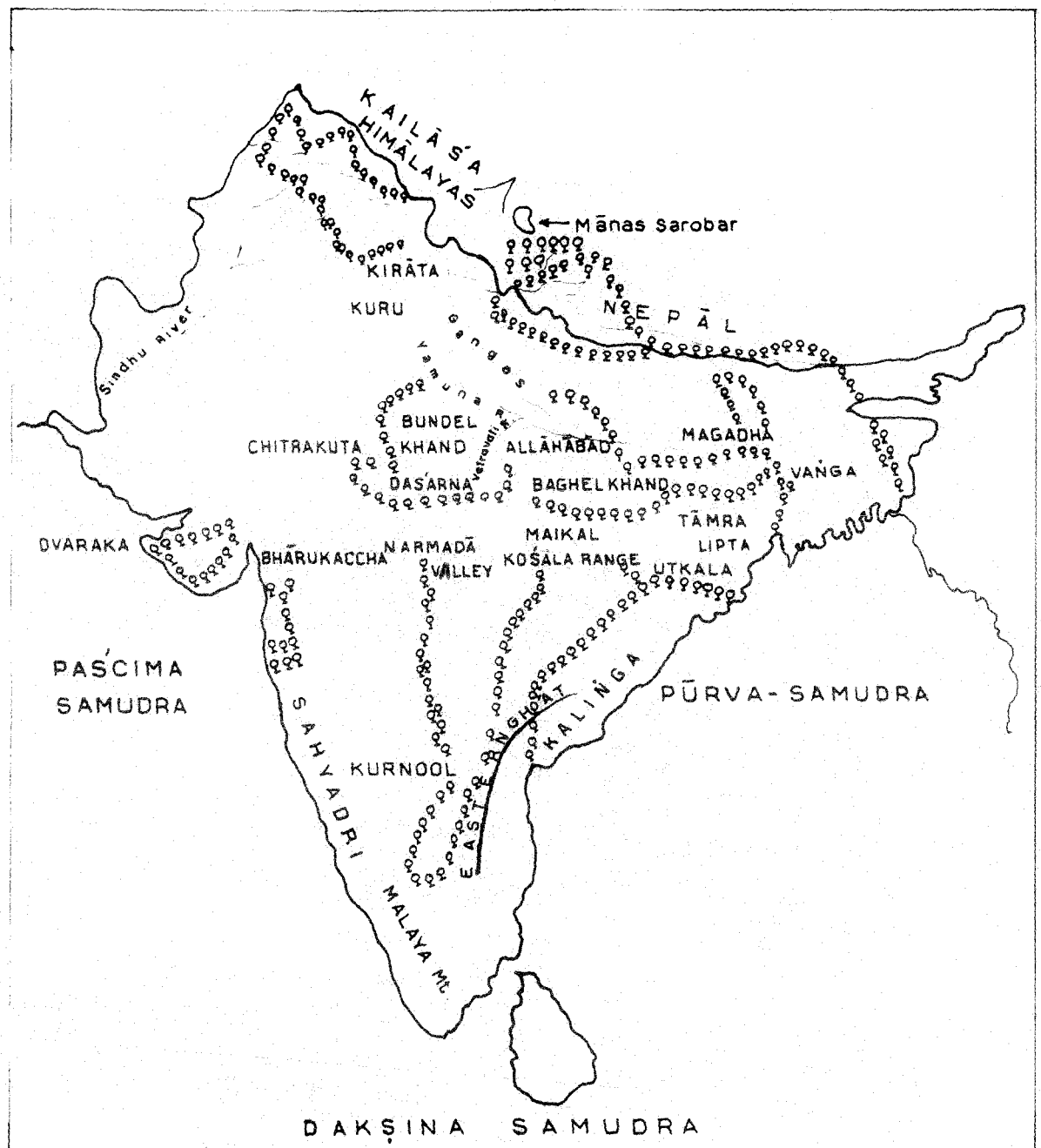


Fig. 8. Presumptive forest tracts in ancient India

is some controversy about the xth Mandala that it was a later insertion). In the next period (1400-1200 B. C.) that of the *Yajus* and *Atharva Saṁhitas* and the earlier Brāhmaṇas, the geographical knowledge of the Aryans had extended as far as the *Gandak* (Sadānīrā) in the east and as far as the Narmadā (*Revottara*) in the South as indicated by the Satapatha Brāhmaṇa.[5] The country situated in the east of Sadānīrā was probably the ancient Mithila.

In the age of the composition of Āraṇyakas and Upaniṣads (1200-700 B.C.), the eastern limit of the Aryan colonies seem to have extended further up to the rivers koshi and the Ganges. In the later vedic literature, the names of the two rivers Ganga and Jamunā occured several times. Narmada still continued to be the southern limit. Regarding the southern limit a much later evidence[15] of the first century A.D. can not be ignored. In the Periplus we see the following description : "Beyond Barygaza the adjoining coast extends in a straight line from north to south; and so this region is called ' Dachinabades... the inland country back form the coast toward the east comprises many desert regions and great mountains, and all kinds of wild beasts leopards, tigers, elephants, enormous serpents, hyenas and baboons of many sorts..." The abundance of such wild beasts clearly prove the existence of dense forest tracts beyond the Narmada river covering a vast area This was probably the '*Aparāntaka-vana*' of the *Viṣṇudharmottara Purāṇa*[16]. But on the upper course of the Godavari there were certain flourishing settlements in *Pratisthana* from the time of the Buddha i.e. 6th century B.C. Up to this time the geographical knowledge of the Aryans was confined to the area mentioned above.

4.4.1. Forest Division

We get from the Arthaśāstra[10] the names of eight forest divisions in ancient India in relation to the availability of different qualitative varieties of elephants. Kauṭilya speaks that the elephants from *Kaliṅga*, *Aṅga*, *Karūsa* and *Prācya* countries constitute the best class; those of *Dasārna* and *Aparānta* are medium and those of Surāstra and Pancañadas are the worst (KA. 11. 2. 15. 16).

The number of Dig-gajas are also eight in different texts as is evident from *Amarakoṣa*[17] as well as *Viṣṇudharmottara.*[16] We also get a list of eight Forest Divisions (*gajānām-van-āstakam*) in the *Viṣṇudharmottara Purāṇa*[16] (1.251). The ancient Indians probably used to think in terms of eight Forest Divisions and eight *Dig-gajas*. " The number of the Dig-gajas seems to have influenced the ancient Indian writers" to classify the Indian elephants into eight typical groups".[18]

The eight Forest Divisions (1. 251.22-37) of Viṣṇudharmottara Purāṇa[16] were as follows :

1. *Prācya-vana*, 2. *Karūśa-vana*, 3. *Dasārnaka-vana*, 4. *Vāmana-vana*, 5. *Kāleśa-vana*, 6. *Aparāntaka-vana*, 7. *Saurāstravana* and 8. *Pañcanada-vana*.

