CHAPTER I  HORTICULTURAL CONCEPT OF ANCIENT WORLD AND MODE OF TRANSFER OF TECHNOLOGY

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Introduction:

Terminology

The word 'Horticulture' is derived from the Latin Hortus meaning garden, and colere meaning to cultivate. The English word Horticulture is first found in 1678 in Edward Phillips The New World of English Words; the word Horticulture first appeared in 1631 in Peter Lauremberg's book by that name. The word 'Hortus' is found in classical Latin.¹

Concept

The concept of garden culture dates back to medieval farming systems that used extensive areas for grains, forages etc., small intensive kitchen gardens and wild lands for timber and game. Modern agriculture has maintained these distinctions in the divisions of agronomy, horticulture and forestry.

Horticulture and its subdivisions

Horticulture is traditionally divided into food crops (Pomology and Olericulture) and Ornamental crops (floriculture and landscape). Pomology deals with fruits and nut crops.

¹ Encyclopaedia Britannica. 1979, v.8, p.1105.
Olericulture deals with herbaceous (non-woody) plants, including carrot (edible root), asparagus (edible stem), lettuce (edible leaf), cauliflower (edible flower), tomato (edible fruit), and pea (edible seed). Floriculture deals with production of flowers and ornamental plants generally cut-flowers, potted plants and greenery. Landscape horticulture is a wide terminology including turf, but particularly nursery crops such as shrubs, trees and vines.

Horticulture covers, among others, a wide range of subjects such as fruit growing, vegetable cultivation, floriculture and cultivation of medicinal, beverage and insecticidal crops. It constitutes, thus a service which is no less important to the well-being and happiness of mankind than any other avocation.

Technological revolutions in agri-horticultural activities have been noticed even in vedic period\(^2\). Agriculture, Craft and Commerce were not mere means of livelihood but also ways of life. The Atharvaveda ascribes the introduction of agriculture to Prthu, Son of Vena of the Pre-vaivasvata period. In any case, the references in the Rigveda and other works clearly show that agriculture was the main occupation of that age and that it was quite advanced. Operations of cultivation

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such as ploughing, sowing, reaping, winnowing and harvesting were known. Dung was considered as valuable manure. Irrigation was in vogue.

The Rigveda reveals that rishis were interested in flora, fauna and human beings. A classification of natural vegetation into Vruksha (Trees), oshadhi or virudha (Shrubs) and trana (Grass) and their characteristics are found in RV. X. 97. About a hundred plants, tree creepers, herbs, flower-plants etc., mentioned in the Vedas and Brahmanas are identified. The most important plant of the Rigveda, soma, is not yet identified. The soma juice, an exhilarating drink was the most sacred drink offered to gods. Its power of sharpening intelligence and of bestowing clarity of thinking are highly extolled. Other important flora include ashvattha, kimsuka, Khadira, salmali, kumuda, kusa, āurva, audumbara, nyagrodha, bilva, khajura, badari, vibhidaka (whose nuts were used as dice) etc. Plants and trees were invested with holiness and were believed to have their own whims and fancies like gods. Medicinal plants were considered as divinities presided over by Soma and Siva.
Review of literature in horticulture.

Early work

The cultivation of plants for food and medicine is of neolithic origin. The type of horticulture in those days mainly referred to gardening where medicinal plants and herbs were grown by priests and physicians. Fruit trees and date palms in the East and the apple trees in the West were perhaps earlier than cereals and they were cultivated even in the neolithic age.

In ancient Egypt the temples were the centres of horticulture, garden design improvement and experiments with new plants. The gardens were confined to the cultivation of fruits, vegetables and grapewines. A steady programme of research and plant introduction existed in Egypt during 2700 B.C. Gardens with pools and the development of a pharmacopeia - a collection of drug and medicinal plants were their notable achievements. Wine making was known to them.

In the middle East, Mesopotamia, Babylonia and Assyria had cultivated herbal crops and had compiled the names of over...
900 plants including 250 vegetables, drug and oil crops. They had developed the technology of horticultural crops around 700 B.C.

