**Review of the Book**

# Animal Science and Plant Science in Ancient India And Her Conservation Ethics

**By**

**Professor (Dr.) Anita Bagchi.**

**Dr. Tapas Kr. Chatterjee****

## Part A

In recent years, there is a well-coordinated programme by a group of scholars to present the history of Science and Technology in the Indian sub-continent, as it has evolved over thousands of years through researches of the great minds, in a motivated template endowed with a high degree of sectarianism and orthodoxy. They refuse to appreciate that science is an evolving discipline and culture. It advances step by step drawing experiences of discoveries, innovations, analysis and interpretations from the past to generate new knowledge which in turn may become obsolete with fresh discoveries. There can not be any sort of a 'great leap forward' in scientific outlook. This school seem to be unwilling to adopt an attitude of critical thinking and prefer to live in a world where mythology is not disentangled from science. In recent years, the sessions of Indian National Science Congress are utilised by this camp to propagate their theories and bizarre presentations of unscientific claims, casting a slur on the prestige and glory of the Science Congress that had a rich legacy due to its association with some of India's finest minds in the sciences.

In this context, that there is a need to appraise and appreciate the history of science in India from the period of pre-history and its journey as it has evolved over centuries of observation, investigation, analysis, research and interpretation by thousands of our great ancestors endowed with rational minds towards observation of the physical reality and attempts to analyse the findings in a dispassionate manner.

Till a few decades ago, there had been an impression, deeply embedded in the minds of educated people in India and elsewhere, that science started only in Europe. During academic conclaves, the Alchemists of Arab countries were occasionally mentioned but there were very few references to India which is known as a great and ancient civilization. However, thanks to the work done by the Indian National Science Academy and several other learned bodies and researchers, the development of science & technology and discoveries during the ancient period in India is now well documented. It has drawn attention of scholars to appraise and appreciate that India has consistently been a country that promoted science and scientific enquiries over past centuries. The knowledge acquired through researches

made in the ancient period, even around 10,000 BCE, in disciplines as diverse as Mathematics, Astronomy, Medicine, Surgery, Ayurveda, Metallurgy, Architectural & Civil Engineering and others have drawn attention of ardent scholars across the world. In fact, we do not find example of yet another civilization except ancient Greece which accorded the same exalted place to generation of new knowledge as science as did that of India. Al-Andalust, the legendary Arab astronomer and historian of science of 11th CE described in detail in his famous Book "Kitab Tabakat al-Umam" the great contributions made by India. An extract of the English translation is quoted here "The first nation which cultivated the sciences is that of the Indians. The nation itself is extremely important, diverse, and is made of powerful kingdoms. It is known for its wisdom and all people and all generations gone by testify that it was distinguished in the various branches of knowledge. -- -- The Indian civilization, among all nations, through the centuries and since antiquity, was the source of wisdom, justice and moderation. They were people of stabilising virtues, creators of sublime thought, universal fables, rare inventions and remarkable flashes of wit." ( Translated into French from Arabic by Regis Blachere, Paris, 1935, pp 35, 43-44 ).

On the other hand, the approach to examine the history of science in India and how it has evolved over centuries has a flip side. There is an extreme position to exaggerate the scientific discoveries claimed to have been achieved in ancient India, even in pre-historic period and present these in ultra-nationalist manner. In recent years, a handful of scholars, academicians even a few scientists, are propagating that highly developed scientific knowledge at par with those discovered just in recent years like stem cell research, ballistic missiles, aviation and aeronautics, plastic surgery, gravitational theory, quantum mechanics etc. were mastered by our ancestors even hundreds and thousands of years ago. This group has been organising seminars and conclaves where only those who bear a similar bent of mind and outlook and concur with their notion of religious glory are invited. They refuse to appreciate that science is an evolving discipline and culture. It advances step by step drawing experiences of innovations from the past to generate new knowledge. There can not be any sort of 'great leap forward' in scientific outlook. They seem to be unwilling to adopt an attitude of critical thinking, and prefer to live in a world steeped in orthodoxy, unable to disentangle mythology from science, and, unfortunately, are susceptible to rumours. In recent years, the sessions of Indian National Science Congress (INSC) are utilised by them to propagate their "theories and bizarre presentations of unscientific claims, casting a slur on the prestige and glory of the Science Congress that had a rich legacy due to its association with some of India's finest minds in the sciences. Let us refer to some claims presented in the 106th Session of INSC. Prof. Nageswara Rao, V.C. of Andhra University, made the following assertions: "Kauravas were born due to stem cell and test tube technologies. Lord Rama used 'astras' and 'shastras' while Lord Vishnu sent a Sudarshan Chakra to chase targets. This shows that the science of guided missiles was present in India thousands of years ago. Ravana didn't just have the Pushpak Vinama but had 24 types of aircraft and airports in Lanka." Another person, Kannan J Krishnan, declared that Newton and Einstein had little knowledge about physics, and they misled the world with their theories. He claimed that his own theory of gravitational phenomenon will be proved more correct and when it is accepted,