The *Viṣṇudharmottara* is regarded as a composition of 4th to 5th century A.D. But there is some controversy about the date of this text and some scholars like Hazra and Winternitz assign the date between 628 and 1000 A. D.[18]

In *Mānasollāsa*[19] the encyclopaedic work by king Someśvara (1126-38 A.D.), the verses embody classfication of elephants according to the sources of their availahility (Man. 1.2.179-81). " *Kāliṅgaṁ vedi-kārūsam Dāśārnaṁ ca vanaṁ varam* I

Āngireyaṁ tathā prācyaṁ madhyamaṁ vanaṁ=isyate II

Aparāntaṁ pañcanadaṁ saurāstraṁ c-ādhamaṁ vanam I

evam = aṣṭau vanāny = āhur = gajānāṁ janmanaḥ padam II

According to Someśvara, *Kalinga Vana, cedi-kāruśa vana* and *Daśarna vana* were the best forests for elephants; the medium quality elephants were available form *Aṅgireya* and *Prācya vana*. Finally, the *Aparantavana*, Pañcanada vana and Saurāstravana were the resideces of worst type of elephants.

So, from the various references, it is evident that the people of ancient India used to think in terms of eight Forest Divisions.

The chapter, *Vana vargādhyāya* of the *Vṛkṣāyurveda* of Parāśara[20] further illuminates us about the distribution of forests in India. This text gives the names, discription and distribution of forets as follows: *Chaitra-ratha-vanam, Kālaka vanam, Kirāta-vanam, Pañcanada vanam, Prācya-vanam, Vedi-kāruśaka vanam, Aṅgireya-vanam, Kalingaka-vanam, Daśārnaka vanam, Aparānta-vanam, Saurāṣtra-vanam* etc.

This Parāśara of *Vrksayurveda*[20] is identified by Sircar with the Parāśara of *Caraka Saṁhīta*. It is said in the beginning of *Vṛkṣāyurveda* that in the *Chaitraratha* Forest, the Ṛsis headed by *Bharadvāja* assembled in a conference and asked Parāśara to give knowledge about the herbs and plants which were considered beneficial to the human being. This *Chaitra-ratha-vana* was situated somewhere near the beautiful *Mānasasarovara* (*Vanaṁ Caitraratham ramyaṁ Māna sasaraḥ sobhitaṁ, Vṛkṣāyurveda Bijotpattikāṇḍa*)[Ch-1]. We get the reference to Kālaka-vanam (near Allahabad) in *Baudhāyana Dharmasūtra* in relation to the definition of *Aryāvarta*.

In addition to the list of the names of *vanas* in *Viṣṇudharmottara* we get two more names viz., *Aṅgireyavana* and *Kaliṅgaka-vana* in *Manosollasa* (1,2.174-81). But the names of *Caitraratha-vana* and *Kirāta vana* are missing in all the texts other than the *Vṛksayurveda*.

However, the resemblances in the names and locations of the forests, in ancient India as appear from the *Arthaśāstra*, the *Dharmottara Purāṇa, Manosollasa* and the *Vṛkṣāyurveda* of *Parāśara* provide sound evidence that the dense forest tracts persisted over a long period and the ancient Indians were aware of the forest resources.

Identification of the Forest Divisions ; The task of locating the forests in eight regions of ancient India as depicted in the *Arthaśāstra* is not very difficult.

Prācya or the Eastern Division of ancient India has been identified as the forested land lying to the east of the Kālaka-vana near Allāhābād or Vārānasi. This was also named as *Mahāvana* and

was comprised of Nepal, Bihar and a considerable portion of Uttar Pradesh. Evidently it extended to the north as far as the Himālayas.

The *Kārūśaka vana* roughly indicates the forest tracts which extended from Bundelkhand area upto Mirzapur in U.P. In the *Mānasollasa* the *Kārūśavana* is associated with the name of the *cedi*. The cedi denotes the Kalacuris of Tripuri near Jabbalpur in Madhya Pradesh. So, if we draw a line from Bundelkhand to Jabbalpur and connect it with Mirzapur touching Beghelkhand we shall be able to form an idea about the extent of the cedi *Kāruśa* vana. But the relevant stanza in Mānasollāsa clearly gives indication that the cedi *Kāruśa vana* was extended still further upto the mountain range of the *Kośala* country in the Raipur Bilaspur region in Madhya Pradesh.

The stanza is as follows (1.2.174 - 75) :

Tripuryām kośal - adrau ca ve (cc) di

Kārūśakṁ vanam ।

Śrīkṣetraṁ Gauḍa - vangālam = āngireyaṁ vanaṁ smṛtam ॥

As the name '*Śrīkṣetram* occurs with *Gauḍa - vangālam*, the *Aṅgireya vana* probably covered *Śrīkṣetra* i.e. Puri in Orissa on the one end and Gauḍa-vangāla on the other. On the basis of the description given in the *Mānasollāsa* (1.2.176-77), Dr. Sircar identifies the *Daśārnaka* forest with the area which covered the *Śrīśaila* (Nallamalur range) in Kurnool of Andhra Predesh, *Vedaśaila* i.e. the Travancore hills and the southern spurs of the Western Ghats.

We get references to *Daśārna* in *Mahābhārata* (11,5-10) as well as in the *Meghadūta* (24-25). In *Kiṣkindhyā-kāṇḍa* of the *Rāmāyana Daśarna* country is connected with those of the Mekalas and Utkalas where Sugrīva sent his monkey army in quest of *Sītā*. There are references in *Karṇaparva* and *Droṇa parva* of the *Mahābhārata*. A *Daśārna* King named Kṣātradeva fought valiantly on the elephant back in favour of the *Pāṇḍavas* and in this connection it is mentionable that the *Daśārna* that Daśārna warriors could fight best on elephants. Probably this *Daśārna* forest lay far away from the *Daśārna* country near Bhopal in Madhya Pradesh though Chatterjee seeks to locate this forest in the east of Malwa. But in the *Viṣṇudharmottara* the description about the location of the Daśārnaka runs thus :

Bilvaśailam Vetravatī Daśārṇām

ca Mahāgirim I

teṣāṁ Daśārṇakaṁ madhye

puṣpadantasya kānanam II

It was bounded by the *Bilvaśaila*, the *Vetravatī* river, the *Daśārnagiri* and the *Mekala*. In *Rāmāyaṇa* also, the Daśārna country is connected with those of *Mekālas* and *Utkalas*.

However, at present it is very difficult to locate this Daśārnaka *vana* with full accuracy.

On the basis of the description of *Vāmana's* forest given in Vāyūpurāṇa (VP 11.8.234), Sircar[18] likes to locate this forest between "*Utkala* (about N. E. Orissa) and the *cedi* country (in the Jabbalpur region).

Chatterjee[2] wants to locate it to the north of Betwa river in the former Goalior state i.e. he wants to push it towards slightly western direction though he also acknowledges the difficulty for locating this forest exactly due to paucity of evidences. Dr. Sircar also agrees that the language of the description of the *Vāmana* forest is defective.

The Viṣṇudharmottara states that *Kāleśavana* was bounded by the *Vindhya, Sahya, Utkala* and the *Dakṣina Samudra* (Indian ocean) (VD. 11. 251.30-31) probably this *kāleśa vana* is identical with the *Kalinga vana of Mānasollāsa*. The *Mānasollāsa* describes the boundary of this forest as

'*Vindhyādri-Citrakūṭādri-kaliṅga-Drāviḍ-āśritam* I

Vanaṁ Kalingaṁ nāma samudrāvadhi kīrtyate II

This forest extended from *Vindhya*, covering *Citrakūṭa* hill, the *Kaliṅga* and *Drāviḍa* countries upto the sea (Indian ocean).