In Greece, kitchen gardens, orchards and vineyards had existed in the 7th century B.C. It had no ornamental gardens. However, a pattern of garden design was established and this pattern lasted around the mediterranean areas for several centuries. Aristotle (384-322 B.C) had contributed quite a good deal to the science of botany and medicine. He travelled far and wide establishing new academies at Assus. He devoted himself to purely scientific work. During the latter part of his life, he organised research in every department of enquiry at the Lyceum, an institution which he established. His pupil Theophrastus had contributed much to the classification, propagation, geographic botany, forestry and horticulture and his thinking influenced very much upto the beginning of the 17th century. His greatest contribution was in the field of botany and the publication of 2 books (1) Enquiry into plants and (2) Etiology of plants. Somewhere about the same period Alexander took lot of interest in the new plant introductions and had brought European plants to Babylon.
In China garden making was an ancient art. The earliest description of garden dates back to the second century B.C. Confucius (551-479 B.C.) made a reference, to "tao," the peach in his writings.

Romans equally did not lag behind in contributing to the botanical science. Varro Marcus T. (116-27 B.C.) had published *Res rusticae* in which he cited over 50 Greek authors in Agriculture. In his book "Roman Farm Management" he published his observations on olives, grapes, pears, apples, pomegranates, nuts, dates and figs. Pliny (62-116 A.D) codified horticultural technology. He mentioned grafting and budding in his writings. The use of many kinds of fruits and vegetables, legumes rotation, fertility appraisals and even cold storage of fruits were mentioned in his works. In his "Natural History" he has given a good account of the fruits grown in India.

In America it was presumed that Andean horticulture existed somewhere around 2500 B.C. Around 500 B.C. important horticultural techniques like propagation by cuttings had existed. Potato, papaya and pineapple reached Andeans from Mexico. Central and South American natives were known for raising ornamental plants.
Renaissance movement

From 1450 A.D. to 1900 A.D. and the latter part of this period came under influence of renaissance movement in the new world. During this period John Parkinson (1567-1650) published the first great English gardening book in 1629 under the title *Paradisi in sole Paradisus Terrestris*. Gerard issued a folio on "History of Plants" in which seven kinds of pippin apples were mentioned. Stephen Hale investigated the movement of sap and his research in plant physiology was published in *Vegetable staticks*. Malpighi Marcella in 1670 A.D. submitted his first work on plant anatomy to the Royal Society in London. During the same year, John Ray experimented on the movement of sap in trees and published "Catalogue Plantarum Angliae."

Camerarius (R J) a Dutch scientist observed sexuality in plants for the first time in 1691 A.D. and had experimentally proved the sexual behaviour of plants.

In Germany the first German book on gardening was by John Peschel in 1597. An eminent German botanist by name Cordus Valerius, published his results in 1561 under the title "History and the description of plants" and it was edited posthumously by Conard Gesner.
A delightful source book on medieval horticulture was brought out in 1538 by Charles Estienne and John Liebault in Italy in which a chapter on apple illustrated such practices as fertilization, grafting, pruning, breeding behaviour and dwarfening, insect control, girdling to promote flowering, harvesting technique, processing and medicinal utilization.

Between 1700 - 1800 A.D. there were more than 20 seminal contributions and between 1800 - 1900, 62 authors subscribed substantially to the world of horticulture. Monumental works like dictionary of gardens, dictionary of economic products, botanical dictionary, eademus planturam and encyclopaedias, besides nursery catalogues, magazines in horticulture, manuals and journals appeared during this period. Among the notable publications "Nova genera et species Planturam - a seven volume compendium" and an "Illustrated handbook on fruits and vegetables" were of high order. Many horticultural societies were established for dissemination of information.

Indian contribution

The Indian contribution to horticulture dates back to

Pre-vedic period. It is as old as Aryan civilization. This can be studied under three periods: They are (1) Pre-Vedic Period (prior to 2500 B.C.) (2) Vedic Period (2500 B.C. to 467 B.C.) and (3) Post-Vedic Period (467 to 1800 A.D.).

Pre-Vedic Period

Shruti, smriti and samhita of the vedic age bear a clear testimony to the fact that the inhabitants of the towns of Mohanjodaro and Harappa used to wear clothes, cultivated crops and fruits. This has been authenticated by the excavations at Mohenjodaro and Harappa.