what the world now knows as gravitational waves would be named as "Narendra Modi Waves", and the gravitational lensing would be known as "Harsh Vardhan Effect". It is absolutely distressing that these claims were made in the Children Science Congress section of INSC where the audience was largely comprised of teachers and young students. Besides these outrageous demands, (i) there have been " Papers" for existence of Dinosaurs in India mentioned in the Vedas by "Brahma", (ii) theories of gravitation, Newton's Laws and Einstein's theories and equations of mass & energy known even during pre-veda or ancient India (iii) knowledge of Nuclear and Hydrogen Bombs and atomic energy during the periods in which Ramayana and Mahabharata were written.

Earlier in 2016, Dr. Satya Pal Singh, Minister of State for HRD, Govt. of India, called for Charles Darwin's theory of evolution to be removed from textbooks. He thundered "Nobody, including our ancestors, in written or oral, have said that they had ever seen an ape turning into a man," and reasoned publicly, "No books we have read or the tales told to us by our grandparents had such a mention." There are many more unthinkable claims too. Recently, in a Seminar at Mumbai organised by a group called "Bharatam Reawakening," the so-called scientist participants aimed to glorify India's past and the contributions of their ancestors to the world, even if it means taking a detour into the fantastic and the unlikely. The talk itself was titled "*Vaimanika Shastra*," which means "Aeronautical Science" in Sanskrit, and at its heart is the claim that an ancient Indian civilization had developed aeronautical technology centuries before the Wright Brothers flew their first plane. A small but significant number of Indians believe that the mention of flying vehicles in Indian mythology is evidence that such technology was already created by their ancestors. ( 3). It's just one of numerous fantastical ideas, fueled by a toxic mix of misinformation and brewing Indian nationalism, that have long percolated through Indian society. In the northwestern city of Jodhpur, one such theory suggests, there is ample evidence of an ancient nuclear war. And even the country's own prime minister, Narendra Modi, the Prime Minister of India placed a query whether the head of the Hindu God Ganesha, depicted as having the head of an elephant and the body of a human, provides evidence that even thousands of centuries ago, the ancient Indian doctors had mastered cosmetic surgery. Such a severely anti-science and bizarre proposition notwithstanding, such stories have generally been banished to the scientific fringe. But the Mumbai event, which included among its speakers Prahlada Ramarao, the former Chief Controller of India's leading military research agency, suggested that these ideas are now creeping perilously close to mainstream scientific circles. The organisers started the session that day by saying 'Our religion is in deep trouble". That itself was an indication of where this talk was leading, said Rohini Karandikar, a post-doctoral fellow at Homi Bhabha Center for Science Education (HBCSE) and a member of a group of Indian activists calling for an end to these sorts of superstitions and conspiracy theories.

It is to be noted that the camp propagating the so-called glory of science in ancient periods call it "Indian Science" ignoring the fact that Science, as the proven truth, is universal. The scientific community in the country is anguished by this type of nonsense being allowed to be presented in the INSC. No wonder that Nobel Laureate Venki Ramakrishnan termed INSC as a 'circus'. Bharat Ratna Professor C.N.R. Rao said that he has stopped attending

INSC Sessions, lest he be considered as supporting these bizarre, nonsense and absurd ideas of pseudoscience.

The trends mentioned above, have worried many academics. As India becomes increasingly polarized, coordinated efforts to popularize pseudoscientific theories, and to aggrandize the nation's own scientific past, have begun to gain ground, they say. It's a worrying mash-up of nationalism, religion, and scientific bunkum that appears to be an increasingly easy sell and one that leaves the population both misinformed and perennially at odds with itself. The narratives and irrational claims have been strongly opposed and refuted by the scientific community in India but advocates for rationalism in the country warn that more such endeavours will follow.