The *Citrakūṭa* has been identified by some with Citrakūṭa near Kālañjara in the Banda district.[21] *Rama* and *Lakṣmaṇa* came at the foot of the *Citrakūta* hill in the Malava country. Here the forest was so very thick that it was difficult to find out any trace of human civilization.

The *Aparānta* forest extended from the *Sahyādri* or Western Ghats upto *Bhṛgukaccha* on the mouth of the Narmadā river. This forest region is corroborated by the Periplus also as has been already mentioned.

The boundary of the *Saurāstra vana* described in *Viṣṇudharmottara* and the *Mānasollasa* is almost the same. This forest is stated to have extended from *Dvārāvati* (*Kuśasthali*), included *Avanti* (west Malwa), the *Arbuda* mountain (Mt. Abu) and the *Narmadā*. This forest may be taken to be the same as the modern Gir Forest in Saurāstra (Kathiawad).

The Pañcanada vana was bounded by the Himalaya in the (north) *Kurujaṅgala* in the east and the junction of the Indus and the sea (Arabian sea) in the south. According to *Rājatarangini*,[22] this foest was bounded by Kālañjara on the borders of Kashmir in the west.In addition to these names of forests we should include the names of *Dandakāraṇya* mentioned in the *Rāmāyaṇa*[23], the Naimiṣāraṇya, recorded in the *Mahābhārata*[23] and *Mahākāntāra* mentioned in the Allahabad Pillar inscription of Samudra Gupta.[24]

The *Dandakāranya* which is celebrated in the *Rāmāyana* in connection with the episode fo Rama's exile, seems to have covered almost the whole of central India from Bundelkhand region to the river Krsna.[21]

The *Dandakāraṇya* along the Vindhyas practically separated the *Majjhimadeśa* from the *Dakṣināpatha*.

Naimiṣāraṇya is generally identified with Nimsar in the Sitapur district of Uttar Pradesh. It is situated on the bank of the Gumti river. Nārada was honoured by the sages when he visited *Naimiṣāraṇya (Padmapurāṇa, Uttarakānda*, 77-78).Mahakantara was a forest kingdom probably comprising parts of the Jaso and Ajaygadh states in Bundelkhand.[2]

4.5. The Ātavika Rajyas

Besides, most of the *Purānas* say of *Aṭavyas*. The *Vāmanapurāṇa* (Vap. 13.47-49) says about the *Āraṇyas*, Probably both the words mean the people living in the forest rregion. That there were people of *Atavi* within the empire of Aśoka is proved by inscriptional evidence[23].

In the Allahabad Pillar inscription Samudra gupta is said to have made all the Āṭavikarajas his servants.[24]

In two inscriptions, Hastin is described as master of *Dabhala* and eighteen forest kingdoms[24] which extended from jabbalpur across the whole of Chhota Nagpur.

So, it appears from the *Arthaśāstra*, the puranic texts, *Mānosollasa* as well as epigraphic references that dense and vast forest tracts existed for a long period and the ancient . Indians were aware enough of the physical boundary of the forested areas and their resources and classified them according to their geographical location.

A critical analysis of the evidences already mentioned provides an impression that the vegetation and forests covered far more extensive tracts than those of the late periods in Indian History.

It is evident that the Himalayan and sub-Himalayan zones had been under a cover of dense and luxuriant forests. But the occurrence of the names of innumerable number of plants, trees, bushes, grasses and the like indicate that there were varied genera and species of vegetation. Dense Forests were the abode of big animals like elephant, tiger, lion etc.

There was dense forest infested with elephants in the vicinity of Benares is evident form *Kasāya Jātaka*. Besides general references to grasses, there is specific mention of two species of grasses in the *Jātaka* stories,[24] *Kuśa* grass and *Munja* grass. In addition to these we get references to thorn-brakes and shrubs.

According to Kāmaṇḍaka[26] forests were divided into two groups, *Kuñjaravana* and *Kaṇṭakavana* (Kam. IV 51,52 ; XV 19-21). *Kuñjara vana* i.e. the elephant forest is the same as the *Gajavana* of the *Viṣṇudharmottara Purāṇa* and the *Nāgavana* of the Pillar Edict V of Aśoka.[25] *Kuñjara vana* in ordinary sense denotes dense forest and *Kaṇṭaka vana* means the thorny shrub forest.

4.6. Development of Imperial Control on Forests

Before the 6th century B. C. , there was no state control over the forests, and people were free to utilise its resources, when they needed. The main reason for such a situation was that imperialism

was yet to take its full shape. A change came with the birth of imperialism in Northern India in or about 543 B. C. as this year was ear-marked by the accession of king Bimbisāra to the throne of Magadha.

The imperial authority gradually became conscious of the forest resources and considered it as source of revenue.[2]

But with the establishment of Mauryan Imperialism, the forest came under the supervision of the state more effectively. From Kautilya's *Arthaśāstra*[1] it is abundantly clear that the state authority completely realised the importance of forest resources for the benefit of state craft and rules were framed for their proper organisation. There is hardly any scope to deny that under the Mauryas, there was more organised efforts for colonisation of uncultivated tracts of lands. It is true that an attempt had been made in this period for conservation of the forests and its living resources by a full fledged department with a Director at its head,

That the forests was one of the main components of the sources of revenue is clear form the *Arthaśāstra* (KA. 11.6.1). Kautilya has given a clear definition of what is to be called 'forests'.

" Enclosures for beasts, deer-parks, forests for produce and elephant forests, - these constitute ' forests' he says (KA. 11.6.6) (*"paśumṛgadravyahasti-vanaparigraho vanaṁ"*).

It is very difficult to prove that there was any separate unit of the government to run the administration and management of the

forests before the Mauryas. It is for the first time in the Indian History that Kauṭilya mentions the post a Director of Forests produce (KA. 11.17.1).

Kāmaṇḍaka also declares the forested land and elephant forests as one of the main sources of the state-income (*Aṣṭavarga*) (Kam. V. 78,79). The economic importance of forests is also emphasised by Śukra[27] (Su. 11. 211-212).

In the section *Bhūmicchidrabidhānaṁ* of the *Arthaśāstra* the king is advised to establish animal-park, forests for produce and elephant forests on the land which are not suitable for agriculture.

"Animal park for the king's recreation with a single entrance protected by a moat, containing shrubs and bushes bearing sweet fruits, having trees without thorns, with shallow pools of water and stocked with tamed deer and (other) animals, containing wild animals with their claws and teeth removed (and) having male and female elephants and cubs useful for hunting(should be established). More parks should be established for the animals where all animals are (well comed) as guests. Naturally, in these parks full protection was assured (KA. 11. 2.3.4.)".

Regarding the forest which are called *dravyavana*, Kauṭilya says, he should establish, one each for the products indicated as forest produce, as well as factories for goods made from forest produce and (settle) foresters, attached to the produce forests (KA. 11.2.5). Here it is very significant that these forests for produce played a very important role in the economic life of the forest people in Ancient India.

Besides, there is clear cut instruction for establishing forests for elephants on the border of the kingdom and these forests should be guarded by foresters. The Superintendent of the elephant forest was entrusted wtih the full charge of protecting the elephant forests whether on the mountain, along a river, along lakes or in marshy tracts. He should have clear knowledge about the entrances and exits of the forests (KA. 11.2.6.7).