Vedic Period

There is abundance of evidence in the vedas that they used to practice medicine, layout gardens and know descriptive botany and physiology. Chandyoga Upanished, Samaveda, Vishnu Purana and Rig Veda - these reveal the vedic conception of evolution, viz., plants were followed in order by the aquatics, amphibions, birds, monkeys and the man for the completion of creation. Europe has been nurtured almost exclusively on the thoughts of the Greeks and the Romans as to the conception of evolution which latter seems to have been influenced by the philosophy of India after the invasion by Alexander the Great.

Post-Vedic period

During this period, horticulture became a religious sanctity, a legal obligation, a pastime and a profession. Number of books were written of which, 88 were recognised as valuable scriptures. The Vriksh Ayurveda, one of the oldest known text on fruit culture to which Kautilya makes a mention in 300 B.C. and the Dhanvantri's Dictionary, a little later is no where to be found.

In the post-Vedic period, Botany was treated as a distinct science. Vaghbhat and Charaka dealt with medicine at great length. Books, "Krishisangraha" and "Abori-horticulture", were published. References were there to make fruits seedless. Books on classification of plant kingdom, planting method, controlling of plant filments, application of tridosh system, and propagation of fruit trees were published in Sanskrit.

The ingenuity of the Indian contribution to plant science lies in the fact that they had codified plant science as early as 800 A.D. the terminology used in forestry and agriculture in the form of sloka, a monumental work entitled "Amarakosha" in which was included "Vanaushadhi varga" which dealt with the classification of soil, lands and implements
used. Memorising of slokas was found to be easy to impart knowledge. Around 1025 A.D. an encyclopaedic work in agriculture and plant science was brought out by Chavanda Raya and this manuscript is available in the Government Oriental Mass. Library, Madras. Sarangadhara wrote somewhere during 1120 A.D. or so a treatise on Vrikshayurveda and this manuscript is available in the Government Oriental Mass. Library, Trivandrum. However, between 1120 A.D. and 1330 A.D., the following treatises were published in the country:

(1) Vatika vidhi or Pushpa vatika vidhi (Mss. No. 538 - Ganganatha Research Institute Library, Allahabad).

(2) Vruksha dosha Kaouthuka Chinthamani - a short treatise on fertilizers and garden culture (Mss. Ho. 11305 available in Saraswathi Mahal library, Tangur).

(3) Vrukshayurjnanam dealing with horticultural practices manuring and grafting (Mss. available in Saraswathi Bhavan Library, Udaipur, Rajasthan).

(4) Vrukshadaya (catalog of plants quoted by Hamadri in Raghuvamsha).

Summing up the outstanding accomplishments of the entire sanskrit period, one can conservatively hold that
the Vedas as compilation begin from the beginning of human civilisation in that they have incorporated all the pre-historic knowledge of the human race even in the field of horticulture.
Materials and method

The material for the study comprised the published literature scattered in various documents. Contributions significant in the core subject, Horticulture, and its peripheral areas have been taken.

Decision regarding contribution

It is impracticable to be thoroughly well acquainted with the subjects that go with horticulture or for that matter any other subject and pin-point a contribution as significant. Hence it is hypothesised to deem a contribution as worthy and significant in this study if it has been considered to be a significant contribution by the specialists in the discipline concerned. For instance, a good history of the development of a subject would normally mention significant contribution to that subject.

Kinds of documents consulted

The following kinds of documents were consulted to collect the data on the contributions;
(1) Encyclopaedia - general as well as those devoted to particular subject fields;
(2) Biographical dictionaries; and
(3) Books and articles on the history and philosophy of different horticultural subjects.

Organisation

After collecting the data on a 3" x 5" slip, duplicate slips were eliminated and the entries arranged in the sequence of the date of contribution.

