CHAPTER I

Introduction

In science, more than in any other human institution, it is necessary to search out the past in order to understand the present and to control the future.

J.D. Bernal

Investigation into the Indian past began with the works of the Indologists. They were mostly the European scholars and their main area of study was language. The study of Sanskrit language rendered practically the main source material for the reconstruction of ancient Indian society.[1] At the outset, the scholars paid much attention to the study of general history of the past, which covered political, economic as well as social life of the people. Religious, cultural and artistic activities also came under the purview of their discussion. But the achievements of the ancient Indian people in the branch of science and technology remained ignored. The reason might be that the indological study was then in its formative stage. The study of ancient and medieval Indian science and technology which involved the methods of the linguists, the philologists and simultaneously the knowledge of scientific disciplines could not make much advance.

Still, India as a whole and Bengal in particular can take pride in the great initiative undertaken by the illustrious scholars associated with The Asiatic Society for the study of the contribution of Indian Science in antiquities.

The Asiatic Researches and the Journal of the Asiatic Society were the two journals in which numerous articles were published on "Mathematical Sciences of the Hindus[2]".

'The Asiatic Society rightly propagated the view that despite the continuity of religious and spiritual concepts in India, science was not ignored or relegated to the limbo[3].

The discovery of manuscripts, extraction of accurate knowledge from the manuscripts by patient study and attempts at co-relation with relic of antiquity by the great scholars like Anquetil du Perron, Sir William Jones and others prepared the way for opening up of new areas of study in the days to come.

The essays on Mathematical and Physical Science, published in the ten volumes of the Asiatic Researches gave a fair idea of Indian scientific achievements[4]. Such learned essays as R. Burrow's 'A proof that the Hindus had the Binomial theorem', John Playfair's, W. Hunter's, H.T. Colebrooke's and other scholars' essays on Hindu and Arabic Science made it abundantly clear that the Asiatic civilizations possess a rich scientific heritage.

Of late a new thrust has been put on the study of science and technology in Ancient India. The first attempt in the direction of developing a branch of study of science and technology in historical outline was made jointly by the UNESCO and the Indian National Science Academy. Under the joint initiatives of the two organizations a Symposium on the History of Sciences in South East Asia was held in Delhi in 1950. Such an initiative was highly needed to understand the history and culture of the people of this ancient civilization. The recommendations of the 1950 symposium got its practical shape in the form of the book *A Concise History of Science in India* containing exhaustive researches on different disciplines of science in India throughout the ages. In the preface of the book the editors have made a remark which is very significant: 'Despite vicissitudes in intellectual and scientific endeavours and period of stagnation, e.g. about the time of the Renaissance in Europe, the Indian sub continent is one of the few areas where a fairly continuous tradition in science and technology is clearly seen'[5].

The history of Science in India is characterized by many historiographical perspectives and, as with all historiography, has been influenced by events and ideas of their time. As the Indian civilization was earlier defined as Hindu civilization, its Science was described as Hindu science. The texts read were limited to Sanskrit and the Indian languages.

Romila Thapar has defined the method of writing the history of science by saying that the historians of the history of science tend to view science from two perspectives. One is the linear projection of the evolution of particular disciplines regarded as scientific and the other is the attempt to view science as culture and as part of the social formation of a socity[6].

'This perspective' (the latter perspective) continues Thapar, 'is obviously more wide-angled and takes in many facets involving interactions and osmosis, which bear on a particular body of knowledge. Whereas the first is frequently the close preserve of scientists, the second approach is the one in which the historians can intervene...'[7].

The proposed work is an attempt for a step forward in the study of plant science and animal science in ancient India along with the concern of our ancestors for protection and conservation of nature, keeping in view the perspective as conceived by this pioneering historian.

The human civilization since its inception is intimately associated with plant and animal world. The climatic changes at the receding of glaciers, 10,000 years B.P. let to a food crisis. This crisis very likely prompted the hunter gatherer people to domesticate animals and cultivate plants[8]. Almost certainly the first animal to be domesticated was the dog which was to become Man's comrade in the hunt[9]. With the progressive domestication of animals, the way was prepared for the evolution from a hunting society to a pastoral society, still nomadic but with the source of food under human direction and control.