During this time, the imperial kingship was trying to assert its authority over every possible source of revenue and income of the state, and warfare became a regular feature of the day. In *Arthaśāstra*, we notice that by this time elephant was established as an important component of the war machinery. So, a full fledged department under the headship of *Hastyādhyakṣa* or the Superintendent of Elephant (KA. 11.31.1) was established.

It is clear that besides the animal parks, there were two types of forests, one for forest produce and the other for elephants and there were distinct posts for Supervisers or Directors for smooth running of these two departments and their respective duties and responsibilities were specified.

Duties and responsibilities of the Director of Forest Produce:

(1) The Director i.e. the *Kūpyadhyakṣa* was in charge of collecting the forest produce and starting factories for finished products with the natural produce of the forests.(KA.11.17.1,2).

(2) He should impose fine for cutting down or causing damage to the trees without permission of proper authority. However, there was provision of relaxation in case of distress (KA.11.17.3).

(3) The Director should have clear knowledge about the quality of wood obtatined from the trees. He should classify the strong trees such as *śaka, tinisa, dhanvana, arjuna, madhūka, tilaka, sāla, śimśapā, arimeda, rājādana, śirīṣa, khadira, sarala, tāla,sarja, aśvakarna, somavalka, kuśa, āmra, priyaka,dhāva* and others. This group of trees was used as timber because of hard quality (KA. 11.17.4).

4) *Utaja, cimiya, capa, venu, vaṁsa, sātina, kanṭaka,bhāllūka* and others constituted the group of reeds (KA. 11. 17. 5).

5) *Vetra, śikāvalli, vāsi, syāmalatā, nāgalatā* and others were grouped as creepers (KA. 11.17.6).

6) *Mālatī, mūrvā, arka, śana, gavedhukā*, atasī and others constitued the group of fibre plants (KA. 11.17.7).

7) The raw materials for making ropes were *munja, bālbaja* and others (KA. 11. 17.8)

8) The leaves of *tāli, tāla* and *bhurja* i.e. the writing materials were distinguished (KA.11.17.9).

9) For medicine, in those days, people were highly dependent on plants and herbs. It was the duty of the Director of Forest produce to distinguish them.

All kinds of bulbous roots, fruits and others which had medicinal properties, were to be preserved (KA. 11.17.11).

10. He should collect the poisonous snakes and insects and preserve the venom in pots for the purpose of setting. It was also the duty of the Director to collect the skin, bones, bile, tendons, eyes, teeth, horns, hooves and tails of the lizard, seraka, leopard, bear, dolphin, lion, tiger, elephant, buffalo, camara, *sṛmara*, rhinoceros, bison and gavaya and also of other deer, beasts, birds and wild animals.

In ancient time, the defence of the country was largely dependent upon the supplies of wood from the forests. The logs of hard woods were stored and were used for setting up palisades for the protection of the cities as is evident from the *Indica of Megasthenes*. The hornes of the rhinoceros and buffalo, the tusks of the elephants, wood and bamboo roots were used for the hilts. Leather constitued the essential element for making various types of defence equipments and dresses. Naturally the superintendent of the armoury had to keep close contact with the Department of forest produce. (KA. 11.18.20).

The Director of the forest produce should have remained careful of the proper protection of trees, plants, herbs, animals and such other natural resources. Because any fraudulent activity concering forest produce was faced with punishment of fine (KA. 11. 5.9). The forest produces were accepted by the royal store house after proper examination by a bureau of experts. So, it is reasonable to believe that the subordinate employees under the Director of forest produce had to remain conversant with each and every matter relating to the improvement of the forests.

4.7. Superintendent of Elephant Forests

There is clear-cut instruction for establishment of forests for elephants in the *Arthaśāstra* (KA. 11. 2. 6).

It is already noticed, that elephants became an indispensible component of war machinery during this period. Kauṭilya discusses in some detail the quality of elephants, their capture and care as well as the conservation of the elephant forests. The elephant forests in the frontier region were undoubtedly inhabited by food gathering tribals. These forest dwelling people in the words of Kautilya were trappers, śabaras, pulindas, chandalas (KA 11. 1. 6).

These forest people were advised to be utilised as forest guards (KA 11. 2. 6). The superintendent of the elephant forests was a separate administrative authority, since in the list of the government officials as depicted in the Arthaśāstra, the name of *Nāgavanadhyakṣa* is separately mentioned. A large number of employees like forest guards, elephant keepers, foot chainers, physicians, trainers and group of attendants served under him (KA. 11.2.10). They were to observe strictly the different behaviour of the elephants and had to maintain records of each and every elephant.

Measures Adopted for Protection of Elephant Forests

(1) The Superintendent had to keep sharp watch over the elephant forests with the help of guards whether it was situated on the mountain, on the river bank or along a lake or in a marshy tracts of land (KA. 11.2.7).

(2) The forest guards were authorised to kill any one staying an elephant (KA. 11. 2. 8.).

(3) A person bringing a pair of tusk form elephant who died naturally, should be rewarded with four *paṇas* and a quarter (KA.11. 2.9).

(4) The crimes of damaging produce-forest or an elephant forest by fire was dealt with capital punishment (KA. IV. 11. 20).

4.8. Reserve Forests : The Abhayāraṇyas

The Mauryan kings maintained some forested areas as hunting recreation. These reserve forests contained shrubs and bushes bearing sweet fruits and trees having no thorn. The wild animals in these forests were shorn of their teeth and claws before being released for pleasures of the royal house. Another type of animal parks were also established where all animals were welcomed as guests and given full protection (KA. 11. 2.3.4). Besides these reserve animal parks, forests were granted to the ascetics for veda-study and sacrifices. Full safety was promised to the inhabitants of these forests. A very relevant example is the *Tapovana* of the sage *Kaṇva*, as depicted by Kālidāsa.[28] Though, the composition of Kālidāsa was of a much later date, yet it is true that such practice of granting wild area to the priest class continued through the ages. That all the creatures living in such class of forests were assured of their safety, is evident from the following quoted lines from the first act of the *Abhijñāna Śakuntalam* when the king Duṣyanta was just making an attempt on the life of a deer in the bordering area of *tapovana* of *Kaṇva* the hermits of tapovana restrained him by saying

" King, the deer belongs to the hermitage, it should not be killed, it should not be killed (AS. Act.I. 13)". The slaughter of animals in such forests were possibily totally prohibited. This is also indicated by the indifferent behaviour of the deer in the tapova na, who paid little care to the sounds of the chariot (AS. ACT. I. 14).

4.9. Game Laws

The preservation of games has become an indispensible part of preservation of forests in modern times. Attempts are being made by the state authority to protect the trees and plants as well as the beasts of the jungles. In ancient India also, unnecessary and wanton destruction of life was prohibited.

The Supervisor of (Animal) slaughter was entrusted with the responsibility of controlling the killing of animals. His duties were as follows:

(1) the supervisor of slaughter should impose the highest fine (for violence) for binding, killing or injuring deer, beasts, birds, or fish for whom safety has been proclaimed and who are kept in reserved parks, the middle fine on householders (for these offences) in reserved park enclosures (KA.11.26.1).