It is in this context, that it is considered necessary and pertinent to present the history of science in India as it has evolved over centuries of observation, investigation, analysis, research and interpretation by thousands of our ancestors having rational minds. As knowledge in India was traditionally transmitted orally rather than by written word, a connected and well-dated account of the development of science in India can only be constructed through archaeological findings and scanning the vast range of Sanskrit literature from Vedic times and those of Buddhist, Jainas, Arabic and Persian works to compile the learned researches from early to ancient times.

It is in this context that the Book of Professor Bagchi is an outstanding chronicle that captures the advent and progress of Science in India over hundreds of years since the ancient period.

However, before we look into the Book and present it's contents, let us relook at the History of Science in India from Ancient to Early Modern Period ( 15,00,00 BCE to 1526 CE ). Let us, at the outset, classify the past civilisations, that existed in the Indian subcontinent within the Period under consideration :

1. Stone Age ( proto-history & pre-history, 15,00,00 BCE - 3300BCE )
2. Bronze Age ( protohistory,3300 - 1400 BCE )
3. Iron Age ( 1400 BCE -1000 BCE /1000 BC - 1100 CE ) comprising two eras, namely (a) Vedic Period (1400 -1000 BCE ) and (b) Post-Vedic Period (1000 BCE - 1100 CE ). Within this time scale, existed the Maurya Empire ( 185 – 320 BCE ), known as the Golden Age of India marked by extensive inventions and discoveries in science, technology, engineering, art, dialectic, literature, logic, mathematics, astronomy, religion and culture. This phase consisted of Chandragupta followed by Asoka ( 270 BCE.),
4. Gupta Empire ( 321 - 550 CE ) called the: peak of golden age of science in India.
5. Mughal Empire ( 1520 – 1757 CE )

6. British Colony ( 1757 – 1947 CE )

A long period of history of the Indian subcontinent, outlined above under sl.no. 3-4, is known as Medieval India covering the timeline 8 CE to 16 CE, essentially the same period as the Middle Ages of Europe. This period may be divided into two parts : the 'early medieval period' which lasted from the 6th to the 13th CE and the 'late medieval period' which lasted from the 13th to the 16th CE, ending with the start of the Mughal Empire in 1526. The Mughal era, from the 16th to the 18th CE, is often referred to as the early modern period but is sometimes also included in the 'late medieval' period.

## 1.1. Science in the Stone Age

During the pre-historic period In the Stone Age ( 15,00,00 – 5500 BCE), there are evidences of hand-axe, cleaver and core tools (Early Stone Age). Flakes including scrappers, burins and blades (Middle Stone Age) and microliths of various types ( Late Stone Age ). The sites of the Stone Age are (i) Sohan and Beas valley in Punjab (ii) Adamgarh Hill and Bhera Ghat near Jabalpur in Narmada valley (iii) Gudiyam cave at Attirampakkam near Madras (iv) Wainganga River sites (v) Nevasa on the Godavari, Khandivli near Bombay etc. The Proto- Historic Period ( 5500 BCE- 3300 BCE), is that corresponding to the time prior to advent of written documents and is known as neolithic-calcholithic period. In this Age, they had knowledge of (i) Plants and Animals, as evidenced by Haematite drawings in caves or sheltered rocks of Vindhya Hills, Kaimur Hills and elsewhere (ii) hand-made Pottery ( finds in the pre-historic rock shelter) and (iii) wheel and wheel - thrown pottery ( finds in Neolithic settlements).

## 2.1 Science in the Bronze Age

The Bronze Age in the Indian subcontinent began around 3300 BCE with the early Indus Valley Civilization. It was centered on the Indus River and its tributaries which extended into the Ghaggar-Hakra River valley, the Ganges-Yamuna Doab, Gujarat, and Southeastern Afghanistan. The civilization is primarily located in modern-day India (Gujarat, Haryana, Punjab and Rajasthan provinces) and Pakistan (Sindh, Punjab, and Balochistan provinces). Historically part of Ancient India, it is one of the world's earliest urban civilizations, along with Mesopotamia and Ancient Egypt. Inhabitants of the ancient Indus river valley, the Harappans, developed new techniques in metallurgy and handicraft (carneol products, seal carving), and produced copper, bronze, lead, and tin. The Mature Indus civilization flourished from about 2600 to 1900 BCE, marking the beginning of urban civilization on the subcontinent. The civilization included urban centers such as Dholavira, Kalibangan, Rupar, Rakhigarhi, and Lothal in modern-day India, and Harappa, Ganeriwala, and Mohenjo-daro in modern-day Pakistan. The civilization is noted for its cities built of brick, roadside drainage system, and multistoried houses.