The archaeological evidence indicates that the first domestication of two major cereals like wheat and barley and domestication of animals like sheep, goat and cattle took place in the western Asia of the Old

World[10]. The horse, the ass, the camel and the llama appear to have been relatively late-comers in the process of domestication. The process, it is likely, provided the stimulus for the beginning of agriculture and animal husbandry in India.

When we speak of Neolithic Revolution it implies a major change in the technique of food production which gave men a control over his environment and saved him from the precarious state of uncertainty of hunting and gathering. Instead of collecting wild grains people now began to control their food supply by cultivating plants. 'Like all great transformations, it was not a single act but a process including numerous observations and inventions, all subservient to the essential achievement — the cultivation of seed-giving grasses'[11].

J.D. Bernal regards the invention of the technique of agricultur ranking with the utilization of fire and power as one of the three most momentous inventions in human history[12].

It is generally agreed that the Indian archaeological data, on crops are inadequate to lead to a co-herent agricultural history[13]. An interesting history of cultivated plants has been reconstructed by the discovery of the carbonized seeds and impressions on potsherds found in the archaeological areas of Indus valley. Practically the history of agriculture in India begins with the practices of the inhabitants of the Indus valley riparian culture.

Vedic people viewed agriculture as an important vocation

Various references pertaining to agriculture, though scattered in nature, bring out that the vedic cultivators had fair knowledge of the quality of land, selection and treatment of seeds, seasons of sowing and harvesting, rotation of crops and other cultural practices of crops. The sources are *Ṛgveda,* the *Atharvaveda,* the *Taittirīya* and the *Vājasaneyī Saṃhitā.*

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 regarding the plants and animals. There is

enough evidence to show that Botany developed as an independent science. The *Vṛkṣāyurveda* of *Parāśara* written perhaps sometimes in the pre-Buddhistic period may be cited as an instance.

The *Arthaśāstra,* the *Bṛhatsaṃhitā* and the *Agnipurāṇa* have each a section or sections on plant scinec. Inspite of agricultural bias, the sections indicate that a separate *Vṛkṣāyurveda* had been in existence. In *Vātsāyana's Kāmasūtra, Vṛkṣāyurveda* is mentioned as one of the 64 arts recognized in ancient India. In this regard, the references to the *Upavana-vinoda* and the *Vṛkṣāyurveda* of *Surapāla* should be taken into account.

The above mentioned texts and some other works provide us plenty of materials indicating how the knowledge of plants and plant life came into clear recognition and a distinct science developed based on empirical data.

Simultaneously with the studies on plants and herbs rudimentary science also came into existence dealing with animals. Agriculture practice without the help of the cattle is not conceivable.

As the empires rose, wars became inevitable and the war machines were perfectd. And Horses elephants played important role in wars. Great care was therefore bestowed on these animals. The *Arthaśāstra of Kauṭilya* lays great emphasis on conservation of elephants. The Director of Forest is to keep strict vigil on every matters relating to the forest animals and forest produce. Independent *Hastyāyurveda, Aśvāyurveda* or *Gavāyurveda* were composed in course of time and they prove that these disciplines were studied with much care:

E. Nordenskiod in his History of Biology remarked: 'The civilized people of Eastern Asia, the Hindus and Chinese, have likewise contributed very little of importance to the development of the science of biology. Hindu Science, in deed especially in the sphere of mathematics, reached a high standard'[94]. But the statement, in all probability is the result of total ignorance of the author of the exact status of knowledge of the ancient Indians regarding the living world around.

The animal remains excavated from prehistoric sites in North West India as well as animal representation on pottery, seals, figurines and toys demonstrate the familiarity of the contemporary men with the animal world. The rich yield of animal remains comes from Mohenjodaro and Harappa. The animal world to the vedic people was a part of the great cosmic sytem.

The *Saṃhitās*, the *Brāhmaṇas, the Āraṇyakyas* and *Upaniṣads* contain several names of animals as well as observations on their habits and habitats.