(2) For binding killing or injuring fish and birds whose slaughter is not current, he should impose a fine of twenty six paṇas and three quarters (for binding) deer and beasts, double (that). Of those whose slaughter is current (and) who are not protected in enclosures, he should receive one-sixth part, of fish and birds one tenth part more, of deer and beasts, duty in addition (KA 11.26.2.3).

(3) In order to make up the loss of wild animals and birds caused by death, one-sixth of the total number of all the different species of them should be set free (every year) in a forest preserve (wild life sanctuary)

(4) Sea-fish having the form of an elephant or a horse or a man or a bull or a donkey, or those from lakes, rivers, tanks or canals, curlew, osprey, gallinule, swan, ruddy goose, pheasant, bhṛngarāja, cakora, mattakokila, peacock, parrot, and *madanaśārikā*, which are birds for sport and auspicious (birds), also other creatures (whether) birds or deer should be protected from all dangers of injury. For transgression of this protection, the first fine for violence shall be imposed.

These Game-laws found in the *Arthaśāstra* were probably in force during the reign of Maurya rulers. But the great Maurya Emperor Aśoka laid down injunctins prohibiting the general destruction of life. These injunctions are found in his famous rock edict and pillar edict.

He brought the Game-Laws under the category of *Dhammaniyamas* or Laws of piety. Various animals have been mentioned in the Rock Edict I and in the Pillar Edict V. He enacted the game laws to minimise their slaughter and prohibited the performance of animal sacrifices.

Edict No. I forbade the general destruction of life both in his own kitchen and in his empire. Aśoka's Pillar Edict in which we find his *Dhammaniyama* or regulation of piety, has been translated by Hultzsch.[25] This is quoted here. King *Devānāmpriya priyadarśin* speaks thus , " When I had been) anointed twenty-six years, the

following animals were declared by me inviolable, viz., parrots, mainās, the aruna, ruddy geese, wild geese, the nandimukha, the gelata, bats, queen-ants, terrapins, bone less fish, the vedaveyaka, the Gangā-puputaka, skatefish, tortoises and porcupines, squirrels (?), the srimara, bulls set at liberty, iguanas (?), the rhinoceros, white doves, domestic doves (and) all the quadrupeds which are neither useful nor edible. Those (she-goats), ewes and sows (which are) either with young or in milk were inviolable and also those (of their) young one (which are) less than six months old. Cocks must not be caponed. Husks containing living animals must not be burnt. Forests must not be burnt either uselessly or in order to destroy (living beings). Living animals must not be fed with (other) living animals. Fish are inviolable and must not be sold, on the three *chāturmāsis* (and) on the *Tishyā* full-moon during three days (viz) the forteenth, the fifteenth, (and) the first (tithi) and invariably on every fast day. And during these same days also no other classes of animals which are in the elephant-park (and) in the preserves of the fisherman must be killed on the eighth (titihi) of (every) fortnight, on the fourteenth, on the fifteenth, on *Tishyā*, on *punarvasu*, on the three *chāturmāsis*. (and) on festivals, bulls must not be castrated, (and) he goats, rams boars, and whatever other (animals) were castrated (otherwise) must not be castrated (then).

On *Tishyā*, on *Punarvasu*, on the *chāturmāsis*, (and) during the fornight of (every) chaturmasi, horses (and) bullocks must not be branded, until (I had been) anointed twenty-six years, in this period the release of prisoners was ordered by the twentyfive times."

Aśoka in his very first edict, holds that no sacrifices should be performed by immolating living beings and no convivial gatherings

held as he found many faults in them.

Excursion : From his Rock Edict VIII we learn that in his tenth regnal year, Aśoka totally abolished the royal hunt. The pleasure encursions (*vihārayātrā*) typified by hunting expedition (*magavyā*) were replaced by the *dhammayātā*.

Earlier, the hunting expedition was a favourite pursuit with the kings of India. We may quote here the description of strabo[29] of the occasion of the hunting expedition.

The king leaves his palace to go to the chase, for which he departs in Bacchanalian fashion. Crowds of women surround him, and outside of this circle spearmen are engaged. The road is marked off with ropes, and it is death, for men and women alike, to pass within the ropes. Men with drums and gongs lead the procession. The king hunts in the enclosures and shoots from the back of an elephant. Of the women, some are in chariots, some on horses, and some even on elephants, and they are equipped with weapons of every kind, as if they were going on a campaign.The picture of entrance and exit of the king into and from the palace for games or others depicted in the *Arthaśāstra* (KA 1.21.23 26) almost resemble with that of given by Strabo. It is evident from various references that pleasure hunting was a part of king's routine work. But Aśoka stopped this practice in the tenth regnal year of his reign. The rock edict I, the rock edict VIII and the pillar edict V, prove beyond doubt that Aśoka's purpose was to stop the unnecessary killing or torture of any animals whether useful or not. The abandonment of the practice of going on hunting excursion must have been in accordance with his Law of Piety.

There is some difference of opinion among the scholars in explaining the meaning of the word's three *Chāturmāsis* when killing of animals and fish was prohibited.

According to Barua " the fish and other creatures got relief for not less than seventy-two days in the year, calculated at the rate of 3 days in every lunar half-month, viz., the first, the eighth and the full or new moon." The three *chāturmāsis* and Tishyā full moon days are all included in the list of full moon days throughout the year. Chatterjee gives the number of non-slaughter day as 72 days in a year, by explaining the three *chāturmāsis* days and the day of the *Tishyānaksatra* (birth star of Asoka) as full moon days.

However, it is reasonable to believe that a quite good number of days in a year were declared as non-slaughter days. Kauṭilya had recommended in his *Arthaśāstra* that the king (in a conquered territory) should order the stopping of slaughter for half a month in every four months, for four nights (and days) on the occasions of full moon nights, for one night (and day) on the days of the constellations of the king and the country. He should prohibit the killing of females and young ones and the destruction of a male's virility. (KA. 5.12.13).

Hora[30]after a careful observation of the prohibitions laid down by Aśoka in pillar edict V, expresses his view that " There is some indication that Aśoka's pillar Edict V records an advancement of knowledge over what Kauṭilya had recommended in his *Arthaśāstra* about 25 to 50 years earlier".

Aśoks's intention was to minimise the slaughter of and inflictions of cruelty on living beings by introducing restrictive regulations, the ultimate aim of which was to serve the purpose of conservation of living resources. This becomes clear when we notice the scientific analyses of Aśoka's fish lagislation by Hora[30]. He says that the peak breeding period of India's principal food fishes is July, August, and September. But Aśoka's prohibition period extends upto the middle of November. This extended period is also scientifically logical because after breeding in shallow areas or upriver the spent fish fall back to their normal habitats. The young also move down to safer habitats after the rains are over. The young and the weakened spent fishes needed protection and it is indeed remarkable that even this was thought of in the remote ancient age by that Great Emperor. This sets an example of highest degree of piety extended to a newly spent mother fish.

