Rare Book

AGRICULTURE IN ANCIENT INDIA

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FOREWORD

It gives me great pleasure that the project of producing a monograph on *Agriculture in Ancient India*, which was sanctioned by the Indian Council of Agricultural Research when I happened to be its President, has seen its fulfilment. This monograph is the result of the co-operation of scholars to whom my congratulations are due, for they have succeeded in producing an authoritative treatise on the subject.

Agriculture and animal husbandry began to be developed in India from pre-Vedic times, for in the *Rigveda* itself we find reference to hundreds and thousands of cows; to horses yoked to chariots; to race-courses where chariot races were held; to camels yoked to the chariots; to sheep and goats offered as sacrificial victims, and to the use of wool for clothing. The famous Cow-Sukta (Rv. 6.28) indicates that the cow had already become the very basis of rural economy. In another Sukta, she is deified as the mother of the Vasus, the Rudras and the Adityas, as also the pivot of Immortality. The Vedic Aryans appear to have large forests at their disposal for securing timber, and plants and herbs for medicinal purposes appear to have been reared by the physicians of the age, as appears in the *Atharva Veda*. The farmers' vocation was held in high regard, though agriculture solely depended upon the favours of Parjanya, the god of rain. His thunders are described as food-bringing.

Our agriculture and animal husbandry begun from almost the beginning of the Vedic period, later developed to a degree of skill rarely known in other parts of the world. In social rank, the farmers were considered next to Brahmans, and the entire village administration appears to have been in the hands of leading farmers who were known as "Kutumbin", from which the word "Kunbi" is derived.

As appears from the texts referred to in this monograph, expert knowledge, besides covering agriculture and animal husbandry, specialised in forestry. Tree planting and preservation was one of the fundamental articles of Hindu religion, for the Indian culture from its inception grew under the shades of trees where the Rishis dwelt. Different kinds of trees and their importance in life, for use as well as beauty, were studied with great care.

Even in the medieval period under the Hindu rulers, we find ample contemporary evidence for testifying to the expert skill in raising crops among them wheat, gram, pulses, barley, sugarcane, indigo, cotton, pepper and ginger, and in the rearing of fruits like pineapple, oranges and mangoes. The farmers only paid 1|6th to 1|12th of their agricultural products to the State.

Things, however, changed with the establishment of the Turkish rule. "If an Empire has to stay, farmers should be exploited", said

Allaudin Khilji, who used to collect half of the earnings of the farmers. Except during the short period under Akbar, who elaborated the land reforms outlined by Sher Shah, exploitation of the farmers became the rule. Naturally, the status of the farmers suffered and his skill came to be restricted to traditional methods.

Perhaps for the first time in a period of thousand years, in Free India the rural economy is being strengthened in the light of modern needs and equipment. But even in doing so, it is essential that those who devoted themselves to developing agriculture should have a background knowledge of the genius of the land in the matter of agriculture, for our new agriculture and animal husbandry, to be fruitful must be built on old foundations.

Most of our setbacks in setting our rural economy on its legs have arisen on account of our trying to apply ready-made methods, which have been devised for other lands and other people.

I have no doubt that this monograph will help in providing the necessary knowledge.

I also hope the Indian Council of Agricultural Research will complete this work by having similar monographs prepared for the medieval period and the British period.

K. M. MUNSHI

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CHAPTER I

LAND AND DIVISIONS

Physically, India may be divided more or less into three main regions *viz.* (1) the mountainous borders of Himalayas in the north and of the Vindhyas in the south with the linings of Ghats in the south-eastern and south-western coasts and the traverse range of Aravalli hills; (2) the Deccan plateau or table land; and (3) the plains or low-lands, a rich Indo-Gangetic alluvium overflown by the rivers — the Ganges, Jamuna and Brahmaputra.

Although primordial mountains remained inaccessible for human settlement, the foothills have been increasingly brought under cultivation and settlement and the upland valleys striking the Himalayas include some of the most fertile of Indian lowland formations. Megasthenes and earlier Greek eye-witnesses whose memoirs were utilised for reference by subsequent classical writers, were all inspired by the great rivers of India. The whole Indo-Gangetic alluvium consists of rich fertile soil and has contributed materially to the growth of civilization.

The utilitarian object of the modern soil survey and soil classification is to assess the inventories of soil resources and their proper land uses. The modern concept of land classification for land use planning has been described as "to determine" the types of production, use and service that can be obtained from the land that will yield the highest social and economic benefits to the people dependent thereon and land classification relates to the grouping of lands according to their suitability for producing plants of economic importance.

Agriculturists in ancient India were quite conscious of the nature of soil and its relation to the production of a specific crop of economic importance. The vast knowledge acquired by experience has been handed over from generation to generation. It is very intelligently and ably moulded in the form of maxims, proverbs etc. which are some sort of guidance to the peasants. Our peasants were trained enough for the choice of a particular soil for a particular crop and they were conversant with the principles of crop husbandry. The available information collected from some eminent authors and from translation of old Sanskrit manuscripts is given below :

R. Gangopadhyay, in his book on *"Some Materials for the Study of Agriculture and Agriculturists in Ancient India"*, 1932, has given an account of 'Soil and Classification' as follows :

"According to fertility, soil is mainly divided into two classes; *urvara* (fertile) and *anurvara* or *usara* (sterile). *Urvara* mrttika is again sub-

divided into different kinds according to their peculiar fitness for the cultivation of different kinds of crops; for instance, *yavya, tila, vraiheyasaleya, maudgina* i.e., the soil fit for barley, for sesamum, *urihi* (rice), *mung*, etc. *Anurvara mrttika* is also sub-divided into *usara* (salt ground) and *maru* (desert). The soil watered by river and that watered by rain are respectively called *nadimrttika* and *deva-mrttika.*"

The exact chemical composition of different kinds of soils might not have been known to the ancient authors but from the following typical maxims of Khana, traditionally known as the wife of Mihira, the famous ancient astronomer, it becomes clear that they made extensive experimental observations about them and obtained a masterly knowledge regarding their characteristic suitability for the cultivation of different kinds of crops.

"Sandy soil is suitable for the cultivation of *Aus* paddy and clayey soil for that of jute".

"Your expectation will be fulfilled if you cultivate *patol* (*Trichosanthes dioica*) in sandy alluvial soil".

"Potato thrives well, if cultivated by the side of a bamboo-grove".

"If *arum* is sown on the bank of a river, it grows three cubits long".

In the Arthasastra, we find an enumeration of the suitability of different lands for the cultivation of different crops.

"Lands that are beaten by foam, i.e., banks of rivers etc. are suitable for growing *valliphala* (pumpkin, gourd and the like); lands that are frequently overflown with water (*parivahanta*) for long pepper, grapes (*mrdvika*) and sugarcane; the vicinity of wells for vegetables and roots; low grounds (*haraniparyanta* — moist bed of lakes) for green crops; and marginal furrows between any two rows of crops are suitable for the plantation of fragrant plants, medicinal herbs, *khus-khus* roots (*usira*), hira (?), *beraka* (?) and *pindalaka* (lac) and the like" (Arthasastra, English translation by Dr. Shamasastry, p. 198).

That water is essential for germination, that the soil must be sufficiently moist and the moisture maintained until the plant is established is fully recognised in the following verse from the Krsi-samgraha (Krsi-samgraha, Bangabashi Edition. All the verses from Krsi-samgraha are translated for the first time by the author).

"Rain is essential for cultivation and the latter is essential for life, so one should first acquire carefully the knowledge about rainfall".

Prof. G. P. Majumdar in his excellent translation of "Upavana Vinoda" published in 1935 by the Indian Research Institute, Calcutta, has shown that more elaborate attention was paid to the topic of classification of soils with characteristic flora in Charaka (Kalpasthana 1, Madanaphala Kalpa, 6, 7-9; Eng. translation, Fasc. LXI, Lesson 1, pp. 1917-1918) and Susruta (Sutrathana, chap. 35, 34-42, Eng. translation by K. L. Vishagratna, Vol. II, pp. 325-326, Calcutta, 1911). The following excerpt is from the work of Prof. Majumdar.

"Charaka divides land into three classes, namely, *Jangala, Anupa* and *Sadharana* according to the nature of the soil (edaphic conditions) and climatic conditions) :

Jangala Region. The region called Jangala is full of unobstructed open spaces, where a steady and dry wind blows, pervaded with expansive mirages, rivers and rivulets scarce, abounding in (artificial) wells (i.e. scarcity of water), also abounding in dry and rough sands and big sandy particles (kankars) (Sl. 6, 7).

Susruta describes this region as 'the country which presents a flat surface, and whose dull monotony is enlivened here and there by scanty growths of thorny shrubs, and tops of a few isolated hills and knolls, and in which the waters from springs and wells, accumulated during the rains, become nearly drained and strong gales of warm wind blow (during the greater part of the year) (Sl. 35).

Charaka gives, by way of illustration, the following list of plants characteristic of this region: Khadira, Asana, Aswakarna, Dhava, Tinisa, Sallaki, Sala, Somavalka, Vadari, Tinduka, Aswattha, Vata and Amalaki, the predominant types being Sami, Arjuna and Simsapa (Sl. 6 & 7).

Anupa Region (literally marshy, or swampy and watery—plants littoral, or inland)—"Mostly abounding in rivers and bordered by seas, swept by cold wind, i.e., charged with abundant moisture. The country is interspersed with rivers, banks of which are decked with—Vanjula and Vanira. Mountains are absent from this region. The region is thickly over-grown with forest bowers, and trees in flowers encircled by verdant trees and tender creepers (inland). The land is covered with dense forests of Hintala, Tamala, Nirikela and Kadali" (Sl. 8).

Susruta describes this region as the country "that contains a large number of pools, and is wooded and undulated with chains of lofty hills traversing its area, and which is impassable owing to its network of rivers and sheets of accumulated rain-water rippling before the currents of the gentle humid air" (Sl. 34).

Varahamihira mentions the following trees as growing in this region: Jambu, Vetasa, Vanira, Kadamba, Udumbara, Arjuna, Vijapuraka, Draksa, Lakooca, Dadima, Vanjula, Naktamala, Tilaka, Panasa, Timira and Amrataka—these 16 kinds of trees are the predominant species of this region." (Brhatsamhita, Chap. 54, 10-11, Vol. II, p. 745 (Text)).

Amarkosa mentions the following plants as growing exclusively in water: Saugandhika, Kalhara, Hallaka, Rakta-Sandhyaka, Utpala, Kubalaya, Indivara, Kumuda, Padma, Kamala, Pundarika, Sitambhoja, Kokanada, Raktotpala, Variparni, Musakarni, Jalanili, and Saivala. (Patala Varga 50-56; of Colebrook's edition (1807), BK. 1, Chap. 2, Sec. 3, 36-42).

Sadharana Region (literally the ordinary—plants mesophytes)—Charaka says that "the region which is endued with creepers, and plants and trees of both the classes, i.e., the Vanaspatis and Vanaspatyas, is called Sadharana." (Sl. 9).

According to Susruta "a country which exhibited features common to both the aforesaid classes is called Sadharana or the Ordinary" (Sl. 36).

As to the amount of rainfall in these regions Kautilya in his Arthasastra mentioned that 16 dronas of rain-fall in the country of Jangala (dry places), half as much more in Anupa (moist) countries; as to the countries which are fit for agriculture (desavapanam)—13½ dronas in the country of Asmakas (Maharastra); 23 in Avanti; an immense quantity in Aparantanam (Konkana), and the foot of the Himalayas. The author finally directs that "Lands that are beaten by foam (phenaghatah, i.e., banks of rivers, etc.) are suitable for growing valliphala (pumpkin, gourd and the like); lands that are frequently over flown by water (parivahanta) for long pepper, grapes (mrdvika) and sugarcane; the vicinity of wells for vegetables and roots, low grounds (hariniparyantah—moist bed of lakes) for green crops; and marginal furrows between any two rows of crops are suitable for the plantation of fragrant plants, medicinal herbs, cascus roots (*usinara*), *hira* (?) *beraka* (?) and *pindaluka* (lac) and the like". (Chap. XXIV, 116-117, (Shyama Sastri Ed. (1915), pp. 143-145).

Our survey in this section distinctly shows that classification of soil was based on two grounds—medicinal and economic. The medical authorities, like Charaka and Susruta, had in view the efficacy of vegetable drugs which depends on the nature of soil in which they grow. And politicians like Chanakya cared for the productivity of different types of soil, an attention to which is necessary on the part of a good Government to prevent famine.

Arable lands were classified in various ways. The Aryans being in Northern India had better experience of ushara land, "Alkali soil". The classification into barren and fertile, high and low, does not require much intelligence. One of the oldest classifications appears to be into those lands in which crops had to depend entirely on rainfall and into those which were inundated by, or could be irrigated from rivers. Kautilya classified tracts of country according to annual rainfall, the maximum being in the Western Ghats and the Southern borders of the Himalayas, and the minimum in deserts. The lands were also classified according to crops which could be successfully raised on them.

The sage Kashyapa in *A Treatise on Agriculture* (translated from original Sanskrit manuscript), has given a division of the earth, according to its fitness for particular crops into hilly, river and stream irrigated, forest and pasture land etc. The following paragraphs are quoted from the English translation of the work.

This multiform earth, which smiles with cultivable lands, the kind should divide into sections (for different purposes) (Sl. 23).

DIVISION OF THE EARTH

From the very beginning of creation this earth, girt by ocean all around, was created plain by Brahma, the creator (Sl. 24).

She has been yielding various kinds of fruits throughout the ages and has been extolled by gods, Gandharvas, sages and the kings. After every dissolution of the world, the earth was created anew and was endowed with life and fruit (Sl. 25).

At some places she was flooded with sea-water, at others the sea retreated from her, and still at others there broke out fissures in different ages according to the exigence of time (Sl. 26).

At places, she had useful and fertile springs, and at places she had elevations and depressions and was chequered with mountains, rivers, streams, big lakes and fertile lands (Sl. 27-28).

Somewhere her soil was gravelly, somewhere she was very hot, somewhere devoid of water, somewhere saline and detrimental to germination. This is how the earth became multiform gradually in the course of ime (Sl. 29-30).

Therefore the king, who is pledged to the welfare of his subjects, ..nould examine the earth which is best suited for producing rich harvest (Sl. 31).

The land (*Bhumi*, too, has to be translated differently according to the context) should be clean, free from pieces of bone and stone, husk and glass (the reading *tusa-kaca* in the text should (in my opinion) be amended to *kusa kasa* which are wild grasses), and its soil soft, strong, cohesive and moist, slightly reddish and dark in colour. Its surface should be level, without pits, chasms or mounds and the soil should emit the pleasant smell of mallika (*Jasminum zambac*), jati (*Jasminum grandiflourum*), kutaja (*Wrightea antidysenterica*), wine, or lotus or blossoms of date-palm or tinisa (*Dalbergia ujjeinensis*).

It may not be surcharged with water or may be watery at all times. It should be conducive to the rapid sprouting of seeds and be easy to plough. It may be covered with the cud of bulls (*Vrsa phena*) and may abound in (beneficient) beasts and insects. It should be compact, solid, heavy in weight fit for the luxuriant growth of herbs, and free from brambles and dry dung, etc. (Sl. 35-36).

The land is of five kinds, viz., the Brahmana land, the Ksatriya land, the Vaisya land, the Sudra land and the land of mixed qualities (Sl. 37).

Of these, the king should select, after due examination, the land which has clear water, and rich soil both at the surface and deeper down and which is fertile (kalpaki?). It should be pleasing to the eye, free from white ants and vermin and depredatory beasts but should harbour (beneficent) beasts and birds. It should not be exposed to storms, whirl-winds and wild fires (Sl. 38-39).

It should have an inexhaustible supply of underground water and should be favourable to the plantation of gardens and orchards and to the growth of thick shady trees and all sorts of seeds. It may have slight depressions, be soft to touch and be good for (the grazing of) cows and cattle. The soil should be suitable for digging wells and for the percola-

tion of water. These are some of the good qualities of land in spite of some defects here and there like the patches of waste or desert land (Sl. 40-43).

The highly qualified land-examiners, water-finders (dagargala-pramanajna) and agriculturists, whether they be Brahmanas, Ksatriyas, Vaisyas or Sudras, should by orders of the king, examine the earth on an auspicious day (Sl. 44-45).

One of the water-experts, having purified himself with a bath, clothed himself in clean garments and wearing a golden ring, should, in the company of Brahmanas, learned in the Vedas, go to the specified piece of land in the morning or in the evening and perform circumambulation (of the land) amidst the blowing of conches, chanting of benedictory hymns and sprinkling of panca-gavya (the five products of the cow) or of water.. He should then dig out the earth with a spade or hatchet and should examine it carefully by smelling, tasting and weighing and then putting it into a pot of water and testing it by means of colours and chemicals (Sl. 46-50).

The earth which is of uniform colour and tinge, compact and smooth is considered to be excellent by gods, kings, sages, Brahmanas and Vaisyas and, on account of its good qualities, is conducive to the prosperity and welfare of all. It promotes the health of the families and the growth of wealth, cattle and grain (Sl. 51-52).

The land-expert should specify which land is the best, which is the mediocre and which is the worst—and the last he should avoid assiduously. He should indicate which land is fit for cultivation, which is suitable for horticulture, which for afforestation and which for water reservoirs. By king's orders he should, on an auspicious occasion, point out this natural and fourfold division of the land (Sl. 53-55).

The land should thus be demarcated for the benefit of those who want to acquire it (Sl. 56).

The wise man, who is expert in distinguishing between different kinds of soil and water, should specify which land is fit for agriculture and which for horticulture, etc. in villages, countries, fortresses, towns and within the precincts of royal palaces for the benefit of those who live there (Sl. 57-58).

EXAMINATION AND CLASSIFICATION OF LAND

The classification and examination of lands as suggested by Shri Misra Cakrapani in "Visva-Vallabha" are described below:

Land is of three kinds, viz., arid, wet (i.e. marsh) and moderate (i.e. neither too dry nor too wet) and is distinguished by six tastes which can be known from the colour of the soil (Sl. 1).

Gray coloured, pale-white, black, white, red and yellow soils are sweet, sour, salt, bitter, pungent and astringent in taste respectively according to the ancient tradition. In the opinion of the author they can be known with certainty by tasting the soil (Sl. 2-3).

Land that is littered with ant-hills, pits and stones is saline and

gravelly and has water at great depth. It is poisonous as far as the planting of trees, etc. is concerned (Sl. 4).

In a region where trees and plants are blighted with frost and in a place (?) littered with stumps, a garden should not be laid (Sl. 5).

Land in which the water is near the soil and is soft is best suited for planting trees. It is in such a place that a garden should be laid for welfare in this as well as the other world (Sl. 6).

On the land which is stony, or soft or shines like molten gold, trees like *gudhapuspa* (*Mumusopa elengi*), *pumnaga, rajadana* (?) and *campaka* grow without much effort (Sl. 7).

The nine kinds of *kunda* and *jati,* sri-sandika (sandal tree?), *Ketaki* (*Pandanus odoratissimus*), *Ketaka* (?), *Ambu* (a kind of Andropogon), plantain, *Asvamara* (horse-bane, *Nerium* odorum), *kakuca, Urdvi* (vine), rose-apple and other (similar) trees and plants grow in marsh lands (Sl. 8).

The cultivated tree like the *Campaka, Patala,* mango, *Bakula, Asoka, Kola, Udumbara, Nimba, Pippala,* banyan, *Cinca,* Asana (*Terminalia tomentosa*), *Aksa* (*Eleocarpus ganitrus*), *Aksota* (walnut), *Madhuka, Sigruka, Mahanimba, Arjuna,* and fruit-bearing trees like the pomegranate and flowering plants should be planted in a moderate (i.e. neither too dry nor too wet) land (Sl. 9).

Trees, plants, and creepers which grow best on arid land are: *Dhava, Khadira, Patasa, Vamsa, Dhatri, Ingudika* (*Terminalia catappa*), *Sivani* (*? Sesbania aegyptiaca?*), *Karabha* (?), pot herbs, *Sallaki* (*Boswellia thurifera*), *sapta-parna* (*Alstonia scholasis*), *Sura-taru* (Deodar ?), *Rajanika* (*Curcuma longa*) and Jatika, etc. (Sl. 10.).

I have enumerated here a few trees. The gods and men may infer about others (by their own observation). As a matter of fact the growth and capacity of plants which bear flower and fruit depends on the nature of the soil (Sl. 11).

But the trees and plants of rich people and kings thrive and bear flower and fruit even in unsuitable soil with immense effort and grace of God (S. 11).

Some trees, plants and shrubs, etc. grow from a seed, some from a scion, some from a bulb, and there are others which grow both from a seed and a scion. I shall now explain their varieties.

Some of the trees which grow from the seed are: *Jambu, mango, Campaka, Madhuka, Kapittha, Cinca, Pumnaga, Bilva, Bakula, Asana* (*Terminalia tomentosa*), *Kancanara, Ksirika* (a kind of date tree), *Panasa, Aksaka, Cocoanut, Tala* and *Tilaka* (*Clerodendrum phlomoides*) (Sl. 14).

Some of the plants that grow from the scion are: *Jati, Gulala* (?), *Taruni* (*Aloe perforiata*), *Nava-malika, Malli, Japa, Tagara, Kunda, Sikhandin* (*Abrus precatorius*), *Kubja* (*Achyranthes aspera*), *Tambulika* (betel), *Salika, Ketaki,* Ketaka (?) etc. (Sl. 15).

The plants that grow both from the seed and scion are: *Bimba* (*Momordika monadelpha*), *Snuti* (*Euphorbia anti-quorum*), *Capdraka*

(*Gynandropsis pentaphylla* ?), *Sinduvara, Sri-khandika* (Sandal), *Asvattha, Vata, Palasa, Pomegranate, Aksa, Muni-dru* (*Agati grandiflora*), *Vamsa* and *Vine* etc. (Sl. 16).

Those that grow from the bulb are *Kunkuma* (*Crocus salivus*, saffron), *Srngavera* (Ginger), *Vidarika* (*Batatas paniculata*), *Surana, Pitaka,* (yellow amaranth, *Odina pennata*), etc. and *Eta* (cardamom), *Ambujani* (various species of lotus and water-lily), etc. are those that can grow both from the seed and the bulb (Sl. 17).

The plantain etc. can be grown both from the bulb and the scion and many others may also be observed to belong to this class. Clever people have noticed them to be suitable for planting in gardens but they have not reared them (?) (Sl. 18).

Now I am going to explain what trees are prohibited from being grown in or near the residential houses, particularly with reference to the quarter in which they are to be planted (Sl. 19).

The pomegranate, citron ,plantain, turmeric, jujube, *palasa, Slesmata, Cinca, Arjuna, Kancanara, Karanja,*—are the trees that are not auspicious to plant in a seat of learning (or educational institution) (Sl. 20).

Planting of trees and shrubs that are thorny or have a milky juice should be avoided in or near the residential houses and people who seek happiness should cut off plants that bear no fruit or grow wild (Sl. 21).

All the trees that bear no fruit or flowers, those that grow wild, and also trees like *Ankola* (*Alangium hexapetalum*), *Vitanaka* (Caryota urens ?), etc. castor-oil tree, white mustard, and|or *Nilika* (*Blyxa octandra*), should not be planted in a garden adjoining a residential house (Sl. 22).

In a garden, mostly flower-bearing plants should be planted, but in a garden adjoining a house all sorts of trees, creepers, herbs, shrubs that are said to bear fruit..... should be grown (Sl. 23).

As far as possible no trees should be grown in a house, but if one cannot help it, only those flowers, trees and creepers should be grown that are auspicious (Sl. 24).

Sumbha (?) is auspicious if planted towards the east of the house, banyan and *Udumbarika* towards the south, peepal to the west and *Drksa* (?) to the north, and not, if planted contrary to this order (Sl. 25).

For trees to be planted far away to the right or left of the house, the rules are different. There, too, all the trees are differentiated as being commendable or condemnable (Sl. 26).

It is prohibited to lay a garden to the south-east, south or south-west of a city (?). It is auspicious to lay it to the east, west, or north which lies between the intermediate points sacred to Siva and Vayu (?) (Sl. 27).

In fortress a normal garden may be laid according to the availability of space and there would be no harm in planting all sorts of trees in it—both wild and cultivated, such as: *Campaka, Malati, Kurabaki* (red

amaranth or Barleria), *Nirmalika* (*Trigonella corniculata*), *Juthika* (*Jasminum auriculatum*), *Sri-khandi, Karavira, Kunda, Bakuta* (*Helleborus niger*), *Sevati* (the Indian white rose), *Karni* (*Premna spinosa* ?), *Kubja* (*Achyranthes aspera*), *Gulala* (?) *Hemasumana* (*Rubia munjista*), *Sindurika* (*Grislea tomentosa* ?), *Ketaki, Bandhuka* (*Pentapetes phoenicea*), *Mucukunda* (*Pterospermum suberifolium*), *Ketaka, Jaya* (*Sesbania aegyptiaca*), *Malli* (a kind of jasmine), Jata (a kind of Andropogon), Agastika (*Agasti grandiflora*) (Sl. 28-29).

Malura (*Feronia elephantum*), *Badari, Rasala, Karaka* (Pongamia glabra), *Cara* (Buchanania latifolia (, *Asana, Sri-phala, Cinca, Marddaki* (?), *Nimba, Puga, Phirasa* (?), mulberry, *Vata,* peepal, Date-palm, *Panasa, Kapittha, Karaha* (?), *Pathya* (*Terminalia chebula*), *Siva* (*Mimosa suma*), *Tinduka,* bamboo, *Udumbari, Sala* (*Vatica robusta*), *Tala, Jatita* (*Acorus calmus*), *Rohitaka* (*Andersonia rohitaka*), *Patala* (*Bignonia suaveoleus*) (Sl. 30).

Rajadana (?), Asoka, *Kadamba, Jambu, Jambira, Naranja* (orange), Bijadhya (*Citrus medical*), plantain, *Amlaka* (*Tamarindus indica*), Pomegranate,*Asana, Alinkari* (?), Lotus, Kala (? Kola?), etc. which bear fruit regularly (Sl. 31).

Akhota (walnut), *Pista* (Pistachio), *Lakuca,* almond, betel, cardamom, *Sata-patrika* (Anethum sowa), vine—and many more trees, shrubs, creepers that bear fruit and flower worth enjoying (Sl. 32).

A wise man should plant *Karamardaka* (*Carissa* carandas), bamboo, etc. to the east, the vine and *Parevatas* (*Diospyros embryopteria*) to the south, *Kapittha,* etc. to the west, and others like *Kola* (Jujube, or *Piper longum*) etc. to the north in the garden, according to their classification as superior, middling and inferior at the prescribed distances (or directions) (Sl. 33-34).

KASYAPA'S CLASSIFICATION OF LAND

Krisi-sukti a comprehensive book on "Agriculture Science" attributed to Kasyapa classified the land into (1) wet lands for paddy fields, named variously *Shuli Bhumi, Jala Bhumi* and *Sasya Bhumi,* and (2) Dry lands called Adhaka bhumi, Tara bhumi and *Usua bhumi.* Lands have also been classed according to their suitability for particular crops. There is given the classification of soils as given in "*Upavana-Vinoda*".

The land is of three kinds, viz., arid, wet and moderate, i.e., (neither too wet, nor too dry). Again it is distinguished to be of six kinds each from its colour and taste (Sl. 35).

From colour it is distinguished as black, pale, dark red, white and yellow respectively, and from taste as sweet, sour, salt, pungent, bitter and astringent. (Sl. 36).

The land which is vitiated by poison, stones, white-ants and holes (of vermin), or is saline or gravelly or has underground water too deep, is not good for the planting of trees. (Sl. 37).

The land which is of a mild colour like the sapphire or the plumage of a parrot, or is of the colour of a conch, Kunda (Jasminum multiflorum), or the moon, or is bright like molten gold and vies with the *Campaka* flower, is considered as excellent. (Sl. 38).

On a land that is even, that has water closely and is green with grass and trees, all sorts of trees grow at their proper places. (Sl. 39).

Neither arid nor wet land is good. It is the moderate land (which is neither too wet nor too dry) on which, no doubt, all kinds of trees can grow. (Sl. 40).

Panasa, Lakuca, Tadi, (toddy palm), bamboo, rose-apple, *Madhuka, Sesamum, Kanta* (?), *Kadamba, Amrata,* date-palm, arecanut, plantain, *Tinisa,* vine, *Ketaki,* coconut, etc. are the trees that grow on a wet land. (Sl. 41).

Sobhanjana, Sriphala (wood apple), *Saptaparna, Sephalika, Asoka, Sami, Karira, Karkandhu, Kesara, Nimba* and *Saka* (? vegetables) thrive on arid land. (Sl. 42).

Citron, *Pumnaga, Campaka, Amra* (mango), *Atimuktaka, Priyangu,* pomegranate and Asva (?=Asvattha= Peepal tree) grow on a moderate land which is neither too wet, nor too dry. (Sl. 43).

But by the grace of God and good luck, by the majesty of the kings and by hard labour trees grow even in an uncongenial soil. (Sl. 44).

SELECTION OF LAND FOR TREE-PLANTING

The selection of the land for tree planting according to *Vrksayurveda* is quoted below :

As the banks of beautiful reservoirs of water are generally devoid of shade, the gardens should therefore, be laid on the borders of the water-reservoirs. (Sl. 35).

The soil that is full of poisonous matter, stones or ant-hills or is saline, gravelly or has bad underground water, is not favourable for trees. (Sl. 36).

In the soil that is dark-coloured, near to water, fallow or full of greensward, the trees of all kinds thrive when planted at proper places. (Sl. 37).

Land that is of average humidity—neither too dry, nor too wet, is considered to be good. All kinds of trees grow on it well without doubt. (Sl. 38).

Panasa, Lakuca, Tali, bamboo, citron, *Jamba, Tilaka* (*Clerodendrum phlomoides*), *ghata, Kadamba, Amrata* (hog-plum), date-palm, arecanut tree, plantain, *Tinisa, Mrdvi* (vine with red grapes), *Ketaki* (*Pandamus oderatissimus*) cocoanut, etc. are the trees that generally grow on wet-land. (Sl. 39).

Sobhanjana (*Moringa pterygosperma*), *Sriphala* (*Aegle* marmelos) *Saptaparni* (*Mimosa pudica*), *Sokalika* (*Vitex negundo*), *Asoka, Sanai* (*Prosopis spicigera*), *Karira* (*Capparis aphylla*), *Karkandhu, Rakecara,*

Nimba and *Soka* (*Semecarpus anacardium*) are the trees that grow on dry (arid) land. (Sl. 40).

The rose-apple, *Vetasa* and *Vanisa* (*Calamus rotang*), *Kadamba, Audumbara, Arjuna,* Citron, vine, *Lakuca,* pomegranate, *Anikola* (*Alangium Hexapetalum*), *Tilaka, Panasa, Timira* (an acquatic plant), and *Amrataka* (*Spondias mangifera*) are the sixteen trees that grow on wet-land. (Sl. 41-42).

Citron, *Pumnaga, Campaka,* mango, *Atimuktaka* (a shrub). *Priyangu,* pomegranate, etc. are the trees and plants that grow on moderate land i.e. neither too dry nor too wet. (Sl. 43).

LAND REVENUE SYSTEM

The evidences show that land revenue in ancient India, as in modern time was based on income from land, or in other words, the revenue was rated according to the productivity and kind of soil. The following passages are quoted from "Social and Rural Economy of Northern India, cir. 600 BC—200 AD, by A. N. Bose, Vol. I, P. 118. Manu fixes it between 1|6, 1|8 or 1|12 according to the quality of the soil (VII 130). Gautama raises the lower limit to 1|10 (X 24). Sukra's schedule gives 1|6, 1|4, 1|3 and 1|2 according to the nature of soil, rainfall and irrigation facilities (IV. ii 227-30). It is noticeable that there is a gradual rise from the moderate traditional rate of 1|10. Elsewhere the Arthasastra significantly recommends upland (sthala) and low-land (kedara) to be entered separately in the field register of the *gopa* and enjoins a three-fold gradation of villages after the manner of Gautama and Manu upon the revenue officer (Samahartar, II. 35; Sukraniti, VV. ii 220). This together with a similar reference in Book V, Chap. II, indicates that differential rates for different classes of soils are intended. The Agnipurana again mentioned rates between 1|6 and 1|8 for different kinds of paddy crops. Thus, the assessment varied according to the quality of land and the nature of the crop, the *sadbhaga* was only a traditional or average rate, not the fixed or universal rate, in this respect resembling somewhat the 'tithe' in European fiscal terminology.

Manu, the Arthasastra and the Sumaniti pre-suppose a careful gradation of land, survey and measurement, calculation of outturn as well as expenses per unit of land and so forth.

We find in the Arthasastra and the Smritis not only stringent rules about leaving a good producers surplus but also a classification of soil on the basis of fertility and differential assessment on the same.

The king's share did not necessarily mean a fixed share. It was determined by consideration of fertility of the soil and by the needs of the State or of the cultivator. The system of measurement and survey and differentiation of soil according to productivity also indicates that land revenue assessment was not permanent but revised at intervals although a constant revision was not necessary.

Megasthenes states that Maurya officers were concerned with the measurement and supervision of alluvial deposits for revenue purposes. If Buhler's identification of Rajukas of Asoka with the *rajjuka* or *rajju-gahava amacca* of the Jataka stories be correct and if both may be aligned with the *agronomoi* of Megasthenes, it would point not only to an organised system of land survey as hinted in the Arthasastra but also a realisation of the great schemes of the Arthasastra to keep a record like the Domesday Book of William, the Conqueror.

CHAPTER II

IRRIGATION AND DRAINAGE

Over a large part of the country rain has always been unequally and irregularly distributed and that is why, we find that from very early times, Indian cultivators have sought to supplement the rainfall by digging wells and conserve it by tanks and storage reservoirs. Evidences, both literary and monumental, have already been given to show that great solicitude was displayed for irrigation in the past. Further, if we believe Wilcox, we have to admit that much larger and more extensive irrigational works were carried out in ancient days than have yet been attempted in modern times.

References to irrigation are numerous and scattered in the whole of the ancient literature. These together with the evidences of foreign writers particularly Megasthenes of the older days and Wilcox of modern times throw much light on the irrigational methods in ancient India.

Irrigation occupied a prominent position in the agriculture of India from the earliest times. A good account of it is found in 'Agriculture and Agriculturists in ancient India' written by R. Gangopadhyaya.

REFERENCES IN VEDAS

From earliest times, irrigation has always played an important part in the agricultural industry of India. In the Rigveda, we find many references to irrigation. The word "well" frequently occurs there (vide ante) and is described as "unfailing and full of water" (Rv. X, 101, 6). Water was raised from the well by means of a wheel, a strap and water pails, (Rv. VIII, 69, 12; also Jat. Nos. 174 and 259) and also perhaps by buckets tied by rope to one end of a long wooden pole, working about a fulcrum near the other end that carried a heavy weight. The same old crude method is still prevalent in some parts of Northern India. Another method largely employed is to raise water by a small canoe tied by four strings—two at each side and worked between two men standing on a wooden platform projecting over a shallow reservoir. The canoe is swung to and fro, and at each end of the swing, water rises and pours out into the main channel. Macdonell and Keith find clear references to artificial water channels used for irrigation as practised in the times of the Rigveda (Vedic Index I, p. 214). In the Atharvaveda also such references are not wanting (See Hymn 13, Bk. III).

REFERENCES IN EPICS, ARTHASASTRA, LAW-BOOKS AND JATAKAS

Narada enunciates, "No grain is ever produced without water, but too much water tends to spoil the grain. An inundation is as injurious

to growth as dearth of water" (Narada Smrti XI, 19). And Brhaspati points out, "That man will enjoy produce who sows fertile land, which has many holes and is wet, capable of irrigation, surrounded by fields on all sides and cultivated in due season" (Nar. XIV, 23). The Arthasastra again points out that irrigational works are the sources of crops (Bk. 7, Ch. 14). The results of a good shower of rain are ever obtained in the case of crops below irrigational works. There are many references to dikes or water courses in the law-books. Two sorts of dikes are mentioned—one *kheya* which is dug into the ground and the other *bandhya* which prevents the access of water. A kheya dike serves the purpose of irrigation and a bandhya serves to keep the water off (Nar. XI, 18). According to Yagnavalkya, the erection of a dike in the middle of another man's field is not a prohibited act as it may be productive of considerable advantage where as the loss is trifling (II, 156, Cf. Nar. XI, 17). In fact, almost all the law-books loudly exclaim the great merit of excavating water reservoirs. In the Sabhaparva of the Mahabharata, we find Narada asking Yadhisthira if he was attentive to the improvement of agriculture by digging tanks in his kingdom at proper distances so that agriculture might not have to depend entirely on rain (Ch. CL. 5). And the Arthasastra (Bk. II, Ch. I) enjoins that the king shall construct reservoirs filled with water either perennial or drawn from other sources. He was also required to provide such amenities as sites, roads, timber and other necessary things to those who would construct reservoirs of their own accord. Indeed, there were cooperative institutions for constructing reservoirs for irrigation. The Jataka No. 76 describes how in sign of coming rain, with spade and basket the men will go forth to bank the dikes (Vol. I, pp. 190-191 and also p. 188). In the Kunala Jataka (Vol. V, p. 219) the Sakyas and the Koliyas are represented as being on the point of fighting with each other regarding the waters of the Rohini, which each wanted when their crops began to fag and droop in the month of Jetthamula. In the Vishnuparva of the Harivamsa again, there is a masked reference to the course of the Yamuna being diverted through Brindavan by Balarama (Ch. 102). It was apparently for agricultural purposes; for, Balarama is characteristically represented as the wielder of the plough (Langala) and the pestle (Musala).

That the ancient Indians extensively employed irrigational methods of cultivation is further corroborated by Megasthenes. He writes, "India has many huge mountains which abound in fruit trees of every kind and many vast planes of great fertility—more or less beautiful, but all alike intersected by a multitude of rivers. The greater part of the soil is moreover under irrigation and consequently bears two crops in the course of the year" (Mc Crindle P. 29-30). The Arthasastra mentions a special Government Officer called Superintendent of Agriculture who assessed land at rates varying according to different methods of irrigation. Those who practised irrigation by manual labour had to pay 1|5 of the produce as water-charges, by carrying water on shoulders 1|4 of the produce, by water-

lifts 1|3 of the produce and by raising water from rivers, tanks, lakes and wells 1|3 or 1|4 of the produce. Remission of taxes was allowed (Arthasastra Bk. II, ch. 24; and Bk. III, ch. 7) to those who built of their own accord tanks, lakes, etc. or repaired neglected or ruined works of similar nature. Chandra Gupta Maurya maintained a regular system of canals and a special department whose business was to measure lands and regulate water-supply of sluices.