We get zoological information from *Pāṇini*, the *Dharmaśāstra, Suśruta Saṃhiā, Caraka-Saṃhitā, Matsyapurāṇa, Agnipurāṇa* etc. Besides, independent treatises on elephant science, equine science, cattle-science and various information relating to these animals are available in the *Arthaśāstra, Bṛhatsaṃhitā*, the *Śukranītisāra*, the *Kāmaṇḍaka Nītisāra* and the *Āryāsaptaśatī* of *Gobardhanācārya*.

Thus vast mass of Vedic and classical literature contain names of animals as well as observations on their habit and habitats. Sifting of scientific information from this vast mass of literature spread over the centuries is a difficult job, yet enumeration and comprehension of information recorded in the texts would reveal that the people of India in the past created store house of knowledge about the living world around encompassing both plants and animals which definitely founded the basis of scientific knowledge of the country in the later period. For that beginning, it would be rational to designate it as proto-scientific knowledge.

After the establishment of the institution of state, it is noteworthy, the scattered knowledges on different aspects related to plants and animals were developed into systematic branches of studies. These studies helped branching out of different sciences. Thus step by step plant science, animal science and allied sciences developed. Practical knowledge led to the formulation and adoption of conservation measures. The period from about 400 B.C. to the early Christian era saw the classification of various fields of knowledge in the form of texts. A

survey of the texts in original on agriculture, plant science as well as animal science reveal that most of the texts are divided into two broad parts, the one being speculative and the other practical. In the speculative part we find various observations regarding the influence of planets and stars. In this part, superstitious ideas are also to be included. But the binary separation of the practical from the speculative is also essential in the analysis of scientific knowledge of ancient India as Romial Thapar perceives, '... the irrational can not be dismissed or ignored'.

Thus the main objective of the present study is to trace: the origin and development of agricultural science; the plant science, and branching out of different allied sciences; the development of animal science and different ayurvedic texts on animal treatment; the dichotomy between emerging sciences and the traditional beliefs; conservation measures from above as well as from below; trans boundary exchange of knowledge and to have a glimpse of women's involvement if any.

Overview of Literature

The genesis of the current interest in the history of sciences, as it is already mentioned, may be traced to the symposium on the History of Sciences held in Delhi in 1950. The symposium emphasized the need for an integrated study of history of science in India, as a result of which the pioneering work was published under the title, 'A concise History of Science in India', New Delhi, 1971. This is an edited book by D.M. Bose *et al.* Physical sciences, Agriculture, Botany, Zoology, Medicine i.e. *Āyurveda* have been individually dealt in the book by different front ranking scientific personalities in their respective fields only with the exception of R.C. Majumdar, the renowned historian in the conventional sense.

The investigation was already started in the field of ancient botany, agriculture and horticulture by G.P. Majumdar in early decades of the 20th century. The pioneering publication in the field of plant science, its origin and gradual development was done by Madumdar, the

title being '*Vanaspati: Plants and Plant Life as in Indian Treatises and Traditions,* Calcutta University, 1927. This deals with the development of botanical science in the ancient period. The author has also tried to trace the relation between *Āyurvedic* medicine and plants in this work. The work is to be regarded as a definite mark in the history of plant science in India. G.P. Majumdar has also thrown further light on the development of botanical and allied sciences in an essay entitled 'The history of botany and allied sciences (Agriculture, medicine, Arborio-Horticulture in Ancient India C. 200 B.C. to 100 A.D.)' The essay has been incorporated in D.P. Chattopadhyaya edited *Studies in the History of Science in India* Vol. 1, 1982.

Another publication under the editorship of D.P. Chattopadhyaya is *History of Science and Technology in Ancient India — The beginnings* with a foreword by Joseph Needham is an important addition to the study of history of science and technology in ancient India. This book was published in 1986. This publication mainly deals with different sciences that developed in the First Urbanization.

The *Positive Sciences of the Ancient Hindus by* B. N. Seal (1958) is another milestone in the study of history of sciences of ancient India. There is a thorough discussion on the 'Hindu ideas about plants and plant life' and 'Hindu classification on animals'.