By the time of Mahāvira and Buddha, settled agriculture and pastoralism paved the way for acquiring large surpluses which made ever increasing pressure on forested land and living resources. More forests were to be utilised for extending the horizon of agriculture. The *Brāhmanial* pantheon, which incurred slaughter of hundreds of animals and burning of vast tracts of forests under the guise of fire sacrifices taking the assistance of the *Kṣatriya* princes as is noticed in the incident of *Khāṇḍavadahana* in the great Epic "*Mahābhārat*" failed to project itself as congenial to the changed socio-economic order. The Buddha raised his strong voice against the killing of cows. Buddhism and Jainism by abandonment of Yajña rituals introduced a new belief system befitting with the changed circumstances leading to the beginning of the convention of prudent use of resources and conservation practices.

Henceforth, the *Brāhmanical* literatures also advocated for non-injury to both plants and animals as has been already discussed.

Emperor Aśoka thought it necessary to create an environment of protection of lives and brought the Game Laws under the category of *Dhammaniyama*. By introducing injunctions against any unnecessary slaughter of animals, Aśoka attempted to inspire the people with a feeling of Love for animals which ultimately proved very effectve for conservation of living resources.

4.10. An overview of post Mourya period

There is hardly any evidence to prove that there developed any new system of forest administration, different from the ideas of Kauṭilya in the smaller states that had developed in India in the post Maurya period. Probably, it will not be unjustified to think that the basic structure of forest department in the later ages was more or less similar to that of the *Mauryas*.

With the rise of the Imperial Guptas, the vast forest tracts stretching throughout the Gupta empire naturally came to be regarded as important sources of revenue. The importance of trees, plants, shrubs, grasses, and woods in a kingdom was highly valued (Śu. 1. 425-28).29

The forest in this period did not remain unexplored. Śukra's advice to connect human settlement with the forests with network of *Rājamārgas* points to the fact that during this period, state authority became more and more conscious of the forest resources and began to pay more attention for developing the communications with the

forested region with the locality. Śukra 's advice is : In a forest of six *yojanas* (i.e. forty-eight miles) the best *Rājāmarga* is to be constructed, in the middle the average and between the two, the worst (?) (Śu. 1. 528-529)

The best *Rājamārga* should be thirty cubits wide, the average twenty cubits and the worst fifteen cubits only (Śu. 11. 207-208).

Sumantra and *Amātyam* these two state officials had to look after the affairs of revenue earned from forest (*Araṇyosambhaba*) and the settlement of the forested land. (Śu. 11. 211-212).

The state officials as Superintendent of elephants and Superintendent of horses discharged duties of their respective departments (Śu. 11 256, 260-263)

The Superintendent of parks and forests (*Ārāmādhipati*) had to remain responsible for growth and development of flower, fruit, trees and treatment against diseases of plants (Śu. 11317-319)

The king is also advised to extend the boundaries of forest area by means of afforestation (Śu IV, 91-93). The trees which had thorns were to be planted in forests (Śu. IV, 113-114).

During this age, rampant destruction of living resources was discouraged and hunting could not be done without prior royal permission (Śu I, 603-8). The king also in course of his hunting expedition was not allowed to kill the animals which were not wild, and cruelty was always discouraged (Śu. I. 665 - 69).

4.11. References

1 Randhaw, M.S; Singh, J ; Dey, A. K. and Mittere, V. *Evolution of Life*. Publications and Information Directorate, New Delhi, 1969.

2 Chatterjee, C. D. *Foresty in Ancient India*. Forest Directorate, Govt. of West Bengal, 1964.

3 Allchin, B. and R. *The Rise of Civilization in India and Pakistan*, New Delhi, 1983.

4 Bose, D.M.; Sen, S.N. and Subbarayappa, B.V. *A Concise History of Science in India*, Indian National Science Academy, New Delhi, 1971.

5 Roy Choudhury, H.C. *Studies in Indian Antiquities*. Calcutta University, 1958.

6 Sen, Satyendranath, Haldar Gopal and Adu Keshab, *Kasiram Das Birochita Mahābhārata, Part I* (in Bengali), Saksharata Prakasan, 1980.

7 Ghosh, A. *The City in Early Historical India*, Simla, 1973.

8 Chattopadhyaya, Debiprasad. *History of Science and Technology in Ancient India : The Beginning*. Firma KLM. Pvt. Ltd., Calcutta,1986.

9 Cowell, E.B. *Jātaka* (Eng trans.) 7 vols. Cambridge 1895-1913.

10 Kangle, R.P (Eng trans.) *The Kauṭilya Arthaśāstra* Part II, University of Bombay, 1972.

11 Wilson, H.H., Ṛgveda (Eng trans), London 1850.

12 Buhler, G. *The Laws of Manu.* Matilal Banarasi Dass, Delhi , Reprint, 1984.

13 Sen U.N. and Sen D.N. *Charaka*, Calcutta, 1316 B.S.

14 Majumdar, G.P. *The History of Botany and Allied Sciences (Agriculture, Medicinal Arbori-Horticulture) in Ancient India, (2000 B.C. to 100 A.D.)*, UNESCO, 1951.

15 Sircar, D.C. *Cosmography and Geography in Early Indian Literature.* (Sir William Meyer Endowment Lectures in History 1965-66), University of Madras, 1967.

16 Shah, Priyabal (Ed.) *Viṣṇudharmottara Purāṇa.* Gaekwad Oriental Series, No. 130, Baroda, 1958.

17 Colebrooke, H.T. *Amarakoṣa* (Eng trans). Serampore 1808.

18 Sircar , D.C. (Ed.) *The Elephant forests of Ancient India, In The Bhakti Cult and Ancient Indian Geography.* University of Calcutta, 1970.

19 Shrigondekar, G.K. (Ed.) , *Mānasollāsa*, 3 vols. (Ed.) Oriental Series.

20 Sircar, N. N. *An Introduction to the Vṛkṣāyurveda of Parāśara* . *Journal of the Royal Asiatic Society of Bengal.* Letters, Vol. XVI, No. 1, 1950.

21 Law, B.C. Historical Geography of Ancient India. *Journal of the Royal Asiatic Society*, London, 1894.

22 Stein, M.A. *Rājataraṅgini of Kalhana* (Eng. trans.) 2 vols. Delhi, 1961.

23 Dutta, M.N. *Rāmāyaṇa* (Eng trans. in prose). Calcutta, 1892-94.

24 Fleet, J.F. *Inscriptions of the Early Gupta Kings and their Successors.* CII, III, Calcutta, 1888.

25 Hultzsch, E. *Inscriptions of Aśoka* (New Ed.) CII, Vol. I. London, 1925.

26 Mitra, Rajendra Lal (Ed and trans.) *The Nītisāra or the Element of Polity by Kāmandaki.* Bibliothica Indica, 1849.

27 Sarkar, B.K. *The Śukranīti* (Eng. trans.). Oriental Books Reprint Corporation, New Delhi, 1975.

28 Bose, R.M. *Abhijñāna Śakuntalam of Kālidāsa* (Eng. trans.). Modern Book Agency Pvt. Ltd., Calcutta, 1963.

29 Barua, B.M. (Quoted) in *Aśoka and His Inscriptions*. New Age Publishers Ltd. Calcutta, 1946.

30 Hora, S. L. Knowledge of the Ancient Hindus Concerning Fish and Fisheries of India. Fishery Legislation in Asoka's Pillar Edit V (246 B.C.), *Journal of the Royal Asiatic Society of Bengal, Letters,* Vol. XVI, No. 1.1950.