During the period of the Harappan (and Mohenjo-daro) culture *( Indus Valley civilization), there were established sea- borne trade* . Commercial and cultural links were set up with the neighboring central and western Asia *(Mesopotamia)* regions. They had developed Irrigation, Agriculture, Farms, Crafts, Industry, Glazed pottery, Metallic tools of copper and bronze, knowledge of minerals, Social sanitation and public hygiene town planning and urban livings/ spinning and weaving and brick-and-mortar constructions. Thick red-slipped ware in cylindrical and goblet shapes, intersecting circles, pipal leaves, rosettes, peacocks, triangular terracotta cakes etc. were in use. Even such advanced utilities like western toilets, sewerage, drainage, plumbing, weights & measures, calibration, deep-sea dock ( Lothal-2400BC), ovens and furnaces for ceramics, kilns, cartography, plough and metal swords were used by the dwelling population.

### 3.1 Science in the Iron Age ( Vedic and Post-Vedic Period )

The discoveries made by our ancient scientists in this period ( 1400 BCE -1000 BCE /1000 BC - 1100 CE ) can be highlighted by mentioning the following disciplines in which remarkable and pioneering researches were done :

**Mathematics and Astronomy / Metallurgy, Chemistry and Medicine ( Use of Copper, Bronze and Iron in Ancient India ) / Geography / Architectural Engineering .**

**Part B**

In the backdrop of the perspective of the historical evolution of the Sciences in India, as presented above, let us now review the Book written by Professor (Dr.) Bagchi (37). Dr. Malaysankar Bhattacharya, Editor of The Historical Review, Indian Institute of Oriental Studies and Research, Kolkata and is an acclaimed senior archeologist, Historian and a respected Author of Books & journals of historical research, has written the Foreword of the Book.

Precursor to the learned work under consideration, are the investigations into the Indian past that began with works of the Indologists. They were mostly European scholars and their main area of study was language. Sanskrit language rendered practically the main source material for reconstruction of ancient Indian society ( 38).They paid great attention to study of general history of our past that covered political, economic as well as social lives. Religious, cultural and artistic activities also came under purview. But achievements of the ancient Indian people in the branch of science and technology remained ignored. The scholars associated with the Asiatic Society deserve the credit to bring to light contributions of Indian Science in antiquities. We may mention numerous Articles published in Journals like the "Mathematical Sciences of the Hindus"( 39). It was rightly pointed out that despite

continuity of religious and spiritual concepts in India, science was not ignored or relegated to the limbo (40). Discovery of manuscripts, patient analysis of these precious texts and co-relation with relic of antiquity by great scholars like Anquetil du perron, Sir William Jones and others paved newer areas of research ( 40). Essays on Mathematical and Physical Sciences were published in ten volumes (40). Such learned Essays as R. Burrow's " A Proof that the Hindus had the Binomial Theorem", eassays by John Playfair, W. Hunter, H.T. Colebrook and others on Hindu and Arabic Science made it abundantly clear that the Asiatic civilization possessed a rich scientific heritage (40).

In 1950, the first attempt to collate the historical achievements was made by UNESCO and INSA by organizing a Symposium at Delhi on " History of Sciences in S.E. Asia". An outcome of this conclave was the Book " a Concise History of Science in India". In the preface, the Editors remarked "Despite vicissitudes in intellectual and scientific endeavors and period of stagnation, e.g., about the time of 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"(3). Yet another exemplary research is found in Articles / Papers in the edited volume (41) in which Romila Thapar has defined the method of writing the history of science by saying that the concerned historians tend to view science from two perspectives – one, the linear projection of the evolution of particular disciplines regarded as scientific and another, to view science as culture and as part of the social formation.

The Book ( 37) is a monumental work to capture the studies and researches by hundreds of scholars in ancient India in the domain of plant science and animal science together with heightened concern of our ancestors for protection and conservation of mother nature.

At the outset, in the Chapter I itself, the purpose and objective of writing the Book has been aptly reflected in a Quote from the legendary Scientist J.D. Bernal :

" 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".