The Lake Sudarsana which was excavated by Pushya Gupta—the Viceroy of Chandra Gupta and whose channels of irrigation were completed by Asoka, is one of the monumental works that still points to the great importance that used to be attached to irrigation in ancient India. In later times also, kings dug many reservoirs for agriculture, the ruins of which are still to be found in Midnapur, Bankura and Birbhum in West Bengal.

"Life in Ancient India", a book written by J. C. Roy contains valuable information on irrigation systems in ancient India. Some important extracts from this book are reproduced below for the convenience of the readers. "The Rigvedic farmers, we were told, constructed channels for irrigation from wells and probably also from rivers which rose on account of the melting of the Himalayan glaciers in summer. Artificial lakes for storing rain-water such as are common in the South were of course not to be thought of in the western Punjab, where the annual rainfall is small, air dry, and summer temperature high. Probably canal irrigation by constructing a permanent weir across a river was not known in ancient times. But there was another method, though possible only in places where the land surface is close to a hill or undulating, and a remarkable example of this method exists in a dry part of the District of Bankura. It is a canal 16 miles long for storing surplus rain-water from the upper basins. It is associated with the name of Subhankara, the celebrated practical mathematician of old though it was his title like the title, Khana. The canal is known as 'Subhankari danda', Sanskrit 'danda' from its resemblance with the trunk of a tree with branches, the distributaries. It is a case of remarkably accurate alignment over a wide tract.

In the Rigveda there is mention of a machine 'asmachakra' for lifting water. It was a wheel made of stone, and water was raised in a pail by means of a leather strap. From this it is difficult to make out the device. There was 'drona,' a sloop, but it is not clear what the size was, and whether any lever weighted at one end was employed to lift the 'drona,. In this form it has been in use, and within its limits it is a highly efficient machine. There was 'araghatta', but I do not know when it was used first. It is a contrivance for lifting water from wells and lakes by working at 'ara' or spokes. It was probably the same known as 'ghati yantra' and 'udghatana.' The latter consists of a drum-shaped wheel turning in a vertical plane over water, round which goes a pair of endless ropes with 'grata' or earthen pots tied to them at equal distances. The wheel has spokes at one end, and is worked like a capstan. It has been known as the

Persian wheel and is a highly efficient lift as proved by its imitation in iron in the name of chain and bucket pumps. It is known also as 'ghata-chakra', and the 'asmachakra' of the Rigveda was probably this, the stone wheel preventing slipping down of the loaded pots which are always on one side. It is worked also by bullocks, the power being transmitted by a crown and spur wheel made of wood. The 'gharghari' of Bengal and other parts of India is a pulley and bucket arrangement as well as the wheel and axle, and used for domestic purposes. The pulley and rope gave rise to the 'mote' of Northern India which is in use for irrigating fields, the rope being drawn by bullocks. There is the 'tera,' the 'tiryaka yantra,' or the *swape,* the weighted end of the pole overbalancing the bucket. In this also *madras* differs and has 'paicotta,' which is a 'tera' but worked by trampling along the pole and therefore requires considerable practice. Kautilya mentions two machines. One is 'udghata' as mentioned above. It was worked by bullocks for raising water from rivers, lakes and wells. The other is 'sroto-yantra,' probably some water-driven water-lift (see infra).

The almost infinite variety of climate and soil of India together with natural crossing of field crops and selection of seed by cultivators during ages has evolved a large number of distinct races, and, in some cases,varieties of our foodgrains of immense economic importance. Taking rice, we find that it can be grown in some form or another throughout the year. There are four groups, named according to tl season of harvesting, such as 'graishmika,' the summer, 'varshika' the rainy, 'sarada', the autumn, and 'haimana', the winter. The ancient medical writers as well as Kautilya did not clearly distinguish an autumn class, the 'laghu dhanya' of Bengal, probably on account of their residence in Upper India where the meteorological conditions are not exactly suitable for moisture-loving paddy. They recognised three classes, viz., Shashtika, ripening in 60 days in summer, Vrihi of the rainy season, and Sali of winter. Some considered the first two classes as one. It is well known that the same seed does well enough for both the crops, and the Vrihi of Vedic literature may be called summer paddy. The climatic conditions of the western and eastern parts of the Panjab differ a great deal, and rice became an important crop when the Vedic Aryans had come to occupy the land of the "seven rivers", 'saptasindhu', where flooding took place and irrigation became possible."

REFERENCES IN PALI WORKS AND EPICS

In Buddha's time the khettas of Magadha were intersected by a net work of canals and ridges,—rectangular and curvilinear which marked the boundaries of arable plots (Literally—"divided piece-meal (accibandham—Buddhaghosa's note 'caturassakedarakabaddham' is insufficient. A raywise division would not help distribution of water) and in rows (palibandham—Buddhaghosa has 'ayamatoca vittharato ca digha mariyadabandham') and by external ridges (mariyabandham—Buddhaghosa gives 'anatarantaraya mariyadaya mariyadabandham') and by cross boundaries

(singhatakabandham—Buddhaghosa explains 'mariyadam vinivijjhitva gatatthane singhatakabandham. Catukka-santhananti attho')", and which resembled a patchwork robe (civara) such as is prescribed by Buddha as a pattern for the order being the least covetable thing (Mv. VIII. 12. 1-2). Watering projects were undertaken by specialists who 'conducted the water as they pleased' (udakam hi nayanti nettika, Dhp. 80, 145; Therag. 19, 877) ("The nettikas, to judge from the commentary and from the general purport of the verse, are not simply water-carriers but builders of canals and aqueducts who force the water to go where it would not go by itself" —Maxmiller's note in the Dhammapada, S. B. E. series). The operations were designed to regulate the inflow and outflow of water in the khettas after the sowing (udakan atinetabbam.....atinetva ninnetabbam, Cv. VII. 1. 2, cf. V. 17.2). The canals and tanks were apparently dug by cooperative effort and for cooperative irrigation (Jat. I, 199 f, 336; V. 412). In the Epics is mainfest the sense of royal responsibility in the matter. "Are large and swelling lakes excavated all over the kingdom at proper intervals without agriculture being in thy realm entirely dependent on the showers of heaven?" So says Narada to Yadhisthira in his discourse on administrative principles (kaccid rastre tatagani purnani ca vrhanti ca: bhagaso vinivistani na krsi-rdevamatrika, Mbh. II. 5. 77). Rama eulogises the land of Kosala as adevamatrka i.e., relying on irrigation and not on rainfall (Ram. II. 100. 45) and the Arthasastra uses the same epithet to describe the qualities of a good country (VI. 1.). The advance made in irrigation may be imagined from the anecdote that when a teacher sent his pupil to stop a breach in the water-course of a certain field, the latter had to lie down to stop the flood and prevent vital injury to the crops (Mbh. I. 3). The position is confirmed by a parable the implication of which is that guards were employed at the vital spots of embankments, the rupture whereof would cause a great flood and damage (The King should be vigilant at danger-gates as at the dam of a large water-work—apaddaresu yuktah syaj-jalaprasravanesviva, Mbh. XII. 120-8).

REFERENCES IN ARTHASASTRA

But the Jatakas and the Epics do not shed off the belief in the dispensation of Sakka or Indra who held the key to their garner from heaven. Law books of post-Christian compilation encourage irrigation enterprises by kings and peoples with the lure of divine reward (Vis. XCI. if, 9; Vas, XVII. 8; cf. Vr. XIV. 23). The Arthasastra marks the evolution of a completely economic outlook. Except for a formal chanting of Vedic mantras (II. 24), the author concentrates on various precautionary measures among which the largest attention is given to irrigation. In Buddha's time irrigation contrivances hardly excelled the old Vedic mechanisms; water was drawn by means of the lever, (tulam), the bullock-team (the reading differs between 'karakataka', and 'karakatanka' and 'karakadaka'; Buddhaghosa explains—'vuccati gone va yojetva hatthehi va gahetvadigha

varattadihi akaddhanayantam) and axle (Cakkavattakam, Buddhaghosa's note—'arahattaghatiyantam' is not clear) (Cv. V. 16.2); the Arthasastra evinces a mature engineering skill. Great caution and experience are required of the cultivator in order to use properly its irrigation projects (II. 9). The offender who breaks the dam of a tank full of water (undakadharanam setum bhindatah) shall be drowned in that very tank (IV. II, Manu, IX. 279). Its irrigation methods by means of mechanical contrivances and air power are corroborated in a later Pallava Plate (Ep. In. V. 8) and in the Sukranitisara (II. 320-24). The costly and perfected water-works necessitated the levy of a graduated water-rate (udakabhaga) and the testimony of the Sukraniti is concurrent (IV. ii. 227-29). But if such works are dug by peoples themselves, nothing should be charged until they realise profit twice the expenditure (Arth. III.-9; Suk. IV. II. 242-44). This provision laid down with slight variation by two outstanding treatises on political economy separated by at least nine hundred years is a most eloquent testimony to tradition and its influence on sociological development in ancient India.

INSCRIPTIONAL EVIDENCE

Later epigraphic records supply copious illustrations of magnificent State enterprises. Instances in early inscriptions are few and far between. Still we do not altogether lack examples of private initiative for sinking wells and reservoirs under royal encouragement. The Ara inscription of Kaniska II alludes to "a well dug by Dasafota.....for the welfare of all beings" on which the king threw a lac as a religious gift. An Andhra inscription of Sri Pulumyi's reign (identified by Sukthankar with Pulumayi II) speaks of a well sunk by a gahapatika (Ep. In. XIV. 7, 9). As a protagonist of irrigation schemes, the Mauryas do not stand on Asoka's Edicts alone. They took a vigorous interest in the irrigation of the country. Megasthenes enumerates a class of officers distinguished from those entrusted with the administration of the city and of the military, who "superintend the rivers, measure the land, as is done in Egypt, and inspect the sluices by which water is let out from the main canals into their branches, so that everyone may have an equal supply of it" (Str. XV. i. 50). The Junagadh Rock Inscription of Rudradaman states how the Sudarsana lake excavated by the governor of Chandragupta Maurya, restored and adorned with conduits by Asoka's governor, had subsequently an enormous breach and was dried up; and "when the people in their despair of having the dam rebuilt were loudly lamenting." (punah setubandhanairasyat hahabhutasu prajasu), the Saka prince undertook the reconstruction in the teeth of ministerial opposition with a large outlay of capital and furnished the lake a "natural dam, well planned conduits, drains, and means to guard against foul matter." (Ep. In. VIII. 6. cf. CV. V. 17. 2 for similar contrivances.) The dimension of the dam (420 cubits x 420 cubits) gives an idea of the vastness of the reservoir, and this was constructed by the

Mauryas even in an outlying province. King Kharavela of Kalinga claims to have similarly strengthened the embankments of springs and lakes with a large expense,....in the famous inscription of Hathigumpha. And Rudradaman was not the solitary instance of his line in magnificent irrigation enterprises. A Sanchi inscription of the 3rd century A.D. records the excavation of a well by a Saka chief (mahadandanayaka) of perennial water-supply for all (salilah sarvadhigamyah sada); and an inscription of the second century in Kathiawad says that a general (senapati) of the time of the Ksatrapa Rudrasimha caused a well to be dug and embanked in the village of Rasopadra for the welfare and comfort of all living beings (sarvasatvanam hita sukhartham). (Ep. In. XVI. 16. f.).

IRRIGATION AND FLOODS

The irrigation schemes provided not only against drought but also against flood and excessive rainfall. Though flood figures in Vedic prayers, among the daivapidanama of the Arthasastra and among the itayah of the Mahabharata (V. 60. 17), as enumerated in the Puranas (these are six calamities of husbandry, viz., drought, flood, locust, rat, bird and foreign invasion) as fore-runner of famine, it is overshadowed by drought in all sorts of literature. In those days, when the river system had probably its natural flow and was not silted up as now, flood did not pay an annual visit with the monsoon. In the Jatakas there is a solitary case of grains being washed away in the rainy season but obviously the khettas were not flooded, for "the corns had just sprouted" (sessanam gabbhagahankalo jato) and the villagers expected a fair harvest if they could hold on for two months (II. 135) (Flood is referred to in Mv. III, 9.4; 28; Mil. p. 277).

In the introduction to the Mahasupina Jataka is narrated how at the sign of desired rain "men shall go forth to bank up the dykes with spade and basket in hand" (Purisesu Kuddalapitakahatthesu alim bandhanatthaya nikkhantesu-1. 336). The implication is same in the Mahabharata simile recalling the uselessness of closing the embankments after the water is let out (gatodake setubandho-VIII. 86.2). The Ramayana allegorically refers to dykes releasing rain water (puranaliva navodakam-II. 62. 10). In the Milinda the Khettas are seen provided with sluices (*matika*) to bring in water and embankments (mariyada) to keep the water in (P. 416). The control over inflow and outflow of water appears in the irrigation process of the Vinaya passage quoted above. It seems that the ditches cut across the embankments raised around the plots, to be fed from tanks, wells and rivers in case of drought, to let out surplus water during excessive rainfall, and in times of rain after prolonged drought, the gaps in the embankments were sealed up to hold the water for the sun-burnt plots almost exactly as peasants do today.

WATER RESERVOIRS

After suggesting how a king should get planned and built by expert architects and technicians villages, towns, fortresses, etc. the sage Kasyapa

gives a fairly detailed account of building water reservoirs, selection of site for them and the benefits that would eventually result from them, in his book "A Treatise on Agriculture". Translation of some of the important portions is given below to acquaint the reader with Kasyapa's knowledge of water reservoirs.

The king should have a reservoir of water constructed in a most suitable place on the west, north, east or south sides of the villages and towns according to the situation of the land (to be irrigated). The reservoir should be deep and fathomless like a moat and should either be semi-circular, oblong or circular in shape. It should have high embankments and be reinforced with strong buttresses and provided with a causeway and channels and sluices for filling and emptying it. Hence the water reservoir should either be constructed near a hill or on a table land with a big lake. On the plain a reservoir capable of holding large volumes of water, should be constructed on a firm-land free from sand and pebbles or at a place near to a perennial spring. The reservoir should be deep and fitted with flood-gates. The king should take care to see that when the reservoir is full to the brim it should not be a source of danger to the village, city, ramparts, gardens, fortresses and waste land by overflow or breach, etc. He should have it frequently inspected every month or every year. He should appoint guards for the safety of the dams. Particularly, in the rainy season he should have numerous canals dug for sluicing away the overflow. The protection of ponds and lakes is calculated to promote the welfare of the people. Where a reservoir of water is kept full and well-protected, there the harvest is plentiful and there is general happiness amongst the people on account of absence of disease and of the danger from fire (Sl. 69-80).

Feeding and protection of bipeds, quadrupeds, birds and reptiles (like snakes) is always laudable. It adds to general happiness and prevents epidemics.

Brahma, who has created all beings, has made water alone a common drink for the bipeds and quadrupeds. Hence the water-reservoir is called the chief source of water-supply. Hence the King, who has taken upon himself the responsibility of protecting his subject, should direct all his efforts towards the constant preservation and protection of such a water-reservoir. According to the extent of the fertile land and the needs of the village he should have one or two reservoirs constructed (Sl. 81-84).

The reservoir may be fed by a mountain rivulet, a big lake, a forest brook or a big river according to the situation of the towns and villages, and it should be provided with a suitable contrivance for the distribution of water. On the banks of the reservoir the king should promote the planting of trees such as the ratan (Calamus Rotang), the banyan (*Ficus indica*), a row of *Kotakanda* (a kind of bulbous plant vermifuge), *plaksa (Ficus infectoria)*, *asvattha (Ficus religiosa)*, *Khadira* and *Khadira (Acacia catechu)*, *tinduka (Diospyros emleryopteris)*, *tintrini* (?), *bhurjara* (birch,

Betula Bhojpatra ?), bamboo, nimba (*Azadirachta indica*), and kadamba (*Nauclea cadamba*)—these being the trees having hard wood.

For common weal the king should have these trees brought (from nurseries ?) at the proper season and get them transplanted properly on the banks of the reservoir, or on its slopes and at the outlet of its sluice in a way that they do not offer any obstruction to the bathing-ghat and provide shelter to watering cisterns. He should also promote the proper growth of beneficent trees like the Banyan on the waste lands; and also of thick shady trees on the banks of tanks, lakes and ponds, in orchards, gardens, resting places and on the highway near to the water-reservoir; and of trees like *vata-pota* (=vatapotha? *Butea frondosa*) and *prasavaka* (*Buchanania latifolia*) which removes the fatigue of the travellers—on places of picnics and other similar resorts (Sl. 85-94).

The king should promote regularly the growth of these shady trees in the gardens attached to temples and palaces, more particularly in hermitages, on camping grounds, in the state rest-houses, on sacrificial grounds and places of offerings. At suitable places he should get planted within enclosures or fencings trees that yield flower and fruit, that are cool and charming, and are dear to the birds, that destroy disease, that are thornless —trees like the bread-fruit, mango (arma and rasala), pumnaga (*Rottleria tinctoria* ? arecanut tree ?), malati (*Jasminum grandiflorum*), *kunda* (*Jasminum multiflorum*), campaka (*Michelia campaka*), etc. and promote their growth by having them watered regularly from the reservoirs (Sl. 95-99).

The sages declare that without a water reservoir there is real discomfort for without it, it is neither possible to have water for bathing, nor for twilight ablutions, nor for the watering of trees. The king should, therefore, intent on public welfare, be alert and have water-reservoirs constructed in villages, estates or in forests and provide it with a very strong and big culvert and several small channels branching out of it for the easy outflow (and distribution) of water (Sl. 100-103).

CANALS AND WELLS

On an agricultural land where neither a water-reservoir nor a canal with a constant and copious supply of water, has been dug or planned to be dug, there it is essential to provide a canal leading to the land, dependent on a river stream. According to geoponic experts such a canal is of four kinds. Firstly, the canal fed from a river, next the one fed from a lake, the third from a reservoir and the fourth from the mountain slopes (i.e., a mountain rill). All these four types of canals should be dug according to the requirements of the country (Sl. 104, 106).

Where a river, etc. exists towards the higher level as compared to the natural situation of the land, an embouchure should be made in the river from which the sparkling water would flow out automatically. Agricultural experts should as a rule make the feeding source of the canal on a higher level than the part of the country on which the agricultural land

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is situated, whether that source be near to that land or far away from it. Whenever a canal is dug out of a river flowing towards the east, it should be made to fall into a river flowing towards the west or another direction or intermediate direction. But in all these cases a higher level is preferable. Having started the construction and laid the bed of a river-fed canal from a river, the king should lead it to his own territory for the benefit of his subjects after making it pass over various kinds of land from village to village and forest to forest (Sl. 107-12).

The breadth of a canal is stated to be four, five, six, seven or ten *hastas* (1 hasta = 1½ feet) (Sl. 113).

Somewhere the canal fed from a big lake remains full of water, so also the one fed from a big river. The farthest extent of a canal is up to one's own fields and its height should also be proportionate to its bed and its depth adjusted everywhere to the volume of its flow. The king should construct such a canal for the benefit of all beings even though it has to cross a big tank on its way (Sl. 114-116).

For the sake of a rich harvest at some places a canal has to be dug from a mountain spring to one's own fields. It may be necessary to dig one, two or even three canals full of water for the benefit of the fields. The geoponic experts say that a canal dug even on a sandy soil is beneficial in some places where there is no river. A land which is free from pebbles, and which has a constant supply of water, good qualities and good fields, is sure to yield a rich harvest. At some places, a canal has to be taken out of a lake for the prosperity of one's own village or for the sake of gardens or pleasure groves in the country (Sl. 117-121).

The fore-sighted sages have declared that the proper construction of canals, sparkling with the flow of water, for the sake of bathing, drinking and the irrigation of cultivated land, is calculated for the preservation of life (Sl. 122).

At some places, the soil of the earth on account of its inherent defects causes the water of the canal to disappear either by absorption or desiccation. Such places should be avoided by canal engineers. At some places the whole tracts of land are covered with saltpetre. Such and other places with terrene faults should also be avoided for the construction of canals. For agricultural prosperity (the king) must have the canals dug. At places, it may be necessary to dig two or even three canals. As a matter of fact their number is determined by the requirements of the locality (Sl. 123-126).

The sages who know this science, say that all the canals should gradually be made to fall into a lake or pond. But where there is no such water-reservoir—be it in an open land, village, city, forest or woodland—the wiseman should make the canal terminate into the fields, particularly, for the promotion of rich harvest. But in such places only small culverts are recommended as beneficial. For, there is no gainsaying the fact that as of living beings, so of the cultivated plants water is the real life.

Therefore, in every land the king should have the canals dug out of rivers or any other sources, protect them and keep them always running. An unprotected canal becomes useless and a dry canal too is to be condemned. Hence the kings would do well if they take good care of the canals. The sages, who have a perception of the truth, too, declare it to be his pious duty. (Sl. 127-131).

Again, irrigation for agricultural purposes is also recommended from ponds, tanks and more particularly from wells. (Sl. 132).

Somewhere a sure supply of water exists above ground and somewhere it is underground. At some places, a stream of water disappears on account of abundance of pebbles and at others on account of some defect in the soil. Wise men have therefore recommended a sandy soil, which abounds in water, for the digging of ponds, wells, etc. (Sl. 134-135).

Where the canal water is insufficient for irrigating cultivated fields or gardens during the summer, the king should have a well dug in that place. He should get a small medium sized or big well dug or a pond made and have it protected in a suitable manner. It may be square, circular or oblong in shape. (Sl. 136-137).

During summer season the water goes underground almost all over the country and even in the river-beds it sinks very low. Therefore wells, etc. should be dug during the summer season for the sake of getting a constant and full supply of water. The king should first ascertain the presence of water by the examination of the soil by one who knows the rules of divining water and by observing the strata of the earth from the (direction of the roots of) trees and then order the digging up of a well or a pond at an auspicious hour and moment of the day. The morning time is generally said to be auspicious for digging. The king should worship Varuna, the Lord of waters, the earth-goddess and the forest-goddess with offerings and then order the construction of a well, pond or lake. At first a big pit should be dug out, oblong, square, or circular in shape, and the excavated earth dumped at a distance. Then brave soldiers and husbandmen should gradually go on removing the earth (from out of the pit) till the water appears. As they proceed down water mixed with sand would be observed and then the base is built for making the foundation strong.

In the stratum where sand abounds the base is built in latticed masonry of burnt bricks. In a hard stratum and sometimes in the construction of an oblong lake, the lower base is built in stone-slabs. At the bottom of a well the base should be gradually made strong by regular removal of the earth mixed with sand and water. And when it is observed that water has begun to ooze copiously, brick masonry should gradually be raised over the base. The walls of the well should be built in bricks laid in lime mortar because the wise have declared it to be very durable. Hence the scientific manuals have definitely recommended that everywhere in the country ponds, wells, etc. should be built in brick and mortar. From the base up to the edge of the ground the whole construction should

be in bricks and steps should also be provided wherever necessary. The structure above ground should be built in stone-slabs in which an opening should be kept towards the east or west or according to the situation of the site.

On the brink of the well, a place for the fixing of the machine for raising water should be built in stone-slabs and for the outflow of water a small conduit should be made on a hard surface near the edge of the well. (Sl. 138-155).

Machines for raising water are of different kinds. The one drawn by bullocks yoked with strong chains is the best. That drawn by an elephant with his trunk is the mediocre type. And the inferior-most type is the one drawn by human labour. It is a common experience that water on lower levels is steadily raised to the surface of the wells, etc., by the revolutions of the water raising machine. That water is carried to the cultivated fields by means of small channels and for that reason the agriculturists are considered to be ingenious in the world. Brahmanas, Ksatriyas, Vaisyas, Sudras and others, too, having raised to the surface the clean and uncontaminated water of a reservoir, a river-fed canal or a lake and convey it to their cultivated fields or vegetable gardens or flowering plants like campaka (*Michelia campaka*) and achieve success in their agricultural efforts. Therefore the first thing that husbandmen should do is to seek for the source of water supply. Definite sources from which water can be had on earth are the canals, wells, lakes, reservoirs, etc. (Sl. 156-159; 163).

During the season of clouds rainfall is certain either accidentally or through the will power of the sages. The rain water poured down by clouds in rainy season should be stored by the king in ponds, reservoirs, etc., for the benefit of the people, and preserved by him with special care; for agriculture solely depends on water. Therefore all the water that can be gathered in the (rainy) season should be well preserved both by the kings as well as other prominent persons—this is the injunction of the great sage Kasyapa. (Sl. 164-167).

LOCATING WATER TABLE

The celebrated Chakrapani, devotee of Rama, born in a Brahmana family of Mathura, was requested by that King to write for his benefit an interesting work which may be useful to the people and be approved by learned men.

In 'Visva-Vallava' he has dealt in detail as how one can have an approximate idea regarding water below the surface of different kinds of lands, based on certain characteristics on the land. He describes these in the following words:

I have composed this work after seeing the works of that type (written by.....) Varaha, Sarasvata, Gargya, Laghna, Samvasyu, Hemadri..... and from my own experience.

Having consulted the scientific works I shall explain everything such as at what depth the water.....by how many cubits..... in this matter..... and again what direction the artery of water follows and whatever is met with in under soil like stones, sweet or bitter (water), *narkara* (*Sarkara gravel*), etc. for the benefit of the whole mankind. (Ch. I, Sl. 10-11).

Although it is a patent fact that (water is found) near or below a marshy place, at sea-side (Sagala Sagara), just by its shore, and in the desert, rocky and mountainous country far deep, yet I shall explain everything in a nut-shell (grahat-samgrahat)—these are the clear indications given by earlier works and I should not be accused for having taken them for granted. There are eight underground arteries of water according as they follow the cardinal and the intermediate points of the compass..... another the ninth. The one that is situated below and shoots upwards is known to have a perennial flow of water.

From a mountain or from the root of a tree the underground artery (sometimes) goes below into a spring (Nirjhara). At some places all the arteries are seen to terminate (Siddhah) in caves. (Ch. I, Sl. 14-16).

While digging if stone-like hard earth is reached and when struck it sounds like a thin slab of stone, then there is sure to be plenty of water beneath it. If in a place devoid of any water reservoir, there is found a rank growth of *Vetasa* (rattan), then there would be an artery of water two cubits below the surface flowing towards the west. Then two and a half cubits away at the depth of seven cubits there would be found stones of golden colour and after them the thin slab below which there would be water (Ch. 1, Sl. 17-18).

If *Vetasa* plant is seen growing in a place where there is no pool of water, then three cubits towards the west of that plant an artery of water would be found after digging seven cubits deep. On digging that place yellow frogs will be found at the depth of a cubit and a half. If the tree *Udumbari* (*Ficus oppositefolia*) is seen growing in a place devoid of a water reservoir of any sort, then three cubits towards its west there will be found an artery of water two and a half man-lengths below the surface of the earth. That is known as *Syama-vetasi* (black-streak). There would be white sand near the water. This is one formula (Ch. 1, Sl. 18).

Where there stands an *Udumbarika* tree, there three cubits towards its west will be found a dark artery of water two and a half man-lengths below the surface. At the depth of one man-length there would be found white sand. If the artery of water is found three cubits towards the east (of the tree) at a depth of two man-lengths, the clay would be red and pale-white and frogs would be found at the depth of a man's length. These are the two formulas (Ch. 1, Sl. 19).

If there is an ant-hill towards the north of an *Arjuna* tree, then three cubits towards the west of the tree, water is sure to be found at the depth of three and a half man-lengths. At the depth of one and a half man-

lengths there would be a whitish grey iguana. Below that would be yellow gravel after that white gravel near the water which would be very sweet in taste. To the south of an ant-hill that stands near a rose-apple tree sweet water will be found at the depth of two man-lengths and dove-coloured earth at half a man's depth. If a *Badari* (jujube) tree stands to the west of an ant-hill, then two cubits towards the west springs of water would certainly be found at the depth of three man-lengths. If there be a *Sinduvara* tree by the side of an ant-hill, then at a man's length towards its south there would be water at the depth of two and a half man-lengths and brown clay and transparent gravel in due succession. And if there is the *Kola* tree, then three cubit towards the west will be found white.... gravel at the depth of three and a half man-lengths (Ch. 1, Sl. 20-22).

If *Bilva* and *Udumbara* trees are found closely inter-twined, then three cubits towards the south there would be water at the depth of three and a half man-lengths, and below that frogs. If *Kasa* and *Udumbarika* are close to an ant-hill, then water would be found along with cow-coloured (*goradrsango-sadrsam*) clay at the depth of three and half man-lengths (Ch. 1, Sl. 23).

East.....artery of scanty water.....at three cubits..... salt and metal like hard earth and an artery towards the north of *Sona* measured by that. If an ant-hill be towards the west of a *Kali* tree at a distance of one man's length, after that the water artery would be found at the depth of four and a half man-lengths (Ch. 1, Sl. 24).

If *Saptahi* stands towards the south of *Karanja* tree, then at the distance of three cubits in the same direction there would be found a tortoise and two arteries of water at the depth of three and a half man-lengths (or at four man-lengths). If towards the north are *Madhuka* trees and in the north-west a *Sarpa* (*Mesua roxburghii*) then at the depth of half a man's length would be found smoke-coloured earth and red stones. (Ch. 1, Sl. 25).

If an ant-hill stands to the south of a *Kapittha* tree then frogs would be found under the tree. Then traversing seven cubits from east towards the north water would be found at the depth of four man-lengths. If *Sarpa* and|or *Kurburaka* be (to the south of *Kapittha*) then black earth will be found at the depth of a man-length along with stone, *putaka* and two arteries of water lying towards the north-west. If a *Tilaka*| tree stands towards the north of an ant-hill and there are also *Durva* and *Kusa* grasses at the site, then there would be found an artery of water to its west at the depth of five cubits and flowing towards the east. If by the side of an ant-hill stands the coconut or palmyra tree, then sweet water would be found six cubits towards the west at a depth of four man-lengths. (Ch. I, Sl. 26-27).

If *Badari* or an ant-hill stands to the left side of *Asmantaka* tree then water would be found six cubits towards the east at a depth of three and a half man-length, provided other signs such as a tortoise at the

depth of the first man-length, next to it grey stone, then towards the south another artery of water flowing to the north and below that, the said perennial artery (Ch. 1, Sl. 28).

If to the left side of *Haridra* plant there be an ant-hill then water would be found three cubits to the east at the depth of five man-lengths, a very white snake and at one man-length yellow clay. Then there would be black earth and an artery of water to the west in front of which towards the south aquatic herbs, plants, grass, tastika and, close to them, water (Ch. 1, Sl. 29).

If there be the plant *Bhargi* (*Clerodendrum siphonantus*), *Danti* (*Croton polyandrum*), black leafed *Nrvrd, Laksmana* (*Hemionitis cardifolia*) or *Malika* (double jasmine), then there is water towards its south at the depth of three man-lengths; or if another tree of smooth leaves (*Snigdhapatra — Karanja*) of which a branch is bent low, then there is water at the same depth (i.e. three man-lengths) or where there are smooth, dwarfish or trees of unusual size or of long or hanging branches. (Ch. 1, Sl. 30).

If stamped (or kicked) by the foot the earth produces a (hollow) sound and from there at the distance of three man-lengths there is the *Kharjuri* tree or *Cakrasir*, then to the west thereof there would be water at the depth of three man-lengths. If there be a *Patasa* tree with white flowers and within three man-lengths of it a *Karnikara* or a *Kola* tree then *Sura-vasati camatkari* would be destroyed within three days. (Ch. 1, Sl. 31).

LOCATING WATER IN ARID AREAS

If there is seen hot vapour (rising from the earth) then there would be found a stream of water at the depth of two man-lengths and underground vegetation. The two-man-deep water would turn pale-white and disappear. Ancient teachers have enumerated many methods of divining water in arid regions, but for fear of increasing the volume of this work, I have explained only a few of them. Now a few common methods of examining the soil in searching for water in arid areas are given as follows.

There are signs approved by (the astrologer) Sanmuni by which now it is possible to divine whether there is adequate supply of water underground or whether the water is sweet. For the felicity of people living in desert places there generally exists underground a rich stream of water as big as the trunk of an elephant. (Ch. 1, Sl. 32, 1).

If to the north of a *Karira* shrub there is an ant-hill then there would be found sweet water towards the south at the depth of ten man-lengths, and at the depth of one man-length there would be yellow frogs. And if on the west of a *Rohita* tree then water would be found at a distance of three cubits and twelve man-lengths below the surface, and towards the west there would be a profuse stream of salt water. (Ch. 1, Sl. 32, 2).

If there is an ant-hill of white colour then close to it towards the

west there would be a water-vein at the depth of five man-lengths, and towards the west stones and yellow clay at the depth of one man-length. If there is an ant-hill to the east of which stands a *Pilu* tree, then at a distance of one man-length to the south there would be water at the depth of seven man-lengths. At the depth of first man-length there would be found a snake with black and white spots and plenty of salt (water) at the depth of three man-lengths. (Ch. 1, Sl. 32, 3).

If an ant-hill stands to the east of *Indra-dru* (*Terminalia arjuna*), then just at one cubit to the west there would be found water at the depth of twenty man-lengths and an iguana only at the depth of one man-length. If *Kantakari* is closely in contact with the *Nispatra* tree (clove or *Capparis sphylla*), then at a distance of three cubits to the west there would be found an artery of water running to the north-east at a depth of eighteen cubits. (Ch. 1, Sl. 32, 4).

If *Rohita* tree is in close contact with *Badara* tree then three cubits to the west there would be water at the depth of sixteen man-lengths and a scorpion at the depth of half a man-length along with white clay, after which there would be met soft stone, a thin water artery to the south and another cool, sweet and copious stream towards the north. (Ch. 1, Sl. 32, 5).

If the *Karkkandhu* tree is in close contact with the *Pilu* tree then three cubits to the east would be found copious salt water at a depth of twenty man-lengths. If the *Bilva* tree or *Karira* be in close contact with Kakuvna (*Terminalia arjuna*) then two cubits to the west there would be found a copious flow of sweet water at the depth of twenty-four (or twenty-five man-lengths). (Ch. 1, Sl. 32, 6).

If there be a group of five ant-hills at one place — the middle one being white in colour — then there would be water under a depth of fifty five man-lengths. If there be *Kusa* grass growing over an ant-hill or there be pale-white *adurva* then twenty one man-lengths below it would be found water. (Ch. 1, Sl. 32, 7).

If a *Rohita* tree stands in the midst of a ring of three ant-hills and other trees, there would be plenty of water under a bed of natural stones at depth of forty man-lengths, and at a depth of sixty man-lengths there would be yellow clay. To the west there would be sand, at one man's depth under the pair of *Sami* and *Palasa* trees standing close together. (Ch. 1, Sl. 32, 7).

If there be a very gnarled *Sami* tree to the south of an ant-hill, then towards its west, according to former authorities, there would be sweet water at the depth of two hundred man-lengths. Or (if there be) white thorns.....there would be water to the south at a depth of eighty man-lengths. And if *Nipa* tree stands in close proximity of an ant-hill, then a snake would be found at the depth of a half man-length and the same (i.e. water) at the depth of twenty-five man-lengths. (Ch. 1, Sl. 32, 10).

If there be a thick and rank growth of *Pasa* (?) on the land then water would be found at a depth of twentyfive man-lengths and black or pale-white clay within the depth of three man-lengths. Seventy man-lengths towards the left side of a *Maha-nimba* tree (*Melia bukajun*) there would be found water and the birds frequenting the place would be sweet-voiced and have a sleek and thick plumage. (Ch. 1, Sl. 32, 11).

Where there are shrubs with very green leaves or a *Nipa-sipa* (?) tree, there water would be found at a depth of fifteen man-lengths and also the adorable serpent. Thus, I have enumerated certain formulae for desert land. More of them may always be noted by clever people from ordinary life and also from other works. (Ch. 1, Sl. 32, 12).

LOCATING WATER IN MARSHY LANDS

In a marshy country there are green herbs and the land is wet and full of mosquitoes. There is *Andropogon muricatus* (*Virana*) or *Valaya* (?) too. Underground there is plenty of sweet water at the depth of one man-length, or there is low-lying land where there is water at the depth of three (?) (Ch. 1, Sl. 33, 1).

Where there are the herbs *Danti, Rudanti* (a small succulent plant), *Trivrta* (*Ipomoea turpethum*), *Siva* (*Mimosa* suma), *Suparni* (? Suparni, a kind of creeper) with growth quick like the swoop of an eagle (garuda), *Jyotismati* (*Cardiospermum halicacabum*), *Vyaghrapadi* and|or *Varahi* (Cyperus), there water is found very near (the surface). And where there are *Masacchacta* (*Glycine debilis*), *Gundraka Kelava, Laksmana* (*Hemionitis cordifolia*), *Salidata* (*Glycine debilis*), *Edaka, Brahmi, Pindaraka, Sariva* and *Nala* reeds there too the water is very near (the surface) (Ch. 1, Sl. 33, 2).

Towards the south of a grove of thick trees and creepers there is plenty of water at the depth of four cubits. In a valley the land is low, covered with green turf, sandy, resonant and rich in water (Ch. 1, Sl. 33, 3).

As in a marshy country water is decidedly near (the surface) and in plenty, there only a few outstanding signs have been mentioned, the rest being ignored (Ch. 1, Sl. 33, 4).

LOCATING WATER IN MOUNTAINOUS COUNTRY

With due deliberation I have given a few of the clear formulae described by Sarasvata. Here I shall mention those that have been described by Varaha and others with respect to the mountainous country (Ch. 1, Sl. 34, 1).

Where there is a cluster of the *Bodhi* tree, *Udumbarika, Palasa* and *Nyagrodha,* at one place, water would be found three man-lengths below them even in arid and marshy lands (Ch. 1, Sl. 34, 2).

The place where the trees have glossy and thick foliage and shrubs and creepers have milky juice, has sweet water very near (the surface) and is inhabited by sweet-voiced birds (Ch. 1, Sl. 34, 3).

In a place where there grow *Kharjuri, Jambu, Sata-patra, Nipa, Sinduvara, Vata, Naktamala, Andumbari, Kakaranva* (?), and *Vibhitaka,* there water would be found at a depth of three man-lengths (Ch. 1, Sl. 34, 4).

Water is said to exist underground in a place where flowering trees and plants like *Jati, Kusthaka, Campaka,* etc. and fruit-bearing trees like the pomegranate, lime (*Citrus acida*) and citron are found to grow (Ch. 1, Sl. 34, 5).