Distribution of data

Formation - sub-periods

It was felt helpful to divide the long period of 3000 B.C. to 1900 A.D. into sub-periods in order to get an idea of the rate of contribution in the field of horticulture at different periods as indicated in the table given below. No particular feature helpful in the formation of the sub-periods was immediately apparent. The whole period was divided into 2 phases and each phase was further divided into 2 sub-periods. Such a division is, however, an arbitrary one.
<table>
<thead>
<tr>
<th>Phase</th>
<th>No. of Seminal contributions</th>
<th>No. of Seminal years</th>
<th>Break through in other supporting areas</th>
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<tbody>
<tr>
<td>I</td>
<td>3000 B.C. - 750 A.D.</td>
<td>28</td>
<td>3750</td>
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<td>II</td>
<td>1451 A.D. - 1800 A.D.</td>
<td>41</td>
<td>350</td>
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Annotation

It is seen from the above table that there were hardly 28 seminal contributions in the field of horticulture over a period of 3750 years which reflects the paucity of individuals who sought knowledge and who worked in the field of horticulture and other subjects which go with horticulture. In the latter half of Phase I, there were 36 seminal contributions over a period of 700 years. This could possibly be attributed to the invention of movable metallic types of Gutenberg and their use in printing.

In the II Phase, a dramatic change could be noticed in the 1st half of the period. There were 41 contributions within a period of 350 years. This change was rapid because of the invention of the paper mill in 1690 A.D. This period also saw the production of multiple copies of books as no human labour was involved in writing the scripts. Infact by the close of the 15th century there were 150 printers in Europe. In the second half of Phase II, there were 62 seminal contributions over a period of hardly 100 years which could be attributed to the invention of electricity and its application in printing. During this period the composing machine was invented.
Librarian's point of view

It is viewed that formation of (1) Phase and (2) sub-periods, approximately correspond to the landmarks in other sphere of knowledge other than agriculture and horticulture and they are found more helpful and relevant in the context of the present study.

Invention of paper making

The invention of paper making in the year 105 A.D.\(^6\) and the spread of this knowledge to Central Asia and Europe by 750 A.D. has been chosen as the landmark and it is found that the number of significant contributions during the latter half of Phase I viz., 751 A.D. to 1450 A.D. was 36 and it took only 700 years.

Printing from movable type

The invention of printing machine using movable metallic types in the mid-fifteenth century and the establishment of the paper mill has exerted a tremendous impact on the publication of literature in horticulture. The position has improved further with the rise of learned societies and

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periodicals in the 2nd half of the eighteenth century.
Phase II also has witnessed the bibliographical developments in the last quarter of the 19th century which has resulted in the increased number of contributions in a short span of time.
Transfer of technology

Resources

There was no dearth of knowledge on horticulture but the problem was that it was practiced mostly by the kings and the elite. Literature on the subject "Horticulture" was very much associated with gardening and medicinal plants only.

Before the art of writing came into use in India, the maxims of science were transmitted from posterity to posterity by word of mouth, called "Shruti" (meaning hear). Later on when the number of these maxims (Chhandas) swelled, they were logically arranged and memorised. This was "Smriti" (meaning memorise). Still later, when the art of writing was perfected, chhandas was compiled and this came to be known as "Samhitas" or Vedas.  

Users

Language barrier

Common language in India was Sanskrit in those days.

Since the language was difficult and was very much restricted to the elite, the transfer of information was conditioned.

Dissemination strategy

Mode of transfer

Transfer of information was done through birds, signs and signals. The documentary evidences were available in the form of clay-tablets, stones copper plates, papyrus rolls, recordings on skin, parchment and vellum which shows that information transfer was very much slow and was found to be tiresome job. "Gurukulas" were common where the young would stay and learn in Ashrams.

Effect of war

There used to be wars frequently. The effect of war was indirectly a scientific and cultural expedition of others to India. There came along with them scholars, astronomers, mathematicians and philosophers. They transmitted their culture, art, literature to the Indians and received in turn Indian contributions.

Diffusion problem

The knowledge was person-oriented, particularly in the case of Ayurvedic and Homeopathic fields. Diffusion of
knowledge was not the order in those days. They use to pass on this information only to restricted persons in whom they reposed confidence. Even today this is in vogue in India.

Summing up of the outstanding accomplishments of the entire Sanskrit period, one can conservatively hold that Vedas as compilation begin from the beginning of human civilization in that they incorporate all the pre-historic knowledge of the human race. Number of books on Sanskrit and Pali were treasured up in the libraries. As such nothing was left un-recorded.