The Author has structured the Book in the following way :

It is comprised of eight ( VIII ) Chapters. There is, at the outset, a General Introduction in Chapter I and in subsequent seven other Chapters are presented a vast, deep and an amazing scale of research on Agricultural Science (Chapter II), Origin and Development of Plant Science ( Chapter III), Animal Science ( Chapter IV ), Attitude and Conservation Measures ( Chapter V ), Involvement of Women ( Chapter

VI ), Transboundary Exchange of Knowledge ( Chapter VII ) and a Concluding Chapter ( Chapter VII ) besides a Section that incorporates an enviable Bibliography of ten (10 ) pages delved on numerous primary and secondary sources.

There are six Tables, namely, The distribution of rainfall according to geographical location ( Table I ), Plant Species as referred in Rigveda (Table II ), Plant Species as referred in *Satapatha Brahmana* of 6$^{th}$ century B.C. ( Table III ), Crops for cultivation ( Table IV ), Propagation methods recommended for different plants in different texts ( Table V ) and Distance between two Plants recommended in different texts for plantation ( Table VI). There are also 25 photo of archeological evidences presented under Figures I to XXV from varied primary sources like Mohenjo-Daro ( seven ), *Nakula's Asva Sastra* ( seven ), *Hastividyarnava* ( ten *)* and one such Figure from various ancient texts depicting presumptive forest tracts in ancient India.

The human civilization since inception is intimately associated with plant and animal world. The climatic changes at the receding of glaciers, during 10,000 years B.C ., led to a terrible food crisis. This crisis very likely prompted the hunters and gathering people to domesticate animals and cultivate plants. (42). Almost certainly the first animal to be domesticated was the dog which was to become Man's comrade in hunting processes (43 ). With progressive domestication of animals, ways were made for evolution from a hunting society to a pastoral society, still nomadic but with sources of food under human directions and control. Archeological evidences indicate that the first domestication of two major cereals like wheat and barley and domestication of sheep, goat and cattle in Western Asia (44). Horse, Ass, camel and Ilma appear to be late comers in domestication process. This provided the stimulus for beginning of agricultural and animal husbandry.

When we speak of Neolithic Revolution, it implies major changes in food production techniques giving men a control over the environment and relief from uncertainties of hunting and gathering. Thus started the period of cultivation of seed-giving grasses and farming of wild grains (44). J.D. Bernal regarded these as a few momentous inventions in human history (45). In contrast to Indian archeological data on crops being inadequate for a coherent agricultural history (46), a more comprehensive history of cultivated plants was reconstructed by discovery of carbonized seeds and impressions on potsherds found in excavations of Indus Valley region (46 ). Various references pertaining to agriculture in Rgveda, Atharvaveda, Taittriya and Vajasaneyi Samhita bring out that the progress made in the Vedic period (46). In post-vedic Age, there are references in Sanskrit literature and commentaries which bear eloquent testimony to more widespread use of plants and animals. The Vrksayurveda of Parasara written presumably in pre-Buddhist period offer more insight (46).The Arthasastra, Brhatsamhita and Agnipurana have each a section on plant science which indicate that a separate Vrkayurveda had been in

existence. In Vatsayana's Kamasutra, Vrkayurveda is mentioned as one of the 54 arts recognised in ancient India. These texts and some other works provide plenty of evidence regarding knowledge of plants and plant as distinct science. Concurrently, rudimentary science also came into existence dealing with animals in as much as without cattle agriculture is not conceivable. Gradually, with wars and other conflicts among empires, war machines started using elephants, horses to play important roles. The Arthasastra of Kautilya lays great emphasis on conservation of elephants, forest produce and forest animals. Texts like Hastyayurveda, Asvayurveda , Gavayurveda were composed in due course of time and provide more evidence of animal life and animal science (46).