Where on a hilly place the *Tala* tree, the coconut, tree, *Kancanara, Vetasa* or any other tree are found to grow, there sweet water is found in plenty (Ch. 1, Sl. 34, 6).

What has been previously described as a *Nirjahara* (water-fall or cascade) is found in a mountainous country issuing from the crevices between the rocks or from the roots of the trees..... (?) (Ch. 1, Sl. 34, 7).

In a wet mountainous country a stream with a copious flow of water is generally found to flow from under the vegetation. Sometimes such a stream is also found to exist underground at holy places with shrines. Near the rocks that glisten like a copper vessel facing the east (i.e. sun), or like glass and *Vaidurya* (cat's eye) or are bright like the pearls, or grey like the *Patasa,* or brown in colour, there is plenty of water. On the rocks that have the colour of silk, honey, ghee, dove or a star, water does exist but it is quickly dried up (?), though the rock may be as high as to touch the sky (Ch. 1, Sl. 34, 8-10).

Where the dark blue soil or the black soil is found in conjunction with gravel, or where there is white coloured soil and sand or where there is yellowish soil, there exists sweet water. In the soil that is as bright as copper and is mixed with sand, the water is astringent and scanty. In brown soil the water is acrid in taste and in polish soil (of smooth surface) it is salt (Ch. 1, Sl. 34, 11-12).

Where the thickets and shrubs are weak, dry and thin, and have sparse foliage, water would be absent there, so also at a place where *Sriparna, Sarja, Anjana, Sali Bilva, Simsipa,* and *Dhava* are found to grow. The growth (or stature) which *Darva, Jambu, Kusa, Picu, Mahanimba, pilu* and *Yavasa* would attain when watered and fully developed in an arid land is less by one quarter of a cubit if they are reared in a hilly place, is less by half a cubit if reared on a partly dry and partly wet land, and is less by one cubit if reared in a marshy place. Clever people should find out which place has scanty, average or profuse supply of water and which has none at all, and according to that they should ascertain the size of the plants and trees. The aforesaid signs are correct and *Durva* and other plants and trees should be classified with respect to the differences in their size according to the places of origin, as prescribed by the sages (Ch. 1, Sl. 34, 13-16).

In this (chapter) I have disclosed in writing the key to the finding

of water as prescribed by the sage, and the first *Ullasa* (chapter), dear to the world, comes to its end.

CONSTRUCTION OF RESERVOIRS

After the location of underground water, Chakrapani describes in chapter 2 of his book "Visva-Vallabha" the construction of reservoirs in the following paragraphs.

When water has been located, reservoirs of various shapes and sizes should be constructed outside the villages, their sites and measurements being determined by the availability of space. (Ch. 2, Sl. 1).

An artificial reservoir may be of ten (? six) shapes, *viz.* circular, quadrangular (i.e. square), triangular, polygonal, oblong and semi-circular (half-moon-shaped). Its capacity may be ascertained after it is dug. The best reservoir should measure one thousand poles (or 4000 cubits) in length, medium-sized would be half of it and the smallest one quarter. The size of other reservoirs is determined by the availability of space. A big reservoir, in which there will always remain a large store of water, can be constructed at a lesser cost by constructing a dam between two hills, or in a mountain valley or on a spacious place at the top of a hill. If there be a wide and high table-land on all sides with great influx of water and a narrow outlet for the exit of water, then a big reservoir can be made by constructing a dam there. A wise person should provide a descent of steps from the top of the dam to the bottom of the reservoir and for making the dam strong he should have it plastered with lime-cement both on the inner as well as outer face (Ch. 2, Sl. 3, 6-9).

A land low from all sides when full of water turns into a pond and becomes a natural reservoir. There can be no prescribed measurements for it...small...pits etc. (Ch. 2, Sl. 10).

In the middle of the lakes and on their banks there are pleasure houses of the kings. For the purpose of pleasure-trip or frolicking in water a boat should be kept there or an approach to the pleasure-house be made by means of a bridge (or causeway) (Ch. 2, Sl. 11).

A tank with three peaks (? angles) and one opening is called *Nanda,* that with *Bhadra,* the one with nine peaks and three openings is *Jaya* and that with twelve peaks and four openings is called *Vijaya* (Ch. 2, Sl. 12).

Well is of several kinds, such as, *Srimukha, Vijaya, Pranta, Dundubhi, Manohara, Cudamani, Bhadra, Jaya, Nanda,* and *Sankara.* If at the bottom of the well there is found to be sand, a foundation pedestal made of hard wood and *Kagara* (?), etc. or *Pusa* etc. should be placed below in a manner that it does not block its springs of water. If the well in a village is *Musyabhuta* (?) then water reservoir..... should not be made. Being situated in the intermediate point of the compass it gradually produces heat (?). It is fatal to the lives of young girls and women. If there be no stream in any direction then a well dug in one of the intermediate quarters....or if at the distance of a thousand poles

(4000 cubits) from the village it will not do any harm if used for watering trees, etc. (Ch. 2, Sl. 14, 16-18).

A *Kunda* (pit) is of four kinds, viz., *Bhadra, Subhadra, Parigha* and Nanda. The first is four-sided, the second is Bhadra, the third Subhadra and in the middle the fourth connected with Peatibhadra. They (i.e. the Kundas) should measure one hundred and eight cubits on each side with four openings, one in each direction, and a half in one corner provided with a quadrangular courtyard and ventilators inside (Ch. 2, Sl. 19-20).

A very deep natural pool which has come into existence of itself may be of various shapes. Its embankments may be paved as they are with stone and lime mortar (Ch. 2, Sl. 21).

BREAKING OF ROCKS

In digging a reservoir many rocks have to be cut. In chapter 2 of his book "Visva-Vallava", Chakrapani gives an account of the different methods of breaking rocks of various types. Translation of some of the relevant portions of this chapter are given below.

I shall now describe several easy methods of breaking the rock with chisels and also the (formulae of) herbs and liquids by the use of which the edges do not become blunt with blows. (Ch. 2., Sl. 25).

Washing it (i.e. the rock) clean with pieces of wood, one should sprinkle it with the juice of *Patasa, Jambu, Dhava* and *Sadara* (?) as well as of *Sirisa, Bambulaka (Acacia arabica), Tinduka, Bhallataka Cinca* (Tamarind), *Khadira,* etc. (Ch. 2., Sl. 26).

Now, one should put *Badara,* whey, and *Kulattha* (?) in sour gruel and keep them for seven days (to ferment). Then heating the rock with fire (lighted over it) one should pour the fermented liquid over it. The rock would be split by doing so (Ch. 2, Sl. 26).

The heated rock sprinkled over with the fermented liquid of the pulverized ingredients (stated above), heated again and again sprinkled over, and lastly sprinkled over with whey (?) is sure to split as under (Ch. 2., Sl. 27-28).

A hard rock that is first heated well and then sprinkled over with the solution of jaggery, natron, turmeric, long pepper, mustard oil and water mixed with sour gruel, splits with very little effort (Ch. 2, Sl. 29).

Take the ashes of the bark and leaves of *Nimba, Apamarga (Achyranthes aspera),* Guduci *(Cocculus cordifolius),* sesamum, *Nala* (lotus stalk) and *Tinduka* and take also water mixed with oil and whey as well as jaggery, white mustard and lake-salt (?). A solution of all these in cow's urine when poured on the heated rock, would be enough to break it (Ch. 2, Sl. 30-31).

One should plaster the rock with the paste of sheep's horn, milky juice of *Arka* and the offal of doves and mice. Then the edge of the chisel will not be blunted with blows if the mixture of oil and whey is poured

over it drop by drop (Ch. 2, Sl. 32).

The edge of a chisel if heated and dipped in the emulsion of oil and whey gets a hard temper. The same result is obtained by dipping it in the emulsion of *Bhrngaraka* juice and oil or in a solution of jaggery and oil (Ch. 2, Sl. 33).

If in the juice of plantain alkali is filliped and kept over for a day (to ferment) and then (red hot) iron chisel is dipped into it, the chisel would not break even in the process of cutting a metal, nor get blunt while operating on the surface of a rock. (Ch. 2, Sl. 34).

If wine, alkali obtained from barley-ashes, jaggery and milky juice of *Arka* are mixed in due proportion in *Sankola* (?) oil, then the edges of tools (heated and dipped into that solution) do not get blunt even while cutting metals (Ch. 2, Sl. 35).

If the powder of *Khadira* is poured into a well whose water is saline or acrid in taste, the water would be turned sweet (Ch. 2, Sl. 36).

The turbid and pungent smelling water of pools etc. would turn sweet and pellucid if the powder as well as the juice of *Kakubha, Musta, Usira,* fruits of *Dhatri* and *Kanaka* and of *Rodhra* (*Symplocos racemosa*) and Rajasana (?) is poured into them (Ch. 2, Sl. 37).

The juice of *Abhaya* (*Terminalia chebula*) and the powder of *Pathya* (*Terminalia citrina*), *Kustha,* Cardamom, *Kugaudhma* (?) and *Kataka* fruit (*Strychnos potatorum*) along with the essence of Khadira and the fruit of *Sriphala* (wood-apple), if thrown in the turbid water or the salt water of well, they would at once turn the water (clear) and sweet (Ch. 2, Sl. 38).

CHAPTER III

TILLAGE AND TILLAGE IMPLEMENTS

The culture of the land is the first and foremost operation in agricultural production. This consists in breaking up the lumps of earth and smoothing and levelling prior to sowing of seed so as to bring about improvement in the physical condition of the soil conducive to the healthy growth of the crops. Plough happened to be the implement utilised for such purposes from the dawn of civilization.

PLOUGH

The plough and the lute seem to be the two symbols of cultural evolution of humanity—the material and the aesthetic. Balarama and Krishna who, according to the Hindu belief, are the two protectors of the entire universe are represented as holding the plough and the lute respectively. In the Satapatha Brahmana, the operations of agriculture are neatly summed up as ploughing, sowing, reaping and threshing.

Plough was held in high esteem and was regarded as a very auspicious article. This is described in a narrative in Jataka No. 28: a farmer deposited 500 ploughs with a friend who ultimately tried to misappropriate them on a false plea. Stealing or misappropriating ploughs was heavily punishable and more so if it was done in the season of ploughing (*Manu* IX, 291). Making a gift of them was believed to be highly meritorious. The Agnipurana says, "the ploughshare should be plated with gold before the gift, whereby the giver would be glorified in heaven" (Chap. XX XI). This clearly shows the reverence and respect with which the plough was regarded.

As described by Parasara, "The plough consists essentially of the following 8 parts: Isa (the pole of the plough), Yuga (the yoke), Niryola (the rod of the plough exclusive of the pole and the share), *Niryolapasika* (iron plates that fix the share to the Niryola. There are two pairs of *Pasika*), *Halasthonu* (a strong piece of wood that is fixed to the *Niryola* at the end opposite to where the plough share is fixed; this is held by the cultivator while ploughing the field), *Addacalla* (the pins of the yoke where the bullocks are tied), *Saula* (an extra piece of wood that tightly fixes the Niryola to the pole and *Paccani* (goad)."

"*Isa* is 5 cubits long, *sthanu* 2½ cubits, *niryola* 1½ cubits, *yuga* (?), *niryola-pasika* and *addacalla* (i.e. about 9 inches, taking the breadth of a finger to be approximately ¾ inch) and *saula* (nearly a cubit). *Paccani* is made of bamboo with iron-top and about 3 or 4½ feet long, (taking the transverse length of a fist to be approximately 4 inches)."

"*Abandha* (a rod of iron which prevents the *niryola* from getting out of the pole) must be cylindrical and about one foot long, *Yoktra* (the tie yoke) 4 cubits in length, a rope 5 cubits long and *Phala* (ploughshare) 1 cubit or 1 cubit and 4 inches, *Pasika* is (nearly 7 inches) and looks like a leaf of *Arka* (*Calotropis gigantea*). *Viddhaka* (a big hoeing instrument) has twenty-one spikes and the harrow is 9 cubits long" (*Loc. cit., verses* 110-117 and 96, 97)."

Besides the plough and its accessories as enumerated by Parasara, there were also the following agricultural implements: "*Srni* (sickle), *Khanitra* (hoe), *Musala* (pestle), *Udukhala* (mortar), *Surpa* (winnowing basket), *Dhanyakrt* (winnowing fan), *Calani* (sieve), *Sthivi* (granary), *Methi* (the post of the threshing floor round which cattle turn to thresh out the grains), etc."

The plough appears to have retained its form since the Vedic times with minor modifications in its parts according to the genius of the people of the different provinces. The essential part is the ploughshare which was in the Aryan plough lance-shaped, and it is still the shape, and often compared with the leaf of the *Asvattha* tree. The shape and size of the ploughshare of the Indian ploughs have often been the subject of criticism. But the utility of deep versus shallow ploughing depends upon a variety of circumstances, for instance, on the nature of the soil and subsoil, crop, season, manure, etc., and it is hazardous to pronounce judgement off-hand. There are ploughshares consisting of a pointed piece of flat iron, one and a half inches wide and a quarter inch thick, side by side with broad and lance-shaped shares. But there will be found sufficient and scientific reason for the choice of the former for soils where the latter would be out of place. Another example of adaptability to conditions is found in the implement called 'Moi', Sanskrit 'Madi', which has been wrongly rendered in English as a ladder. The ordinary form consisting of a pair of half bamboo with stays to keep the pieces parallel and a part may be used as a ladder, but is in reality a leveller. In many places the 'Moi' is a piece of timber of rectangular section, and quite suitable for soft loamy soils. For the uplands of Bankura, the soil of which is gravelly and contains pieces of quartz, the 'Moi' is made of a pair of planks inclined upwards towards each other and kept in position by a few ties. The object is twofold. It levels the ploughed up soil, and collects the stones which come up between the planks. Parasara does not describe his 'Moi', but simply states the length which was about 14 ft. Evidently his fields were large and his 'Moi' was of the usual type. He mentions another implement, 'Viddhaka', 'bida' in Bengali, the Indian harrow, which is widely used. The Deccan possesses a series of implements, probably the invention of the early Dravidians, many of which are unknown in Northern India. Agricultural implements like our household furniture are the result of various causes, and the law of the survival of the fittest is not only true in the organic world but also in industrial machinery (Ancient Indian Life by J. C.

Ray, p. 32).

AGRICULTURAL REQUISITES AND ACCESSORIES

(Translated from Sanskrit Text "A treatise on agriculture" by Kasyapa). Kasyapa says:

A wise cultivator who is a connoisseur of land, should, with a happy mind and on an auspicious day of the new year, after meditating on the Divine Trimurti, launch upon his agricultural operations with the intention of reaping a rich harvest. (Sl. 230).

With an ingenuous mind he should contemplate on and worship the Earth-goddess and the Corn-goddess with devotion and then begin to gather the agricultural requisites. (Sl. 231).

He should have the cow-pen or cow-shed plastered with cow-dung and make it redolent with flowers and incense and then furnish it with tying-posts of hard wood trees like *tinduka* (*Diospyros embryopteris*), *tinisa* (*Dalbergia ujjeinensis*), *sarjaka* (*Terminalia tomentosa*) and with chains, etc. (Sl. 232-233).

Having decorated the place with flowers, saffron and incense, the wise man should circumambulate it or make the cows walk over it. (Sl. 234).

He should then drive in the milch-cows along with their calves and white limbed bulls with their horns capped with gold or brass and bodies scented with perfumes—all animals bearing auspicious marks. (Sl. 235).

At an auspicious moment he should store in a specified place in the cow-shed fresh grass, fodder and straw and place auspicious troughs full of water. (Sl. 236).

He should then tie there the white bulls bearing auspicious marks, the milch-cows and the buffaloes which he has already bought. (Sl. 237).

He should thereafter place on a clean place the ploughs tied with ropes as well as ploughs with or without poles and shafts, made from hard wood, and consecrate them with incense, mango leaves, flowers, sandal paste or saffron and then with auspicious blowing of conches he should worship the corn-goddess. (Sl. 238-239).

He should also offer special worship to the Earth-goddess, Lakshmi, Sarasvati, Parvati, Indra, Varuna and Kubera. (Sl. 240).

Thereafter he should go to his field at an auspicious hour and moment along with the bulls and beautiful ploughs and begin ploughing from any of the corners of the field lying to the north-east, the south-east or towards the west (—the directions presided over by Siva, Agni and Varuna respectively). (Sl. 241-242).

One who is conversant with the art of tilling should, in order to make the earth easy for furrowing, first water his field well all over and then have it ploughed with a plough drawn by oxen. (Sl. 243).

He should have the field tilled with the plough four or five times for six days or more, and then, having cleared it of clods and stumps, manure

it with cow or goat dung or pit-compost (valaga?) in order to increase its fertility (Sl. 244-245).

He should then bring a proper stock of all the agricultural tools and implements such as spades, sickles (Sankula), small hoes (? *taluka*), long and short knives (*Khadga* and *Churika*), scythes and threshing apparatus (lava-saraka) (Sl. 246).

In the opinion of the sages the best time for tilling is that when the first showers of rain fall on the earth in a particular locality (Sl. 247).

Or, in the sowing season the field should be irrigated thoroughly with canal water before tilling (Sl. 248).

Hence in all parts of the country the husband-man should, according to the season of cultivation and the appearance of an auspicious sign and hour, first have the land tilled properly and with the advice of his friends (Sl. 249).

DESCRIPTION OF PLOUGH-WORSHIP

Kasyapa says:

Before tilling, the husband-man who knows the signs, should perform the worship of the plough, etc. and especially of the oxen (Sl. 250).

The worship of the field or of the earth with pure water, incense and lamps brings its own reward (Sl. 251).

"O goddess Earth, O all-enduring wide expanse! salutation to thee. Now I am going to begin cultivation. Be pleased, O virtuous one ! (Sl. 252).

"Tilling, tapping and whatever other injury I have inflicted on thee, pray pardon me for all that and yield me a rich harvest." (Sl. 253).

"Thou alone art declared to be the mother of all beings. Therefore, be gracious to me. O goddess Earth! and bring me a boundless reward". (Sl. 254).

Thus, having praised and offered prayers to the Earth-goddess, the consort of Visnu, and having gone round her with salutations, the husband-man should also extol the deities and guardians of the quarters and the life-promoting sun and then begin the noblest task of tilling the land (Sl. 255).

WORSHIP OF STURDY OXEN

Kasyapa says:

"O Lordly Bull, O sinless and strong offspring of the cow, pray help me in the task of tilling the land". (Sl. 257).

"I am offering worship to thee today with incense garland and flowers etc. Mayest thou, O Virtuous one, bring gain to me. May it be exceedingly well with thee." (Sl. 258).

"I am feeding thee respectfully fresh grass and water. Mayest thou, by Siva's grace, always bestow rewards on me." (Sl. 259).

"Producing calves regularly as strong as thy own self. Mayest thou embellish my cow-pen. I am feeding thee with regard." (Sl. 260).

"O lordly Bull, thou alone art the cause of increase in money and grain. Thou art the very image of Virtue on this earth. For that reason I feed thee. (Sl. 261).

"Mayest thou be kind to me in such a manner that my sacrifices to the gods and living beings may bear fruit. Mayest thou pardon my faults also." (Sl. 262).

Having thus offered prayer and worship to each of the bulls, he should take toil from them to the extent that they are not fatigued nor exhausted. (Sl. 263).

Inflicting of torture on them is sure to bring ruin. Hence one should never yoke the bulls to the plough when they are tired. (Sl. 264).

After this, the sages have prescribed the worship of cows. (Sl. 265).

AUSPICIOUS MARKS OF COWS AND BULLS

Kasyapa says:

Cows and bulls who are distinguished by auspicious marks are said to confer security and welfare both on their master and on the country. Such bulls are fit for agricultural purposes and bring increased merit. (Sl. 266).

Those bulls, who have a white body, beautiful eyes, a deep bellowing sound and are somewhat high in stature, belong to the Brahmana class. (Sl. 267).

Those whose body is red, who are very high in stature, have a deep rumbling sound and possess fiery energy and strength—they belong to the Ksatriya class. (Sl. 268).

Those who have white and red spots forming circles on their bodies and are neither very high nor very low—they belong to the Vaisya class. (Sl. 269).

Those whose body is black and stature not very high, who are irritable and ferocious and possess.....they belong to the Sudra class. (Sl. 270).

All of them are good and suitable for agricultural purposes. (Sl. 271).

The horns of a bull that are not very long nor very small and thin, are considered to be auspicious. Absence of disproportion (that is to say symmetry) between the two horns is highly valued. (Sl. 272).

The hoofs of the bulls that are neither too small nor too big and are strong and free from mutual disproportion are indeed worthy of praise and so also are their pleasing gait and long tail. (Sl. 273).

Absence of too much of corpulence or of leanness, capacity for carrying burdens (for drawing weights) and good humour while engaged in toil are some of the best qualities of bulls. A bull who is white at the horns, forehead, tail and hoofs and is of different colour elsewhere is considered to be auspicious and promoter of prosperity. (Sl. 274-275).

Bulls who have a pleasing temper and shining bright colour, who are cheerful and possess auspicious whorls of hair curling backwards, are

a source of increase in money and grain. (Sl. 276).

The bulls who are covered with fine gown and have deep bellowing sound and lovely eyes, are considered to be harbingers of auspiciousness. (Sl. 277).

The bulls whose colour is red, smoky or bad, horns big, gait faltering, body lean and devoid of energy and strength, limps rough to touch and hoofs harsh, and who are voracious eaters, irascible and drowsy, they are of the inferior most type and should be avoided altogether. (Sl. 278-279).

Those whose body is white or red all over in colour are considered to be auspicious and a source of increase in money and grain. (Sl. 280).

Husbandmen (i.e. agriculturists) should, in their own interest and welfare, be very particular in securing bulls of a pure breed and good qualities and who are free from defects. (Sl. 281).

They should also collect buffaloes, and cows and buffalo-cows, yielding copious supply of milk and bearing auspicious marks. (Sl. 282).

Often goats and sheep are also found useful in agricultural work. (Sl. 283).

For the success of agricultural operations and for their own welfare people should be very careful to keep bulls, etc. who are known to be free from defects or are declared to be so after examination by experts. (Sl. 284).

A wiseman should fix up a sanitary cow-shed for his cattle and the women of the household and others should nourish them daily with wholesome feed at the proper time and protect them from disease. (Sl. 285).

Bulls and cows of excellent quality and good breed are of primary help in agricultural operations. Hence the agriculturists both in towns and villages, should be very particular in securing and keeping hundreds of milch-cows. They should nourish them with grass, straw and water and protect them with many careful attentions. (Sl. 286-288).

Maintaining of milch-cows conduces to the extinction of disease, the protection and sustenance of children and old people and the achievement of the three objects of human existence, viz., discharge of duty, acquirement of wealth and the gratification of desire. (Sl. 289).

In countries in which thousands of cows are maintained with tender affection there the rains must fall without doubt. (Sl. 290).

From the protection and gifts of cows results the highest pleasure of gods and also the welfare of the people in general—says the sage Bhargava. (Sl. 291).

Hence the agriculturists should protect their cattle-wealth with utmost attention everywhere, be it in the village or in the forest. (Sl. 292).

Worship of cows every year at an auspicious time by oneself and his servants and particularly by cow herds is highly commendable. (Sl. 293).

Besides, their worship every evening with incense, flowers, etc. brings glory and welfare and is advocated by all the scriptures. (Sl. 294).

A wiseman should during the summer keep and protect all his work-

animals like bulls, goats etc. under the shade at noon time. (Sl. 295).

During winter they should be kept in a shed and well maintained with wholesome feed for general welfare as well as of the king's family. (Sl. 296).

Protection of cows must be done by the kings for it is said to be his virtuous duty. (Sl. 297).

Their protection from cattle-lifters and beasts of prey and particularly their employment in agricultural operations yields rich rewards. (Sl. 298).

Here ends the preliminary advice on the subject.

Some agricultural implements of the Buddhist period are preserved in the Archaeological Museums at Sanchi which are: (1) Bakher or smoothing ploughshare, (2) ploughshare of two types, (3) trowel and (4) sickles of three types whose descriptions and dimensions are given in the catalogue of Museum of Archaeology at Sanchi, Madhya Pradesh.

PLYING OF PLOUGH

Krisi—Parasara gives a detailed account of how and when the plough should be put into operation. Translations of the important portions from this Sanskrit manuscript are given below:

Under the *Svati, Uttara-Rohini, Mrgsiras, Mula, Punarvasu, Pusya, Sravana* and *Hasta* constellations, the (first) plying of the plough should be done. (Sl. 122).

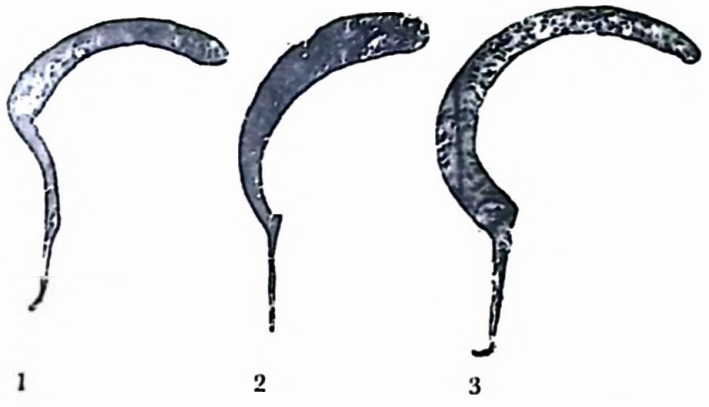
The cultivators should commence the working of the plough on Fridays, Mondays, Thursdays and particularly on Wednesdays for the increase of their happiness (?). Beginning of cultivation on Tuesdays, Sundays and also on Saturdays forbodes revolution in the kingdom. Similarly, the tenth, the eleventh, the second, the fifth, the thirteenth, the third and the seventh days of lunar fortnights are auspicious (for the commencement of cultivation) (Sl. 123-125).

The new-moon day brings loss of harvest, the twelfth day causes death or imprisonment, the sixth day gives immense trouble, and the no-moon day is fatal to the cultivator. The eighth lunar day is destructive for the oxen, the ninth for the crop, the fourth produces vermin (—pest) and the fourteenth kills the land-lord. (Sl. 126-127).

The plying of the plough should always be done when the sun is in the Taurus, Pisces, Virgo, Gemini, Sagittarus, or the Scorpio sign. Plying of the plough when the sun is in the Aries kills the cattle, when in the Cancer, there is danger from (lack of excess of) water (i.e. rain), when in the Leo, there is the fear of snakes and when in the Aquarius, that of thieves.

In the sign Capricornus, the sun destroys the crops and in the Libra, it causes danger to life. Hence, one should always take great care in selecting the moment of the sun's entrance into a zodiacal sign at the commencement of ploughing (Sl. 128-130).

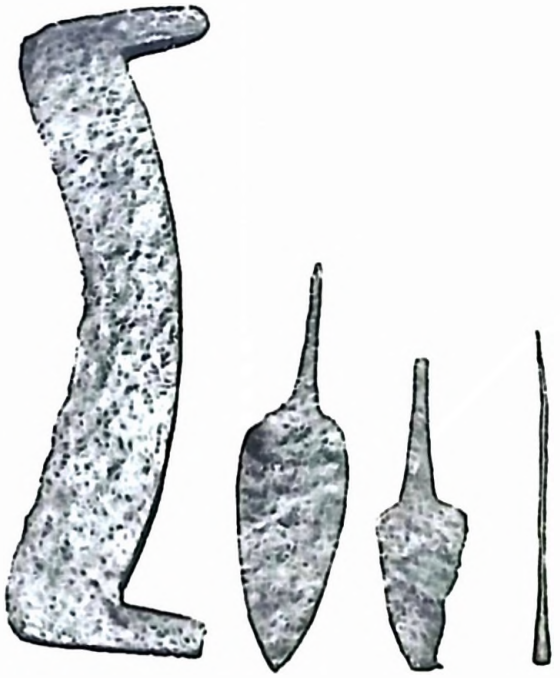
On an auspicious day when the sun is in conjunction with the moon



1 2 3

FIG. 1. Sickles — Sanchi. 1. Diameter 9¼ inches, blade resembles the arc of an ellipse. 2. Diameter 9¼ inches, point broken. 3. Diameter 11 inches semi-circular in shape.

FIG. 2. Smoothing ploughshare (*Bakhar*), ploughshare and trowels — Sanchi. The smoothing ploughshare length is 21⅞ inches and width 3⅛ inches. The blade has two vertical tangs, one on each end, which are fixed into the flat wooden back, when the ground has been ploughed and the surface is still loose and uneven, this ploughshare is used to smoothen it. It is worked with bullocks like the ordinary plough. It is also commonly used for removing old stubble from the field. Ploughshare length is 15⅝ inches and width 3½ inches. It has a broad leaf blade flat on one side and convex on the other; edge is blunt; with long tapering tang and rectangular in section. Trowels are hollow and chisel-like in shape with edges flat and blunt.



Courtesy: Department of Archaeology, Government of India.

FIG. 3. Fish hooks—Mohenjo-daro

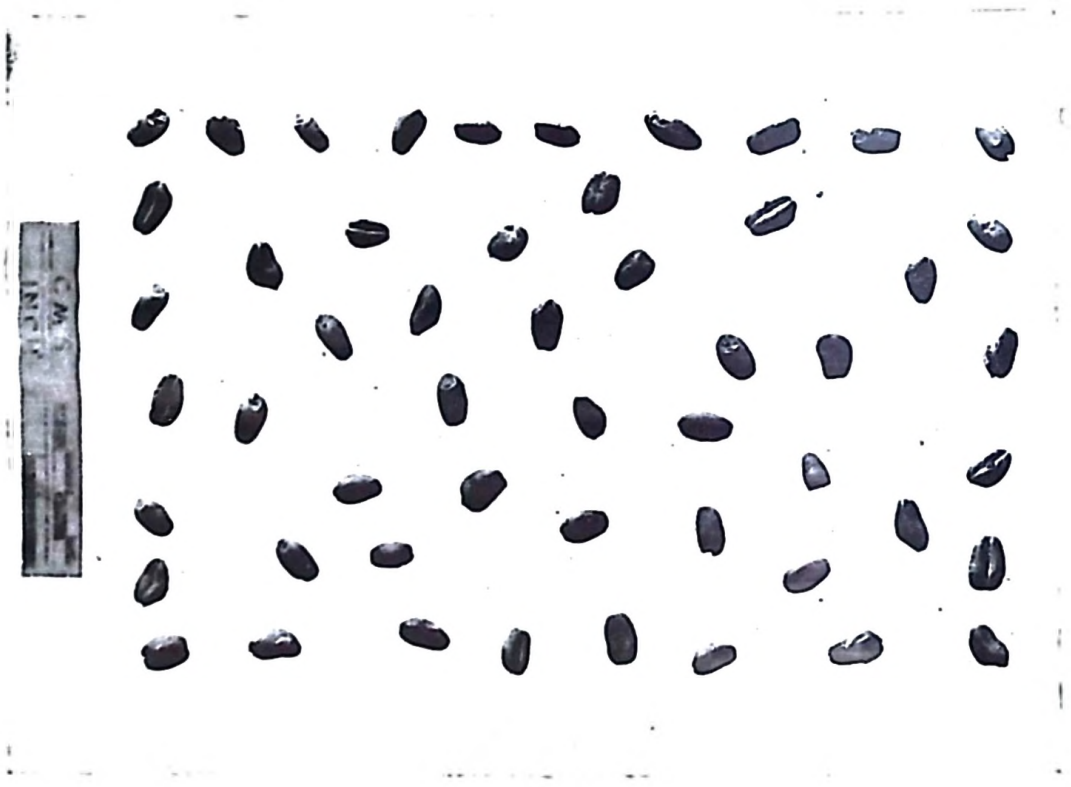


FIG. 4. Grains of charred wheat

Courtesy: Department of Archaeology, Government of India.

(i.e. on the new or full-moon day) one should take a bath and put on white and perfumed clothes and having first of all properly worshipped the *Prajapati* along with the planet Earth, he should go round the fire and give away a gift to the *Brahmanas*. After that, he should touch the ploughshare with a piece of gold and besmear it well with honey and then carrying the plough on his left shoulder, he should commence ploughing. (Sl. 131-133).

Black, red, or black-and-red bulls are commended for yoking to the plough. Therefore at the commencement of tilling the land one should take care to select bulls of this kind and smear the sides of their mouths with butter or ghee. A bull that is rogue or whose horns or hoofs are broken or whose horns are either too short or too long (?), should, as far as possible, be avoided in ploughing (Sl. 134-135).

Standing erect and facing the east he (i.e., the cultivator) should make the offering of milk and then he should worship the plough and put wreaths round the (neck of the) bulls (Sl. 136).

O Lord of the gods and the husband of *Sachi* (i.e. Indra) ! accept our offering consisting of white flowers, curd, milk and ghee, and, pray, send good rainfall (Sl. 137).

In the course of ploughing he should avoid striking and hurting the tail and the ears of the tired oxen and also refrain from beating them too often (Sl. 138).

As *Parasara* has said, broken furrows should never be made (with the plough). The furrows of the plough are either one, three or five (?). The first (?) furrow gives wealth, the third effects the fulfilment of his desired object, and the fifth, the major and the principal furrow brings rich harvest (Sl. 139-140).

If he happens to dig up a tortoise in the course of ploughing, his wife dies or he suffers loss by fire. If the ploughshare splits or breaks, then there occurs banishment (or deportation of the cultivator) from the country, and if the plough breaks, then the master (i.e. land-lord) dies. If the shaft of the plough or the yoke breaks the ploughman, too, does not survive. A brother dies or a son is drowned in water if any harm occurs to the team (?). If the tie of the yoke breaks, he falls ill, and if the rope snaps, there occurs a loss. At the falling down of the Darpakarana (?), there is trouble or imprisonment (?). If in the course of ploughing one of the oxen (breaks loose and) runs away, then the cultivator dies of fever and dysentery (?) along with his younger brother. If while ploughing the bull goes running, there would be failure of cultivation as well as bodily trouble (Sl. 141-146).

If one of the bulls moves at the mere word of command then one should expect wealth and four-fold harvest. If during the course of ploughing there is an urge for urination or evacuation (to the bulls), then their evacuation would be conducive to an increase in harvest and micturition to its devastation (?) (Sl. 147-148).

How can he, who does not resort to ploughing in the months of *Magha* (January-February) and *Kumbha* (?=Phalguna=February-March), reap the harvest or expect the reward of cultivation? (Sl. 149).

The earth when cultivated by ploughing in the month of *Magha* is like gold, in the month of *Kumbha* (=Phalguna ?) it is like silver, in *Caitra* (March-April) it is like copper, in *Radhava* (?=Madhava=Vaisakha =April-May) it is like any other metal, in *Jyestha* (May-June) it is like mere dust, in *Asadha* (June-July) it is full of mud and in *Kartaka* (?) it bears no fruit. (Sl. 151-152).

CHAPTER IV

MANURES AND MANURING

The ancient Indian cultivators were a wealthy and respectable section of the people and possessed a fair knowledge of climatology, plant physiology, soils, rotation and protection of crops, and different kinds of manures. Indeed, one will be filled with astonishment and admiration if he cares only to look into the elaborate injunctions as are found in the *Arthasastra,* the *Brhat-samhita* and *Agnipurana* regarding the selection and treatment of seeds and the use of animal excreta, fish and bones, beef and fish-washings, minute fishes and various kinds of mixtures and decoctions as fertilizers. Except what is given in Khana's maxims, the ancient agricultural precepts are now no longer known, and it is only too evident that agricultural methods known to people in ancient India were forgotten with the lapse of time.

The origin of manuring of the soil, a necessity for the nourishment of plants, can be traced as early as to a verse in *Atharva Veda* (II, 8, 3). But, a more elaborate instruction is given in the *Brhat-Samhita* (Ch. 58), the *Agnipurana* (Ch. 281), the *Krishi-Sangraha* of *Parasara* (Sl. 107, 108 and 109, Bangabasi Ed., cal. 1322 B.S.) and Sukraniti (Sukra IV).

Fertilizers consisted of the dung of goats, sheep and cattle and flesh rotten in water. *Vraha, Sukra* and *Agnipurana* prescribe composts made of various substances such as pulses, sesamum, barley, goats' and sheep's dung, fish, flesh of cattle and hog, fat etc. Kautilya advises to dig a trench round the tree, burn the inside soil and fill it with bone and farmyard manure. This treatment, according to him, is necessary at times to make the tree fruitful. In another place under *Vastu lakshana, Agnipurana* prescribes other fertilizers (dohada), such as cold fish water for mango, salt water for date and cocoanut palms, and vidanga, fish and flesh water for all trees. As to watering, the instruction is to water both in the morning and evening in summer, every alternate day in winter, and in the rainy season when the soil becomes dry. Such in brief were the gardening operations and as they were based on experience we have nothing to add to or modify them. But it is surprising that oil-cake was not used as a manure. The present knowledge of agricultural chemistry has enabled us to make composts with materials other than barley, pulses and other foodstuffs.

PREPARATION AND APPLICATION

Parasara says: "In the month of *Magha,* a dung-heap is raised by a spade, dried in the sun and made into smaller balls. In the month of

Phalguna, these are placed into holes dug for the purpose, and afterwards scattered on the field at the time of sowing. The paddy-plant only grows without manure, it does not bear fruit." (Sl. 107-109).

The value of manure in cultivation was appreciated in India as early as the time of the *Rigveda.* But the ancient Indians did not apparently know the use of chemicals as artificial fertilizers; they have come into use only about hundred years ago. Besides bones, flesh of animals, fish-washings, vegetable and animal products etc., the manure that they primarily used consisted of the excreta of various animals mixed with litter which absorbed the urine and kept the animals clean. Whether they knew the exact chemical composition of the yard-manure is not known, but they certainly appreciated its fertilizing property and also its physical effects upon the texture and water-holding power of the soil. It is only a modern discovery that the farm-yard manure contains all that is necessary for the nutrition of plants, *viz.,* nitrogen, phosphoric acid and potash. Nitrogen compounds are the chief fertilizing elements in the manure, but the nitrogen is inevitably lost to a certain extent. The loss can be minimised only if the dung-heap is not disturbed; for any disturbance causes rapid fermentation of the liquid portion of the manure, *viz.,* urine, with a consequent increase in the evaporation of ammonia. The direction of Parasara to keep the dung-heap undisturbed up to the month of *Magha,* i.e., for ten months of the year is thus significant. Again, the sentence is also significant, for if any easily fermentable material still remained in the active form, it should be got rid of by drying. This process thus reduces active ammonia which would otherwise be injurious to the seeds and the tender roots of plants. The direction is also very important in as much as the manure, as it decomposes under the earth, increases the stocks of humus which oxidises and tends to decrease in the open air, so that when the manure is scattered over the field, it is comparatively rich in humus that contributes greatly to the fertility of the soil. Knowledge of manuring at the time was probably a result of extensive practical and not scientific observations.