A note-worthy early publication on animal science in ancient India is '*Hindu Prāṇī Vigñān*' by P. Ghosal in Bengali. S. P. Ray Chandhuri's A *Short Account of the Agricultural Methods Practised in Ancient India* 1941, is an early attempt at constructing an account of agricultural practices in ancient India.

As in plant science, G.P. Majumdar is the pioneer also in the field of rediscovering the agricultural heritage of ancient India. He and the well-known Indologist S.C. Banerjee spent their full academic energy to bring out the Sanskrit text and translation of the important agricultural work *Kṛṣiparāśara.* The text was published in 1960 by the Asiatic Society in *Bibliotheca Indica Series* No. 285.

S.C. Banerjee's *Flora and Fauna in Sanskrit Liteature* (1980) is a mentionable addition to the study of animal and plant science. In this book the author has given different names and features of the plants as well as of the animals. The topics like morphology, plant physiology, taxonomy and ecology have been dealt with in the book.

Hastyāyurveda, Aśvśāstra, Pisciculture and Ornithology have been incorporated in the faunal section. O.P. Jaggi published in 1969 his series dealing with science and technology under the title *History of Science and Tecnology in India.* The series contains the following volumes:

1. Dawn of Indian Technology : Pre and Proto-historic Period, 1969.
2. Dawn of Indian Science: Vedic and Upaniṣadic Period. 1969.
3. Folk Medicine, 1973.
4. Indian System of Medicine, 1973.

These volumes are indeed milestones in the study of natural sciences in ancient India covering agriculture, plants, animals, medicines etc.

The Cultural Heritage of India, Vol. VI was published under the editorship of P.R. Ray and S.N. Sen in 1986. This is a comprehensive account of science and technology in India covering the whole span of Indian history from ancient to modern periods.

P. Sen Sharma's *Ethnobiological Information in Kauṭilya's Arthaśāstra* (1998) is an absolutely new venture among the volumes on *Arthaśāstra.* As a botanist, he has tried to extract scientific information from this encyclopedic text.

A socio-economic perspective of ecological history of India and prudence and profligacy on nature have been dealt by Gadgil and Guha in 'This Fissured Land: An Ecological History of India (1993).

The Asian Agri-History Foundation has published a voluminous book, the title being *Glimpses of the Agricultural heritage of India* (2007) under the editorship of Y.L. Nene.

It has covered a wider area of agricultural practices and animal management during the ancient and the medieval period.

Besides, a number of original manuscripts in Sanskrit, old *Kannaḍa,* Old *Mālayālam,* and Persian have been published with their English translations under the initiative of the organization. Most of the manuscripts are yet to be used for reconstructing the history of agricultural and plant science of India.

Illustrated manuscripts written both in Sanskrit and Marathi on elephants and horses are available in the Sarasvathi Mahal Library, Tanjore. The manuscript collection of Sarasvathi Mahal Library is quite a legion.

Aśvaśāstra was edited with English notes by S. Gopalan (1952). Manuscripts on horse-lore are available both in Sanskrit and Marathi. An American author F. Edgerton used manuscript of this library on elephant in his work *Mātaṅga Līlā. Hastyāyurveda of Pālakāpya* and illustrated *Gajaśāstra Prabandha* of Raja Serfoji Bhonsle are in the custody of this library. This collection offers rich quarry to those who want to specialize on the subject. The role of the Government Oriental Manuscripts Library, Madras also is inspiring. The publications of manuscripts under the title *Madras Government Oriental Series* helped in the advancement of studies in the history of Scientific literature.

Some other manuscripts which are essential for construction of the account of scientific knowledge in ancient period are lying in the custody of Adyar Government Oriental Manuscript Library i.e. Library, Chennai; Rajasthan Prachya Vidya Pratishthan or in some museums, both famous and less known. The *Kāmarupa Anusandhān Samiti,* Guwahati and Department of Historical and Antiquarian Studies, Government of Assam have taken much initiative in documenting indigenous traditional knowledge. Society for Appropriate Technology, Guwahati now is working in this field. The *Hastividyārṇava* and *Ghorā Nidān* are the best examples of development of material culture in the north eastern part of India.