5. Conclusion

Within the narrow compus of this paper, an humble attempt has been made to highlight India's age-old tradition of protection/ conservation of plants, animals and of forests - the three main components of nature what are now known as three major components in an integrated system of a biosphere.

The growth of the industries opened various new avenues of profession and for raw materials more areas were to be deforested. So, this is a cruel reality that from the time immemorial forests have been fighting a losing battle all through the centuries, since the beginning of human settlement. In this battle man's role is of a predator. He is compelled to do damage to the natural vegetal world. But simultaneously it is man himself who guided by his empirical knowledge has been trying to protect this sole shelter for his own existence by prudent and sustainable utilization of forest resources.

The Ancient social thinkers with a view to protecting the green world and animal domain, introduced scriptural injunctions as is evidenced from literary and inscriptional sources. The ancient thinkers did not rest content by merely assessing the economic benefit and material utility of the living world, they also sought to derive lessons from it.

Man is advised to follow the nature of trees with a view to attaining perfection of his qualities. Kālidāsa has sighted that " the loftiest trees bend down by the appearance of furit, clouds (when pregnant) with new water, hang very low ; good men are (never)

turned arrogant by riches. This (as) indeed the nature of the succourer of others." (*bhabati namrāstarava phalāgamairnavāmbubhi-rdur-bilambino ghanāḥ I anuddhatāḥ satpurusāḥ samṛddhibhiḥ svabhāb a ebaiṣa paropakāriṇām* II (AS. V, 12).

The deep regards for plants and animals, and finding analogy of good qualities, virtues and ethics of man in plants explain that human soul is blended with that of plants.

We have strong ground to belive that this esteemed heritage evolved in India from environmental consciousness. The present concept of the need of conservation of bio-diversity and sustainable utilisation of natural resources was conceived by our fore-fathers long ago. In reality we are now attempting to recycle our rich age-old heritage of nature consciousness as is envisaged in the hymns of the Ṛgveda: "Sweet as honey (i.e. exhilarating) is the breeze that is blowing. Sweet as honey (i. e. refreshing)is what the Sindhus (the Indus and its tributaries) are emitting. May our medicinal herbs be sweet as honey (i.e. healing).! Sweet as honey(i.e.charming) are the night and the dawn. Sweet as honey (i.e. pleasant) is the dust of the earth. May our fore-fathers be in Heaven which is sweet as honey (i.e.delightful)! Sweet as honey (i.e.cooling) are our umbrageous trees. May the sun be sweet as honey(i.e. envigourating) ! May our cows be sweet as honey (i.e. provide us with milk, sweet as honey)! (*Madhu bātāṛtāyate madhukṣaranti sindhabaḥ mādhvinaḥ santvoṣadhiḥ I madhu nakta mutoyaso madhumatpārthivaṁ rajaḥ madhudyaurastu naḥ pitā I madhumānno vanaspatiṁadhumaṁ astu sūryaḥ mādhvirgavo bhabantu naḥ* II (Ṛg. 1.90.6, IX. 112. 1., X. 75. 5-6; X 97. 1-23)."

5. BIBLIOGRAPHY

Agarwal, D.P. Metal Technology of the Harappa Culture, *Indian Journal of History of Science,* Vol.2, pp. 238-252, INSA, New Delhi, 1970.

Allchin, B. and Allchin, R. *The Rise of Civilization in India and Pakistan.* New Delhi, 1983.

Apte, V.M. *Social and Religious Life in the Grihyasūtra.* The Popular Book Deptt., Bombay, 1954.

Auboyer, J. *Daily Life in Ancient India* (from C. 200 B.C. to 700 A.D.), Eng. trans. by S.W. Taylor, Bombay, 1965.

Banerjee, S.C. *Flora and Fauna in Sanskrit Literature.* Naya Prokash, Calcutta, 1980.

Barua, B.M. *Aśoka and His Inscriptions.* New Age Publishers Ltd., Calcutta, 1946.

Basak, R. *The Arthaśāstra of Kauṭilya with Bengali translation,* Vol.1. General Printers and Publishers Pvt. Ltd., Calcutta, 1964.

Bhaduri, J.L.; Tiwari, K.K. and Biswas, B. Zoology. In *ACHSI* (Eds.

D.M.Bose, S.N.Sen and B.Subbarayappa), INSA, New Delhi, 1971.

Bhattacharyya, P.K. *Historical Geography of Madhya Pradesh from Early Records*. Motilal Banarasidass, New Delhi, 1977.

Bloomfield, M. *Hymns of the Atharvaveda*. Oxford, 1897.

Bose, R.M. *Abhijñana Śakuntalam of Kālidāsa (Eng. trans.)*. Modern Book Agency Pvt. Ltd., Calcutta, 1963.

Buhler, G. The Laws of Manu (Eng. trans.). In *The Sacred Book of the East*, Vol. XXV (Ed. by F. Max Muller). Motilal Banarasidass, Delhi, 1984.

Calder, C.C. *An Outline of Field Science in India*, (ed. by S.L.Hora). Indian Science Congress, Calcutta, 1937.

Chakravarti, M. Animals in the Inscriptions of Priyadasi. *Memoirs of the Asiatic Society of Bengal*, pp. 361-374, Calcutta, 1906.

Chatterjee, C.D. *Forestry in Ancient India*. Forest Directorate, Govt. of West Bengal, 1964.

Chattopadhyaya, D.P. *History of Science and Technology in Ancient India* : The Beginning. Firma KLM Pvt. Ltd., Calcutta, 1986.

Chattopadhyaya, D.P. *Science and Society in Ancient India*. Research India Publication, Calcutta, 1971.

Childe, V. *New Light on the Most Ancient East*. (revised edn.). New York, 1954.

Chowdhury, K.A. Botany : Prehistoric Period. In *ACHSI*, INSA, New Delhi p.371, 1971.

Chowdhury, K.A. and Ghosh, S.S. Plant Remains from Hastinapur, 1950-1952. *A.J.* 10, 11, 121, 137, 1954, 1955.

Colebrooke, H.T. *Amarakoṣa* (Eng. trans.). Sreramporе, 1808.

Cowell, E.B. *Jātaka* (Eng. trans.) 7 Vols. Cambridge, 1895-1913.

Cunningham, A. Ancient Geography of India, London, 1871.

Deshpande, M.N. *IJHS*, Vol. VI No. 1, p.6, 1971.

Dutta, M.N. *Rāmāyana* (Eng. trans. in prose). Calcutta, 1892-94.

Dutta, M.N. *Viṣṇupurāṇa* (Eng. trans.). Calcutta, 1894.

Dutta, M.N. *Agnipurāṇa* (Eng. trans.). Calcutta, 1901.

Dutta, M.N. *The Dharam Śāstra : Hindu Religious Codes*, Vol. IV. Cosmos Publication, New Delhi, 1979.

Fleet, J.F. *Inscriptions of the Early Gupta Kings and their Successors*. CII, III, Calcutta, 1888.

Gadgil, M. and Guha, R.C. *This Fissured Land : An Ecological History of India*. Oxford Univ. Press, New Delhi, 1993.

Ghosh, A. *The City in Early Historical India*. Simla, 1973.