There are also many other writers who speak of manure. Varahamihira in the *Brhat Samhita* (*Brhatsamhita* edited by Dr. Kern, Ch. 55, 304) says, "To promote inflorescence and fructification, a mixture of one *adhaka* (64 *palas*) of sesame, 2 *adhakas* of excreta of goats or sheep, one *prastha* (16 *palas*) of barley powder, one *tula* of beef thrown into one *drona* (256 *palas*) of water and standing over for seven nights should be poured round the roots of the plant." (Sl. 17, 18). He further prescribes that the seeds before sowing should be treated as follows.

The seeds should be taken up in the palm greased with ghee and thrown into milk; on the following day the seeds should be taken out of the milk with greased fingers and the mass separated into single seeds. This process is to be repeated for 10 successive days. Then, the seeds are to be carefully rubbed with cow-dung and steamed in a

vessel containing pork or venison. Then the seeds are to be sown with the above mentioned flesh and lard in a soil where previously sesame was sown and dug up, or trodden down, and then sprinkled daily with water mixed with Ksira (Sl. 19, 20).

"To ensure the growth of *Ballaris* (i.e. sprouting and the growth of luxurious stem and foliage), the seed should be properly soaked in an infusion of powdered paddy, *masa* (bean), sesame and barley mixed with decomposing flesh and then steamed with *Haridra* (turmeric). This process will succeed even with *Tintidi* (*Tamarindus indica*). For the *Kappittha* (*Feronia elephantum*), the seeds should be soaked for about two minutes (literally, such length of time as it would take one to make a hundred rhythmic claps with the palms in a decoction of 8 roots,— *Asphota* (*Jasmine*), *Amalaki* (*Phyllanthus embellicus*), *Dhava* (*Grislea tomentosa*), *Vasika* (*Tustica guarderussa*), *Vetula* (*Calamus rotung*), *Suryavalli* (*Gynandropsis pentaphyla*), *Syama* (*Echites fructescens*) and *Atimuktaka* (*Aganosma caryophyllata*) boiled in milk. The seeds then should be dried in the sun. This process should be repeated for 30 days. A circular hole should be dug in the ground, a cubit in diameter and 2 cubits deep, and this should be filled with the milky decoction. When the hole dries up, it should be burnt with fire and then pasted over with ashes mixed with ghee and honey. Three inches of soil should now be thrown in, then the powder of bean, sesame and barley, and then again three inches of soil. Finally washings of fish should be sprinkled and the mud should be beaten and reduced to a thick consistency; then the seeds previously prepared should be placed in the hole under three inches of the soil and fish washings (with fish). This will lead to luxuriant ramification and foliage which will excite wonder".[1] (Sl. 26-27).

The Agnipurana gives the following directions: "A tree becomes laden with flowers and fruits by manuring the soil with powdered barley, sesamum and the offal matter of a goat mixed together and soaked in washings of beef for seven consecutive nights. A good growth of trees is secured by sprinkling them with the washings of fish." (Translation by M. N. Dutt, Vol. II, p 1038). Khana advises the cultivators thus:

"O worthy cultivator, for a vigorous growth of bamboo, give an infusion of powdered paddy to its roots, for the growth of arum, ash, and for that of cocoanuts, salt".

In the *Arthasastra* it is stated that: "The seeds of grain are to be exposed to mist and heat (*tusarapayanam usnam ca*) for seven nights; the seeds of *Kosi* such as *Mudga, masa* etc. are treated similarly for three nights; the shoots of sugar-cane and the like (kandabija) are plastered at the cut end with a mixture of honey, clarified butter, the fat of hogs and cow-dung; the bulbous roots (kanda) with honey and clarified butter; cotton-seeds with cow-dung; and water pits at the root of trees are to be

1. Translation of these verses from the *Brhatsamhita* are taken from Dr. Seal's *Positive Sciences of the Hindus.*

burnt and manured with bones and cow-dung at proper seasons. The sprouts of seeds when grown are to be manured with a fresh haul of very small fish and irrigated with the milk of *snuhi (Euphorbia antiquorum)"* (Shyama Sastri's translation, 2nd ed., p. 141).

Sukracharyya (*Sukra* IV, VV, 94, 107-112) gives the following recipes: As a general measure to cause healthy growth, the plants should be nourished "by stools of goats, sheep, cows, water as well as meat." "If trees have their fruits destroyed, the pouring of cold water after being cooked together with *Kulattha, Masa, Mudga* (all pulses), *Yava* and *Tila* would lead to the growth of flowers and fruits." Growth of trees can be helped by the application of water with which fishes are washed and cleansed. The power of the dungs of goats and sheep, the power of *Yava, Tila,* beef as well as water should be kept together (undisturbed) for seven nights. The application of this water leads very much to the growth in flowers and fruits of all trees." These materials contain nitrogen and phosphorus which are essential for the nutrition of plants.

NOURISHMENT OF PLANTS

Upavana-Vinoda contains elaborate details about the manuring of plants. Some of the important portions from G. P. Majumdar's translation of Upavana-Vinoda are reproduced below:

Trees do not produce fruits and flowers merely for being planted; here it is stated the rules relating to the nourishment of plants as framed by the Sages. (Sl. 147).

If one applies powdered oil-cakes of white mustard or sesamum at the root of *Kharjjura, Vilva* and *Lakuca* trees—all these three grow; and the mango tree grows if it is watered with water in which husks are soaked; *Airavata* and *Nichulapatra* grow by simple watering, but they grow also if watered with flesh and paddy washings. (Sl. 148).

For the (growth of) old *Amalaka* trees the pulse *masa* is extremely beneficial; for young *Tinduka* trees application of water and milk is very helpful; powders of barley help the growth of cocoanut trees; and all trees rapidly grow if in the plains. (Sl. 149).

Mango trees bear very fragrant and sweet fruits at an early date if they are watered with decoction made up of milk, *pancapallava,* i.e. leaves of mango, *Asvattha, Vata, Plaksa* and *Yajnadumura,* together with the fat of deer, jackal, elephant, horse, etc. (Sl. 150).

A decoction made up of clarified butter, *kunapa* water, *vacha,* and pig's stool—is extremely favourable to the development of fruits of *Dadima* trees. And water or decoction made up of powders of *kulattha* is favourable to the roots of the same tree. (Sl. 151).

If one, after besmearing the trunk of a pomegranate tree with *Saphari* fish and powders of *triphala* (fruits of *Amalaka, Haritaki* and *Bayeda*), applies to its roots the powders of above three fruits and mango paste and also fumigates with frankincense, the fruit of the said tree is

sure to be as large as the palmyra fruit. (Sl. 152).

If one waters a fruitful *Kadamba* or *Nagakesara* tree with the compound liquid made up of curd, fermented rice water, wine made out of rice, plum, sesamum, *menthi, kunapa* water, and wine prepared from sugar and milk, they are sure to bear innumerable fragrant flowers. (Sl. 153).

If one fills the trenches around a *Nagakesara* or *Champaka* tree with the decoction made up of priyangu, gunja fruit, nimba, pippali, vacha, haridra, tila and sarsapa—all taken in equal parts together with clarified butter and broth of *Asvakarna* (bark) they are sure to grow luxuriantly. (Sl. 154).

If one waters the roots of vines with the compound liquid made up of stools of fowls, (flesh and fish), straw and husks of paddy, it bears fruit and flowers and grows; and if one compounds 6 maunds and 10 seers of *Garudi* creepers with leaves and besmears the trunk of a jackfruit tree from top to foot with it and waters the roots of the said tree with the broth of vacha,—it bears fruits all over its body from head to foot. (Sl. 155).

If a *Kapittha* or *Vilva* tree be watered with clarified butter, milk and honey, it bears fruits which are sweet to the taste, full of fleshy substance containing scanty number of seeds. (Sl. 156).

A *Madhuka* tree puts on a beautiful and dignified appearance like a worshipable being when it is watered with the compounds made up of the broth of the roots and leaves of *Kosataki, Pippala, kunapa* water, and powdered resin. (Sl. 157).

A plum tree bears fruits which are as sweet as sugar when its roots are developed through being watered with the decoction of tila and *Yastimadhu* and with *kunapa* water. (Sl. 158).

A *Vijapura* tree bears fruits again and again when the compound substance consisting of the stools of goat, sheep, pig etc., vidanga and the stools of men, is applied to the roots and then these roots are watered with the urine of horses and sheep. (Sl. 159).

All creepers are bent down under the weight of their fruits when their roots are pierced with the stings of scorpion and fumigated with clarified butter and watered with the fats of mice and pig. (Sl. 160).

A *Ketaki* tree if watered with the urine of cows and *kunapa* water in summer, bears fragrant flowers and sharp thorny leaves in the rainy season. (Sl. 161).

One should apply to the roots of all trees, in profusion, soil scented by fragrant flowers. (Sl. 162).

Any flowering tree bears fragrant flowers in course of a month if it be watered with the liquid compound of the powders of kustha, patra, mura, musta, tagara and usira. (Sl. 163).

If one applies to the roots of a lotus plant which is barren, the compounded dust of kulattha and the tusks of elephants, it is sure to be graced with sweet lotuses every day. (Sl. 164).

If one applies to the roots white mustard, plantain leaf, safari fish, stools of pig and cat in equal shares mixed with clarified butter, besmears the trunks and fumigates them therewith, they (trees) become free of all diseases, grow luxuriantly and the branches become graced with flowers and a number of bees. (Sl. 165).

A sisoo tree grows very luxuriantly if one, after fumigating it with barley, wine, fermented rice water and clarified butter, besmears its trunk with cakes made up of vidanga and sesamum bathed either in milk or *kunapa* water. (Sl. 166).

All trees, with a few exceptions, always become graced with an abundance of fruits and leaves and flowers, become immune from diseases and afford pleasant shades if one applies to them the decoction of Ankola flower mixed with clarified butter and honey, fats of deer and boar added thereto powders of white mustard, and well watered. (Sl. 167-168).

One should make a paste of yastimadhu, Madhuka flowers, white kustha and honey, make them into pills and scatter them around the roots of all trees. (Sl. 169).

Any fruitful tree verily bears very sweet fruits if any experienced or wise man waters its roots with milk. (Sl. 170).

One should boil the flesh, fat and marrow of deer, pig, fish, sheep, goat and rhinoceros in water, and when it is properly boiled one should put the mixture in an earthen pot and add into the compound milk, powders of sesamum oil-cakes, masa (pulse) boiled in honey, the decoction of pulses, clarified butter and hot water. There is no fixity as to the amount of any of these elements; when the said pot is put in a warm place for about a fortnight the compound becomes what is called *kunapa* water which is very healthy (for plants in general). (Sl. 171-174).

Except these general instructions regarding manuring, specific manuring practices have been suggested for specific crops. They will be discussed later on for individual plants.

"Vrksayurveda" by Surapala contains interesting accounts of preparing and application of manure. According to him *kunapa* water is prepared in the following two ways. Some principles of applying manures as described by Surapala are given in these pages.

Water in which the dung, fat, flesh, marrow, brain and blood of a hog have been put and which is buried under-ground for a fortnight is called carcass (*kunapa*) water. (Sl. 101).

The other method of carcass water is that one should gather together as much as available the lymph, marrow, and flesh of a horse, hog, fish, sheep, goat and other horned animals and put them in water and boil them on fire. He should then put that boiled flesh, etc. into a greased vessel and add to it powdered oil-cake of sesamum along with honey. He should also add boiled Mashas, their soup, urine and .....(?), one by one into the vessel and put the vessel in a warm place. In this way *kunapa* (carcass water) is prepared which is very nourishing for the trees. I have

described it in accordance with the prescription of the ancient sages. (Sl. 102-106).

For the rapid growth of a young tree a porridge prepared from the flesh of fish and sesamum should be administered cold, every seventh day. (Sl. 107).

The juice extracted from the fruits of herbs, urine, fat, milk, carcass-water, ordure and flesh are the substances suitable for the nourishment of trees. (Sl. 112b, 113a).

All the trees thrive in flower and fruit if they are nourished with water in which flesh and Kinva (a fermenting drug) has been boiled and in which *kunapa* water has been mixed. (Sl. 113b, 114).

The trees quickly begin to bend under the weight of flower and fruit, if they are nourished with the fat of deer and hog, honey, ghee and the juice extracted from the leaves of the Nicula (?) tree. (Sl. 118).

Trees that are nourished with ghee, *Vidanga,* diluted milk, and honey and fumigated with ananta (*Vitex trifolia?*), Kutha and the pollen (or powder) of Aja (?), quickly become laden with excellent flower and fruit. (Sl. 119).

The plants become laden with flowers and fruit like the paradise Kalpa creeper if they are always nourished with the fat of a python,..... and fish. (Sl. 120).

The creepers bear flower and fruit if they are stung (at the root?) by a scorpion, fumigated with (the flesh of) the fish and ghee, and nourished with the fat of a hog and rat. (Sl. 121).

The vine would bend under the weight of its flowers and fruit if its roots are manured with the powdered ordure of cocks and nourished with the broth of the flesh of fish. (Sl. 122).

The mango trees are pleased and become bent under the weight of big fruit rich in sweet juice, if they are nourished with the juice of ripe Ankola fruit, ghee, honey and the fat of a hog. (Sl. 123).

The palm and cocoanut trees bear (rich) fruit, if they are watered with the boiled juice of the flesh of a cow, hog, porpoise and Ocha (?) and are anointed with (the flesh of) the fish and pounded sesamum. (Sl. 124).

The cocoanut trees keep free from disease and bend under the weight of big nuts, if they are plastered at night with (the paste prepared from) Maireya wine, Kinva (a fermenting drug), sesamum, Masha, and Mura liquor mixed with honey, salt and Vidanga. (Sl. 125).

The cocoanut trees always bear nuts as big as jars if they are nourished with diluted milk mixed with barley meal, or with sour rice-gruel. The Panyamalas (?) bear rich fruit if nourished with the soup of Masha. (Sl. 126).

The pomegranate tree is greatly satisfied and becomes bent under the weight of very large fruit rich in sweet and luscious seeds, if it is nourished with the flesh of a cat, blue jay, deer, and hog, plenty of fat, and buffalo-milk. (Sl. 128).

The pomegranate tree becomes quickly laden and bent with fruit full of copious and delicious juice, if it is properly nourished to satiation with the flesh of a jackal and is inundated with copious water in which sugar has been dissolved. (Sl. 129).

The pomegranate tree would bear large fruit, if it is plastered with turmeric, ghee, fish and honey and is then fumigated with the powder of three myrobalans mixed with ghee. (Sl. 130).

The pomegranate tree would become laden with large and delicious fruit, if it is nourished with non-poisonous snakes (*Dundubha*) boiled in milk, and the broth of fish. (Sl. 131).

The pomegranate tree would become laden with fruit, if the skull of a blue jay is hung on it. And the Amrata tree would bear rich fruit if the neck of a broken jar is hung on its top. (Sl. 132).

Panasa tree bears abundant delicious fruit, large and without stone, if it is watered with the decoction of three myrobalans and decorated (?) soon with straw. (Sl. 133).

The Kola tree bears fruits as big as wood apple and as delicious and fragrant as ambrosia, if it is nourished with water mixed with liquorice, Madhuka, sesamum and honey and is irrigated at the roots with carcass (water). (Sl. 134).

The *Karkandhuka, Lakuca, Badari, Dhatrika,* and rose-apple trees, anointed with ghee and thoroughly plastered with the paste of *Rodhra* mixed with honey and krsara (boiled rice and pulse) as well as plenty of barley, fumigated with sesamum honey and barley for twelve days, and at the time of efflorescence watered with diluted milk, would bear excellent fruits. (Sl. 135).

And again, if they are watered with an unstinted quantity of liquor, they bear large fruits, as delicious as ambrosia. (Sl. 136).

The *Bilva* and *Kapittha* trees bear luscious fruits and beautiful leaves, if fed with jaggery, ghee, milk and honey. (Sl. 137).

The plantain trees bear plentiful and large fruit if their roots are always dressed with old straw, dry cowdung, and ashes and are sprinkled with the waters of *Kasapala* (?). (Sl. 138).

The *Tinduka* trees are pleased with the soup of rice and Masa, and the *Paravata* trees become bent with (the weight of) fruit if fed with the juice of the leaves of *Nicula.* (Sl. 139).

The *Matulungi* (citron) trees, if well fed with copious supplies of the decoction of milk, flesh, fish, dung, sali rice and *Kinva* (fermenting drug) and the solution (in water) of sesamum oil-cake, become weighed down with soft, pulpy and delicious fruit as large as water-jars. (Sl. 140).

The *Bijapuraka* (citron) bears fruit if nourished with the flesh of a jackal coated with sugar. The orange bears excellent fruit if fed with broth of flesh, jaggery and milk. (Sl. 141).

The orange trees, if watered with the infusion of *Vidanga, Masa,* sesame, mustard and *Bilva* mixed with the flesh of *Samasasaka* (?) and

milks and plastered and fumigated with the flesh of a rabbit, become weighed down with the weight of their fruit. (Sl. 142).

The *Madhuka* tree bears flowers as beautiful and bright as the camphor powder, if it is fumigated with the mass of flesh mixed with the powder of *Ankola* bark and *Kalaya* (=Kalama-rice ?) and seasoned with *Phadala* (? = Patala ?). (Sl. 143).

The *Syama, Nagakesara, Kasa* and vine become weighed down with bunches of very fragrant flowers, if they are nourished with *Sanvira,* whey, curd, *Kola* and sesamum mixed with wine, milk, Indika (?) and carcass (—water). (Sl. 144).

All kinds of flowering plants effloresce profusely if nourished with the decoction of rose-apple leaves, *Usira* and *Musta* mixed with wine. (Sl. 145).

The *Ketaki* plant becomes laden with a wealth of flowers, if nourished with the infusion of the aromatic substances like cardamom and the broth of flesh. (Sl. 146).

The *Ketaki* plant, if nourished only once with water (from the mouth of young women), puts forth blossoms and the Bakula tree if sprinkled by young women with mouthfuls of wine. (Sl. 147).

The mango tree becomes thrilled with joy as if it were in the form of putting forth blossoms when it is scratched even with the tip of a finger nail by a young woman. (Sl. 148).

The Asoka tree puts forth a wealth of blossoms when kicked amorously by a young woman, the ensign of cupid, with her lotus-like foot painted deep red with lac-dye and wearing beautiful jingling anklets. (Sl. 149).

The Kurabak trees reveal the glory of its blossoms when closely clasped in a sportive embrace of a coquette within her lovely creeper like arms which are slim like lotus-stalks and are wearing tremulous bracelets. The Tilaka tree does so at her mere glance. (Sl. 150).

Closely clinging to a tree, when the Syama creeper blossoms, it looks like a damsel clad in finery, wearing the auspicious martial thread and ready for marriage. (Sl. 151).

The *Madhavi* creeper, *Karavira* and *Kuranta* put forth glorious blossoms when in the evening they are sprinkled with urine in the prescribed manner. (Sl. 152).

The *Malli* creeper reveals the glory of its blossoms when sprinkled (?) with mouthfuls of *Kitakalapa* (?), tremulous like (the blades of) grass and (the flames of) fire. The *Patata* becomes the sole play-haunt of bees (i.e. puts forth blossoms) when irrigated profusely with water mixed with *Kitakalapa.* (Sl. 153).

The cotton plant puts forth beautiful blossoms when nourished with the flesh of fish; the *Yuthi* (jasmine), when watered with milk; the *Tilaka* and *Saptacchada,* when fed with the solution of dung in water; and *Sephalike,* when nourished with flesh and fish-broth. (Sl. 154).

The vegetable of the species of cucumber and gourd (e.g. *Chirbhati, Labu, Karkaru, Trapusa,* etc.) put forth abundant fruits if on a Sunday they are fumigated with the bone and ordure of a hog. (Sl. 155).

The *Alabu*-gourd creeper always yields abundant fruit if sprinkled with the stale scum of rice kept overnight. (Sl. 156).

The *Patola* creepers singed (?) with straw fire in the month of Phalguna, bear fruit in the month of Chaitra when sprinkled with a solution of oil-cakes in water mixed with spirituous liquor. (Sl. 157).

The pottage of boiled *Sali*-rice mixed with curd, if scattered all over the fields, would at once stop the falling of hail. (Sl. 159).

Here ends the chapter on nourishment.

"Vrksayurveda" by Surapala contains an interesting account of the preparation of different kinds of manures and also recommends the type which should be applied to various crops, trees and plants. Translation of the important verses of this Sanskrit book are given below.

Carcass water. One should collect the flesh, lymph, marrow and fat of deer, worms, fish, sheep, goat and rhinoceros and put them together in water on fire to cook. When well cooked they should be poured into a cauldron. Then, to this mass should be added milk, powdered sesame-oil-cake, honey, steamed *masa* (*Phaseolus radiatus*) along with their soup, ghee and hot water—there being no prescription of quantity for any of the ingredients. A wiseman should put the cauldron in a warm place for a fortnight, after which the flesh would become suitable for the nourishment of plants. (Sl. 82-85).

Ankola-oil. Taking the husk-less seeds of *Ankola* (*Alangium hexapetalum*) one should pound them and soak them seven times in sesamum oil. Then rubbing them with hot water, he should get the oil expressed by the machine of an oil-man. Or, he should plaster two bell-metal plates with that paste and place them (aslant) in the sun facing each other. He should then collect the oil dripping from them in another bell-metal vessel placed beneath them. (Sl. 112-114).

For the blossoming of *Jati* and *Mallika* species of Jasmine fragrant water is beneficial and for that of *Jati* which is always in flower, the flesh of a tortoise is recommended. (Sl. 115).

The *Madhavi* (spring-flower, *Gaertnera racemosa*) as well as Oleander (*Nerium odorum*) and yellow amaranth put forth ever lovely flowers if they are watered with wine at the close of the day. (Sl. 116).

One should rear the plants by manuring them with the dung of goats, sheep and cows and by watering. In this way all kinds of trees, creepers, etc. always continue bearing fruit. (Sl. 117).

The following is the common requirement of the trees, plants and bushes, etc. The flesh of the fish mixed with *Vidanga* and rice when applied to the trees etc. in cow's dung and urine and also used for watering them, increases the growth of flowers and fruit. (Sl. 118-119).

One should water the trees with the decoction of barley, *Mudga,*

sesamum, *Masa* and *Kuluttha,* when cooled down, for the luxuriant growth of sprouts, leaves, flowers and fruit. (Sl. 120).

Flesh boiled in water is used for the growth of the date-palm, cocoanut, bamboo and lotus plants. (Sl. 121).

The cocoanut tree always puts forth fruit quickly if watered with the cooled down decoction prepared by boiling the seeds of *Masa, Mudga* and *Mura* (a fragrant plant) in water and then grinding and mixing them with wine and salt. (Sl. 122).

The bread-fruit tree bears fruit with prickly rind as if bristling with joy if wrapped with the leaves of *Kramuka* (betel-nut tree, *Areca faufel*). (Sl. 123).

The mango tree bears rich fruit in season if its basin is well watered even once with milk in which the fats of jackal, iguana, deer, duck and pig mixed with the five sprigs (of *Amra, Jamba, Kapittha, Bijapuraka* and *Bilva*) have been boiled. (Sl. 124-125).

The mango tree bears rich fruit if nourished with water, milk and curd in which the five sprigs and the fats of hog, jackal, mouse, deer and horse have been boiled. (Sl. 126).

For the abundance of pomegranate fruit the best treatment is to water the tree with the gravy of sheep's flesh and fumigate it with the fumes of sheep's wool and flesh. (Sl. 127).

When besmeared and fumigated at the root with honey, ghee and the three myrobalans mixed with the serum of a superior kind of flesh, the pomegranate trees put forth fruit like the palmyra tree. (Sl. 128).

Watering of pomegranate trees with the decoction of sheat fish boiled in water along with the powder of *Kuluttha,* is conducive to the abundant growth of its fruit. (Sl. 129).

The citron (or sweet-lime) fruit with the flesh of a jackal and the trees (in general) grow more fruit if nourished with jaggery, milk and gravy (or serum). (Sl. 130).

The orange must bear fruit if nourished with the flesh of any animal mixed with jaggery and cow's milk. There is no doubt about it. (Sl. 131).

If a basin is dug round the citron tree in the month of *Asadha* (June-July) and filled with oil-cake then it would yield abundant fruit. (Sl. 132).

If the cocoanut tree is plastered at night with *Mura, Mudga* and *Masi* boiled, cooled down and ground into a paste, it would put forth fruit with full vigour. (Sl. 133).

The yield of the cocoanut tree is sure to increase if salt, *Kapala,* husk and sugar is poured on its roots. (Sl. 134).

The arecanut tree would give rich fruit if every year its basin is filled with ordure in the rainy season. (Sl. 135).

The plantain would yield fruit if it is pierced at the place of its fruit and roots with iron rod heated in the fire of ivory powder. (Sl. 136).

The plantain yields abundant fruit if its root is cauterized with iron rod heated in the fire of the dung of a boar or horse. (Sl. 137).

If the root of the plantain is filled with the ashes mixed of husk and dried old dung and is watered at proper time, there is then abundant yield of fruit. (Sl. 138).

Liquorice water (or honey and liquorice water) is best for the jujube trees. One should take equal parts of pounded sesamum and liquorice. Then mixing them with honey and water he should, at the time of blossoming, sprinkle with that solution the root of the jujube tree and it would quickly bear fruit — big, sweet and fragrant. (Sl. 139-140).

The *Campa* plants, nourished with water mixed with the powder of long pepper (*Kana*), *Abrus precatorius* (*gunja*), *Syama*, white mustard, *Jangati* (*Mucuna pruritus*) and pounded sesamum become richly covered with blossoms. The flesh of jackal, fish etc. should also be fed to the *Campaka* trees. (Sl. 141).

If one spreads straw sparsely between the clumps of the *Valti* creepers and sets it on fire, then the creepers put forth very lovely blossoms. (Sl. 142).

One should have the vine watered even once with the decoction (or gravy) of a hare's flesh, and it would yield a rich crop of sweet and luscious grapes. (Sl. 143).

The date-palm, *Bilva* and *Likuca* thrive on white mustard and the mango trees on oil-cakes and husk dissolved in water. The cardamom plant flourishes if sprinkled with the water of *Nicula* leaves and|or with water containing *Vrihi* rice. (Sl. 144).

Masa beans are dear to the old emblic myrobalan trees, diluted milk is good for young *Tinduka* saplings, the cocoanut trees are pleased with the feed of barley — and all of them thrive in the low land. (Sl. 145).

The *Sahakara* mango gives a quick yield of very fragrant fruit if nourished with the water of five sprigs and with milk in which the fats of deer, hog, spotted antelope, jackal, horse, etc. have been boiled. (Sl. 146).

The dung of a boar mixed with ghee and gravy, and water are very beneficial to pomegranates. The boiled *Kuluttha* or its powder is also good for raising abundant fruit. (Sl. 147).

The pomegranate tree, which is plastered with the three myrobalans and flesh of a fish and fumigated with the fumes of ghee and three myrobalans, gives a wealth of fruit that vies with the palmyra fruit. (Sl. 148).

Curd, whey, sour gruel, liquor, jujube, sesamum, *Madhika* (*Trigonella Foenum* Graecum), flesh and milk, all these make the *Phaline*, *Kadamba*, *Kula* and *Kesarika* (*Mesua ferrea*) laden with fragrant flowers. (Sl. 149).

If nourished with the soup of ground sesamum (palala) and fish and manured with the excrement of cocks the *Gostani* (red grape) vine thrives with flower and fruit. (Sl. 150).

The bread-fruit trees become laden with fruit from top to bottom if their stems are stuffed with lumps of ground sesame and they are nourished with the water of *Vaca* (*Acorus colamus*). (Sl. 151).

If *Kapittha* and *Bilva* trees are watered after being given treatment with ghee, jaggery, milk and honey, they always yield an enormous quantity of luscious fruit that taste almost like nectar. (Sl. 152).

The *Madhuka* (*Bassia latifolia*) tree puts on a gorgeous splendour if it is fed and treated with water in which the leaves of *Kosataki* (*Trichosanthes dioeca*), roots of water lily and flesh together with the powder of long pepper are boiled and with water in which incense is mixed. (Sl. 153).

The jujube tree, which is nourished with water containing sesame, liquorice and honey and whose roots are fed with carrion, bears fruit as sweet as sugar. (Sl. 154).

The citron tree, manured with the ordure of goats, sheep, pig and birds and watered with the urine of horse and *Avijitari*, yields abundance of fruit. (Sl. 155).

All sorts of creepers bend under the weight of fruit if they are pierced with the thorn of *Vrscika* (*Boerhavia procumbents*), fumigated with incense and fed with the fat of mice and hogs. (Sl. 156).

Coriander (*Saurabha*) grows in a month if fed with water in which the powder of *Kustha* (*Costus speciosus*), *Patra* (*Laurus Cassia*), *Musta* (*Cyperus rotundus*), *Tagara* (*Tabernaemontana coronaria*), *Usira* (*Andropogon muricatus*) and wine are mixed. (Sl. 157).

The powder prepared from white mustard, plantain leaves, fish and ordure of hog and cat, all in equal parts, and mixed with ghee and wine is beneficial for the (growth of) trees. Treatment with incense and plasters removes their diseases and makes them bristle with branches, leaves and flowers over which the bees hover (with delight). (Sl 158).

Fumigation with the fumes of ghee mixed with earth, sprinkled with barley-water, and regular watering with diluted milk on carrion-water, and plastering with *Vidanga* and sesamum-oil-cake, are conducive to the rapid growth of young plants. (Sl. 159).

Trees fed with ghee and honey in which the decoction of *Ankola* (*Alangium hexapetalum*) has been mixed and nourished with the fat of hog and deer as well as white mustard, always grow luxuriant with foliage, flower and fruit, keep free from disease and have thick shade (Sl. 160-161).

In the sixth chapter of "Visvavallava", Misra Chakrapani gives details of manuring different plants. Translation of the important portions are given below.

The date-palm, *Bilva, Lakuca, Asana,* the cocoanut, the walnut, *Panasa,* the mango, *Madhuka* and *Campa* — all of them thrive well .....if dressed with the powder of sesamum and mustard and watered with the scum of boiled rice in which oil-cake has been dissolved. (Sl. 11).

Watering with carrion broth is always good for the blossoming of all trees and particularly of the pomegranate. Its fumigation too produces quick and large fruit. (Sl. 12).

If a pomegranate tree, of which the fruit is yet unripe, is plastered with the paste of fish, ghee and three myrobalans and is fumigated with the fumes of ghee and three myrobalans, it would yield very big fruits. (Sl. 13).

Watering with the decoction of *Kulattha* powder or that of cotton seeds in water and dressing with soil mixed with cowdung promotes the growth of pomegranate trees. (Sl. 14).

Boiled *Masas* containing soup are said to promote an abundance of fruit even on an old emblic myrobalan tree. The fruit of tree, watered with milk, is always very sweet when ripe. (Sl. 15).

Dressed with the offal of cocks and watered with the washings of fish's flesh the vine thrives very quickly and bears rich blossoms and abundant fruit. (Sl. 16).

Priyangu, white mustard, *Vaca*, turmeric, *Vidanga*, *Gunja*, sesamum, *Nimba*, *Krsna* (*Piper longum*) — if all of them are churned in ghee and juice of *Asva-Karna* (*Vatica robusta*), they promote the growth of *Campaka* and *Kesara* (*Rottleria tinctoria*) very much (when administered). (Sl. 17).

If sprinkled on the stem with *Patasa* (?) and watered with the decoction of *Vaca*, the *Panasa* tree thrives well and quickly bears fruits that are luscious. (Sl. 18).

The Madhuka tree, if watered with the decoction of the leaves of *Kosataki* (*Trichosanthes dioeca*) and flesh of the fish mixed with long piper, puts forth rich blossoms and if fumigated also it bears lovely fruit (?). (Sl. 19).

The *Kapittha* and *Bilva* trees, if dressed with the powdered *Madhuka* mixed with milk, ghee and honey at intervals (?), would bear fruit, sweet and without stone. (Sl. 20).

The citron tree, if dressed with *Vidanga* and the offal of goats, sheep and pigs and nurtured with urine and turbid water, would always bear ample fruit. (Sl. 21).

The *Badari* tree bears a wealth of fruit if nurtured with water in which honey, liquorice and sesame have been mixed. And the *Patala* (*Bignonia suaveolens*) bears rich flowers if watered with the decoction of cotton-plant (seeds ?) and fish. (Sl. 22).

Treated and watered with the decoction of sesamum, ghee and flesh of the fish, *Sephati* (*Vitex negundo*) and *Pitika* (turmeric, or yellow jasmine, or saffron) would blossom in a day. (Sl. 23).

On an orange tree the fruit grows big and luscious if the tree is watered with the decoction of *Masa*, flesh, jaggery and milk. (Sl. 24).

With the nature of the broth prepared from *Karkkandhu*, *Methi* (? *Trigonella Foenum Graecum* ?), sesamum, *Mastu* (whey), *Rodhra* (*Symplocos racemosa*), *Dadhyara* (?) and *Nala* (lotus stalk), the *Priyangu*, *Pumnaga and Kadamba* trees bear fragrant flowers in ten days. (Sl. 25).

On rose-apple *Asoka, Dhatri* (*Emblica officinalis*), *Kamarakha* and *Lakuca* trees having become barren, one should inflict cuts on their roots, then plaster them with the paste prepared from the milky juice of *Jambala* (*Blyxa octandra*), *Radhra,* honey, ghee and sesamum, and then nurture them for ten days with the solution of honey, milk and water. In this way they would begin yielding fruit as sweet as nectar. (Sl. 26).

By manuring the roots of the *Bakula* tree with the mixture of sesamum, jaggery and Vidanga and with the mixture of the powder of Madhuka flowers and soft soils, and then watering it with the decoction of the roots of Kola, it becomes laden with highly fragrant blossoms in ten days. (Sl. 27).

The sages state that for the blossoming of the mulberry tree cuts given to it during the spring with an axe are beneficial or helpful (Sl. 28).

For the plantain trees the ashes of rice and cowdung are beneficial and the husk rice is said to be specially good for palm trees (Trna-dru) (Sl. 29).

Plastered with ghee and reddish earth and water with the solution of lac, the Asoka tree becomes laden with blossoms as richly as it would do at the kick of a young maiden. (Sl. 30)

The *Bakula* (*Mimosops elengi*) is said to put forth blossoms when sprinkled with wine from the mouth of lovely women; Tilaka, at their hug and Asoka at their kick. (Sl. 31)

The lotus plant (*Nelumbium speciosum*), growing in mud, if plastered with ivory dust, *Kulmasa* (sour gruel) and honey everyday, it would grow blooming lotuses. (Sl. 32)

If watered with perfumed water and carrion-broth in summer, the *Ketaki* would, at the approach of rains, be laden with sweet smelling blossom (Surabhi-data). (Sl. 33)

The well-planted mountain creepers (or plants) of all kinds, if fumigated with cow's ghee and well nourished and fed with the fat of *Bos Gavaeus* and water, bear rich fruit. (Sl. 34)

The Amrataka tree is safe from danger (sukhi) if the neck of a broken pot is placed on its top, and the sages say that a full (?) pot placed on the pomegranate tree promotes the growth of its fruit. (Sl. 35)

Nurturing with water in which the root of *Bhillota* (*Symplocos racemosa*), barley, milk, Vidanga, oil and the seeds of *Wrightia antidysenterica* (Indra-bija) are mixed, dressing of the roots and the basin with loam mixed with dry dung, and fumigation are some of the means for removing the diseases and promoting the growth (of the trees). (Sl. 36)

The paste of white mustard, plantain leaves, fish, and offal of hog and cat—all in equal parts mixed with ghee, is beneficial for the trees. Nourishing treatment given by fumigation and plastering remove their diseases and their branches, shoots and bark become charming and their foliage and blossoms sway merrily. (Sl. 37)

Plastering with *Vidanga,* honey and sesamum, fumigation with ghee, dressing the basin with loam, and nurturing with barley, milk and water as well as carrion (?) is conducive to the growth of young plants. (Sl. 38)

Plastering may be done with the thorn-apple (Datura Metel), *Vatari* (*Ricinus communis*) and *Mallika* mixed with *Sinduvara,* sesamum and Masa, as well as barley, ghee, honey and milk and nurturing with water in which the same mixture may be dissolved. (Sl. 39).

Plastering with dry ginger, ghee, honey, *Vidanga,* and *Kustha,* fumigation with vermifuge....(?) and nurturing with water or carrion broth, are especially good for the holy fig-tree (Ksira-taru). (Sl. 40).

Trees which are dressed with loam, whose roots are watered with goat's urine, and which are fumigated and sprinkled with water, grow well.....(Sl. 41).

Plants thrive well and become free from disease if they are watered with the decoction of the fat of a hog and deer and *Kola* (Jujube, or hog's flesh) in which ghee and honey have been mixed. (Sl. 42).

CHAPTER V

CULTIVATION OF CROPS

From the earliest times, rice and wheat and millets have been the staple food of the vast population of India. In addition to these, references are abundant in ancient literature about the existence and usage of several other crops of economic importance such as sugarcane, barley, mango, jute, ginger, turmeric, pumpkin, gourd, cucumber, pepper, turnip, sesamum, mustard, cabbage, potato, radish, peas, *kalai* (pulses) etc.

From the modern genetic point of view, it is seen that different varieties or strains of a particular crop have to be evolved either by breeding or by selection to suit a particular type of soil and climate. Considering the wide diversity in soil and climate found in India, it is expected to find a large number of varieties of a crop. Taking rice as an example, it is surprising to note innumerable forms of rice found in ancient literature. About 5,000 forms have been collected in the Indian Museum and Sir George Watt observes that "these are probably not all distinct, but even if halves, the number would still be sufficiently significant of the vast antiquity of the cultivation".

Rice was grown throughout the year and based on the harvesting season they were classified in four main groups, viz., *graishmika,* the summer; *varshika,* the rainy; *sarada,* the autumn; and *haimana,* the winter.