The author presented results of an extensive research conducted by her based on literature survey and archival secondary data to highlight the remarkable history of science in the ancient period ( 47 – 49). The findings start with Chapter II laying an exhaustive description of Agricultural Practices. The Chapter is split into two Sections, namely, Early Period comprising Vedic and Post-Vedic Periods ( 4700 till 400 B.C.) and Later Period ( 400 B.C. to 700 A.D. ). In Section I, the author has cited archeological evidences and archeo-botanical investigations of the Harappan or Indus Valley Civilization ( 3200-2500 B.C. ). We find detailed discussion on "Advent of the Aryans : Beginning of the Study of Indian Flora by the Aryans" ( 2300- 1750 B.C. ) and decline of the Harappan era in about 1750 B.C. The Aryans were careful observers of flora and fauna of the newly acquired territory. Rigveda Samhita illustrate the achievements made by the Vedia Aryans. In the post-vedic period, the political unification brought about by monarchs of Magadha contributed a great deal to development of Agriculture. This Section refers to sources like Santiparva of Mahabharata and Arthasastra by Kautilya. Section II ( later Period ) cites references like Brhatsamhita by Varahamihira in which cultivation of crops, cereals, corns, pulses, oil seeds and rice of varieties like Sali, Kalamsali, Yavaka, Sukaraka, Sastika, Raktasali, Panduka, Gaurasali and Nispava have been described. Even fibrous plants like cotton, hemp, linseed, sugar cane were produced in large scale during this era. Carasamhita, Susruta Samhita, Bhavaprakasha, Sutrusthana, Krsiparasara, Parasa, Kasasyapiyakusisrkti, Krsi-Gita, Meghamuni and other textx have been analysed to present the history of cultivation and scientific processes and practices by the population.
Chapter II lists 56 references.

Chapter III describes Origin and Development of Plant Science and is divided into two Sections. Section I depicts the Early Phase ( 1700-1550 A.D.) containing 52 references. The other Section titled Later Phase cited 43 references. The Section described Types of Plants, Seed Treatment, Constellation of Sowing, Distance between Plants, Designing and Layout of fields, Watering, Nourishment and Horticulture Wonders.

Chapter IV presented Animal Science comprising discussions about Advent of th Background or Contexe Ayans, Horse and Kine, Birth of Imperialism and its Effects on studies of Animals and their Habitats and 94 references.

Chapter V highlighted Attitude and Conservation Measures comprising discussions about a treatise on Advent of the Ayans, Protection and Conservation Measures. The latter consisting of discussions on the roles of King Asoka on protection and conservation, Scripture Dicta of the ancient Hindus, Manu on plant protection, Agnipurana, Manu and Visnu on Animala, extent of forests, Feudal grants and the context of forests, Protection / conservation of Plants by Punya Enticement, Conservation from below and 68 references.

Chapter VI dealt with involvement of the Women in agriculture and horticulture of extensive information collected and based on 29 references.

Chapter VII is on Transboundary Exchange of Knowledge. It is well documented that throughout the ages, India maintained her trade relations overland and by sea with Western Asia, Greece , Rome, Egypt and China and the East. This connection resulted in exchange of ideas and scientific data. One can find new art styles like the Gandhara School of Art and knowledge of medicine and medical herbs. India had monopoly of export in pepper, cinnamon, edible spices to Europe. The imports included commodities like tin, leads, glass, amber etc. The Baveru-jataka, Digha Nikaya of Sutta - Pitaka ( 50-52). This Chapter concluded with 25 references.

Next comes the Concluding Section ( Chapter VII.). Thereafter comes the Section on Bibliography consisting of 44 primary sources and as many as 245 secondary sources. There are Glossary, Index and illustrations in color ( 25 such ).

We will like to mention the information detailed out in Chapter V on " Attitude and Conservation Measures" in ancient India in view of the grave environmental degradation seen all around us at present and the kernel of environmental studies. 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. These scriptural messages were aimed to create a congenial atmosphere for the living world. It was clearly underscored that any profligacy in using nature's wealth will be perilous to the very existence of humans and injurious to all components of nature. Contributions of the early thinkers and activists have been presented exhaustively in pp123 -150 with 68 references.

**Part C**

At one point of time, the generally accepted corollary was that the history of science since antiquity had essentially been a European legacy ( Gregory Blue, 2001). A paradigm shift in this assumption began to emerge among historians with import of new humanism of George Sarton who argued explicitly against Euro-Centrism and discussed scientific developments in other civilizations, mostly of Asia and North Africa ( 53). Needham (54) countered the conventional notion of western monopoly and he made an exhaustive study of non-western contributions in evolution of science and indigenous traditions in non-European countries. However, these studies did not cover the scientific knowledge and practices in India. One had to wait for the Orientalists, Nationalists and the Positivists and, of course, the pioneering researches and presentations by the great J.D. Bernal ( 55).