With the advent of printing technology and the invention of paper making, books were printed in large numbers which helped in a big way to promote learning and technology transfer.
Discussion

According to the evolutionary theory of Darwin, "The present is the child of past and father of the future in all things." This phenomena is all pervasive and found to be true even in the case of scientific hypothesis. The present scientific innovations have a direct bearing of the past and the future is based on the present scientific innovations.

If we look back to the scientific achievements, it resembles more or less to the made of "solo research", but this process was very slow and was found to be time consuming. Although the research has produced fantastic results in fundamental research, the trend changed and resulted in "relay research" which helped the scientific approach more liberal. Later this trend culminated in "team research".

Scientific innovations in horticulture in the bygone days have been mentioned by Sri Varma (Sanjhi Ram) and the same is produced hereunder:

"There is abundance evidence in the Vedas that they used to practice medicine, lay-out gardens and know

8. Ibid., p.46-49.
descriptive botany and rudimentary plant physiology. As to the conception of evolution, Europe has been nurtured almost exclusively on the thoughts of the Greeks and Romans, which later seemed to have their own from the Indian Philosophy after the invasion of India by Alexander the Great.

The vriksh Ayurveda, one of the oldest known texts of fruit culture of which Kautilya makes a mention in 300 B.C. and the Dhanavantri's Dictionary a little later, is nowhere to be found. In such a state of affairs 13 under-mentioned sanskrit books and several more in English were consulted.

1) Vraksharopana vidhi  8) Kshetra thatwa
2) Upavana vinoda      9) Kedarkalpa
3) Vishnu darmothar    10) Parasharasamhitha
4) Neethisaar          11) Udyan nirmana vidhi
5) Angi puraana        12) Bag vijyan
6) Druma Chikitcitha   13) Vruksha doha
7) Ehruhan samhita

It is noticed that there was a classification system and the plants were grouped under (1) the Trina (2) the Drume (3) the Gulma and (4) the Data. Planting process, control of
plant ailments, contact preparation and fumigants were in vogue. Bhruhat samhita exhorted that grafting or budding operation be performed carefully and the resulting wounds be plastered over with a grafting clay containing cow dung and urine. Grafting as a method of propagation was really very old. This could be traced as far back as 500 B.C. Budhgosha in his commentary on Digha Nikaya, a pali treatise, written 2000 years ago mentioned budding (Aggabijam) as a method of propagation.

During the British regime, however, several commissions were appointed to look into agricultural activities. As horticulture was not much in the eyes of the Commission, everything was done for agriculture. However it is clear that modern science of horticulture in India is not older than 1928.

Upto 19th century, the scientific efforts were of pure and fundamental in nature. This research was a base for future efforts at the scientific level. Upto this period horticultural science had not gathered much momentum as only a few individuals were involved in research pursuits. In the pre-manuscript days, the technology transfer was through word of mouth. This should have been continued in the
pre-printing days as the manuscript was costly and often unique in that the writings were on palmyra leaves, barks etc. Even after the invention of printing, this tradition of transferring technology continued for a few centuries until printing was made cheaper and copies of books could be had in plenty. However, most of the research results during the latter half of the 18th century and thereafter was brought into India by the invaders and visitors. In the last quarter of the 19th century, however, bibliographical aids came to be used for transferring the technological information in all disciplines of knowledge including horticulture.
Summary and conclusion

The framework of this study examines the genesis, growth and development of horticulture in the occidental and the oriental world. The seminal contributions made during this period have been indicated. Horticulture was not new. Fruit growing was very much in vogue and was part of the agricultural activities which dated back to the dawn of civilization itself.

Modern concepts such as plant breeding, grafting etc., were not new but much publicity was not given. Botanical gardens were considered to be the sources of aesthetic and intellectual delight and they had a proud part of the national heritage making the science of botany a handmaiden of horticulture. Even floriculture was given much importance in beautifying the surroundings of the dwelling places. In brief, horticulture was conceived as food, aesthetic view and medicinal value.

Information is considered as money now, but information services were considered in those days as noble service and were given on humanitarian grounds free of cost. This
sort of noble understanding is expressed by Manu:

"To carry knowledge to the doors of those that lack it and to educate all to perceive the right, even to give away the whole earth cannot equal that form of service."

In conclusion, transfer of information was not considered essential. It was very much restricted, and used for the welfare of mankind as is evident in the case of medicinal and herbal plants.