The ancient medical writers as well as Kautilya did not clearly distinguish an autumn class, probably on account of their residence in upper India where the conditions are not suitable for moisture-loving paddy. These classes were recognised by them: *Shashtika* ripening in 60 days in summer, *Vrihi* of the rainy season, and *Sali* of winter. The first two classes are considered by some to be one, as the same seed does well for both the crops whereas *Vrihi* of Vedic literature may be called summer paddy. The climatic conditions of the West and East Punjab differ a great deal, and rice became an important crop when Vedic Aryans had come to occupy the land of the 'seven rivers', ('saptasindhu') where flooding took place and irrigation became possible. The only class which would be cultivated was *Vrihi,* and in some parts Shastiva. The original wild form was called 'Nivara'. 'Uridhan' in Bengali, which was considered by the fastidious as "Pure", since it was not the product of cultivation which was often accompanied with destruction of insects. It is remarkable that wild variety contains more protein than the cultivated forms that are found in India.

Kasyapa in his book deals with the cultivation practices of some of the most important individual crops. Translations of the relevant portions of the book are given below.

Everywhere in the world the wisemen who are conversant with agricultural operations should, after having fed the bulls, the cows, the buffaloes, the servants and the labourers who know their respective jobs, promote the growth of grain sown in the fields by various methods suited to the requirements of each field. In the beginning the main step is to ascertain the proper time. In all the countries such as Kashmir, *Vainga* (Bengal), Nepal, *Pancala, Kosala* (Oudh), *Kuru* (near Delhi), *Virata, Avanti* (Ujjain), *Malava* (Central India), *Saka-country, Sindhu-sanvira* (Sind and neighbourhood of Indus), *Sura-sena* (Mathura), *Cedi* (Bundelkhand), Konkana and Andhra cultivation is advisable only in times when there is rainfall. (Sl. 299-303)

In places connected with river-fed canals cultivation should start in summer when canal water is let out for irrigation. Cultivation is also advisable in all such places which are irrigated by culverts connected with great water-reservoirs. (Sl. 304-305)

A wise husbandman should start cultivation suitably, keeping in view the fertility of the soil and after having assured himself of necessary water supply either from rainfall or from a big water reservoir or from a canal. (Sl. 306)

On river banks, in villages, in forest lands, on mountain slopes and on high and low grounds the fields on this earth are divided into two kinds according to their inherent nature. (Sl. 307)

Of them the first is the *Salibhumi* (paddy-field) which is declared to be the best by the sages. The second is *Adhakabhumi* which, even though of mediocre type, yields good crop. (Sl. 308).

The paddy field is kept constantly flooded with water and is full of marsh and soft clay. It is irrigated by a network of conduits and small channels and is enclosed by a small bank of earth-work for protection. (Sl. 309)

The situation of the paddy-field is determined by its vicinity to a waste land, to a village habitation or to a series of other fields. (Sl. 310)

The channel which receives water (from its source) the slope of its bed somewhere towards the east, somewhere towards the west, somewhere towards the south and somewhere towards the north. Somewhere it has an almost level bed, and somewhere the flow of its water is capable of being led from one field to another. According to this the situation of the paddy field is determined. (Sl. 311-312)

If from the beginning of the first tilling the paddy field is kept inundated with water till the sprouting of the paddy, it is said to yield a bumper harvest. (Sl. 113)

The raised land bordering on a village habitation or forest region and at some place by the river-side is the second type of land called *Adhaka*. It requires scant irrigation and is suited to the bumper growth of gram. There is no need of providing canals or other means of irrigation for it. It usually becomes fit for cultivation by a small effusion of

water. Therefore at the time of sowing it should be watered slightly. In this land watering at the proper time gives life to (i.e. promotes the germination of) the seeds. The *Adhaka* land nas thus been described as possessing the aforesaid qualities. (Sl. 314-317)

The farmers should collect seeds of various kinds fit for sowing in the *Sali* and *Adhaka* fields respectively. (Sl. 318).

COLLECTION OF SEED

Kasyapa gives the following account of the myth and methods of seed collection.

In the beginning (of creation), the Great forefather of mankind, being requested by the Earth, created seeds of various kinds and then began to ponder. (Sl. 319)

Anticipating His intention the great goddess Earth addressed the Creator cheerfully for effecting the happiness of the living being, saying: "O Lord, various kinds of these seeds created by thee will doubtless sprout forth quickly when carefully scattered in me". (Sl. 320-321)

"By the grace and power and particularly of Indra, there shall be timely rains every year. (Sl. 322)

"Everywhere in the various countries on the surface of the earth, the common people and the cultivators shall be thriving and happy when they shall get timely rains and, having sown seeds in their fertile fields, reap a bumper harvest. (Sl. 323-324)

"The gods will be immensely pleased, there will be increase in sacrifices, people and their guests will be satisfied with abundant provisions of food, so too would be the cattle by timely feeding and the *Bhutayajnas* will also be successfully performed." (Sl. 325).

Thus addressed by the goddess Earth, the Lotus-throned god said, "May it be so",—a sentence calculated to the welfare of all living beings. (Sl. 326).

Since that time the acute-minded cultivators everywhere on this earth preserve the various kinds of seeds carefully. (Sl. 327).

The sages have declared rice, etc. to be the first, the *Adhaka* (cereal ?) the second, the vegetables the third, and the creepers (including trees ?) and flowers to be the fourth class (of seeds). (Sl. 328)

This four-fold form of cultivation on this earth as explained by Yogis like Narada, gives nourishment and fruit, satisfies the gods and more particularly men in all seasons, provides sustenance to animals like cows, bulls, camels, horses and elephants. (Sl. 329-330)

Even the best of kings have done the cultivation of land in their respective kingdoms with diligence which was looked after by their servants. (Sl. 331).

Thenceforth this art, which depends mainly on seeds, was taken up by Brahmanas, Ksatriyas, Vaisyas, Sudras and others and was variously practised in good fields at proper times. (Sl. 332).

Hence wise and eminent agriculturists in the world should make a proper collection of seeds. (Sl. 333).

Now I shall enumerate in due order the names of different seeds for your benefit. (Sl. 334).

The agricultural experts have distinguished three kinds of rice according to their flavour and colour. They are *Sali, Kalama* and *Sastika*. Of them *Kalama* rice are somewhat hard and bright and possess great flavour. But *Sastika* have been made without flavour by Brahma. Experts have declared *Sali* to be of twenty six varieties according to the various countries and the soils in which it is produced. The 26 various varieties of *Sali* are:—

(1) White *Sali*, (2) Red *Sali*, (3) Thick *Sali*, (4) Long *Sali*, having sweet flavour, (5) White-coloured *Kalama*, (6) Red-coloured *Kalama*, (7) Thick-grained *Kalama*, (8) Long-sized *Kalama*, (9) Sambaka rice called *hema* (golden), (10) Reddish brown *Sambaka*, (11) Red *Sambaka*, (12) Black *Samba*, another variety considered to be very flavoury, (13) *Suka* rice, (14) another thick variety of *Vrihi*, (15) Hard *Vrihi*, (16) *Palasa Vrihi* which is full of flavour, (17) *Svadu Vrihi* which is very sweet, (18) *Phala Vrihi*, (19) *Draksa* (grape) *Vrihi*, (20) *Nivara* which has black and white spots, (21) & (22) white *Yava* and black *Yava* both of which are thick, (23) *Sammar Vrihi* which has an abundant crop or swells much on boiling, (24) *Kala Vrihi* which is very nourishing, (25) White *Vrihi* and (26) Yellow *Vrihi* which removes indigestion. These are the twenty-six varieties of rice, and of all these the seeds should be preserved. (Sl. 335-346).

When they are ripe and have been dried in the sun by spreading over the threshing floor, it is the first duty to store them in one's house for prosperity. Or they should be stored by the king and afterwards distributed at the proper season, for seeds are the biggest fortune and the primary wealth of agriculture. They are the source of pleasure to both gods and men and the fittest commodity for gifts. Therefore, it is well that agriculturists should properly preserve the seeds. (Sl. 347-349).

These are the seeds that yield abundant crop. Of them some ripen in three months while others in four, five, six, seven or eight months or even more. (Sl. 350-351)

Therefore undertaking of the cultivation of paddy in the fields of one's country with proper arrangement of water for irrigation is sure to bring happiness. (Sl. 352).

At some places cultivation depends on artificial means of irrigation while at others it depends on rainfall. (Sl. 353).

Cultivation is best when done according to proper season and in suitable land (soil) and it yields fruit both to the kings and their subjects. (Sl. 354).

It provides definite comforts of life even to the cattle (i.e. animals) and birds. (Sl. 355).

The preservation of the seeds of the following plants also affords happiness:

1. *Adhaka* seeds, 2. *Masa* (*Phaseolus radiatus*), 3. *Mudga* (*Phaseolus mungo*), 4. grams, 5. wheat in particular, 6. Sesamum, 7. *Kiraka* (?), 8. *Kodrava* (*Paspalum scrobiculatum*), 9. Yavara (?), 10. *Kulattha* (*Dolichos uniflorus*), 11. *Syama* (*Artemisia* indica), 12. *Krsnasarins* (*Acacia catechu* ?), 13. *Iksu* and *Pundara* varieties of sugarcane according to yield of juice, 14. various kinds of spices (*Usna-tujaka*) coriander, cumin-seed, mustard and black-pepper, 15. exotic cotton, 16. castor-oil seeds, cucumber and egg-plant. (Sl. 356-360).

There are creeping plants like *Jatika, Rasi-Jatika, Vallika, Vanavallika,* and *Savaka* which are said to be of various kinds and are full of juice. (Sl. 361).

Then there are vegetables of various kinds distinguished by their colour, taste and genus. The preservation of the various kinds of seeds of pumpkin-gourds, *Kalata, Kustumba, Kata, Dhanyaka,* Turmeric, and ginger. (Sl. 362-363).

Experienced cultivators should also preserve the seeds of *Surana* (*Amorphophallus campanulatus*), bulbous roots, *Sakuta, Rasaka* and bananas. There are cardamoms, grapes, *nalada* and *Nagavalli* full of juice, their seeds as well as those of *puga* and *Kramuka* should also be preserved. Again the seeds of the following flowering plants and trees must also be preserved:

1. *Mallika* with yellow flowers, 2. *Kunda,* 3. *Atimukta,* 4. *Campeya,* 5. *Sigru,* 6. birch tree, 7. *Karanja,* 8. *Sami,* 9. *Naktamala,* 10. *Dedodar,* 11. *Vibhitaka,* 12. *Priyangu,* 13. *Emblic myrobalan,* 14. *Pinditaka,* 15. *Nimba,* 16. *Lakuca,* 17. *Sirisa,* 18. Asoka, 19. Pomegranate, 20. *Sri-parna,* 21. *Tamala,* 22. *Sindhuvara,* 23. *Kapittha,* 24. Rose-apple and 25. *Sapta-parna.* (Sl. 364-370).

The preservation of the seeds of all the following various trees bearing foliage, flowers and fruit and beneficial to men and birds especially is for the common welfare:—

1. *Udumbara* (*Ficus glomerata*), 2. *Caladala* (*Ficus religiosa*), 3. *Tinisa* (*Dalbergia ujjeinensis*), 4. *Paribhadraka* (*Erythrina indica*), *Palasa* (*Butea frondosa*), *Madhuka* (*Bassia latifolia*), *Vata* (*Banyan*), *Plaksa* (*Ficus infectoria*), Mango, *Tinduka* (*Diospyros embryopteris*), *Tilaka* (*Clerodeudrum phlomoides*), *Nipa* (*Nauclea cadamba*), *Arjuna* (*Terminalia arjuna*), *Sarjaka* (*Terminalia tomentosa*), *Badara* (Jujube tree), *Pibi* (*Salvadora persica*), *Jambira* (citron tree), *Pumnaga* (*Rottbria tinctoria*), Bamboo, *Kasa* (*Saccharum spontaneum*) of various kinds and *Matulunga* (citron tree). (Sl. 371-374).

The husbandmen should take the well ripe seeds of various kinds, dry them in the sun and preserve them in various kinds of vessels, heaps of straw or basins. They should not be allowed to be spoiled by rabbits, rats and cats, or by showers of spray, wind, rain etc. The stores of seeds

should be preserved in the house on threshing floors and should not be allowed to deteriorate by any kind of pest. (Sl. 375-377).

The sages have said that the preservation of the best kind of seeds conscientiously brings prosperity to the cultivators. The cultivators whether Brahmana, Ksatriya, Vaisya, Sudras or of mixed caste should buy and store the seeds of rice, vegetables, trees, bulbous roots, etc. and should sow them in the right manner and in proper sequence in their native fields which have been duly ploughed by oxen and promote their growth by watering them at proper times. (Sl. 378-382).

PLOUGHING LAND FOR SOWING

Kasyapa mentions in his book that persons skilled in agricultural science have prescribed different methods of sowing. An account of these is given below.

For sowing all kinds of rice, the paddy-fields must be tilled with the help of best oxen. (Sl. 384)

The authorities on agriculture have also prescribed that bulbous roots, etc. should be nursed first on the dry land. (Sl. 385).

Then having made separate wet fields or well-watered dry fields fit for sowing by tilling them with the help of oxen and making them smooth, the farmer should plant the seedlings into them expeditiously and with proper spacing. (Sl. 386-387).

The tilling of the fields is done with the help of oxen, the smoothing and levelling with the help of spades and rakes (*Kheta*), whether the land is in pleasure-groves, gardens, palace-gardens or lies within or without the bounds of the village or town. (Sl. 388-389).

For the sowing of seeds in the fields, the experts have recommended furrowing at some places, smoothing (or dressing ?) at others and digging at still others. For the sake of planting bulbous roots one should dig a pit. (Sl. 390).

The herbaceous plants like the plantain tree are grown either by the proper insertion of seedling or by transplantation or from a scion. (Sl. 391).

Sages of right perception have said that implantation is fruitful only if done in proper time and in a good field which has been smoothed and dressed. (Sl. 392).

Therefore tilling is recommended everywhere whether a paddy-field or on dry land suitable for the cultivation of plants and vegetables or of trees and gardens. (Sl. 393).

An experienced cultivator should either do the tilling, or furrowing or the digging of pits (i.e. dibbling ?) according to the requirement of his field. (Sl. 394).

For sowing he should assign that land which has been first irrigated and then drained off or gradually dried up in the sun. And for planting trees, creepers, plantains, bulbous roots and seedlings, etc. he should carry

out tilling and other agricultural operations expeditiously according to the traditional usage, if he is anxious that his labours should bear fruit. (Sl. 395-397).

CULTIVATION OF VARIOUS FOOD-GRAINS

The sages have said that the cultivation of paddy is best done in countries like Kosala where the fields are irrigated with river-water. Therefore wise husbandmen, who have decided upon reaping a harvest of different kinds of rice like Kalama and Vrihi, should first irrigate their fields well by means of channels drawn from reservoirs, rivers or lakes and then till them with the help of oxen. (Sl. 398-400)

The tilling in the flush fields is beneficial if done from the north-eastern corner or somewhere in the eastern or western side. (Sl. 401).

Then the cultivator should order the uprooting of the wisps of paddy seedlings which have already been grown closely in a separate nursery, and then, tying together each wisp, he should on an auspicious hour, have them transplanted by servants in rows evenly in the paddy field in which the clay has become soft by tilling and has been carefully dressed with the dung of cows or goats or with (decayed) vegetable matter. (Sl. 402-404).

Afterwards only a small quantity of water should be allowed to remain in the field and care be taken to provide an outlet for superfluous water. (Sl. 405).

Then, in order to make the labours fruitful, care should be taken to provide such protection that no damage occurs to the seedlings. But where the damage to the seedlings does occur on account of various reasons like excessive rain, there a wiseman should get new seedlings transplanted for his ultimate benefit. (Sl. 406-408).

In a large number of village fields or elsewhere in the forest region or grassy land, a collective tilling of the cultivable land by one, two, three, four or five members of families with the help of ten yokes drawn by twenty oxen is useful for the harvest. (Sl. 409-410).

Simultaneous sowing of seeds by the village community with one accord and with the help of a number of yokes is considered to be very beneficial. (Sl. 411).

In this manner, the paddy seedlings transplanted in rows in a well-ploughed paddy field full of saline water, in a village, town, forest or woodland, irrigated by a canal and provided with several outlets for draining away the surplus water, are made to take root by the Creator (i.e. Nature) after the lapse of seven or ten days and then the new shoots sprout forth and make their blessed appearance. Then the land shines forth with that fascinating bloom which is found on the plumage of parrots or on the body of a damsel in the prime of her youth. (Sl. 412-416).

In this way at the expiry of the first month gradual growth of the paddy blades is discernible. (Sl. 417).

There is an all round growth of shoots and increase of splendour

on the plants which feed on water daily and hold out a promise of rich harvest. (Sl. 418).

At that time in the slush of the paddy fields there springs up inevitably a rank growth of wild grasses and weeds which, the sages say, are definitely detrimental to the crop. (Sl. 419).

Therefore the cultivators should systematically and assiduously weed out the wild grass and weeds and other injurious rushes like munja from their fields. It is best to destroy the wild grasses, rushes, weeds, etc. which affect the growth of grain and reduce the yield of crops, from their very roots. An experienced person should first fill the paddy fields with water and then gradually root out the weeds, etc. row by row. Or it is best to have the pest removed daily by the servants. When the parasitical growths have been eliminated by the cultivators their fields shine forth lustrous and luxuriant. (Sl. 420-423).

The growth of the paddy is then ensured in the second month. But even if at that time parasitical weeds are discovered they should also be systematically destroyed in order to ensure a bumper harvest of all the various kinds of paddy. (Sl. 424-425).

The cultivation of all the various kinds of rice like the white *Sali*, red *Sali*, *Kalama* etc. which have been enumerated above is done in the same manner. (Sl. 426).

First there is the tilling of land, then seed-sowing, then careful weeding and ample watering and last of all the preservation and protection of the crop, all these processes are the same in all cases notwithstanding that, the different varieties of rice like *Sali*, *Samba*, *Kalama* etc. ripen within different periods of time—some in three months and some in four, five or six months according to their species and colour. (Sl. 427-430).

Therefore, everywhere in the country, the veteran agriculturists advise the watering of the fields at proper times by the cultivator after having ascertained the respective times of the appearing of ears in the different varieties of paddy. (Sl. 431).

When the ears at the top of the rows of plants gradually grow solid and full of milky-juice (or sap) and appear to be somewhat bent, then they should be protected, especially from the parrots. This caution applies equally to all countries. (Sl. 432-433).

Then by and by the juicy grains in the ear would become harder at the core and would finally ripen into the rice. Till then regular irrigation of the fields is advisable and beneficial, otherwise there would be the loss of crop. (Sl. 434-435).

Therefore the cultivators should continue to observe the development of the sap frequently and should regularly water their fields at the proper times for the sake of increasing the sap. (Sl. 436).

Special pains should be taken to irrigate the fields from the river, water-reservoir, lake or well according to the locality. Only then by the grace of the goddess Earth and will of the Creator would cultivation bear

fruit and bring happiness to the living beings. (Sl. 437-438).

On this earth, the various kinds of seeds when sown in cultivated fields in that manner grow spontaneously and yield a splendid harvest. (Sl. 439).

It is extremely beneficial if the crop is protected from rats, locust, parrots, and other various animals. (Sl. 440).

The ripe paddy, which is so beneficial to the living beings, should be honoured by those who live on it, with circumambulations and then preserved by them after having determined the period of life of the grain from its appearance, the stamina of its seed and the quality of the soil from which it is produced or from actual experience. (Sl. 441-442).

When the ears of the paddy have gradually ripened according to their respective duration of time, then water should not be let into the fields. This is the advice of the agricultural experts and should be followed in the case of all paddy-fields. (Sl. 443-444).

Therefore the cultivators should be alert to protect their crop at the time of ripening against all sorts of depredations. (Sl. 445).

When the ears at top of the plants become ripe then their stalks bend their head very low to the ground. Seeing them bend so, the husbandman should himself or through his servants protect them in the field for a period of twenty days. Now, when the stalks have become ripe and assumed a golden hue, the cultivators should then reap them with sickles etc. They may have the harvest mown in one day or in several days successively with the help of their dependants and other servants working in cooperation. (Sl. 446-449).

But reaping would be useful only if care is taken that the stalks are not damaged during the operations nor the harvest spoiled by rain or carried away by thieves. (Sl. 450).

The cultivators should have the reaped plants with their ears stacked on threshing floors with the help of their servants and attendants. It is advisable to keep the harvest lying on the threshing floors for three to five days. By threshing the ripe stalks from which the ears become loosened, the grains drop on the threshing-floor and sparkle like the heaps of bright pearls. On the second round of threshing done by having the crop trodden over by bulls and buffaloes, the remaining quantity of the grain also drops on the floor. After having the paddy thrashed in this way on the threshing-floor, they (the cultivators) should gather the assorted stuff that is thick and substantial. (Sl. 451-455).

The cultivators should carefully sift the superior grain from the inferior stuff by means of the winnowing fans, etc. and gather the former into a heap. A wiseman should then dry them in the sun and get them cleaned of impurities. He should then, having apportioned one share to the gods, one to the king, one as a gift to a Brahmana learned in the Vedas, and one for the maintenance of the servants, keep the remaining stock of paddy in his own house. (Sl. 456-458).

He should carefully preserve the grain in suitable receptacles like *Kathinya* (or Kathini) or in well-baked clay pots or in vessels of strong glass, or in containers woven of ropes and plastered with mud, according to the custom of the locality. At some places, the farmer should dig a pit in the hard earth, provide it with descending steps and store the paddy into it, taking care that it is safe from the hazard of damp, thieves, parrots, rats and other noxious animals. (Sl. 459-462).

All good cultivators advocate the preservation of the different varieties of rice like *Kalama, Vrihi,* etc. in this manner after drying them in the sun. After they have preserved the grain produce in their house, the cultivators should gather the tender straw, obtained from the paddy stalks dried in the sun and trodden over by the bulls, into small piles and preserve it in their house or in the cow-shed. This straw provides sustenance (i.e. fodder) for the cows, bulls, buffaloes both male and female—goats and even deer. (Sl. 463-466).

The Brahmanas, Ksatriyas, Vaisyas, Sudras, men of mixed castes, and all others who possess land, and are engaged in cultivation, after having stored the ripe crop in their blessed home, worshipped the corn-goddess and the wealth-goddess with incense, flowers and pure things prescribed in the Sastras, feasted the Brahmanas and paid them their auspicious fee, and gained glory, happiness, riches and God's favour in this world, keep always cheerful and bright in the company of their wives, dutiful sons and grandsons. (Sl. 469-473).

Enterprising people do cultivation expeditiously a second time in their own native place, in forest-regions or even in villages on good soil, on dry-land or on fertile land which remains always filled with water and reap a second harvest. It is, therefore, recommended that cultivation should be done twice every year everywhere in all sorts of lands for the sake of abundant produce. It is desirable that second cultivation should be done after increasing the fertility of the soil by manuring it with goat or cow-dung or with compost (?). Action and inaction are both said to bring reward when occurring at a suitable time (?). (Sl. 474-478).

By continued vigilance over their paddy-field, by holding cultivation in esteem, and doing it methodically and by the care of their cattle, the cultivators get richer rewards as well as peace of mind. Hence experienced cultivators, having cordial relations among themselves and intent on having two crops every year, should consider it their first duty to protect their cattle, servants, seeds, water-channels, reservoirs, tanks, lakes etc. spades, sickles, etc. threshing-floors, fences and fields diligently and practising the bountiful art of cultivation according to their local custom, snug in the fulfilment of the three aims of their life, live in great happiness. (Sl. 479-480).

Kasyapa says: Cultivation of beans and pulses like *Masa* (*Phaseolus radiatus*), Canaka (Grams), *Mudga* (*Phaseolus mungo*), *Kuluttha* (*Dolichos unifloms*), *tila* (sesamum), and of seeds of pepper and *Ciraka* (?) should

also be done at some places. (Sl. 484-485)

In the sowing season the clever cultivators should sow the seeds of *Adhakas, Masas, Mudga,* according to their time, in lands situated in villages or forest regions, which have been tilled by ploughs and watered by small showers of rain or canal water. (Sl. 490-491)

The texts say that there are two qualities of *Adhakas, Masas, Mudgas, Tilas* and *Canakas,* one of bigger and the other of smaller size. (Sl. 492).

The sowing of the seeds of sesamum (tila), etc. is advocated in tracts of land on a higher level which have been irrigated with water. After the lapse of four, five or six days the shoots of Adhaka, etc. would be visible in the furrows. Sprouting of the seeds is sure with the addition of manure as is attested by the personal experience of experts in the various countries. (Sl. 493-495)

The paddy-fields are called the low land (marsh?) and the fields in which *Masas,* etc. are grown are termed the high land. Therefore, Bhargava has recommended the cultivation of *Adhakas, Masas,* etc. in the fields on the high land. But if in some places sowing of *Masas,* etc. has to be done in paddy-fields (i.e. low land) owing to established custom or the feasibility of the situation of land, it does yield the harvest as is also mentioned in this treatise of Kasyapa. (Sl. 496-498)

Just as the harvest is raised in a field on a low or a high land, ploughed in time, according to the prevalent custom, times or situation, even so it is generally raised on a plain. (Sl. 499)

The cultivators may sow in due season and in regular rows the seeds of big *Adhakas, Masas, Mudga, Canaka,* wheat *Kulutha, Kira, Kodrava, Vavara, Marici,* cotton, castor-oil cumin, mustard, etc. in fields on the high land. (Sl. 500-503)

Experienced cultivators should, according to the custom of their own country, sow in due season the select seeds, whether previously moistened with water or not, in the regular furrows of the field or in different regular rows. (Sl. 504-505)

After the sprouting of seeds sown in the two kinds (i.e. high and low) of land, the cultivators in their respective localities would observe that more or less in month's time weeds have grown rank all over the fields. They should weed them out totally (root and branch) and then water those fields. (Sl. 506-508).

If on the *Adhaka*-land, there is too much of rainfall after the sowing, the seeds would surely be destroyed. Therefore it is best to spray the field lightly or irrigate it sparingly with canal water. (Sl. 509-510)

When the wild growth detrimental to the seeds of sesame, wheat gram, *masa, mudga, adhaka,* etc. has been weeded out, then the cultivator should apply rich manure to the roots of every individual seedling. (Sl. 511-512)

After the rank growth of parasitical roots and grasses has been completely destroyed the plants of *masa,* etc. are sure to thrive. At that time

charming lustre and the flowers would make their appearance. (Sl. 513)

After the appearance of flowers, ears would follow and when they turn reddish-brown, the ripe grain of *adhaka,* etc. is formed. The harvest of *masa, adhaka, canaka,* wheat etc. is ready in three months or in more time in some places. (Sl. 514-515).

The sprinkling of water at the roots of the plants when the ears have turned reddish-brown is said to promote the inner substance of the grains. (Sl. 516)

In this way are produced *masa, adhaka,* sesamum, etc. everywhere on earth by God's grace. (Sl. 517)

When the inner substance of the grains in the ears becomes hard then the *masa,* etc. growing in rows, are ready for harvesting. At that time the blades of the plants begin to sere and fall and tops begin to bend. (Sl. 518-519)

Then the cultivator should water the sesamum and wheat growing on high-land according to proper time. (Sl. 520)

The season and the time of the appearance of ears (of different grains) is fixed. Differences in species, appearance and process of cultivation are due to the quality of the land. In agriculture all these things are taken into account. (Sl. 521)

When the grain of adhaka, etc. has become hard and ripe in the ears, it is time for reaping the harvest with the help of servants, able-bodied men and guards and preserving the produce for use. The ears, cut and separated from the stalks, should then be beaten on the threshing floors and then dried in the sun. The farmers should also preserve the stalks, etc. of *adhaka* for the fodder of the cattle. (Sl. 522-525).

The preservation of the stalks, etc. of adhaka gathered from the threshing floors, in a proper place in one's house or in the court-yard of the cowshed, saves a lot of worry. (Sl. 526).

A cultivator who knows his business, should also collect and preserve the straw, dried blades and stalks, etc. of paddy, *adhaka, masa,* wheat, gram which provide sustenance and nourishment to cattle in all seasons and keep them healthy and fit. (Sl. 527-528)

He should collect the crops of wheat, sesamum, *masa, adhaka,* mustard, *Kira, Mudga,* and other grains on the threshing floor after having them sifted free of gravel (? *Ksudra-grama*), *Katu* and *Grama* (? *grama*-stones) by means of fans and winnowing and cleaned by the processes of *pecana* (?) and *camana* (?).

After they have been cleaned and dried in the sun, he should bring the gram, *adhaka, mudga,* etc. to his house, and store and preserve them in separate vessels, ready for cooking when required. (Sl. 531-532)

The experienced cultivators should cultivate all cultivable commodities like paddy, *Adhaka,* pepper, etc. in different kinds of soil in fields situated near the villages, towns and cities and suitable for the growth of each commodity, according to the local usage and in proper time and

manner. For, agricultural enterprise, whether on a low or high land, is a sure means of plentiful gain (Sl. 533-536).

In every country and village Kodrava, Yavara, and barley should also be grown in proper season as they too are very nourishing and their stalks provide sustenance for the cattle (Sl. 537).

Hence in all countries the cultivators should grow particularly the nourishing and valuable grain like *Kodrava, Yavara* and barley as well as *Agaste grandiflora* and sugarcane according to nature of soil. (Sl. 538).

The cultivation of sugarcane is highly recommended as it has a bush growth, gives jaggery and sugar and is the best feed for the elephants. Sugarcane grown in low (i.e. wet) land is hard and takes time to grow. It may be profitably grown on high land fields (S. 539-540).

Digging a row of pits in the field the cultivator should implant the scions of sugarcane as well as of plantain. (Sl. 541)

Of these, the seed is not sown anywhere. Only the scions of sugarcane are implanted in the pits in autumn or any other season according to the climate of the country and then water is let into the fields. After lapse of ten days shoots burst forth and from those shoots grow the blades, etc. The plants mature for harvest in two months and somewhere in three months. (Sl. 542-545).

When the sugarcane plants have grown to the height of a man or still higher the farmer should daily let water into their root-pits at the proper time and protect them from strong wind, etc. very carefully (Sl. 546-547).

The same process of cultivation is applied to the plantain which is a perennially fruit bearing plant and is of various species (Sl. 548).

Experienced farmers should grow plantain and sugarcane in all seasons in accordance with the nature of the country and its climate. In every place they yield a continual harvest. (Sl. 549)

An experienced cultivator should, after examining the nature of the soil, grow plantain and sugarcane on mountain slopes, hill tops or firm land for his own welfare. They yield regular harvest in all sorts of soil, but they should never be grown in saline and defective soil (Sl. 550-551).

Therefore the cultivator should grow grams, *Adhakas, Mudga,* etc. which are suitable for making soups, protect them and when ripe, take them home. (Sl. 552)

In some places he should grow cotton of the *picu* and *tula* varieties on high land for the sake of making linen. (Sl. 553).

And in hot places he should cultivate whatever is traditionally known to be beneficial or found so by experience. (Sl. 554).

The sages, who are the authorities on the subject, say that the cultivation of cotton and other plants is commended on the Khala-land, in the vicinity or on the borders of the village, inside a pleasure grove, or in any other place like the vicinity of a reservoir or a village habitation on

a plateau. (Sl. 555-556)

CULTIVATION OF VEGETABLES

For the cultivation of vegetables Kasyapa gives the following account.

In spite of the various species of rice and other provisions like Adhaka, etc. want of food is still felt all over the world. Therefore the farmers should cultivate delicious vegetables like *Jatika, Rasijatika, Valhika, Vana-vallika, Patolika,* egg-plants, *Savaka,* pumpkin-gourd, *Kalata, Kustumburu, Surana, Sakuta,* and turmeric and ginger—both cultivated and wild—as well as various other luscious plants for the sake of cooking. In the writer's opinion these are the principal vegetables. (Sl 558-563)

In some countries the varieties of vegetables are different depending on their species, shape, taste and colour. (Sl. 564)

The cultivators should grow vine, Indian spikenard, cardamom, etc. in their respective regions of cultivation. (Sl. 565)

A wiseman should grow indigenous vegetables on low as well as high land according to the season and country after learning the method of cultivation. (Sl. 566)

Of the cultivable commodities the varieties of paddy occupy the first place, the pulses the second, and the vegetables the third. In the fourth place come ghee, milk, curds, etc. These four kinds of products comprise the entire food-stuff. This stuff promotes the happiness of all the gods and is the means of sustenance of the whole human-kind. This gives nourishment, health and long-life and was created by Brahma at the beginning of creation all over the earth. (Sl. 567-570)

With the help of this food-stuff the whole earth is full of life and the object of Brahma's creation was fulfilled from its very start. This stuff, grown in various kinds of fields in all the countries promotes the three objects of existence (viz., virtue, wealth and desire) of sages, ascetics, and men everywhere. Therefore the cultivators should particularly devote themselves to cultivation of vegetables, etc. in good soil in the villages, towns, forests, woodlands and in places near the habitations more particularly near the water reservoirs. (Sl. 571-574)

In the spring, the summer and at some places in the dewy season the cultivation of vegetables is sure to bring rich reward. (Sl. 575)

The seeds of the egg-plant, *Valli, Jatika,* pepper, *Savaka* etc. dried in the sun should be sown in ploughed field for the sake of sprouting. The seeds of the egg-plant, etc. dried in the sun, should be sown in the soil dressed with cow-dung, etc. for sprouting. They should be regularly watered and then covered with the straw-shed. In three days the sprouts appear in the depressions where the seeds were sown. After twenty days when the sprouts have taken firm roots, the wise cultivator should transplant them in a properly ploughed field. (Sl. 576-580)

Watering the roots at that very time promotes the life of the plants. The egg-plant thrives well if its basin is kept full of water. (Sl. 581)

FIG. 5. Worship of Bodhi tree—Sanchi

Courtesy: Department of Archaeology, Government of India.

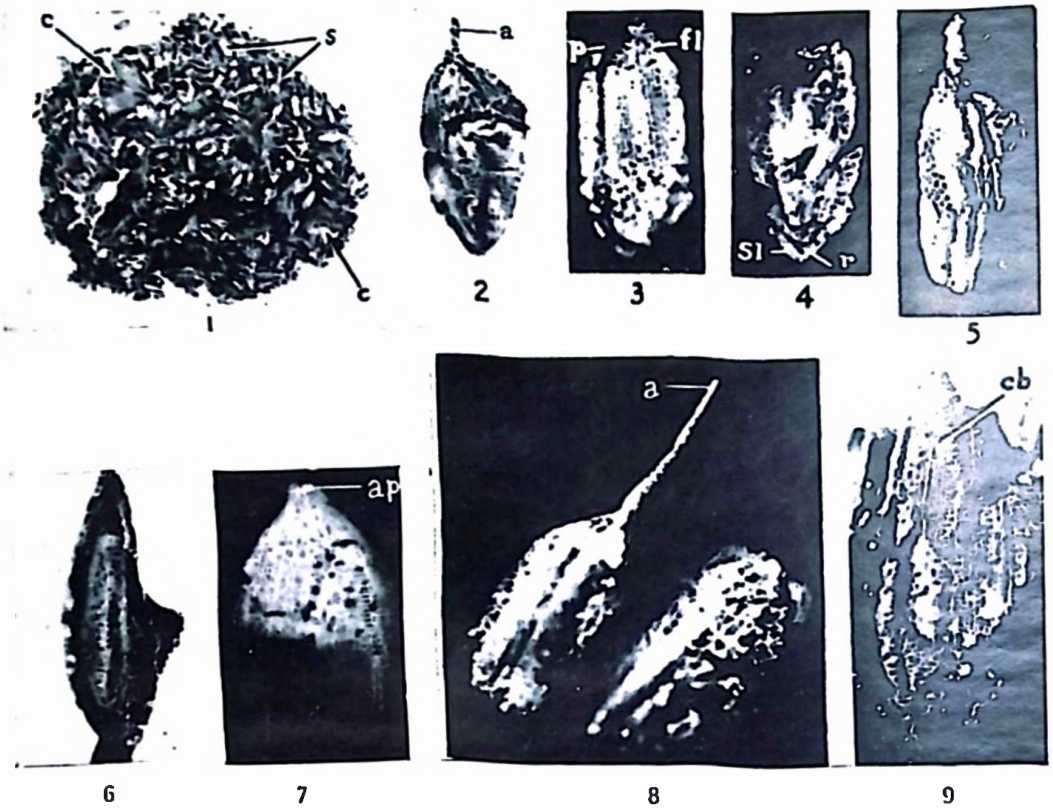


FIG. 6. Grains of charred rice. 1. Spikelets (s) charcoal chips of natural size (c) 2. Broken spikelet with awn (a). The lower portion of the grain is exposed due to the breaking off of the husk (x 8) 3. Spikelet showing fertile lemma (fl) and palea (p), (x 8) 4. Collapsed spikelet showing fertile lemma (sl) and expansion of rachilla (r), (x 8) 5. Flattened spikelet with awn. 6. Grain embedded in tar-like substance (x 15) 7. Part of spikelet showing tredentate nature of apiculus (ap), (x20) 8. Two spikelets one with awn (a). Note their shape and size (x 8) 9. Outer surface of paddy with chess-board pattern (c.b.), (x 20).