The indigenous strength of India and her cumulative traditions of knowledge are stored in different texts and treatises. Archeological evidences give clear clue to the scientific and technological development both in qualitative and quantitative terms. Childe referred to the transition of early societies to agriculture as Neolithic Revolution ( 56 - 57 ). Among food grains, only Yava is mentioned in Rgveda, rice in Atharvaveda. Use of various types of rice such as plasuka, asu, hayana etc. is evidenced by the Satapatha Brahmana. Samhitas, Brahmanas, Aranyakas and Upanishads bear ample testimony to progressive extension of knowledge in material culture. Agricultural pursuits definitely made much progress in later phase of Vedic Period.

Growing acquaintance with plant life is reflected in appreciation of medicinal properties of plants. In the Atharvaveda, different herbs and plants are highly praised for their medicinal values. Selection of the edible varities was an outcome of long experience. We come across exceedingly discernible science-potential of the contemporary people like “order of the universe” and instinctive awareness of a primordial complex of natural order as well as of social order. Later, with the emergence of kingship, these scattered but viable knowledge obtained through observations and experience came to be codified and emerged as systematic branch of studies. Experiments began to be performed to validate empirical and theoretical knowledge. Texts were written to record organized knowledge systems. Royal Courts extended support for documentation works. Thus flourished different branches of science gradually. The rulers also patronized veterinary sciences pertaining to health of elephants and horses being indispensable part of the army, defender of the state. The comprehensive treaties of Kautilya may be cited in this respect. Thus developed Krsisastra, Vrksayurveda, Hastyayurveda and others as series of texts written in Sanskrit and also in many regional languages of India through the centuries. For example, Lokopakara in old Kannada, Krsigita in old Malayalam, Hastividyarnava in Tai-Ahom, Ghora Nidan in old Assamese scripts and Gajasastraprabandha in Marathi.

In this way, the Book under Review trails the emergence, growth and written texts in relation to a profuse and vast history of animal and plant sciences in ancient India and their conservation ethics.

**References**


1. History of Indian Science by Dr.P.Priyadarshi, MBBS, MD, FRCP, https://iitk.ac.in/vs/vs/rs/downloads/premendra_talk.pdf.
2. Acharya , P. K ., Dictionary of Hindu Architecture. London, 1927.
3. Bose , D. M ., Sen , S. N., and Subbarayappa , B. V. (Eds.), A Concise History o f Science in India. Indian National Science Academy, New Delhi, 1971.
4. Chatterji, Sunm Kumar (Ed.), The Cultural Heritage o f India. Vol. V. The Ramakrishna Mission Institute of Culture, Calcutta, 1978.
5. Chattopadhyaya , Debiprasad (Ed.), Studies in the History of Science in India (2 Vols.). Editorial Enterprises, New Delhi, 1982.
6. Dampier, W. C., History of Science and its Relations with Philosophy and Religion. 4th Edn. Cam bridge, 1961.
7. Haldane , J . B. S., Science and Indian Culture. New Age Publishers Pvt. L td., Calcutta, 1965.
8. Frawley, D., Planets in the Vedic literature, Indian Journal of History of Science. 29. 1994.
9. B Datta and A N Singh, History of Hindu Mathematics: A Source Book, Parts 1 and 2 (single volume), Asia Publishing House, Bombay, 1962.
10. George G Joseph, Crest of the Peacock, Non-European roots of mathematics, Third edition, Princeton University Press, Princeton, NJ, 2011.
11. Agrawal, D. P. and Ghosh, A. (eds.)., The Copper- bronze Age in India. Munshiram Manoharlal, New Delhi, 1971.
12. Agrawal, D.P., Ancient Metal Technology and Archaeology of South Asia (A Pan-Asian Perspective), Aryan Books International, New Delhi, 2000.
13. Balasubramaniam, R., Marvels of Indian Iron through the Ages, Rupa & Infinity Foundation, New Delhi, 2008.
14. Bhardwaj, H. C., Aspects of Ancient Indian Technology, Munshiram Manoharlal, New Delhi, 1979.
15. Biswas, A. Kumar., Minerals and Metals in Ancient India, D.K. Printworld, New Delhi, 1996.
16. Elgood, C., Medicine in India, New York, 1934.
17. Ashri, S.B., Delhi‘s Jantar Mantar Observatory, New Delhi, 2005
18. Volwahsen, Andreas., Cosmic Architecture of India, Astronomical Monuments of Jai Singh, London, 2001.
19. Bhatnagar, V.S., Life and times of Sawai Jai Singh, Delhi, 1974.
20. Al-Hasan, A.Y., Science & Technology in Islam, UNESCO, 2001.
21. Mukhopadhyaya , G. N., History o f Indian Medicine (3 Vols.). Calcutta University, 1923.
22. Jaggi, O. P., Science and Technology in Medieval India. Atma Ram & Sons, Delhi, 1977.