Besides, a number of notable publications in different journals has thrown much light on many issues related in one or other way to the theme of this research project.

Mention may be made of the following articles: Animals in the inscriptions of Piyadasi (1906) by M. Chakravarti; Sanskrit names of fish and their significance (1948) by S.L. Hora; Knowledge of the ancient Hindus concerning fish and fisheries of India: Fishery Legislation in *Aśoka's* Pillar Edict V (1950) by S.L. Hora. References of the articles like, 'An Introduction to the *Vṛkṣāyurveda* of *Parāśara*' (1950) by N.N. Sircar; 'Forestry in ancient India' (1964) by C.D. Chatterjee are to be added.

The environment related issues became a much discussed area since 1972 at international level when the United Nations Conference on Human Environment Was held in Stockholm. Increasing concern for environment took a definite shape when the Earth Summit was held in 1992 in Rio de Janeiro.

This conference, which is known as United Nations Conference on Environment and Development though failed to reach any consensus among the countries belonging to different tiers of economic development, it created a deep impression through out the world for environmental studies. The objective of the Earth Summit was to outline the goal of sustainable development which means 'development for meeting the needs of the present without compromising the ability of the future generations to meet their own needs'[15]. Thus the issue of protection and conservation transcends the boundary of science and involves the scholars in social Sciences for investigating and rediscovering the tradition of the country for the benefit of the future. Consequently, a series of publications on environment and other related problems is visible since 1990s. A few of such article are: India's concept of environment and concern for nature (1994) R.R. Mukherjee; Nature and Environment in *Kauṭily's Arthaśāstra* (1994) by R. Ghosh Ray; Personal hygiene, Public Health and Environmental Science in *Caraka Saṃhitā* (1995) by M. Saha.

Environment and Identity in the Indian Historical Context: An initial vision (1994) by A. Bandopadhyay and Towards an understanding of the environmental history of India (1994) by the same author; Forest policy of the Mauryas: an ecological perspective (1996-1997) by Sukla Das is also an important addition. Some writings of course are essentially concerned with colonial period in India.

Thus it stands that the historians are seriously concerned with the task of retrospection, which may define the niche of achievements, find out the lacuna in the process and thereby suggest a direction towards advancement.

References

1. Thapar, R., *Interpreting Early India,* Oxford University Press, Delhi, 1995, p.2.
2. *Time Past and Time Present : Two hundred and Twenty Five Years of the Asiatic Society,* The Asiatic Society, Kolkata, 2008, p. 20.
3. *Ibid.*
4. *Ibid.*, p. 7
5. Bose, D.M.; Sen, S.N.; Subbarayappa B.V. (ed.) *A Concise History of Science in India,* Indian National Sciene Acadmy, New Delhi, 1989, p.V. (Henceforth will be written as ACASI).
6. Thapar, R., History of Science and the Oikoumene in S. Irfan Habib and D. Raina (ed). *Situating the History of Science: Dialogues with Joseph Needham,* Oxford University Press, New Delhi, 1999, pp. 16-28.
7. *Ibid.*
8. Gadgil, M.; Guha, R.C., *This Fissured Land: An Ecological History of India,* Oxford University Press, Delhi 1993, p. 30.

9. Calder, R., *The Inheritors: The Story of Man and the World He Made,* Heinemann, London, 1961, p. 36.

10. Randhawa, M.S.; Singh, J., Dey, A.K.; Mittre, V.; *Evolution of Life.* Publication and Information Directorate. New Delhi, 1969, p. 281.

11. *Ibid.*

12. Bernal, J.D. : *Science in History,* Vol. I, London, 1969, p. 92.

13. Chakraborti, D.K.: The patterns and problems in the history of crops in N. Lahiri (ed.) *The Decline and Fall of the Indus Civilization,* Permanent Black, Delhi, 2000, p. 365.

14. Bhaduri, J.L., Tiwari, K. K. and Biswas, B., Zoology in ACHSI, pp.403-444.

15. Mukherjee, R.G., Change in human attitude and that of business houses in P. K. Saha and A. K. Chakraborty (ed.) *Environmental Studies,* Allied Publishers Limited, Calcutta, 2000, p. 133.