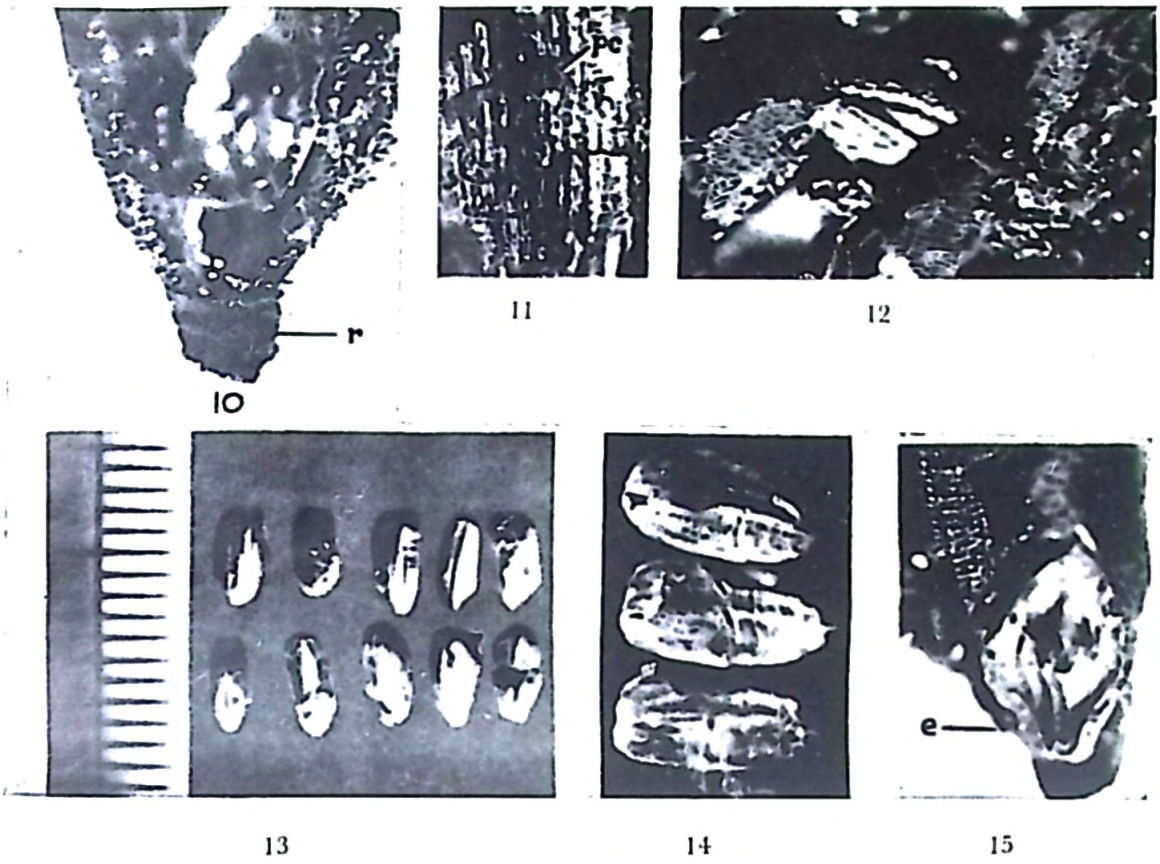


FIG. 6—*(continued)* 10. Portion of the spikelet showing thickening of the rachilla (h) (x 30) 11. Inside view of the husk with pericarp (pc) attached (x 32) 12. Surface view of the husks (x 18). 13. Grains, note their shape and size (x 35) 14. Enlarged view of grains (x 8) 15. Basal part of the grain showing embryonic region (e) (x 30)

Courtesy: Department of Archaeology, Government of India.

FIG. 7. Grinding millstone—Mohenjo-daro

FIG. 8. Seal of a bull—Mohenjo-daro

Courtesy: Department of Archaeology, Government of India.

Watering also helps the growth of the creeping plants like *Patolika, Vallika* to their full extent. (Sl. 582).

The cultivation of vegetables is good in low land in the summer and not in the rainy season. It is successful in other seasons also. (Sl. 583)

In the same manner the bulbs of *Sakuta, Surana* and turmeric should also be implanted in hollow depressions or in a bed of hot soil and they will thrive. In this way, the cultivation of creeping plants is manifold. (Sl. 584-585).

Pumpkin-gourds, wild pumpkins, cardamom, spikenard and *agavalli* (Piper Betel) may also be grown on high land. (Sl. 586).

A wise man may grow plantain, sugarcane, piper betel and arecanut (*pugika*) in a low land, a garden or a pleasure grove. He may also grow the plantain, *Musa sapientum* (*moca*), bread-fruit (*panasa*) tree, *Likuca* (*Artocarpus lacucha*), the *Rasala* and *Amra* varieties of mango, rose-apple and cocoanut trees in the house-orchards, in gardens, or on high or low land. (Sl. 587-588).

The Brahmanas, Ksatriyas, Vaisyas, Sudras, men of mixed castes, hunters and soldiers (*vira*) should all grow to their best efforts coriander, *surana, valli,* pumpkin-gourd, and *Patolika,* in their own land of whatever sort it may be (Sl. 589-591).

In the first place the land should be ploughed and afterwards it should be dressed with cowdung in order to increase its fertility. Then depressions provided with water-channels should be made in which egg-plant, etc. should be planted. Depressions provided with water-channels should also be made for planting *malati, kinda, campeya, kutaja,* etc. The cultivator should then sow the seeds or implant seedlings in the depression according to local usage or exigencies of season. Then after the lapse of a month the roots of egg-plants, etc. should be cleared of weeds and ill-growth. (Sl. 592-596).

A wiseman should let water into the basins round the roots of the plants through the channels every fifth or sixth day, particularly in summer. If the field is frequently watered and kept clear of weeds, the yield of the fruit of the earth would be plentiful. (Sl. 597-598).

Sometimes parasitic vermin grow on the leaves of the vegetables like the egg-plant, *patolika, valte, savaka,* cucurbits, *Kalatas, Surana, Sakuta, turmeric, ginger,* etc. In order to kill the vermin, the cultivators should sprinkle the leaves with ashes, dust or lime-water according to the local usage. (Sl. 599-601).

Experienced cultivators carry out all the processes needed for the infixing of the seeds, weeding of the ill-growth and protection of the plants till the time of efflorescence, under their own supervision and according to the traditional usage. (Sl. 602-603)

For the sake of obtaining luscious edibles wisemen should undertake the cultivation of *Patolika,* egg-plant, gourds, jambir (citron), *Lakuca,* cardamom, vine, date-palm, etc. according to the local custom and proper

season. Of these vegetables, either leaves, flowers, fruit, unripe fruit or bulbous roots are taken for use either at the beginning of efflorescence, or in the middle or end of it, as the case may be. (Sl. 604-607)

Some of the fruits are delicious to eat, and others good in sucking their juice. Of the plantain tree in particular all the parts—root, stem, flower, unripe fruit and ripe fruit—are delicious and agreeable to eat. It is recommended as an excellent food by the sages. (Sl. 608-609)

Of *patolika*, egg-plant, *Saka* (leafy vegetables), and *Savaka*, the unripe young fruit is tasteful and is therefore highly commended. (Sl. 610)

The half-ripe fruit of the bread-fruit tree, the mangoes and gourd, too, is very delicious. (Sl. 611)

But the juice of sugarcane, cocoanut, *lakuca*, mango, etc. is considered to be suitable for fermentation at the time when they are fully ripe. (Sl. 612)

In this way all these vegetables and fruits may be used according to the nature of their species, season, local usage and recommendations of the cookery-books as well as their good or bad effect on the bodily humours like bile etc. (Sl. 613)

The cultivators should preserve the art of cultivation by practising it in their homes, pleasure groves, land, field-beds, on the banks of ponds and lakes, below the water-reservoirs or near to their sluices. (Sl. 614-615)

They should also grow in a proper manner the plantain trees, arecanut trees, *pumnaga* (*Rothleria tinctoria*), cocoanut, mango, bread-fruit, cardamom, vine and *malati* (jasmine) as well as egg-plants, *valte*, gourds, etc. (Sl. 616)

He should cultivate, nourish and protect the various *sakas* (pot-herbs), which are fit for eating, sucking and chewing. (Sl. 617)

The cultivators should after making depressions etc. in their various fields, cultivate seasonably in spring, summer, rains, autumn, dewy season and winter pot-herbs and other vegetables whose leaves, rind, flowers or bulbous roots are (edible and) delicious, nourishing and health-giving, and reap the rich fruit of their labours. They should grow, seasonably and according to usage, instructions of former sages and the nature of the soil, cardamom, cloves, ginger, arecanut, betel plant, sugarcane, plantain trees and other life-promoting and beneficial herbs like the long-pepper in their field-beds or on high land (i.e. wet or dry land) as the case may be. (Sl. 618-623).

Whatever the former sages have declared in their treatises to be fit for cultivation and salutary for living beings, all that the cultivators should properly and diligently grow in their respective fields. (Sl. 624).

The Brahmanas, Ksatriyas, Vaisyas, Sudras and others are advised by sages, who have written authoritative works, to practise the art of cultivation for the sustenance of their own families as well as for securing the pleasure of gods (Sl. 625-626).

In the beginning of creation, Brahma, the creator, created several

kinds of seeds on this earth. They were held with care by the Earth-goddess for fulfilling the needs of the created beings. (Sl. 627).

"One seed would doubtless multiply itself and yield manifold fruit to men"—were the words which the goddess Earth uttered at first and were heard. (Sl. 628).

The science of cultivation as explained by the goddess Earth was brought to the earth by the sages. That was preserved by kings who bore the responsibility of protecting their subjects. In the course of time, that was studied particularly by the Sudras. (Sl. 629).

That original treatise on agriculture was greatly developed and expanded by the denizens of earth according to the time of rainfall. (Sl. 630).

In this way, as the ages passed, people in different countries studied diligently their own treatise on agriculture, practised it in their fields and nursery-beds and reaped a rich harvest with which they fed the living beings, particularly the population of their respective places with the help of the king and the grace of god. (Sl. 631-632).

The sages have, therefore, advised the kings to render the best possible help to the agricultural industry. For, it has been the experience of the people and the hired labour that without the king's (i.e. State) help agriculture cannot thrive fully in villages, towns and the country. (Sl. 633-634).

Hence, for the welfare of the provinces and districts of their territory the kings should encourage agriculture everywhere with their help. (Sl. 635).

For the increase of their own as well as of others welfare, for their reputation, stability of virtue and the pleasure of gods it is their sacred duty to encourage agriculture by giving grants of land and cattle to the Brahmanas and persons of various families, learned in the Vedas, by digging canals and in many other ways that are of benefit to the Brahmanas, Vaisyas and Sudras who are incapable of doing agricultural work. (Sl. 636-638).

The establishing of water-reservoirs and machines for raising water and the punishment of thieves who damage the harvest in many ways are some of the enterprises which bring fame and merit to noble persons. (Sl. 639-630).

In this way the kings should render various kinds of help advocated by the sages. (Sl. 640).

For the protection of the people who are incapable of agricultural work in villages, cities or the country and for the benefit of the residents of the capital and thickly populated towns, the kings should acquire fertile land of both kinds (i.e. high and low, or wet and dry) and by employing his own servants, common people, unemployed men of mixed castes and the Sudras for the purpose of cultivation, they should, raise rich harvests of different food-grains, *adhakas*, vegetables and excellent flowers like

malli and *champaka* for the general weal. (Sl. 642-646).

The king should collect the produce of vegetables, grains *adhakas*, grams, sesamum, *masa*, mustard, grapes and the various seasonal fruits and stock them for the benefit of the people in shops, market-places, stalls or other places especially built for the purpose on the cross-roads and provided with a spacious yard with or without a shed. (Sl. 647-650).

All the commodities mentioned above and useful necessities such as blankets, cloth, curds, milk and other articles of food, jaggery, oil and other useful products of agriculture, the king should place in the market places of the villages, towns, cities and particularly of the capital. There he should appoint rich Vaisyas who are well-versed in trade for the sale and purchase of these commodities. (Sl. 651-654).

He should collect the crop raised in spring and other seasons, and all other goods produced by machines, weavers, oilmen, florists, perfumers, etc. and stock and protect them for the benefit of the people in the market places, stall and various kinds of open places. He should provide the Vaisyas appointed there, with measures like *prastha, kunja, drona, nadika* and *ksudra* for the measuring of commodities like rice, *adhaka* etc. (Sl. 655-659).

The king should have the measures like *prastha* made from iron sheets or boards of hard wood and introduce them into the whole of his realm. (Sl. 660).

And similarly he should have the measures like *pala* and *kara* made from iron and introduce them into the country. These measures should be of the same shape, same capacity and same size of the mouth. (Sl. 661).

He should have the capacities of the measures announced to the Vaisyas and particularly to the village people through his servants, especially through the Brahmanas. (Sl. 662).

The king should also introduce balances with a beam and scales made of bronze or brass for the weighing of vegetables. (Sl. 663).

He should have the measures like *prastha*, etc. especially marked by his high officials before introducing them into the country. (Sl. 664).

He should also have the rates of buying and selling the food grains, etc. announced in all parts of his country. (Sl. 665).

Whatever help in the cultivation of food grains and vegetables, etc. and in the procurement of oils, cloth, etc. is recommended by former sages in their treatises that the king should render for the happiness of his subjects in every village and every house as well as for his own welfare. (Sl. 666-667).

Both bipeds and quadrupeds on the face of the earth would face misery if there were no cultivation. Hence, for pleasing the gods and protecting the people the king should take keen interest in agriculture. (Agriculture should also be practised) by priests, Brahmanas and Ministers particularly. (Sl. 668-669).

As agriculture is considered superior to all other industries, a

Ksatriya king, who takes upon himself the responsibility of protecting his subjects, should strenuously and regularly look to the proper preservation of agricultural pursuits in his country. (Sl. 670).

A wise king should grow a pleasure grove or a garden in a suitable place in the village, city and particularly in the capital. He should have a grove of trees planted outside or inside the town. He should also have a garden planted especially for the diversion of the ladies of his harem. He may have a grove of trees grown on the precincts of a forest. (Sl. 671-672).

By growing trees like the Sara (*sal* tree) and sandal he should provide material for house-building for his subjects. (Sl. 673).

In his palace garden he should grow various kinds of beautiful and fruit-bearing trees such as the different species of the plantain (*Rambha, Moca,* etc.) and citron (*Jambira, Matulunga,* etc.) and the Indian spikenard. (Sl. 674-675).

He should also encourage the cultivation of the various species of grass (such as Kusa, Kasa), basil, the wood-apple and the fragrant and seasonal flowers which may be suitable for worship and household remedies. (Sl. 676-677).

For religious festivals he should have a garden planted on the temple land inside or outside the village according to the availability of land or local custom. (Sl. 678).

In his palace he should have an excellent pleasure grove attached to the gynaeceum bristling with beautiful trees and flowers like the *Malati* (jasmine). He may also have one such grove planted outside his capital for the diversion of the people. (Sl. 679-680).

In forest regions or on their precincts and on the top and slopes of the hills he should grow big forests radiant with many kinds of trees. There he should also order the preservation of the seeds of all kinds of trees. (Sl. 681).

From these trees the people get flowers, fruits and wood for the construction of their houses. (Sl. 682).

Therefore the king, taking upon himself the responsibility of protecting his kingdom, should grow on vast tracts of land or with walled enclosures trees and plants like the following:

Karanjaka]
Nakta-mala] *Pongamia glabra*
Eranda—Castor-oil tree
Bhurjaka—Birch, Betula Bhojapatra
Arjuna—Terminalia arjuna
Sarjaka—Terminalia tomentosa, Vatica Robusta
Nipa—Nauclea cadamba
Kadamber—Nauclea cadamba
Sigru—Moringa pterygosperma
Sama-Prosopis spicigera, Mimosa suma
Maruvaka—Marjoram, A kind of Ocimum
Devadaru—Deodar
Sri-paruaka—Premna spinosa or longifolia
Tinduka—Diespyros embryopetris
Vata—The banyan tree
Plaksa—Ficus infectoria
Bhadra-dasu—Pinus deodora, Pinus longifolia
Priyangu—Pancicum italicum Aglaia odorata

Vibhitaka—Terminalia bellerico
Amalake—Emblic Myrobalan
Haimavati—
Karnikasa—Pterospermum acerifolium
Likuca—Artocarpus lacucha
Nimba—Azadirachta indica, Margosa
Asoka—Jonesia Asoka Roxburghi and *Saraca indica*
Sirisa—Acacia sirissa
Dadima—Pomegranate
Jambu—Rose-apple
Kapitha—Feronia elephantum
Sarvotobhadraka—Gmelina arborea
Campeyaka—Michelia campaka
Kukhaka—
Varuaja—
Karnika—
Tapincha—
Tamala—Xanthochymus pictorius
Sinduvara—Vitex negundo
Tintrini
Vamsa—Bamboo
Cuta
Rasola, *Amra* — Varieties of mango
Badari—The Jujube tree, *zizyphus jujube*
Ratha-druma—Dalbergia ougeinensis
Madhuka—Bassia latifolia
Pilu—Careya arborea, Salvadora persica
Pumnaga—Rottleria tinctoria, calophyllum inophyllum
Kovindara—Bauhinia variegata
Paribhadra—Erythrina indica

He should preserve them by regular watering and protect them from conflagration, noxious animals and thieves. (Sl. 683-692).

In this manner, he should have great forests, radiant with groves of trees, planted by the cultivators and other people on river-banks and in various countries like Gandhara, Kunti, Pancala, Kasmira, Avanti, Sindhu, Nepala, Nisadha, Kosala, Anga, Dhurjara (Gurjara) and Saurastra, one fertile land provided all round with tanks, canals or ponds, etc. He should have them well guarded by brave soldiers and fighters for the benefit of the people. (Sl. 693-696).

The king should also have the strata of the earth examined and mines for metal ores dug in the vicinity of rocks, forests and other places. (Sl. 697).

Having mined iron, copper, gold, silver, red ochre, etc. he should have the various war-weapons and agricultural implements prepared by expert ironsmiths, cutters, and goldsmiths in the villages and cities. The former he should distribute among the soldiers and also keep at the army headquarters for the protection of towns, palaces and fortresses and the latter he should distribute among the village people. (Sl. 698-701).

He should also have various ornaments prepared from the mined gold and silver and from coral and pearls obtained from the ocean, and having first offered them to the deities and Brahmanas, he should wear them himself and also enjoy himself by adorning his queen and the ladies of the harem with them. (Sl. 703-704).

In this way, the king should provide all sorts of things necessary for comfort in every part of his country. (Sl. 705).

He should promote agriculture by regulating cultivation, sowing, etc. according to time and season, and cold and hot places. (Sl. 706).

Taking into consideration all the consequences he should practise cultivation according to the strength of the soil as well as the situation of the pasturage, water-reservoir and the time of rainfall. (Sl. 707).

If the king is happy everything goes on successfully in this world, but if he is unhappy everything goes to ruin. (Sl. 708).

Therefore a happy king, wishing for plenty in his kingdom, after collecting the revenue tax from the cultivators, in cash or kind, should protect all created things, movable and immobile, in a just manner like his own family. (Sl. 709-710).

CULTIVATION OF WHEAT

Although wheat was introduced long before the Christian era, it attained its importance only after it. It was the chief food of the 'mlechcha' (non-believes in God), "the barbarians", perhaps the Greeks and the people living outside India, and received the name 'mlechcha-Bhojana' (food for the non-believers). It was for a long time known as 'Yavana'—a kind of barley. A Greek writer has also mentioned about wheat. Parasara, in *Krishi-samgraha,* speaks of wheat being a winter crop.

CULTIVATION OF SUGARCANE

The cultivation of sugarcane in India is as old as rice. The Rig-Vedic Aryans had the cane, and possibly the family name Ikshaku, had connection with large plantation. Apparently the cane was mostly chewed only and sometimes pressed and the juice used as drink. The idea of drying up the juice over fire came later, and the earliest known product was 'gula', or 'guda', a ball. In Bengal it is known as 'bheri' or 'bheli', from its form resembling a kettle-drum. There was no attempt at crystallization. In course of time the next stage came, when crystals were allowed to form, culminating in the production of 'sitopala', white crystals like rock crystals. A thoroughly scientific classification of the products of manufacture will be found in our medical works. It is also interesting to note that while only two varieties were known to Charaka, the number had increased to twelve by the time Susruta came. Among the latter's twelve there was one called 'tapasa', evidently the wild ancestor of the modern forms. It is a remarkable fact that there is still a variety of cane known as 'Uri akh' in the north-west of Bengal which flowers freely, and the cultivators use the seed for propagation, the adjective, 'uri' meaning wild, as in 'Uri dhan'. One of the twelve varieties of Susruta was 'paundraka', or 'paundra', the same as 'paunda' and 'punri' of our cultivators, undoubtedly the best of the indigenous canes. The commentators of Amarakosha tell us that the variety is so named because it grew in the country called Pundra, or Northern Bengal. It seems the country derived its name from this fact just as the name Gauda from 'guda'. The people who cultivated the cane were known as Paundras.

Kautilya noticed that the cultivation of sugarcane involves trouble and expense. The difficulty was overcome by co-operation. The cultivators formed a 'grantha' or 'knot' or club among themselves both for the purpose of cultivation and manufacture of sugar. Co-operation was resort-

ed to whenever the individual peasants were unable to meet the wants separately. It is known as 'ganta' in Bengali, and is not at all a new idea recently introduced. The share-produce system of cultivation so common in our country is a form of co-operation.

CULTIVATION OF FRUITS

The forests yielded a large variety of edible fruits—mango, pomegranate, jack, banana, date, vilva, kapittha, rose-apple, jujube, mascot, cocoanut, palm,—these being the commonest and best. Vines, dates and palms were specially grown in the Punjab and the North-West Frontiers. Panini speaks of Kapisa as the premier vine-growing district of India (also Str. XV. i. 8). Plantains as big as elephant's tusks and jack-fruits as big as water-jars are hyperboles to impress the abnormal growth of the fruits. Many of the arboreal products were unknown to the Greeks as they confessed. It is equally difficult for us to identify the various names found in descriptive texts and some of the fruits enumerated may have now gone into extinction (Mbh. III. 157. 44 ff; IX. 37. 58-61; Jat. V. 405, VI. 527 f; Ayaramgasutta II. i. 8. 1).

CHAPTER VI

SEQUENCE OF CROPPING

In the Yajurveda, distinct references to the rotation of crops are found. From the very Rigveda VIII, 91, 5-6, it appears that crops were grown in the same field by rotation and the system of fallowing was also known. The Taittiriya Samhita distinctly mentions that in the course of a year, two crops were harvested from the same field (V, 1, 7, 3). It also mentions different seasons for ripening of different crops and the proper times for harvesting them. Kautilya gives directions for seasonable cultivation and harvesting.

The Greek writers highly praised the fertility of Indian soil and favourable climate condition and inner-system while describing the principal agricultural products of the land. Since there is double rainfall in the course of each year, one in the winter season, when the sowing of wheat takes place as in other countries, and the second at the time of the summer solstice which is the proper season for sowing rice and 'bosporum', as well as sesamum and millets—the inhabitants of India almost always gather in two harvests annually (Diodorus II. 36).

The Greek writers also affirm that India has a double rainfall and the Indians generally gather two harvests. Megasthenes witnesses the sowing of wheat in early winter rains and of rice, 'bosporum', sesamum and millets in the summer solstice (Diod. II, 36). Megasthenes adds further to the winter crops, viz., "wheat, barley, pulse and other esculent fruits unknown to us" (cf. Str., XV. i. 13). In a descriptive passage of the Ramayana sali, godhuma and yava are seen waiting for harvest with the advent of winter (III. 16. 16f.). But wheat and barley are winter or *rabi* crops sown in October and gathered at the end of May. Ploughing in autumn is seen in Sn. III. 155. The Arthasastra evinces not only thorough acquaintance with these two harvests (II. 24; v. 2) but even with a third. A king is instructed to march against his enemy in Margasirsa (January) in order to destroy his rainy crops and autumnal handfuls, in Caitra (March) to destroy autumnal crops and vernal handfuls, and in Jyesthamula (June) to kill vernal crops and rainy season handfuls (IX. 1). Thus there were three crops—one sown in rainy season and garnered before Magha, another sown in autumn and garnered before Caitra and a third sown in spring and stored by Jyaistha (Cf. Barley "ripened in summer being sown in winter, rice ripened in autumn being sown in the rains, while beans and sesamum ripened in winter and the cool season." (Tait. Sam. VII. 2.10.2). Elsewhere the Arthasastra catalogues the crops of different seasons. Paddy, kodruva, sesamum, panic, daraka and varaka

are sown in the first season (purvavapah), mudga, masa and saivya are sown in the second season (madhyavapah), kusumbha, lentil, kuluttha, barley, wheat, kalaya, linseed and mustard are sown in the last season (pascadvapah, II. 24). The purvavapah and the pascadvapah of the Arthasastra agree with our *kharif* and *rabi* crops respectively. Seasonally the *kharif* is the vassikam and the *rabi* is the haimanam of the list in Bk. IX, Ch. 1). The Milinda speaks as well of a third monscon (pavussako) besides the regular rains of the later summer and early winter (p. 114). The three monsoons of course did not uniformly visit every part of the country each year; and whether a locality grew one or two or three crops depended on rainfall, climatic conditions and character of the soil.

In many places the food crops as well as edible fruits and vegetables grew spontaneously without tillage. To the Greek observers these phenomena seemed strange. The description of the forest scenery in the Epics (Ram. III. 16. 16 f; Mbh. III. 157. 44 ff, IX. 37. 58 ff.) and the Jatakas (V. 37 f, 405) frequently go at length over the crops and fruits growing in wild areas without human labour.

In Arthasastra, it is stated that raising of a second crop by the cultivators was sometimes made compulsory as a last resource for taxation. After a careful observation of the meteorological charts, it suggests the quantity of rain required by a specific crop and the cultivator is instructed for the particular crop along the rain forests.

CROP-ROTATION IN RIGVEDA

Whether crop-rotation is mentioned in Rigveda or not is a matter of controversy and interpretation. Continuous cropping was a practice, no doubt, but pulses (legumes) and other crops were also sown. "The cultivators harvesting the crops in general, separately and in due order" (X. 131. 2) has been interpreted to be giving an idea of crop-sequence or crop-rotation and line-sowing and avoiding overlapping during harvest. Similar to the practice of naked fallow rotation of fields in the later primitive agriculture, resulting one of the necessities in settled life, and the experience gained in the nomadic stage, the rotation of legume and non-legume crops is the resultant of mixed cropping, the climate of the second stage, through the experience gained leading to the beginning of the traditional agriculture during which period most of the principles of agronomy found their start in the process of developing to a sufficiently high degree of perfection.

The importance attached to food quantity in Anna Sukta (I/187) shows that arable farming was given equal importance as stock farming. The praise of land, bullocks, seeds and peasants in various hymns clearly indicates importance attached to arable farming, crop husbandry with different types of field grasses for food and fodder being considered for the dual purpose of man and animal (X. 27. 8).

Yava, although it literally means barley, has been taken as a grain crop in several Vedic translations. Aryans might be using for their cattle, either the crop at field stage as green fodder or the green for human beings and its straw and bhusha for cattle feeding. The importance of food gift (X. 117) and worth of vegetables for sacrifice signify the preference of vegetarian to non-vegetarian food and this could have only developed when the production of food was sufficient. The idea of good soil management for better harvests (II. 47. 21 to 28) can be attributed to this stage only, in which India answers to the question related to soil improvement.

CHAPTER VII

PROTECTION OF CROPS FROM DISEASES AND PESTS

Various laws and instructions are quoted in literature regarding protection of crops from damage by insects, pests and diseases. Destruction of corn by locusts, mice, and borer and their protection are described in Atharvaveda (Hymn 50 of Book VI).

"Kesava and Sayana in their introduction to the ceremonies prescribed in connection with this hymn at Kausika 51, 17-22 mention a long list of pestiferous insects. The performances are as follows. 17. While the hymn is being cited, the performer ploughs a furrow with an iron plough about the field. 18. He scatters stones upon the field. 19. He ties a hair through the mouth of a tarda (insect) and buries him head downward into the middle of the field. 20. He while walking offers thrice to the Aswins milk of a cow with a calf of the same colour as herself. 21. He offers a Bali offering to Asa (region), to Asapati, to the two Aswins and to kshtrapati. 22. On the day he performs the ceremonies, he shall remain silent up to the time of sun-set".

In the Kallavagga (X. 1.6) it is mentioned that crops of paddy are destroyed when they are attacked by 'mildew' and the same fate meets sugarcane if the disease called 'blight' attacks it.

In the Rigvedic period (X, 68, 1) the cultivators kept away birds from the corn fields by making din and noise. In Matravagga (I. 50), scare crows were used for the purpose.

In Jataka (No. 11), it is mentioned that cultivators used to set traps and dig pit-falls and fix stems in the field to protect the crops from the attack of wild animals.

During the cropping season, the domestic cattle were sent out for grazing on pastures. They were kept under the charge of herdsmen. The herdsmen were severely punished if the crop was by chance destroyed due to their negligence. Law books were provided for this type of punishment.

In case of damage or destruction of grains, the owner usually claimed equivalent amount of grains. The owner and the herdsman would be corporally punished. The fine imposed depended on the kind of animal, the damage and was fined in terms of 'masha'. The fine was one 'masha' for mischief done by a cow, two 'mashas', in the case of a buffalo, and half a 'masha' in the case of a goat or sheep trespassing with its youngs (Manu VIII, 241, Yagnavalka Smriti II, 161; Narada and Brhaspati, XI, 29; Vishnu Purana V, 146). The proprietor of the field might keep the animal in custody and would not return it till the compensation was paid (Narada Smriti XI, 39). But fines were exempted if the field was not protected by

a fence and when the field was 'situated on the borders of a village or contiguous to a pasture ground. Exemption was also made in the case of a pregnant or newly delivered cow or an unmanageable cow.

Agnipurana also lays down such fines, the fines being increased four times (Chap. cc. LVII).

METHOD OF PROTECTING TREES

"Vrksayurveda" describes the "Science of medicine for plants". Relevant passages are quoted below:

"Om, may it be well with all! That Hanuman, who displayed his valour when residing in Kishindha and who lived upon the orb of the sun which he had devoured, orders and destroys the rats, birds, ants, etc."

When there is danger of damage to the crop from locusts, rats, birds, ants, etc. one should mutter the above *mantra* one hundred and eight times and write it down on the leaf of a tree. Then writing the word *Manu* on the leaf, one should bury it under the ground. In this way the insects, birds, rats, ants, etc. in the field would be destroyed. (Sl. 73-74).

Trees and plants must be carefully protected from hoar-frost, storm, smoke, fire and web-footed birds (like geese). (Sl. 75).

For the protection of trees one should take the ashes of a tree struck by lightning and scatter them around the trees. By so doing there would be no fear of damage from hoar-frost. (Sl. 76).

In order to ward off the evil eye of men one should take the porridge of boiled white Sali mixed with curd and Saindhava salt and scatter it all over the grove of trees. (Sl. 77).

TREATMENT OF PLANT DISEASES

Like men the plants also suffer from the disorders of the three humours, wind, bile and phlegm. On observing any of the disorders, treatment must be given for its removal. For trees eaten away by vermin, burnt by fire, broken by storm or struck by lightning, cutting down is the only remedy. But for other afflictions there are different remedies. (Sl. 87-88)

A tree afflicted with the wind affection is gaunt, too tall or too stunted, dry, sleepless, less sensitive and does not bear flowers or fruit. (Sl. 89).

A tree which cannot stand the sun, which is pale, shorn of branches and of which the fruit ripens out of time, is said to be suffering from bilious disorder. (Sl. 90)

That which has glossy leaves and branches and is glorious with flowers and fruit but is rendered pale by the strangulating creepers, is said to be suffering from the disorders of phlegm. (Sl. 91).

The disorders of the wind are removed by medicines of bitter, pungent and astringent taste, bilious affections are cured by bitter, hot, salt and acid medicines and the phlegmatic troubles by oily, sweet, acid

and salt medicines. (Sl. 92)

The wind affection disappears with bland gravy of flesh. Biliousness is removed by very soft, sweet and cool waters and phlegmatic trouble is cured by the proper administration of bitter, acid and cool waters. (Sl. 93)

Usually there are vermin at the root of a tree of which the leaves and flowers wither and the body becomes disfigured without any apparent defect. They (i.e. the vermin) should be destroyed with special effort. After their extermination if the tree is smeared with the paste of cow's urine, ghee, *Vidanga,* mustard and sesamum and watered with diluted milk as well as fumigated with incense, it recovers very quickly. (Sl. 94)

Treatment given with the bark of *Karanja, Aragradha,* soap-berry tree, *Sapta-parna,* pounded in (cow's) urine along with *Musta* (*Cyperus Rotundus*) and *Vidanga* destroys the vermin. (Sl. 95).

A tree singed by fire once again puts forth leaves glistening like emerald if its roots are watered with gravy and milk and the whole body is besmeared with (the paste) of lotus and *Kanda* (bulbous root of *Amorphophallus campanulatus*). (Sl. 96)

A tree, which has been broken by storm, would become healthy and whole again and bear much fruit if it is propped up with stakes, secured with ropes and the cracks filled with the soil of the *Plaksa* tree and then besmeared with (the paste of) the barks of *Plaksa, Arka* (*Calotropis gigantea*) and *Udumtara* pounded in ghee, honey and sweet stale milk and watered repeatedly with milk, its basin being kept full of water. (Sl. 97)

Listen to the remedy that works like the elixir of life to a tree which is struck (and blighted) by lightning. Having pounded *Madga, Masa,* barley and sesame with *Ghana* (bulbous root of *Cyperus hexastachys communis*), *Usira* (*Andropogon muricatus*), Madhuka in diluted milk, one should sprinkle the trees repeatedly with this mixture. Nourished by the sprinkling over the trees would regain its natural condition. (Sl. 98-99).

When after having yielded fruit and flower (for the normal term of its life), a tree grows old, it can be made to bear fruit again if watered with the mixture of milk and gravy. (Sl. 100)

Seeing that branches of a tree are withering away either for want of watering or with excessive watering, one should at once water it with ghee, *Vidanga* and milk for just one week. (Sl. 101)

When one notices that a tree suffers from sleeplessness, smells like fish, is shorn of its leaves and infested with ants, and that its bark flakes off on account of indigestion caused by water-logging, then he should give it medical treatment. (Sl. 102)

He should drain away its malignant sap by giving axe-blows at its roots, and then sprinkling the worm-killing mixture of ghee and honey fill up the gashes with clay and then water the tree with diluted milk. (Sl. 103)

By watering with the solution of sugar, sesamum and milk and smearing (their paste) as well as by fumigation the ailment of the drying up of the tree ceases. (Sl. 104)

With the application of the decoction of the barks of *Priyangu, Vatsa* (*Wrightia antidysenterica*), *Tarkari* (*Sesbania aegyptiaca*), *Vetasa* and *Arjuna* boiled in milk, stops the morbid flow of the trees. (Sl. 105)

INCANTATION FOR WARDING OFF (OR DESTROYING) PESTS

Parasara gives the following incantations in his book Krishi-Parasara to ward off the pests, etc.

"Om, success! Salutation to the feet of the preceptor. Hail! From the snow-clad peak of Himalaya, which is as white as a conch, *Kunda* flower and moon and which resembles the heavenly garden Nandana, the venerable feet of the great lord, *Paramabhattaraka Maharajadhi-raja,* the illustrious Ramchandra order the victorious Hanuman, the foremost amongst the millions of monkeys assembled from all countries situated on the sea shore, whose hands have very hard and sharp nails and the tail stands erect, who, with the impetuosity of his ordinary gait which surpasses the velocity of the wind, shakes up hundreds of mountains, and who crushes the forces of the enemy, — saying, "If evil spirits like *Rata, Bhomma, Uda, Gandhiya, Bhombho, Gandhi, Drodhi, Pandaramukhi, Mahisamundi, Dhulisringa, frogs,* etc., *Talajanghas* and sparrows, parrots, deer, buffaloes, rats, boars, locusts, etc., which are the destroyers of crop, do not leave the entire field of such and such illustrious person belonging to such and such family in such and such village, then thou shouldst strike them with your adamantine tail, "Om, Am, Srim, Ghrim, Salutation".

According to another School the pest—averting incantation is as follows:

"Om, Success. Salutation to the feet of the preceptor. Salutation to the feet of the illustrious Ramachandar. Hail'.....

'If the demoness *Triputi* along with her seven sons has visited the entire field of so-and-so, of such and such family in such and such village, in the guise of pests like *Bhombha, Bhombhi, Pandara-mukhi, Gandhi, Dhulisrngi,* etc., and is doing various kinds of harm to the crop, then thou shouldst strike her along with her sons and relatives with thy staff-like tail, which is harder than adamant, and having torn them all into pieces with thy very hard nails, throw them into the brine of the southern ocean. If thou tarriest even for a moment in this task, then mayest thou be cursed by (or sworn by the name of) thy father *Kasarin* wind and thy mother *Anjana.* Otherwise, I shall not be thy master, nor thou my servant". Om, *ghram, ghrim, ghrati!*

Having written this incantation on the *Ketaki*-leaf with the thorn of *Eilva,* one should on a Sunday, (go to his field) with the hair of his head let loose, tie it to the blossoms of a plant in the midst of the crops

on the north east corner of his field.

He should write the second variant of the incantation with lac-dye, and tie it to the crops. Then there would be no fear of harm at all from diseases, insects, and wild beasts.

In his book *Visva-Vallabha,* Misra Chakrapani gives detailed instructions about the protection of plants. Translation of the important portions is given below.

The plants should be very carefully protected against the strong wind, frost, smoke, fire, vermin, porcupines and rats, for these are the pests of the plants. (Sl. 1).

If props and stakes are fixed near the plants, the danger from storm is averted. Plants that are recently planted should be watered in the morning during rains and at mid-day in winter. In spring they may be watered in the morning or in the afternoon. (Sl. 2).

By putting a check.....on (burning fire.....under them (i.e. plants), they would be protected from smoke. Care should be taken to keep the fire in a shed in a place full of grass and straw (in order to avoid danger) from conflagration. (Ch.7, Sl. 1).

Vermin and rats can also be destroyed by medicines that may be used to block the holes and by incantations and magical diagrams. Medicines are of several kinds such as those emitting offensive smell or having acrid taste, and the magical diagrams consist in drawing mystical figures, etc. that ensnare (or paralyse the victim). Incantations are of various sorts, for instance those mentioned in the *Saringa-dhara-paddhati*:- When there is apprehension of danger from locusts, rats, birds and ants, then one should, after muttering the following incantation one hundred and eight times, write it down (on a leaf): Om, hail! The illustrious Hanuman, (the Monkey god) who, while living in *Kiskindha,* had exhibited his valour and had concealed the sun, commands the vermin—"Let rats, birds, ants, locusts, young elephants, cranes, insects, *Gandhika* (?), *Bimbi* (?), etc. no longer stay here!" He orders and the body of the moving vermin is held down. He drives it away. He destroys it as does the wind of that striding Narasimha, entering the enclosure of the sea, destroy the cloud! Hum! Phat! Salutation:—Writing down this incantation on a leaf and muttering it, one should bury the leaf under the earth. By doing so the insects, birds, rats, ants, etc., that may be in the field, are destroyed. (Ch. 7, Sl. 2)

A wiseman should sow the land intervening between the trees thickly with *Sata-puspa* (*Anethum sowa*) and *Kuveraksi* (*Bignonia suaveolens*), and the insects would disappear. (Ch. 7, Sl. 3).

One should always protect the young plants under a shed, or a wrapper of straw or a cover of leaves.....(Ch. 7, Sl. 4).

One should put the pulverized sesamum into the roots of the tree and scatter their ashes all over it. Then with a cloth or grass tied to the end of a pole or with the feathers of a peacock the pest (?) is wiped off.

(Ch. 7, Sl. 5).

One may as well effect protection of trees by growing thorny shrubs or digging trenches around them. Clever people should employ all other means to do so, according to emergency. (Ch. 7, Sl. 6).