23. Taton , Rene (Ed.), History of Science: Ancient Medieval Science from the Beginnings to 1450. Translation, Thames & Hudson, London, 1963.
24. Agrawala , V.S., India as Known to Panini, Lucknow University, 1953.
25. Cunningham , Alexander , The Ancient Geography o f India. Indological Book House, Varanasi, 1963.
26. Dey, N. L., The Geographical Dictionary of Ancient and Medieval India. Luzac and Co., London, 1927.
27. Law, B. C., Geographical Essays Relating to Ancient Geography o f India. Bharatiya Publishing House, Varanasi, 1976.
28. Law, B. C., Historical Geography of Ancient India. Paris, 1954.
29. Nainar, M. H., Arab Geographer's Knowledge o f Southern India. University of Madras, 1942.
30. Sinoii, M. R., A Critical Study o f the Geographical Data in the Early Puranas. Punthi Pustak, Calcutta, 1972.
31. Sircar , D.C., Cosmography and Geography in Early Indian Literature. Indian Studies, Calcutta, 1967.
32. Sircar , D.C., Studies in the Geography of Ancient and Medieval India. Motilal Banarsidass, Varanasi, I960.
33. S. M. Ali, Geography o f the Puranas. People's Publishing House, New Delhi, 1966.
34. Upadhyaya , B. S., India in Kalidasa. S. Chand and Co., Calcutta, 1968.
35. Chakravarti, Ranbir., _Agricultural Technology in Medieval India', The Medieval History Journal, Vol.11, No.2, July-December, 2008.
36. Niyogi, Puspa., Agrarian and Fiscal Economy of Eastern India (From the 4th to the 12th Century A.D.), Kolkata,2010.
37. Bagchi Anita, Animal Science and Plant Science in Ancient India And Her Conservation Ethics, B.R. Publishing Corporation, Delhi -110052, 2025. ( brpc73@gmail.com ).
38. Thapar R., Interpreting Early India, OUP, Delhi, 1995, p.2..
39. Time Past and Time Present : Two hundred and twenty five years of the Asiatic Society, The Asiatic Society, Kolkata, 2008.
40. Ibid
41. S. Irfan Habib and D. Raina (ed), Situating the History of Science : Dialogues withg Joseph Needham, OUP, New Delhi, 1999.
42. Gadgil M., Guha R.C., the Fissured Land : an Ecological History of India, OUP, Delhi,1993.
43. Calder R., The Inheritors : The Story of Man and the World He Made, Heineman, London,1961.
44. Randhawa, M.S., Singh J, Dey A.K., Mittre V., Evolution of Life, Publication and Information directorate, New Delhi,1969.
45. 45. Bernal J.D., Science in History, Vol.I., London, 1969, p.92.
46. Chakraborty 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.
47. Bhaduri J.L., Tiwari K.K. and Biswas B., A Concise History of Science in India, pp. 403-444.
48. Mukherjee R.G., Environmental Studies, Allied Publishers Ltd., Kolkata, 2000.

49. Das Sukla, Forest Policy of the Mauryas : An ecological Perspective, 1996.
50. Mookerjee R.K., A history of Indian Shipping, Kitab Mahal Pvt. Ltd.,Allahabad, 1962, p.58.
51. Ibid.,p.57.
52. Ibid.,p.61.
53. Sarton George, The History of Science and the New Humanism, Indian University Press, Bloomington,1931.
54. Needham J., Science and Civilization in China, Vol.I,Cambridge University Press, Cambridges, 1961
55. Bernal J.D., Science in History, Vol.I., The Emergence of Science, C.A. Watts and Co., Ltd., London, 1969.
56. Childe V., Gordon, Man Makes Himself, London, 1951.
57. Childe V., Gordon, What happened in History, Penguin Book, Great Britain, 1961.

***Former Registrar, University of North Bengal. ( tps.chatterjee@gmail.com )**