Ghosh, A.K. and Sen, S.N. Botany :P The Vedic and Post-Vedic Period. In *ACHSI*, INSA, New Delhi, p. 375, 1971.

Griffith, R.T.H. *Vājasaneyī Saṁhitā* (Eng. trans.), 1899.

Gopalon, S. *Aśvaśāstra of Nakula*. Madras Govt. Oriental Series, No. 57, Tanjore, 1952.

Gupta, U.C. (Ed.). *Aśvavaidyaka of Jayadatta Suri*. Asiatic Society, Calcutta, 1887.

Hawkes, J. and Wooley, L. *History of Mankind : Cultural and Scientific Development*, Vol. I. Prehistory and the Beginning of Civilization. UNESCO, London, 1963.

Hora, S.L. Sanskrit Names of Fish and their Significance. *Journal of the Royal Asiatic Society of Bengal, Science*, XIV. pp. 1-6.

Hora, S.L. Knowledge of the Ancient Hindus Concerning Fish and Fisheries of India. 1. Reference to Fish in *Arthaśāstra* (Ci 300 B.C.). *Journal of the Royal Asiatic Society of Bengal, Science*, XIV. pp.7-10, 1948.

Hora, S.L. Knowledge of the Ancient Hindus Concerning Fish and

Fisheries of India. 2. Fishery Legislation in Asoka's Pillar Edict V (246 B.C.). *Journal of the Royal Asiatic Society of Bengal*, XVI, No. 1, pp. 43-56, 1950.

Hultzsch, E. *Inscriptions of Aśoka* (New Ed.) CII, Vol. 1, London, 1925.

Kangle, R.P. The *Kauṭiliya Arthaśāstra, Part II.* University of Bombay, 1972.

Keith, A.B. *Taittirīya Saṁhitā* (Eng. trans.). Harvard Oriental Series nos. 18, 19, 1914.

Kosambi, D.D. *Introduction to the Study of Indian History.* Bombay, 1956.

Lal, B.B. Essays in Indian Proto-History (Ed. by D.P.Agarwal & D.K.Chakraborty). New Delhi, 1979.

Law, B.C. Historical Geography of Ancient India. *Journal of the Royal Asiatic Society*, London, 1884.

Mackay, E.J.H. *Mohenjodaro and Indus Civilization* (Ed. J.Marshall). Arthus Probsthain, London, Vol.I, 1931.

Majumdar, G.P. *Vanaspati : Plants and Plant Life as in Indian Treatises and Traditions.* Calcutta University, 1927.

Majumdar, G.P. *Upavana Vinoda/Śārangadhara* (Ed. and trans., Foreword by B.N.Seal). Indian Research Institute, Calcutta, 1935.

Majumdar, G.P. *The History of Botany and Allied Sciences (Agriculture, Medicine, Arbori-horticulture) in Ancient India* (C. 2000 B.C. to 100 A.D.). UNESCO, Paris, 1951.

Majumdar, G.P. and Banerjee, S.C. Kṛṣiparāśara. Asiatic Society, Calcutta, 1960.

Mazumdar, R.C. Medicine. In *ACHSI* INSA, New Delhi, 1971.

Marshall, J. *Mohenjodaro and the Indus Civilization - being an official account of archaeological excavations carried out by the Govt. of India between the years 1922 and 1927*, 3 Vols, London, 1931.

Mitra, Rajendra Lal (Ed. and trans.). The Nītisāra or the Element of Polity by Kāmandaki. *Bibliothica Indica,* 1849.

Mughal, M.R. In *Possehl's Ancient Cities of the Indians.* New Deli, 1979.

Panini. *Astādhyayī.*

Radhakrishnan, S. *Thirteen Principal Upaniṣads.* London, 1953.

Randhawa, M.S. ; Singh, J.; Dey, A.K. and Mittere, V. *Evolution of Life.* Publications and Information Directorate, New Delhi, 1969.

Ray Choudhuri, S.P. ; Gopal, L. and Subbarayappa, B.V. Agriculture. In *ACHSI*, INSA, New Delhi, 1971.

Roy Choudhury, H.C. *Studies in Indian Antiquities*. Calcutta University, 1958.

Sarma, Sivadatta, *Hastyāyurveda of Pālakāpya*, An Ānandāśrama Sanskrit Series, No. 26, Pune, 1894.

Sarkar, B.K., *The Śukranīti* (Eng. trans.). Oriental Books Reprint Corporation, New Delhi, 1975.

Sastri, G. Nilkantha (Ed.) *Mātanglīta*, Trivandrum, 1910.

Sastri, S. and Bhat, M.R. (Eds. and trans.). *Bṛhatsaṁhitā*, 2 vols. Bangalore, 1947.

Sen, Gananath, *Āyurveda Paricaya* (in Bengali). VisvaBharati Granthalaya, Calcutta, 1944.

Sen, U.N. and Sen, D.N., *Caraka* (Beng. trans.). Calcutta, Bengali San 1316.

Sen, Satyendranath, Halder Gopal; Adu Srikeshab. *Kasiram Das Birochita Mahabharat* (in Bengali). Saksharata Prakashan, Calcutta, 1976.

Shah, Priyabal (Ed.) *Viṣṇudharmottarapurāṇa*, Gaekwad Oriental Series, No. 130, Baroda, 1958.

Shrigondekar, G.K. (Ed.). *Mānasollāsa*, 3 vols. (Ed.), Gaekwad Oriental Series.

Singh, M.R. *A Critical Study of the Geographical Data in the Early Puranas*. Punthi Pustak, Calcutta, 1972.

Sircar, D.C. *Cosmography and Geography in Early Indian literature.* (Sir William Meyer Endowment Lectures in History, 1965-66), University of Madras, 1967.

Sircar, D.C. (Ed.). The Elephant Forests of Ancient India. In *"The Bhakti Cult and Ancient Indian Geography*. University of Calcutta, 1970.

Sircar, N.N. An Introduction to the Vṛkṣāyurveda of Parāśara. *The Journal of the Royal Asiatic Society of Bengal,* Letters, Vol. 16, 1950.

Stebbing, E.P. *The Forests of India*, Vol.I. The Bodley Head, London, 1922.

Stein, M.A. *Rājatarangini of Kālhāna* (Eng. trans.). 2 vols. , Delhi, 1961.

Tamaskar, B.G. Contributions to Historical Geography of India. Inter-India Publications, New Delhi, 1985.

Tarkaratna, P. *Agnipurāṇam,* Calcutta.

Tarkaratna, P. and Bandopadhyay, M. *Vātsyāyana's Kāmasūtra.* (Bengali trans.). Sanskrit Pustak Bhandar, Calcutta, Bengali San 1398.

Vishagratna, K.L. *Śusruta* (Eng. trans.). 2 vols., Calcutta, 1911.

Weber, A. (Ed.) 1885, Trans. by Eggling. Satapatha Brāhmana. In *The Sacred Books of the East.* Oxford, XII, XXVI, XLI, XLIII, XLIV, 1882-1900.

Wheeler, M. *Early India and Pakistan.* Thames and Husson , London, 1959.

Wheeler, M. *The Indus Civilization, The Cambridge History of India, Supplementary Volume.* Cambridge University Press, Cambridge , 1960.

Wilson, H.H. *Ṛgveda*, (Eng. trans.). 6 vols., London 1850.