A plant affected with wind is rough and dry (i.e. without fat), stunted, thin, or tall, sleepy, insensitive and does not bear flower, fruit or *Valya* (?). (Ch. 8., Sl. 10).

Nurturing with tepid liquids that are hot in effect and with the broth of flesh and fat and dusting with ashes of cowdung is beneficial for plants suffering from wind affections. (Ch.8, Sl. 11).

The disorders of wind in the trees are allayed by watering them with the decoction of *Nirgundika* (*Vitex negundo*), *Aragvadha* (*Cathartocarpus Cassia fistula*), five leaves, cinnamon, Andropogon and plastering their roots with the same with the addition of sesamum. (Ch. 8., Sl. 12).

Protection with a covering, dressing the roots with oil-cake and watering with the urine of goats is beneficial to the saplings. For the mango sapling sour gruel, offal of sheep, and watering with the decoction of cinnamon and *Asvagandha* (*Physalis flexuosa*) are useful. (Ch. 8, Sl. 13).

If there are tumours and protuberances on the sides of the trees due to wind disorder, then plaster of cowdung, *Bhillautaka* (*Symplocos racemosa*) and fat and watering with carrion-broth should be done. (Ch. 8, Sl. 14)

Watering with the infusion of *Rasna* (the ichneumon plant, or *Mimosa octandra*), *Asvagandha, Pavanari* (*Ricinus communis*), *Naga* (*Mesua roxburghii*), *Kana* (long pepper) is good (for wind diseases of the trees) and that with the infusion of *Satapuspika* (*Anethum sowa*) allays even an acute attack of a wind disorder. (Ch. 8., Sl. 15).

Fumigation with the fumes of *Nirgundika, Guggula* (bdellium), sopha (? aniseed ?), ghee, *Kuvara* (?), *Netra* (?) and the seeds of *Asana* (*Terminalia tomentosa*) and the dressing of the roots with goat's offal and oil-cake are beneficial for the trees affected with the disorders of the wind. (Ch. 8, Sl. 16).

A tree which is affected by the disorder of the bile, has pale leaves and dry branches, is lean and *Pragna* (?). It is unable to bear the heat of the sun and its fruit ripens out of time. (Ch. 8, Sl. 17).

The bilious disorders of the trees quickly disappear with the administration of oily, cool and sweet potions and by nurturing them with cold and perfumed waters in which *Sita* and *Vidanga* have been dissolved. (Ch. 8, Sl. 18).

The treatment is also given with *Usira, Musta* (*Cyperus rotunders*), honey, milk and ghee or with the plaster of Jambala (*Blyx octandra*) and *Vatala* (?) as well as with the fumigation with the fumes of *Sita*, honey, ghee, etc. (Ch. 8, Sl. 19).

The tree, whose leaves and bark are glossy, the flowers of bright hue, and the fruits insipid and smeary, which is entwined with creepers,

circular (? parimandala) in girth and late in putting forth young shoots, is affected with the disorders of phlegm. With potions that are pungent, hot in effect, unoily, bitter or astringent the disorders of phlegm disappear quickly. Nurturing with tepid water also gives relief to phlegm-affected trees. (Ch. 8, Sl. 20-21).

An infusion prepared from the barks of *Plabha* (?) *Arjuna, Udumbari, Sapta-parni,* and *Nimba* (?) as well as from Vama (?) *Ghana* (the bulbous root of *Cyperus hexastachys* communis), *Rohisa* (? Rohita ? *Cyprinus rohitaka*) is prescribed for trees affected with the disorders of phlegm. (Ch. 8, Sl. 22).

Watering for seven days with the decoction of *Vyaghri* (Solanum *jacquini*), *Sahacara* (*Barleria prionitis* or Cristata ?), *Arista* (Soapnut), Vasa (*Gendarussa vulgaris*), *Khadira* and *Rohisa* (?) is beneficial for trees affected with disorders of the phlegm. (Ch. 8, Sl. 23).

The wind affected tree recovers to normal health if treated with the decoction of *Marudbhava* (*Rubia munjista*), *Amvata* (?), *Vasa* (*Gendarussa vulgaris*), *Vyaghri and Rohisa* (?). (Ch. 8, Sl. 24).

Plastering for seven days with the juice of *Vyaghri* in which *Katphala* (commonly called Kayaphala) has been mixed is beneficial for the *Ghanapatra* (*Boerhavia procumbens*) and *Kara* (?) trees that may be suffering from the disorders of phlegm. (Ch. 8, Sl. 25).

Sleeplessness, paleness, loss of leaves, withering away of the ends of branches, and bad smell in the fruits are generally caused by overwatering or by the ant-pest. (Ch. 8, Sl. 26).

One should give slight cuts to the roots of a diseased tree and let the morbid sap flow out in proportion to its size. Afterwards he should put the plaster of *Vidanga* mixed with ghee and sesame on the cuts and fill the tree's basin with loam and nurture it with milk and water. The tree would then be free from disease and thrive (?). (Ch. 8, Sl. 27).

Plastering with (the paste of) *Plabha* (?), *Arjuna, Tvac* (cinnamon), *Krmi-bhuj* (*Embelia ribes* ?) and milk, dressing the roots with ashes and watering sparingly are treatments that are beneficial to a tree. (Ch. 8, Sl. 28).

As a result of indigestion caused by want of nourishment, the trees do not put forth leaves. If infested with ants, then their leaves shrivel up. (Ch. 8, Sl. 29).

One should dress the roots with the three myrobalans and *Kubera-kai* (*Bignonia suaveolens*) and then water the tree. Plastering with *Vidanga, Ingudi* and honey is also beneficial to the tree. (Ch. 8, Sl. 30).

A tree is relieved of indigestion if its roots are dressed with the powder of the leaves of *Vaikankata* (*Flacourtia sapida*) and is nurtured and fumigated with ghee and honey. (Ch. 8, Sl. 31)

A tree whose branches dry up at their ends, the bark begins to peel off and the leaves wither away would certainly grow strong and thick-leaved by medicinal treatment. Harmful effect of medicines on a tree are

removed by plastering it with the (paste of) seeds of *Karkkandhu* and *Vara* (*Achyranthes aspera*) soaked in cow's milk. (Ch. 8, Sl. 32-33)

One should dig out the wet clay from the roots of a diseased tree and fill up the basin with fresh loam and having thickly plastered the tree with honey, ghee and milk, he should nurture it with milk and water. (Ch. 8, Sl. 34)

A tree that is fumigated with *Sita,* ghee and *Guggulu,* becomes relieved of disease and puts on the splendour of lovely foliage and bark. (Ch. 8, Sl. 35)

If without any apparent fault the leaves of a tree begin to fall off, the branches begin to wither at their ends, the bark begins to peel off, and there is loss of colour and rapid wilting, then one should conclude that it is being consumed by vermin. (Ch. 8, Sl. 36)

The insects are of two kinds, those that attack from outside and the others from inside. Of the outer ones some infest the leaves and bark, and the others, flower and fruit. (Ch. 8, Sl. 37)

/There is an insect called *Kandaraka* which lives inside the roots and branches. Infested with that the tree perishes. Treatment should therefore be given to it. (Ch. 8, Sl. 38)

Insects generally breed in the trees due to the defects of the soil or water or to their morbid longings. I shall now describe their remedies according to the scientific works on the subject. (Ch. 8, Sl. 39)

Plastering with the powder of *Aragvadha, Arista, Karanja, Saptaparna,* cinnamon, *Jantu-ripu* (*Embelia ribes*) dissolved in cows urine and kept overnight, would destroy the insects that attack the trees from outside. (Ch. 8, Sl. 40)

Plaster of *Vidanga,* white mustard, the three spices (black and long pepper and dry ginger), *Bhallata* and *Vaca* prepared in cow's urine, when applied to the branches, kills the insects inside them and restores the bark of the tree to its natural colour. (Ch. 8, Sl. 41)

Fumigation with *Gosringa* (*Acacia arabica*), *Bhallataka, Nimba, musta, Vaca, Vidanga, Amivisa* (?) and Karanja in conjunction with *Sarja* (*Vatica robusta*), white mustard, and *Sinduvara,* destroys the insects of the trees. (Ch. 8, Sl. 42)

Plastering with (the paste of) the offal of cats, jackals and pigs in combination with white mustard and cow's urine kills the insects that infest the inside of the tree and fumigation with ghee added to it destroys those that infest the outside. (Ch. 8, Sl. 43)

Fumigated, nurtured and sprinkled with milk and water all over the foliage and branches and plastered with (the paste of)..... white mustard, *Vaca, Vidanga,* asafoetida, *Arjuna,* cinnamon, sesame and milk. (Ch. 8, Sl. 44)

Worms and insects of all the trees can be destroyed by nurturing them with water in which *Ingudika*-fruit and cinnamon have been mixed. Fumigation with milk, ghee, *Ingudi* and jaggery also helps in restoring its

normal firmness. (Ch. 8, Sl. 45)

A *Palasa* tree, planted in the midst of other trees, when it is fully developed, wards off the diseases arising from the water and the aquatic insects as well in the same way as does the *Asoka* tree. (Ch. 8, Sl. 46)

Nurturing with water, application of cow-dung on the top (of the broken stump), filling the basin with cow-dung and loam and plastering with milk in which *Vidanga*, honey, ghee and sesamum have been mixed ————would make a broken tree grow again. (Ch. 8, Sl. 47)

A broken tree would quickly grow again if it is first anointed with the oil of *Ankola* and afterwards plastered with mud from a well and nurtured with milk and water. (Ch. 8, Sl. 48)

A frost-beaten tree would grow again if it is plastered with *Ankola,* milk, ghee, and honey, if its roots are fed with loam and oil and if it is nurtured and plastered with milk and sesame and then watered. (Ch. 8, Sl. 49)

A tree blighted by frost would put forth shoots again if its roots are dressed with the powdered sesame mixed, *Vidanga, Kulmasa* and milk, and it is plastered with (the paste of) mustard in *Ankola* oil. (Ch. 8, Sl. 50)

Dressing the roots with cow-dung and ashes, watering with the infusion of *Nirgundika* and *Sopha* (? Asoka or aniseed ?) and plastering and nursing with a hog's fat (?) would make the tree put forth shoots very lavishly. (Ch. 8, Sl. 51)

A tree singed with fire would put forth leaves again if it is nurtured with milk and water and plastered with honey, lotus roots and milk and its basin is filled with loam. (Ch. 8, Sl. 52)

A tree singed with fire would begin growing again if it is plastered with *Karkkandher,* marrow and honey and with mud, as well as with milk and *Atasi* (linseed, *Linum usitatissimum*) and is watered with carrion-broth. (Ch. 8, Sl. 53)

A tree blasted by lightning would soon begin to grow again if its roots are nourished with milk and water in which the powder of *Madhuka, Mudga,* sesamum and *Masa* are mixed and is plastered with ghee and honey. (Ch. 8, Sl. 54)

A tree struck by lightning would grow again if it is plastered and nourished with *Usira, Musta,* honey and milk, and fed with *Sita, Vidari,* sesamum, *Naga-jahva* (?), *Kumudvati* (stalk of a water lily? or *Villarsia indica* ?), Suna (? bud ?), milk and water. (Ch. 8, Sl. 55).

A tree broken by storm would put forth thick branches and foliage and bear flower and fruit, if it is first propped up by fixing the stakes and tying it with them with ropes and then plastering it with *Plaksa, Apla* (? =*Amla*= tamarind ?), *Udumbara,* cinnamon, honey, ghee, *Sita,* and milk. Its roots should then be dressed with dried dung and loam and watering done with diluted milk. (Ch. 8. Sl. 56-57)

An old and worn out tree or one crushed under pressure would regain strength if it is helped with the feed of milk and water or *Vidanga,*

milk and water. (Ch. 8, Sl. 58)

The roots of a plant that has been uprooted and transplanted in another place should be dressed with powdered *Madhuka* and sesame and also filled with loam and cow-dung. (Ch. 8, Sl. 59)

Under a tree that has been sat over (and crushed) by foolish animals like the elephant, dry dung should be spread and a basin dug and filled with loam. Then that tree should be smeared with honey and ghee and nurtured with water and milk. (Ch. 8, Sl. 60)

A tree diseased by contagion recovers quickly if the affected tree standing by its side (?) is cut down and the earth under it is dug out and replaced with a healthy soil and then fed with water....(Ch. 8, Sl. 61)

Or if a tree has to be transplanted from one place to another, one should, first dig a pit, wash it and fill it with loam, then plant the (dug out) healthy tree and feed it with water. (Ch. 8, Sl. 62)

If a tree suffers from the disturbance of its seasonal reproductive functions, one should get it treated medically or by magical diagrams and incantation of sorcerers. (Ch. 8, Sl. 63)

The basins of the plants that have been brought together (?) should be filled with loam, and the earth around them furrowed and sown with sesamum. They should be plastered with honey, ghee and milk and watered at long intervals. (Ch. 8, Sl. 64)

Watering with an infusion of paddy and grass, plastering with sesamum, ghee and milk, and nurturing with the decoction of milk, *Arjuna*, cinnamon, *Krminud* (*Embelia ribes*) and water, is coducive to the abundant growth of flowers and fruit. (Ch. 8, Sl. 65)

Nurturing with milk and water is also beneficial for the promotion of flowers and fruit on a tree that is adversely affected by wrong treatment. Plastering and nurturing with sesamum, milk and ghee is also good for the harm caused by the administration of a wrong medicine. (Ch. 8, Sl. 66)

A tree with pale, withering and falling leaves and fruit, with scant flowers and the growth of shoots and branches stopped, is restored to normal foliage (?) by sprinkling (?) or nurturing. (Ch. 8, Sl. 67)

A tree that is fumigated with honey and ghee and watered with the decoction of milk and barley-flour and also fed with carrion would put forth green foliage and yield fruit constantly. (Ch. 8, Sl. 68)

The drying up (consumptive process) of all trees is completely cured by plastering and nurturing with sugar, sesame and cow's milk. (Ch. 8, Sl. 69)

By application of the plaster of ghee in which *Katu* (*Trichosanthes diocca*), *Anga* (?), Bhillota, *Vaca*, *Vidanga*, white mustard, *Krsna* (Piper longum) and *Rajani-dvaya* (*Curcuma longa* and *Aromatica*) have been cooked and milk added, the trees feel great discomfort. (Ch. 8, Sl. 70)

If a tree does not thrive in spite of the treatment of its disease, it should be transplanted at another place for promoting its growth. (Ch. 8, Sl. 71).

The morbid flow (or miscarriage of fruition) of trees stops by the application of plaster prepared from the barks *Dhava* (*Grislea tomentosa*), *Vetasa, Tarkari, Priyangu and Arjuna,* cooked in milk. (Ch. 8, Sl. 72).

The morbid flow of trees stops if they are watered with the decoction of sesame, barley, *Satavpuspa* (*Anethum sowa*), fish and the leaves of *Dhattura* (*Datura alba,* white thornapple) and if they are nurtured with the solution of jaggery, water and milk, they feel very happy and their flowers and leaves grow luxuriantly. (Ch. 8, Sl. 73)

Surabhi-trna (? fragrant grass), Vidari, Padmaka (lotus), *Usira, Pathya* (*Terminalia chebula* or *citrina*), *Tagara, Rajani* (*Curcuma longa*), *Kustha, Sri-dru* (wood-apple, or cloves), *Jantughna* (*Embelia ribes*) and *Rodhra*—all these taken about a *Prastha* in measure and cooked in *Sura-taru* (?), water and milk, and sesame oil—are useful in driving away the diseases of plants. (Ch. 8, Sl. 74).

Nurturing with *Sita,* milk and water in which *Vidanga* and *Rodhra* have been mixed, and fumigation are always beneficial to trees and creepers. In winter particularly the basins of the creepers and trees should be filled with loam and they should be nurtured with sesamum, milk and water. (Ch. 8, Sl. 75-76)

TREATMENT OF PLANT DISEASES SUGGESTED BY SURAPALA

Surapala in his well-known book Vrksayurveda gives an interesting account of treating the plant diseases. Translation of the important portions of this book is given below.

One should cure the diseases of wind-disorders by the administration of flesh, lymph, fat and ghee. Nutriment provided by these substances removes all wind-troubles. (Sl. 185).

Liberal fumigations with oils in which soap-berry, cow's horn, horse's hair, black pepper, ghee and porpoise have been boiled and the lymph of a hog added, quickly remove the diseases of the wind. (Sl. 186).

One should cure the diseases caused by phlegm-disorders with astringent, bitter and pungent substances, decoctions of *Panca-mula* (fine-roots) and perfumed water. (Sl. 187).

In order to cure all kinds of diseases of phlegm, one should dress the roots of a tree with the oil-cake of white mustard and irrigate it with water in which sesamum and ashes have been dissolved. (Sl. 188).

Having dug out the earth near the roots of the trees affected with wind-disorders, a wiseman should replace it with fresh dry earth in order to cure their disease. (Sl. 189).

A wiseman should cure the diseases of all species of trees caused by the disorders of bile mostly by means of substances that are cool (in effect) and sweet. (Sl. 190).

The trees are cured of bilious diseases by being watered with the decoctions of liquorice, honey and *Madhuka* and with milk mixed with honey. (Sl. 191).

All kinds of trees are relieved of bilious diseases if they are watered with the decoction (?) of the three myrobalans in which ghee and honey have been mixed. (Sl. 192).

A wiseman, having dug out the insects like Kandaraka (?) from the roots of the tree, should irrigate the tree with cold water for seven days. (Sl. 193).

Insects are destroyed by the administration of water containing milk, carcass, *Vaca* and cowdung and by the plaster prepared from white mustard, *Musta* grass, *Vaca, Kustha* and Ativia. (Sl. 194).

Fumigation of the tree with the fumes of white mustard, *Ramava* (?), *Vidanga, Vaca,* black pepper, beef, *Ambu* (?), horn of buffaloe and flesh of a pigeon mixed with the powder of *Lodhra,* at once destroys the colonies of insects infesting the trees. (Sl. 195).

Plastering with Vidanga 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* (?). (Sl. 196).

One should irrigate a worm-eater plant with a solution of oil-cake in water. Insects on the leaves are destroyed by dusting them with ashes and brick-dust. (Sl. 197).

Injury caused by insects is healed by a plaster of *Vidanga,* sesamum, cow's urine, ghee and white mustard, and by watering with milk. (Sl. 198).

Trees that are damaged by frost and storm should first be protected by outward screening and then feeding them with carcass water and milk proves beneficial. (Sl. 199).

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 *Plaksa* and *Udumbara* mixed with ghee, honey, wine and milk and then tightly tied with ropes and sprinkled with the buffalo's milk, and finally watered copiously at the roots. (Sl. 200-201).

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 their branches are plastered with honey and ghee and they are watered with diluted milk. (Sl. 202).

Trees singed with fire would grow good foliage, if the burnt place is scrapped (or cut) off and sprinkled with diluted milk, and fumigated with the skull of a crab, etc. (Sl. 203).

Trees damaged by fire would cover the sky with foliage, if they are plastered all over with the paste of the lotus-plant and fed with carcass-water. (Sl. 204).

Trees struck by lightning would bear beautiful leaves, if they are plastered with Vidari, sugar, red arsenic, and sesamum, and watered with diluted milk. (Sl. 205).

Shrivelling caused by fire is removed with an all over plaster of sugar, water, sesamum and milk as well as by thorough feeding with the same, so also does the plaster of the paste of lotus plants. (Sl. 206).

If the shrivelling up is caused by sterile soil, then that soil must be removed from the roots and replaced with other fertile soil and the tree should be watered with diluted milk. (Sl. 207).

If the shrivelling up is caused for want of water, then one should water the tree with diluted milk and fumigate them (i.e. the shrivelled trees) with crab, etc. (Sl. 208).

Wood of trees is healed by proper plastering with (the powder of) the banyan and *udumbara* barks mixed with cowdung, honey and ghee. (Sl. 209).

Defluxion stops with the plaster of the (powdered) barks of *Dhava, Sriparnika, Syama, Vetasa* and *Arjuna* mixed with ghee and honey. (Sl. 210).

Diseases caused by wrong nursing are cured with the plaster of the paste of Sasva (?) mixed with the powder of *Vidanga,* and irrigation with diluted milk. (Sl. 211).

The jaundice of trees is cured in a week if they are nourished regularly with the flour of barley and wheat and honey dissolved in diluted milk. (Sl. 212).

Barren trees begin to fulfil all hopes with the yield of flowers and fruit if they are nourished with milk and carcass-water. (Sl. 213).

Barren trees fulfil the hope with flower and fruit if they are fed with cooled down pottage of sesamum, barley, *Kulattha, Masa* and *Mudga.* (Sl. 215).

Nourishing the (barren) trees with sesamum and the powder of the dung of goats and sheep, measuring one *Adhaka* each, a *prastha* of barley meal, a *drona* of water and beef equal to all by weight—all (mixed and) kept over for a week—makes them yield flower and fruit. (Sl. 216-217).

The (barren) trees begin to yield flower and fruit if they are nourished with the milk of she-elephant and buffalo to which liberal quantities of the broth of the flesh of a tiger, panther and jackal are added. (Sl. 218).

In cases of indigestion caused by water-logging, one should dig up the earth and drawing out the roots, he should plaster each of them with honey and *Vidanga* and pour water into them (Sl. 219).

Vegetables like cucumbers become free from disease if fumigated with the fumes of the bones of a cow and dog and the ordure of a cat. (Sl. 220).

A shrewd person should not administer pungent substances or apply fumigation to saplings. He should avoid even light plastering. (Sl. 221).

A wise-man should transplant in another soil of better quality a tree of which the disease does not yield to the (above) recipes applied in various ways. (Sl. 222).

Here those who are happy at the feet of the illustrious Ramachandra command *Sri Hanumant* here on the sea-shore, amongst hundreds of thousands of monkeys—him, the son of Wind-god and swift as wind, who has sharp nails and teeth and yet a gentle aspect, who has a huge and marvellous

tail, and who crushes the hostile forces:

"O Hanuman! if all the harvest-destroying brood of the d Taraka, such as *Simasira, Ratri, Hira* (?), *Pandara, Bhudika* (?) *Lapok* Dhuli, *Simhi, Gabhandaka* and others as well as *Subhranaka* (?), *C* (?), *Kata* (?), hogs, deer, buffaloes, rats, etc. who infest the field of and-such person of such-and-such family, do not disperse at my w then, pray, destroy them with your tail. Om, dham, dhim! salutatio thee), destroy them, pray, destroy them.

Writing this incantation down one should tie it in the middle c field. Then there would be no fear from (plant) disease, vermin beasts at any time.

FROM VRIKSAYURVEDA BY SURAPALA

Of all species of trees, the diseases may briefly be classified in groups, one of those arising from the body, i.e. internal and the oth those attacking from outside, i.e. extraneous. (Sl. 165)

The bodily or internal diseases arise from the disorders of w phlegm and bile, and the extraneous diseases and ailments are cause vermin, frost, etc. (Sl. 166)

The diseases and ailments of trees are usually caused by an ex sive nourishment of dry, astringent or such other substances, by desi tion of land or by fire. (Sl. 167)

They result in shrivelling up (or gauntness), distortion, swel tumour, rank growth of foliage, roughness, lack of sap or insipidity fruit. (Sl. 168)

The diseases arising from (the disorders of) phlegm are caused an excessive nutriment of sweet, oily, sour and cold substances and usu attack at the beginning of winter or in spring season. (Sl. 169)

They manifest in the form of delayed fructification, yellown shrivelling of leaves, stunted or arrested growth, fruitlessness, and of juice or sap. (Sl. 170)

The diseases arising from (the disorders of) bile are caused by excessive assimilation of bitter, sour, salt and pungent substances and usu ly attack in summer or at the end of rains. (Sl. 171)

They manifest in the form of extreme yellowness of leaves, fruct cation out of season, defluxion, drying up, withering away of leaves, flow and fruit and decay. (Sl. 172)

The trees that are afflicted with the disorders of wind, have th roots eaten up by insects, become dried up, show yellowness of leaves a are prone to excessive withering. (Sl. 173)

By the velocity of a gale, the trees are either broken, or uprooted are bent down. In this, too, there are two varieties, one in which there partial break (without severance) and the other in which there is comp severance. (Sl. 174)

The drying or shrivelling up of trees may be caused by fire, lightni

sterility of soil or drought. (Sl. 175)

Blows with an axe, etc. cause wound to the trees and all sort of trees are susceptible to drying up. (Sl. 176)

Defluxion takes place even without an injury by the disorder of phlegm, and diseases of wind-disorders, etc., are each caused by wrong nursing. (Sl. 177)

When a successive decline is seen in the leaves, flowers and fruit every day, it should be attributed to water-logging, to heat, to defect in the soil or to inclemency of the season. (Sl. 178)

The disorders arising from excess of wind give rise to jaundice. Afflicted with this the trees have their trunk, leaves and fruit turned yellow. (Sl. 179)

All kinds of trees are turned barren by some defect in the seed, by absence of nursing, wrong nursing or injurious nursing, or by strong winds. (Sl. 180)

Putrid smell, absence of smell and shrivelling up of leaves and sprouts is caused by the pest of ants or by indigestion caused by excessive watering. (Sl. 181)

Fire, wind, friction with another tree, situation in a constant shady place or near a herd of goats, tangle or creepers and vicinity of rank under growth are some of the causes of the destruction of trees. (Sl. 182)

A person of superior intelligence, having diagnosed the various diseases by their respective symptoms described above, should administer medical treatment with strenuous efforts. (Sl. 183, 184)

HERE BEGINS THE VRKSAYURVEDA

The water reservoirs which have no shade on their banks are not pleasing. Hence gardens should be laid in the precincts of reservoirs of water. (Sl. 1)

Soft soil is good for all kinds of trees. First, one should sow sesamum in that soil and when they grow and put forth flowers, they should be uprooted. This is the first process in preparing the land. (Sl. 2)

The soap-nut tree, Asoka, Pumnaga, Sirisa, Priyangu, are the auspicious trees and should be planted first in the gardens or the houses. (Sl. 3)

The bread-fruit tree, Asoka, the plantain, the rose-apple, Lakuca, the pomegranate, the vine, Pativata, the citron and Atimuktaka—these are the trees that grow from scion plastered with mud. They should be carefully planted by taking their stem or by digging them up from the roots. (Sl. 4-5)

Plants that have not put forth branches should be transplanted in the winter; those that have put forth branches, in the beginning of winter (i.e. the dewy season); and those that have developed trunks, at the advent of the rainy season according to their respective quarters. (Sl. 6)

Transplanting of the trees is done after plastering them root and branch with ghee, Usira, sesamum, honey, Vidanga, milk and cowdung. (Sl. 7)

One should transplant a tree after having purified himself by taking a bath and anointing himself and having performed the worship of that tree. Thus transplanted the tree grows with the already existing leaves. (Sl. 8)

The transplanted trees should be watered both morning and evening during summer, on alternate days in winter and during the rainy season when the soil becomes dry. (Sl. 9)

The rose-apple, Vetasa, Vanira, Kadamba, Udumbara, Arjuna, the citron, the vine, Lakuca, the pomegranate, Vanjula, Natka-mala, Tilaka, Panasa, Timira and Amrataka—are the sixteen trees that grow in the wet or marshy soil. (Sl. 10-11)

The best kind of planting is that in which the trees are planted at a distance of twenty cubits from each other, the middling one when they are sixteen cubits apart and the worst when only they are at a distance of twelve cubits from each other. (Sl. 12)

Trees that grow too close and touch each other, do not yield adequate fruit owing to their roots entwining and injuring each other (under the ground). (Sl. 13)

Diseases like the searing of leaves, arrest of the growth of leaves, drying up of the branches and excessive exudation of the sap, afflict the trees owing to exposure to cold wind and the sun. (Sl. 14)

Their remedy, according to scientific works, lies first in clearing them (of the diseased part) and then plastering them with the paste of Vidanga and ghee and nurturing them with water mixed with milk. (Sl. 15)

Cessation of bearing fruit (i.e. sterility) is cured by Kulattha, Masa, Mudga, sesamum and barley. Along with this, nurturing with boiled and cooled down milk is conducive to the increase of fruit and flower. (Sl. 16)

Two adhakas of the dung of sheep and goats, one adhaka of sesamum, one prastha of meal, a *drona* of water and beef equal in weight—all these (mixed together and) kept for a week (lit. 7 nights) should be administered as nurture to trees, creepers, thickets and plants for making them bear flower and fruit for all times. (Sl. 17-18)

Seeds that are soaked in milk for ten days, kept in two hastas of ghee, fumigated with the fumes of the flesh of a hog and deer, and mixed with the fats of fish and hog, grow bearing flowers simultaneously, when sown in a prepared and cleaned soil and nourished with water mixed with milk. (Sl. 19-20)

The Tintidi tree turns into a creeper when nourished with the ground meal of rice, Masa and sesamum mixed with putrid flesh and regularly fumigated with the fumes of turmeric. (Sl. 21)

In order to turn the Kapittha tree into a creeper, its seed should be placed in milk which has been cooled down after boiling in it the roots of Asphota (?), Dhatri, Dhava and Vasika, and the plants Palasini, Vetasa, Surya-valli, Syama and Atmuktaka along with Asta-muli. This process should be repeated everyday for one month and the seed dried in the sun

everytime before sowing it. (Sl. 22-23)

A pit one cubit wide and twice as much deep should be dug and filled with water. When it becomes dry it should be heated with fire and then plastered with honey and ghee mixed with ashes. (Sl. 24)

It should then be filled with ground Masas, sesamum and barley mixed with soil. Then pouring the broth of the flesh of fish over the filling, it should be beaten down till it becomes hard and compact. (Sl. 25)

If the (above mentioned) seed is sown into it four fingers deep and is nurtured with fish-broth and gravy, it grows into a surprising creeper with glistening leaves and soon spreads over the entire bower. (Sl. 26)

A seed that is kept a hundred times in the ground mass of the Ankola fruit or in Ankola oil or in the pulp of Slesmataka fruit, when mixed with hail and then sown in the soil, grows instantaneously and puts forth branches weighed down with fruit—what wonder! (Sl. 27-28)

After removing the shell of the seeds of Slesmataka, a wise man should soak them in the juice of the Ankola sauce seven times. Drying them up every time in the shade, he should rub them in the dung of a buffalo. Then putting them into the dry dung of the same animal he should mix hail and soil with them. No sooner are they sown than they sprout up and bear fruit on the same day. (Sl. 29-30)

The astrologers have declared the following constellations to be auspicious for the planting of trees etc. Dhruva, Mrdu, Mula, Visakha, Brhaspati, Sravana, Asvini and Hasta. (Sl. 31)

CHAPTER VIII

SOWING OF SEEDS

Sowing of seeds was a highly developed art in ancient India. Plants were grown from seed, scion and bulbous roots even in olden days. Surapala gives a very detailed account of growing various types of plants in his book Vrksayurveda. Translations of the important portions are given below.

Large trees called *Vanaspati*, other trees called *Druma*, creepers and thickets called *Gulma* are the species of plants. There are three different ways of planting (the various plants), viz., by sowing, by insertion of a scion in soil and by planting a bulbous root. (Sl. 45)

The *Vanaspati* trees are those that bear fruit without blossoming, and *Drumas* are those that bear fruit along with flowers. (Sl. 46)

Creepers are said to be those plants that creep and spread their tendrils all round, and those that grow a number of stems are called thickets (*Gulma*). (Sl. 47)

Rose-apple, Campaka, Pumnaga, Nagakesara, Cincini (?), Kapittha, Badari, Bilva, Kumbhakari (?), *Priyangu, Panasa,* mango, *Madhuka, Karamarda,* etc. are the trees that grow from seeds, and betel, *Sindhuvara, Tagara,* etc. are those that grow from a scion. (Sl. 48-49)

Patala, pomegranate, *Plaksa, Karavira,* banyan, *Mallika, Udumbara, Kunda,* etc. are the plants that grow both from seeds as well as scion. (Sl. 50)

Saffron, ginger, garlic, *Alakada* (Alu and Kanda) grow from bulbous roots, and *Ela* (cardamom), red lotus and blue water lily grow both from the seed as well as bulbous roots. (Sl. 51).

Extracting the seed from a fruit that has ripened in due season and dried, one should soak it in milk, and, having dried it for five days, he should fumigate it with the fumes of ghee in which *Vidanga* has been mixed. (Sl. 52).

A seed, which has been steeped in milk, besmeared with the ashes of Brhati and sesamum and with ghee, rubbed in cowdung and fumigated with the fumes of fat, grows at once when sown. (Sl. 53).

A seed, soaked in milk and rubbed well in cowdung and, after drying, again rubbed repeatedly in honey and the powder of *Vidanga,* grows without fail. (Sl. 54).

Wisemen, of clear intellect, declare a seed, that has been soaked in milk, dried well in shade and rubbed in the ashes of *Brhati* sesamum, *Nala* mixed with mustard (?), to be excellent for sowing. (Sl. 55).

The moist (i.e. fresh) seed of mango, roseapple or *Panasa* (bread-

fruit) is best when carried through the above process, and then after drying, it is purified in the aforesaid manner..... (Sl. 56).

The seed of *Ervvaru* (?), soaked in water in which plenty of jaggery has been dissolved, and then packed well in plenty of leaves and kept for three days under the ground on which there is constant fire, when taken out after thus heating it, becomes suitable for sowing. (Sl. 57).

All kinds of seeds that are treated in the aforesaid manner become excellent, and the trees (or plants) that grow from them bear abundant flowers and fruits of excellent quality (?). (Sl. 58).

Having bathed and become pure and after putting on clean clothes, worshipping the gods, saluting the preceptor, making the gift of money or land to a meritorious person and making obeisance to the presiding deity of the house-building, one should himself first sow a few seeds and then, after him, his attendants should do so all over the field. (Sl. 59).

Having covered the receptacle of seeds with straw, one should sprinkle it with milk and water. When the seeds have sprouted with the help of water, one should remove the straw and dry the seeds. (Sl. 60).

First day of the bright fortnight, *Pusni* (?), the fifth and the thirteenth days of the lunar month, as well as Thursdays, Fridays, Mondays are said to be the days of *Asaumyas* (?). (Sl. 61).

The constellations Visakha, Satabhisaj, Mula, Mrgasiras, Citra, the three Uttaras, Rohini, Anuradha, Jyestha and Krttika as well as the time of sun's conjunction with Sthira zodiacal signs are said to be auspicious. (Sl. 62).

One should plant or sow the trees on a land which has not been ploughed and on which are scattered flowers, sesamum and *Masas* (*Phaseolus radiatus*). (Sl. 63)

The distance between trees may be fourteen, sixteen or twenty cubits which is considered to be bad, of middling worth and excellent respectively for the growth of the trees. (Sl. 64).

The interval between *Gulmas* (thickets) may be four or five cubits and between trees like *Puga*, it may be two or three cubits. (Sl. 65).

If the interval is kept greater than what is prescribed, there would be danger (to the trees) from storm and if it is kept less then the fruit would be poor. Therefore, one, who is anxious for the prosperity of his trees, should not transgress this rule. (Sl. 66).

The sowing and especially planting of mangoes, pomegranates, etc. and of pumpkin-gourds and *Alambuka* is considered to be best done in a pit, measuring one cubit all round. The pit should have been recently dug, dried, filled with cow-bones and cowdung, well-burnt and allowed to cool down naturally, and then after removing the ashes, irrigated with carcass water and filled with manure. (Sl. 67-69).

When after two months they have put forth leaves, an expert should dig them out and in *Asadha* (?) implant them in any place he desires. (Sl. 78).

One should bend the branches of pomegranate and Karavira trees and taking scions from them, he should cover the lower end with best cowdung and plant them. (Sl. 79).

For two months he should water them regularly. Then, when they have borne leaves for a long time, he should cut them in the middle. (Sl. 80).

All bulbous roots should be planted in a pit measuring one cubit all round and filled with soft sand mixed with (soft) soil. (Sl. 81).

One should plant a plantain tree after covering its root with the best cowdung and then inserting the root in a pit and feeding it with plenty of water. (Sl. 82)

An expert should plant the saplings in pits full of soil at an interval of one cubit from each other after having plastered their roots with honey, lotus stalk, ghee and vidanga. (Sl. 83)

In the same way even big plants may be transplanted with their roots wrapped in *Talayika* (? mat?). And on the evening of the following day and in the forenoon one should repeat the following incantation:

"O tree, I shall transfer thee from this place to a better place and shall water thee so that thou shall be happy. Thou shalt thrive there and shalt be safe from the danger of being struck by lightning. There I shall nourish thee like my dear son that cannot move." (Sl. 84-86)

A wiseman should plant *Ksirika,* mango, pomegranate, *Bakula* tree, etc., in the month of *Sravana* and *Rajakosa* (?), Amra (mango), *Lakuca,* etc. in the month of Bhadra. (Sl. 87)

In the month of *Asvin* one should sow *Gomla,* brinjal, etc. and in the month of Kartika majoram, *Satapatrika, Dhanyaka* (coriander) *Mulaka* (radish ?), etc (Sl. 88)

In Phalguna, *Patola,* etc. and in Caitra, *Kakaruka,* etc. should be sown. In Vaisakha and under the Venus a wise man should plant plantain tree, etc. (Sl. 89)

In the month of Asadha he may sow all sorts of seeds and plant anything at will. The months of Margasirsa, Pausa and Magha are forbidden for sowing, etc. (Sl. 90)

A wise person should take care to plant a *Lodhra* tree in all the quarters of his garden for the sake of keeping the trees free from disease. (Sl. 91)

A wise man, reflecting on the science of horticulture and conversant with its rules, should acquaint himself with the distinguishing characteristics of the trees that are still out of his knowledge and plant trees like his own good progeny and thereby please the preceptor of the gods (i.e. Brhaspati) and wash off all his sins. (Sl. 96)

On this earth trees alone are the cause of welfare both in this and the other world, because trees are the means of tiding over extreme poverty. (Sl. 97)

The manuscript of Vrksayurveda which is available in Adyar Li-

brary, Madras contains a number of verses which explain in detail how different plants should be grown. Translation of these verses is given below for the benefit of the readers.

Saffron, ginger, garlic, *Alu* (potato or *Arum campamilatum*) and *Kanda* (*Amorphophallus campanulatus*) are grown from bulbs, while cardamom, *Padma* (lotus, *Nelumbium speciosum*), *Utpala* (the blue lotus, *Nymphaea caerulea*) etc. are grown both from the seed and the bulb. (Sl. 50)

Soft soil is the most suitable for the growth of trees. In that sesamum should be sown and when they blossom, they should be crushed and trampled down. This is the first step in preparing the soil. (Sl. 51)

In a level and well ploughed field *masa* (*Phaseolus radiatus*) and sesamum should be grown first and when they have ripened, they should be rooted out and seeds (of the trees) should be sown profitably there. (Sl. 52)

The seeds that have ripened in proper season should be extracted from the fruit, steeped in milk and dried for five days. Then they should be fumigated with the fumes of ghee in which *Vidanga* (*Embelia ribes*) has been mixed. (Sl. 53)

The seed steeped in milk, *Vitupta* with solanum, sesamum and ghee rubbed with cowdung and fumigated with the fumes of fat, grows very quickly. (Sl. 54)

The seed steeped in milk, rubbed with cowdung and then after drying again rubbed with honey and the powder of *Vidanga* (*Embelia ribes*) repeatedly would grow well. (Sl. 55)

One should sow the seeds of rose-apple, bread-fruit, mango, *sarala* (*Pinus longifolia*) and *Likuca* after having steeped them in milk and rubbed with ghee, cowdung and *Vidanga* (powder). (Sl. 56)

Panasa, Asoka, plantain, rose-apple, *Likuca,* pomegranate *Plaksa,* emblic myrobalan, citron and *Atimukta* are the trees and plants which grow from their scion smeared with cowdung. They should be carefully planted either by digging them from the root (i.e. transplantation) or by cutting a scion. (Sl. 57-58)

Transplantation should be done after smearing the roots and stem with ghee, *Usira* (*Andropogon muricatus*), sesamum, honey, *Vidanga, Ksura* (*Asteracantha longifolia*) and cowdung (all pounded together). (Sl. 59)

One should gather the seeds ripened in full time, dry them and then having steeped them in milk put them out for drying for five days. Thereafter they should be fumigated with the fumes of ghee in which the extract of *Vidanga* has been mixed. Then one should rub the seeds softly in the ashes of the five parts (root, bark, leaves, flowers and fruit) of *Brhati* (Solanum) and *Kurari* (*Capparis aphylla*) mixed with *Vira* (manioc root) for five days. Then he should soak the seeds in the cow's dung and urine for one day. Afterwards if they are smeared with cowdung and sprinkled

with milk they grow very fast. (Sl. 60-62)

The seed smeared with *Vidanga* and honey grows very quickly and the seed smeared with cowdung and dried also grows fast. (Sl. 63)

One should spread straw in the vessel in which the seeds are put. Then he should sprinkle them with milk and water. When the seeds sprout, he should remove the straw and dry the seeds. (Sl. 64).

Having bathed in the morning and observing a fast one should first sprinkle the seeds with water from a golden jar and then sow them again and again (i.e. one by one) after sanctifying them with *Mantras* (incantations) and the blare of a happy day and trumpets. (Sl. 65)

Having bathed and become pure and after putting on clean clothes, worshipping the gods, saluting the preceptor, making the gift of money or land to a meritorious person and making obeisance to the house personified as deity, one should himself first sow a few seeds and then, after him, his attendants all around. (Sl. 66).

SEEDS AND SEED RATES

India for ages has been known for its pithy sayings and proverbs which contain specialised information on various subjects in a concentrated form. All the important sayings popular in Hindi, Bengali, Maithili and Tamil languages have been compiled in the Vraksayurveda. Many of the sayings given in this compilation pertain to sowing of seed and the rate at which they should be sown in different types of soils. Some of these sayings are given below :

Wheat should be sown in a somewhat dry field and barley in a wet field. If there is heavy rain, then chicken-pea should be sown. (Sl. 91)

Go and tell the cultivator that he should sow cucumber (seeds) at the intervals of a deer's leap, cotton (-seeds) at the intervals of a step each and the sugarcane too close.

Indian hemp should be sown so close that wind should not be able to pass through the plants. (Sl. 92)

Maize, jowar and millet should be sown somewhat sparsely. (Sl. 93)

One should expect the possibility of making ropes only when one sows the hemp too close. (Sl. 94)

Whosoever sows millet at the intervals of a step and jowar at the intervals of a frog's leap, would be able to fill his barn with the crop. (Sl. 95)

Sparse sowing of barley, chicken pea and cotton is good. But those who sow sugarcane sparsely, should give up all hopes (of a good harvest). (Sl. 96)

Sowing of the hemp too close, the cotton sparsely and the millet at the intervals of a foot-step, would relieve one of poverty. (Sl. 97)

If the August-September (Bhadon) sowing of paddy be done in a field which has been well dug up and prepared (in the month of Jeth i.e. May-June) then there would be plenty of rice-flakes (chinda) to enjoy.

(Sl. 98)

Those families would go to ruin which at the instance of others sow Bari and sugarcane in fields from which these crops have been reaped immediately before. (Sl. 99)

Sowing should be done on Wednesday and reaping on Friday. (Sl. 101)

One who sows at the Divali festival, would become bankrupt, that is to say, he will have poor crop. (Sl. 105)

Carrots, sweet potatoes and radish—all the three should be sown sparsely. (Sl. 106)

If a poor soil is manured with indigo-stalks, the more the stalks decay, the richer grows the soil. (Sl. 107)

A buffalo that begets a male calf, a bride that gives birth to a daughter and rain that falls in the month of Kartika (October-November) —all these portend ominous times (or ill luck). (Sl. 108)

A cultivator should finish the weaving of his charpais (bedsteads) under the constellation Rohini and the construction of his shed under the Mrgasiras, so that he may be free to sow paddy during the time of the constellation Ardra. (Sl. 109)

Paddy should be reaped under the constellation Kanya (Virgo) and barley under the Mina (Pisces) everywhere. (Sl. 110)

Poppy and linseed should be sown (close) in a wet field. (Sl. 111)

One should sow Urad (*Phaseolus radiatus*) only if one is capable to do so, otherwise one should make cakes and balls of it (for cooking). (Sl. 112)

He should be regarded as an experienced (i.e. fullfledged) cultivator who sows paddy after reaping the harvest of cucumber from his field. (Sl. 113)

In one Bigha of land the following quantities of different seeds should be sown:

Barley and wheat	—	25 seers each
Peas	—	30 seers
Chicken-peas	—	15 "
Maize	—	2 "
Arhar, Mothi and Urad	—	2 "
Cotton	—	1½ "
Rice	—	25 "
Jadhan	—	15
Sanwan (rice)	—	1¼
Sesamum and mustard	—	a handful each
Barrain and Kodon	—	1 seer each
Linseed	—	1½ seers
Millet, Bajri & Sanwan	—	1½ "
Kodon and Kakun	—	½ "

A cultivator who sows according to the above proportion would be rewarded with double the crop. (Sl. 114)

Chicken peas, if sown under the constellation Citra, would yield a four-fold crop and wheat yields best harvest if sown under the Svati. (Sl. 115)

For as many days as the west wind blows during the month of Bhadon (August-September) for so many days frost should be expected in Pus (December-January). (Sl. 153)

How did sugarcane crop get infected with Kana (a plant disease which reddens the pith and reduces the sugar in the juice)? Because there were showers during the constellation Svati. (Sl. 154)

A great calamity befalls him whose sugarcane (harvest) is infected with Lohai (disease that reddens the pith). (Sl. 155)

If there be moisture below (in the soil) and clouds above, then the veterans declare that Gerui disease would be rampant. (Sl. 156)

If the east wind blows during the month of Phagun (February-March) then wheat crop would be infected with Gerui. (Sl. 157)

If the east wind blows in the months of Magh and Pus (December-January), then mustard would be eaten away by Mohun (an insect). (Sl. 158)

(If the south wind blows, how it would be possible to taste the scum of boiled rice (for, there would be no harvest of paddy)? (Sl. 159)

The gerui disease begins when the sun is in the sign of Aquarius (i.e. February-March) and disappears when it is in the sign of Pisces (March-April). It starts from the stalk and eats away the leaves. (Sl. 160)

If wheat is infected with Gerui and paddy with Gandhi then the cultivator would die of starvation (i.e. want of food-grains). (Sl. 161)

If in the month of Magh (January-February), the colour of the cloud is red, then surely there would be a shower of hail-stones. (Sl. 162)

If chicken-pea crop is chilled with cold, then it could be eaten away by the insect called Gadhaita. (Sl. 163)

If there is rainfall under the Chitra constellation, then the entire harvest would perish. (Sl. 164)

Under the Magha constellation the locusts thrive and under the Purva the Dans (insects) flourish. But under Uttara all these are destroyed. (Sl. 165)

If there is continuous rainfall day and night, then sawan and sathi would be ready for harvesting in sixty days. (Sl. 166)

With rainfall under the constellation Magha and food served by the mother, the starving person (would get so much that he) will not have to pray to God for food. (Sl. 167)

If there be rainfall at the rise of the constellation Chitra and at the setting of Hasta, then the people would not complain howsoever heavily they may be taxed by the King. (Sl. 168)

The Magha constellation gratifies the earth (with rainfall). (Sl. 169)

By rainfall under the constellation chitra the harvests of three commodities, viz., *Mothi, Masha* (*Phaselous radiatus*) and sugarcane, are destroyed. (Sl. 170)

If there is rainfall under the constellations Punarvasu and Svati, then neither the buzz of spinning nor the twang of carding is heard (for the cotton crop is destroyed). (Sl. 171)

If there are no rains under the Magha constellation then even barren and salty soil will suffer from drought. There would be no milk for want of grass and no pottage of rice for want of water. (Sl. 172)

If the weather is not sufficiently cold in the month of Magha (January-February), then take it for granted, my friend, that food-grains would become dear (by their prices rising high). (Sl. 173)

If the south wind blows during the months of Pus and Magha, then it is a good sign for (rainfall during) the months of Sawan. (Sl. 174)

If there were no hottest month like Jeth in the year, then everybody would be tempted to sow sugarcane. (Sl. 175)

If there is rainfall under the Magha constellation, then all food-grains will have good crop. (Sl. 176)

If there is rain under the Hasta constellation and the sky is overcast under the Chitra (with a promise of rain), then the cultivator would sing merrily sitting in his house. (Sl. 177)

If the Hasta constellation wags its tail (i.e. sends showers just before setting), the wheat would thrive without much effort. (Sl. 178)

If the month of Sawan (July-August) goes dry then the Kharif crop suffers and if Bhadon goes dry then the Rabi crop suffers. (Sl. 179)

If the rain falls in the middle of *Pausa* (i.e. at the beginning of January), then the harvest would yield half the quantity of grain and half straw, i.e. the crop would be good. (Sl. 180)

If there is no rain at the rising of *Ardra* and at the setting of Hasta, a householder would be as woe-begone as a guest who is neither received with a welcome nor seen off with a farewell. (Sl. 181)

CHAPTER IX

AGRICULTURAL METEOROLOGY

Meteorological observations leading to predication of rainfall, scarcity of water, etc., were made by experts in India from very early times. Generally, these observations were correct as these were based on the position of different stars, direction of the wind, etc. The following account which is a translation of the important portions of the famous Sanskrit book Sivatattava—ratnakara written by Basave Raja of Keladi, gives useful information about the meteorological system of ancient India.

"In what season and what sort of clouds drench the earth with rain? With what object does the rain descend from them? Tell me all this if you have any kindness for me, O teacher. I shall tell you, my child, everything which you are anxious to know." (Sl. 1-2)

If the rain falls in the months of *Kartika* or *Margsirsa* at the time of the passage of the sun into the next Zodiacal sign, then the harvest is moderate. But if it rains in the month of Pausa, then there is plenty. (Sl. 3)

If it rains on the *Dipavali* festival, then the Mars and the sun are inauspicious. If the clouds roar in the month of *Karttika,* there is continuous rain for four months, and the agricultural produce is excellent with the result that there is abundance of food-grains. (Sl. 4-5b)

Clouds of all colours are seen floating on the sky separately. If the clouds are white or yellow, then there is rain at some places and drought at others. (Sl. 5b-6)

If in the month of Karttika, the nature of the vapour is such that at some parts of the sky the clouds are black, at some they are copper-coloured, at some bronze-coloured, while at others they have the colour of vermilion, then one should attribute this (i.e. the nature of the vapour) to the position of the moon in a particular mansion, and should predict the fall of rains on the fifteenth day. (Sl. 7-9a)

Wise persons know that the clouds that arise in the bright fortnight rain in the dark fortnight and vice versa. Those that arise at night, rain in the day and vice versa. Those that are seen to rise in the morning, rain in the evening (and vice versa) and those that arise in the east, rain in the west and vice versa. In the same manner one should infer the change in the course of the winds. (Sl. 9b-11)

If there are good vapours (i.e. nimbus) under the constellation Asvini, then there is plenty. Plenty is also expected if clouds with excellent vapours appear on four days beginning from the third lunar day of the bright half of the month of Margasirsa. (Sl. 12-13a)

If on the fourth lunar day of the dark half of Margasirsa, there is the constellation *Aslesa* and thundering clouds accompanied by lightning are seen (on the sky), then there would be constant rains, so also if similar signs appear in the dark fortnight of the month of *Asadha.* (Sl. 13b-14)

In the bright fortnight of *Asadha* if nimbus appears on the fifth, sixth and seventh lunar days when *Aslesa,* citra and *Purva* constellations are in conjunction, then there would be continuous rains. (Sl. 15-16a)

AUSPICIOUS MOMENT FOR CULTIVATION

Braht-Parasara Samhita as cited in Vacaspatya Kosa contains an account of auspicious moments for commencing cultivation. Translation of the important portions from the above book is given below:

Ploughing (of the field) is recommended under the constellations *Mula, Visakha* and *Magha* and under mobile, fixed, slow and quick planets, or when the evil planets or stars are of weak influence, and the moon is in the mansion called *Jala* (*Purvasadha*) and is visible in her full aspect and vigour along with Venus, and when *Brhaspati* (Jupiter) is in the Langna mansion. It should not be done on Sundays and Saturdays, nor at the time of sun's entrance into Leo, Aquarins, Cancer, Aries, Capricorn, or Libra, for that causes emaciation of the body (of the cultivator), nor on the fourth, sixth, ninth and fourteenth days of the lunar month called *Rikta* (for the same reason). (Sl. 181)

The sowing of the seeds is auspicious under the constellations other than *Sravana, Satabhisaj, Punarvasu,* and *Visakha,* but not on Tuesday. Again, eight constellations beginning from the one under the influence of *Rahu* are inauspicious, next three are auspicious, then one inauspicious, next three auspicious and one inauspicious, then again three auspicious and one inauspicious, and finally three auspicious and four inauspicious. For ploughing, the sages have declared that three constellations from the one vacated by the sun are inauspicious, then eight auspicious, then nine inauspicious and finally eight auspicious. (Sl. 182)

One should begin ploughing under the nineteen constellations comprising *Mula, Visakha* and *Magha* along with the mobile, fixed, slow and fast constellations. Here is what Narada says :—

"The first ploughing with the bulls should be done under the constellations that are slow, fixed, fast and mobile as well as under *Visakha* and those sacred to the Pitrs (Manes)." (Sl. 183)

More elaborately says Sripati: One should do the first ploughing with healthy and uncastrated bulls under the constellations that are slow, fixed, fast and mobile as well as *Mula, Magha,* and *Visakha.* Here the word uncastrated is added because the orchids of the bulls being fertile, ploughing with ungelded bulls would make the cultivation fertile and that done with gelded animals would make it sterile. As regard the avoidance of Sunday in ploughing a quotation from *Vyavahara-tattva* is given: "Cultivation is not recommended under the constellations called *Purva, Dvisa* (?)

Yama (Bharani) and *Agni* (Krttika) on Sundays and Saturdays and on the *Rikta* days of the lunar month." (Sl. 184-185)

In support of the *Lagna* etc. the following quotations from Ratnamala and Kasyapa are given:

"Cultivation should be done when the Venus and the moon are in full vigour, the Saturn, Mars and the Sun are weak, and the moon is in the *Purvasadha* mansion and the Jupiter is in the auspicious mansion." (Sl. 186)

Kasyapa says: "It is auspicious to start cultivation when Jupiter is in his *Lagna* mansion, Venus is strong, and the moon is in conjunction with *Purvasadha* and when the evil stars are weak." (Sl. 187)

"As regards prohibition of certain signs of the zodiac and lunar days, the following quotations from *jyotih-sara-Sagara* are given:

"Cultivation done at the moment of sun's entrance into the aries, is fatal to the cattle, into the cancer forebodes danger from water, into the Leo is baneful for the crop, into the Libra destroys the plough (yoke), into the Capricorn too destroys the crop and into the Aquarins portends danger from thieves.

"Cultivation done on the eighth lunar day kills the oxen, on the ninth is fatal to crop, on the sixth causes insect pest and on the fourteenth is fatal to the cattle. On the fourth lunar day, too, similar consequences are expected." (Sl. 188-189)

"The exclusion of the constellations mentioned in verse 182 implies that sowing may happily be done under the other 15 constellations comprising *Mula, Magha, Danistha, Svati* and under those that are fixed, slow and fast. A quotation from Ratnamala is given to support it.

"Sowing is said to yield bumper crop if done under the constellations *Hasta, Asvin, Pusya, Uttara Rohini, Citra, Radha Mrgasiras, Revati, Svati, Dhanistha, Magha* and *Mula.*" (Sl. 190)

"Sowing of seeds yields the best harvest if done under the constellations the two *Dhatrs, Mula, Paitra* (Magha ?), Pusya, the three (?) *Hastas,* the three *Uttara* constellations, *Revati, Dhanistha* and *Asvins.*" (Sl. 191)

Narada says: "Sowing of seeds yields excellent harvest if done under the constellations that are slow, fixed or fast, under *Magha, Svati, Punarvasu* and *Mula.*" (Sl. 192)

Kasyapa too says: "If, after meditating on *Sita,* sowing is done under *Punarvasu, Svati, Mula,* and under the constellations that are fast, fixed and slow, it yields rich harvest." For prohibition of a particular time the following quotation from *Rajamartanda* is given: (Sl. 193)

"When the sun is very fierce and in an unfavourable position (?) there are duststorms on the earth (corresponding to menstrual periods of a woman). Therefore sowing should be avoided from that time for three days." (Sl. 194)

Narada says "From the planet or star covered by *Rahu,* the three constellations on the head are baneful to the harvest, the three on the neck cause blackness in the grain, the twelve in the belly make the crop thrive,

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the four on the tail are said to cause absence of seeding (or grain), and the five that fall outside the body lead to the ruin of the harvest." (Sl. 195-196)

In *Ratnamala* too, it is mentioned that "From the planet Rahu risen at the sowing time, three constellations are towards the head, three on the neck, twelve on the belly, four on the tail and five outside the body, and they are the cause of ruin of the harvest, blackness in the grain, increase in growth, and absence of seeding respectively, as well as forebode dangers of natural calamities." (Sl. 197)

Some people take the word *Phani* to mean "the sun" on the basis of the single testimony of Sarvodaya. But this is not correct, for Narada clearly takes it to mean Rahu and is supported by Kasyapa who says: "From the planet Rahu, the next eight constellations are portentous of barrenness." (Sl. 198)

About the determination of the auspicious *Lagna* (moment) Vasistha says:

"Now for ploughing the field, three constellations from the one left by the sun, are inauspicious in due order. From those, the next eight are auspicious, then the next nine inauspicious, and the last eight again auspicious. For example, if the sun is in conjunction with *Ardra*, his abandoned constellation would be *Mrgasirsa*. Beginning from that the three *Mrgasirsa, Ardra* and *Purnarvasu* are inauspicious, the next *Pusya, Aslese, Magha, Purva Phalguni Hasta, Citra* and *Svati* are auspicious. The next *Visakha, Anuradha, Jyestha, Mula Purvasadha, Uttarasadha, Abhijit, Sravana* and *Dhanistha* are inauspicious. Then *Satabhisaj, Purva Bhadrapada, Uttara Bhadrapada, Revati, Asvini, Bharani, Krittika,* and *Rohini* are auspicious." (Sl. 199)

As Vasistha has said: "The three constellations—one left by the sun, the other occupied by the sun and the third to be occupied next by him are undesirable. Eight constellations next to them counting on both sides backwards and forwards are auspicious. And the remaining nine on the tail end of the cycle are again unpropitious." (Sl. 200)

Narada, too says: "At the time of commencement of ploughing, the three constellations, beginning from the one left by the sun, are fatal to the oxen. The next three bring wealth and the further five happiness. The next nine cause three-fold pain and bring death in their wake, the five contiguous to them are for prosperity and the last three on the tail end of the cycle are auspicious." (Sl. 201-202)

As regards the influence of the zodiacal cycle on ploughing, Kasyapa says "Three, eight, nine and seven constellations beginning from the one left by the sun cause loss, gain, death of the cultivator and the acquisition of wealth respectively." (Sl. 203)

In this connection which takes into consideration 27 constellations, the Abhijit is not included. Now, what is the reason for leaving out the five constellations? To this it is said that they are included in that. By

"that" is meant the upper rod of the plough and the upper rod of the Sula (?). In between them the aggregate of five each should be considered as conducive to prosperity. This accounts for ten constellations. And the three constellations on the upper part of the rod of the plough should be recorded as productive of auspicious results.

Cycle For Sowing Seeds

From the constellation occupied by the sun one should place Rahu after every three constellations beginning from the sun occupied asterism. Three constellations are included in his head, three in his neck, twelve in his belly, four in his tail and five outside his body. (Sl. 230-231)

Under the constellations in his mouth, the sowing of seeds results in the failure of crop; under those in his neck it results in *angaraka* (live coal—loss by fire?); under those in his belly, it is conducive to a prosperous harvest; and under those in his tail, it results in the ruin of the crop. In this cycle of seed sowing there would be calamities in the country. The calamities are said to be six in number, viz., excessive rain, drought, locusts, rats, birds and foreign invasion. (Sl. 233-234)

The cycle of rainfall is of the shape of a bull with all its limbs intact. One should draw the figure (of the bull) and insert the constellations therein beginning with the one which bears the name *Vrsa* (the sign Taurus). In the mouth, eye, ear, head, horn and shoulder should be inserted two constellations each, three in the back, two in the tail, eight in the feet and three in the belly. (Sl. 235-236)

I shall declare the entire auspicious or inauspicious effects from the constellation on the day on which ploughing or sowing is done and from its position on the part of the body of the bull. (Sl. 237)

If the aforesaid operations are done under the constellations in the mouth, there would be loss; if under those in the eye, there would be felicity; if under those in the ear, the cultivator would be reduced to the state of wandering beggar; if under those in the head, he would be possessed of fortitude; if under those in the horn, he would be happy; if under those in the shoulder, he would be blessed; if under those in the neck, he would be in trouble; if under those in the tail, it would be auspicious for him; if under those in the feet, he would be subject to constant travel; and if under those in the heart (belly?) he would keep in comfort. This has been declared by wise men as the effect of the bull-cycle in conjunction with the moon. (Sl. 238-239)

Extracts From Dipika

The ploughing of land is recommended under the constellations other than the *Purva, Krttikas, Bharani, Rahu, Magha* and *Siva* (?) on the lunar days excluding the *Riktas* (4th, 9th and 14th), the eighth and the new moon day, at the rise of the *Dvyangaligo* (?) on the week days other than Tuesday and Sunday and at the divisions of the day which are in conjunc-

tion with the moon. (Sl. 240)

The method of sowing too is said to be like that of ploughing. Sowing may also be done under the constellation *Citra*..... (Sl. 241)

Extracts From Bhima-Parakrama

The cultivator should begin ploughing facing the north and yoking the black bull on the left and the red bull on the right side of the plough. (Sl. 242)

It is declared by Garga that if in a field the bull takes a mouthful of grass after it has been yoked to the plough, there is sure to be a harvest twice the ordinary yield. (Sl. 243)

For the commencement of cultivation the first day of the lunar month is felicitious, the second brings success to the undertaking, the third is conducive to good health, the fourth always causes pest of insects, the fifth brings prosperity, the sixth leads of feuds, the seventh brings relief and enjoyment, the eighth is fatal to the bulls, the ninth ruins the harvest, the tenth brings prosperity, the eleventh is conducive to the increase in wealth and grain and fulfilment of desires, the twelfth is dangerous to the life of the cultivator, the thirteenth brings all round success, the fourteenth causes the death of the land-lord and the fifteenth proves sterile. (Sl. 244-247)

One should also avoid the new moon day, the eighth, the sixth and the *Riktas* (the 4th, 9th and 14th), and if cultivation is commenced on Sunday or Tuesday, there would be loss of wealth. (Sl. 248)

Commencement of cultivation under the constellations *Rohini, Sravana, Pusya, Magha, Hasta,* the *Uttaras, Asvini, Svati, Revati, Mula, Punarvasir,* and *Mrgasiras,* on Monday, Thursday, Friday and Saturday, and at the entrance of the sun into the zodiacal signs Virgo, Taurus, Pisces and Gemini, is considered as auspicious. (Sl. 249-250)

In the north-east (corner of the field) the cultivator, well-dressed, should worship the Kactrapala (the guardian of the fields) as well as adorn the plough with garlands and besmear the tip of the plough-share with curd, ghee and honey. He would be wise enough to begin the tilling with a brand new plough. (Sl. 251-252)

The sowing of the seeds is commended under the constellations *Hasta, Asvin, Pusya, Mrgasiras, Rohini, Dhanistha, Sravana, Satabhisaj, Svati, Krttikas,* and the *Uttaras,* and on Sundays, Mondays, Tuesdays, Thursdays and Fridays, and at the time of sun's entrance into the Gemini, Virgo, Taurus or Pisces. (Sl. 253-254)

Extracts from Rajamartanda

The following constellations and days of the week are auspicious for the sowing and reaping of the crop. The constellations *Rohini, Sravana,* the *Uttaras, Punarvasu, Magha, Revati, Pusya, Asvni, Mrgasiras, Satabhisaj, Svati* and *Visakha,* and the week days Sundays, Mondays, Wednesdays,

Thursdays and Fridays as well when the planet Saturn rises. (Sl. 255)

Extracts from Devala

Sundays, Mondays, Thursdays and Fridays are conducive to welfare, prosperity and auspiciousness, whereas Tuesdays, Wednesdays and Saturdays are futile. (Sl. 256)

The signs Aries and Scorpio, from their very nature, are fatal to all the cattle. At the entrance of the sun into the Cancer the commencement of agriculture will hardly bring any happiness and at its entrance into Libra, the seeds will not sprout. (Sl. 257)

Leo is baneful to the crop, the Sagittarius brings calamity to the king, and in Capricornus and Aquarius nothing but danger is predicted. (Sl. 258)

In Aries, Virgo, Gemini and Pisces, there is plenty of crop. The moon and the star are also commendable. Having bathed and dressed himself in clean white dress, the cultivator should worship the goddess Earth along with other planets and *Prajapati* in a proper manner with flowers and incense. Having circumambulated the fire, he should make munificent gifts, and then yoke black bulls to the plough, anoint the sides of their mouths with ghee or butter, and touch the end of the ploughshare with gold. He should, then, make an offering with milk, facing north-wards. Thereafter, auspicious and illustrious, he should begin the task of ploughing. (Sl. 259 a-b)

CHAPTER X

LIVESTOCK IN AGRICULTURE

Animal husbandry deals with the production of domestic animals or livestock, and it embraces all the phases of breeding, feeding and management. A. L. Anderson in his book 'Introductory Animal Husbandry' says: "The raising of animals is as old as civilization itself, for our common domestic animals were domesticated before the beginning of written history. Paleolithic man hunted animals for food and raiment; his successor, the Neolithic man, tamed and confined them. It was in the Neolithic or New Stone age that men first practised agriculture, which included the raising of domestic animals."

The cattle are so intimately associated with the science and practice of agriculture, that in ancient literature, they have been dealt with simultaneously. This is more so in the case of cows and bulls. In what a high esteem the cows had been held, is quite clear in innumerable *slokas* and verses used for the oblation and praise of cows. Even now-a-days, in the twentieth century, Hindus consider, rear and call them as "mother". In any Hindu festival, cow and cow produce including dung are the most auspicious articles and are essential parts in the religious rituals.

Cattle breeds in India have suffered much deterioration. But, this was the land where once existed the famous cow "Kamdhenu" (meaning producing according to desire) of Bashistha as spoken of in Mahabharata. The deterioration may be attributed to decrease in grazing areas, inferior and inadequate quantity of fodder, competition with human being for food, ignorance of the cultivators and many other factors. Somehow, the link with ancient culture was lost and the degradation followed.

In ancient India cattle tending was one of the items of *varta* and it was entrusted to a certain section of the people who thoroughly understood the business. "When *Prajapati* created cattle, he made them over to the *Vaisya;* and if a *Vaisya* is willing to keep them, it must not be kept by any other caste." (*Manu Samhita* IX, 326-327). Vaisyas were primarily agriculturists, formed a wealthy and respectable section of the community and produced fine breeds of cattle. There were certainly expert and well-experienced cattle breeders in India who built fine and rich cattle herds—some of which exist still in recent times in certain parts of India such as Punjab, Bihar, Gujarat and Kathiawar.

Agriculture, cattle-rearing, trade and commerce constituted the fourfold *vartha* or pursuits suitable for making fortune. Cattle-rearing has been noted in the Epics as important and universal an occupation as farming (*Ramayana* II. 67.12; 100.45; *Mahabharata* II. 5.79; 13.2; XII. 88.28),

It has already been mentioned in Part I (crop husbandry) how agriculture and cattle farming flourished simultaneously.

Contrary to the instruction of Manu that cattle rearing was the occupation of Vaisyas only, there are records in available literature that livestock and animal farming were not the business of a particular group or section of people. The kings themselves, the Ksatriyas, owned and reared the cattle and cattle-wealth was the mainstay of their house-hold finances. The outstanding examples are the emperor of Kosala (Ramayana II. 100.50) or of the prince of Kasi (Jataka. I. 240).

Besides horses, elephants, cows, sheep, and goats, they maintained buffaloes, camels, asses, mules, swine and dogs for a variety of purpose (*Arthasastra* II. 29). In the *Dhumakari Jataka* (III. 401), the high bred Brahmin is a goat keeper. "All the seventy families in a Brahmana hamlet on the slopes of *Grdhrakuta* mountains near Rajagraha took to cattle breeding as the sole means of livelihood (Chinese Dharmapada by Beal)" The *setthis* or merchants mentioned in *Jataka* (I. 388) were also keepers of cattle. The universality of cow-keeping and cattle trade is manifest in the common use of cows as a standard of value and medium of exchange in the transitional stages between barter and money transaction.

Animal husbandry was the occupation, either sole or part, of most of the people. Economic condition of the former classes of people was mainly dependent upon agriculture. Some of them were really very rich and possessed extensive farms. This is best illustrated by the example, in the Dhaniya, the son of a *setthi* in Vedaka (as mentioned in Suttanipata by Paramatthajotika). Dhaniya owned about 30,000 head of cattle, of which 27,000 were milch cows and luxuriant meadows for pasture. The ganapati Mendaka enjoyed a bigger farm which had been managed by as many as 1,250 cow-keepers (Mahioagga 34.19).

Every villager also used to keep a few animals for draught purposes or for doing or to meet the supply to his own household. The village maintained common on pay or on a share of produce, shepherds, who were entrusted with the work of taking the animals to the pasture ground in the morning and bring them back in the evening (*Anguttaranikaya.* I. 205; *Rigveda* X. 10. ef).

The herds were taken to be kept in forests in spite of great inconvenience and constant threat from wild beasts and cattle-lifters. Village happened to be surrounded by vast arable land. Beyond that was situated the pasture land interspersed with wild tracts of dense forest infested with wild animals. It would be dangerous for crops if the herds are allowed to graze near the crop fields and for this reason, they were driven to distant woods for grazing. This was not necessary when there was extensive pastureland outside the crop zones.

How much was the responsibility and hard was the duty of herdsman may be clearly understood from the following extracts of the book 'Social and Rural Economy of Northern India, Vol. I by A. N. Bose.

"This custom illustrates what a grave responsibility and thankless job was the herdsman's. The depredation of lions and tigers (*Jat.* I, 388, III. 149, 479; *Dn.* XXIV. 2.5; *Arth.* II. 29; *Mbh.* VII. 1.24, 95.23) was not the only menace to prevent; much more troublesome to cope with was the perpetual interference of thieves. Cattle-lifting was a universal crime indulged in equally by the smallest pilferer (*Jat.* I, 140, IV. 251, VI. 335) and by the suzerain emperor of Jambudwipa (*Mbh.* III) (Cf. *Mbh.* I. 215; Ep. In. VI. 16. B; VII. 4) and such was its magnitude that the author of the Arthasastra was exasperated into laying down that thieves of cattle and abettors are to be put to death (II. 29).

Apart from protection against brutes and thieves, herdsmen had other responsibilities classified into 11 qualities in the Buddhistsuttas calculated to bring success in looking after the herd and in promoting its increase. The competent man (i) has knowledge of form (rupannu), (ii) has an eye for marks (lakkhanakusalo), (iii) gets out ticks (asatikam sateta), (iv) dresses sores (vanam paticchadetva), (v) smokes out the lairs (dhumam katta), (vi) knows about fords (tittham janati) and (vii) watering places (pitam janati) and (viii) roads (vithim janati) and (ix) pastures (gocarakusalo), (x) does not milk dry (svasesadohi) and (xi) tends with special attention the bulls that are the sires and leaders of the herd (te usabha gopitaro goparinayaka te atirekapujaya pijeta hoti, Mn. 33, An. V. 350). The Arthasastra rule requires of him the knowledge to treat cow diseases and ford them safely (II. 29). The knowledge of tittham is further illustrated in the Majjhima nikaya (34) where a man courts disaster to his herd in trying to drive it across the Ganges where there was no ford (presumably there was miry or steep bank, strong current or a cataract or whirling pool), and another safely drove it across. Here as well, preference is given to the sires and lords of the herd.

The Arthasastra wants the best herd to be entrusted for a fixed wage (vetanopagrahikam) for otherwise they may be spoiled by overmilking. Herds of the next grade are surrendered for a fixed amount of dairy produce (karapratikara), viz., 8 varakas of ghee per year which the owner will receive. Only the useless and abandoned lot (bhagnotsrtakam) is given for a share of dairy produce which is fixed at 1|10 (II. 29). There is a touch of realism in the joke flung at Nagasena by a brother that he was carrying his canonical lore for the benefit of others just as the herdsman tends cows while others enjoy the produce (seyyatha pi..... gopalako gavo rakkhati anne gorasam paribhunjati, Mil. p. 18). Truly, the herdsman's was not an enviable job.

Domestic Animals

To turn now to the different species of domesticated animals and their economic utility. In the Mahabharata is given that lion, tiger, boar, buffalo, elephant, bear, and ape are the seven wild animals (aranyah); and cow, goat, sheep, horse, mule and ass are seen domestic animals

(gramyah, VI. 4. 13f. Bengal text). Of the former group, boar, buffalo and elephant are found to be reared. These animals were very often cultivated by single species. We come across, for example, not only the *gopalaka* and *ajapala* but also the *pindaraka* and *sukaraposaka* (Arth. II. 29; Dn. XXIII. 25) (the varieties of animal flesh were also disposed of from separate stalls in the market place and different sets of stockists and butchers throve on them; e.g., the cattle-butcher (goghatako), sheep-butcher (orobhiko), pig-sticker (sukariko), fowler (sakuntiko), deer-stalker (magaviko), etc., Mn. 51 cf. Iguana-trapper (godhaluddako) in Jataka I. 488. Rhys Davids observes the absence of any custom of breeding cattle for the meat market (Buddhist India, p. 94). Against this may be noted the frequent reference to the slaughter house (suna, parisunam). The camel and the dog are conspicuous in royal stables and kennels (the mention of dogs in royal house-hold is frequent in the Ramayana. Alexander received 150 dogs as present from King Sopeithes (Str. XV. i 31) and the fawn noise about the village farmyard. The ducks are not seen in domestic animalry. Cow, buffalo, goat and sheep were reared for dairy (gorasam) as well as for meat supply and skin. Swine and fowl were meant entirely for consumption. The ox alone drew the plough. The bull, mule, ass and camel were used for draught (on rare occasions also horse and elephant (Arth. II. 30 ff; Mbh. V. 132. 21; Pliny. VI. 22; Solin, 52. 6-17; Arr. XVIII) and could be let out on hire by owners (Str. XV. i. 41; Jat. I. 195). The dog assisted herdsmen to reconnoitre grazing forests (Arth. II. 29) or guarded royal apartments (*Jat.* I. 175) or served as hunting accomplices to the king (*Jat.* IV. 437) or nomadic huntsmen (*Jat.* VI. 428). The horse and elephant were employed according to their varied nature for draught riding and war. Animals used for draught purposes were generally castrated and sometimes their horns were cut off (Mbh. XII. 15.51). The beasts, wild and domestic yielded a large variety of animal produce, viz., skin, claw, horn, hoof, plume, tusk, wool, etc."

CHAPTER XI

COWS AND BULLS

Cows have been mentioned as a symbolical representation of the "Earth", rays of sún or the Goddess of speech. In the *Matsya Purana,* the earth is represented as taking the form of a cow. Again, in *Sutta Nipata, Brahmandhammika* Sutta (13, 24), we find that Buddha, in his discourse on the preaching against the killing of cows, says "Live unto mother.....The cows are our best friends.....As water, earth, gold, wealth and corn, even so are the cows for the men, for this is a requisite for living beings."

The respect and praise for cows, naturally by virtue of the immense benefit and economic importance, are clearly evident from the following extracts of Rigveda (VI. 28)—translated from original Sanskrit manuscript.

These (the cows) are not lost, nor lifted by a thief, nor their wicked foe attempts to harass them. For many a year their master lives with them with whom (i.e. with whose products) he sacrifices and offers gifts to the gods.

The steed with dusty nape never overtakes them, nor do they ever go near to the slaughter-house. These cows of the worshipping mortal roam about fearlessly over a wide pasture.

Cows are (the god) Bhaga, they seem to me to be Indra. Cows are the draught of the first-pressed soma. These very cows, O men, are Indra. I long for Indra with my heart and thought.

O cows, you fatten the lean one and make beautiful the appearance of one who is ugly. O ye with auspicious voices, make my house blessed. Your power is loudly applauded in our assemblies.

Turn back, do not proceed further; visit us, O you wealthy ones. Agni and Soma, who bring wealth again and again, bestow riches on us.

Turn them back to us again, bring them near to us again. May Indra Agni and Soma, who bring wealth again and again, bestow riches on us.

Let them return to us again. Let them feed under this cowherd. O Agni, keep them here and whatever wealth is there (with us) let that remain intact.

REARING AND CARE OF COWS

Detailed account of rearing of cows is given in Brhat Parasara-Samhita as cited in Vacaspatya-Kosa. Translations of the relevant portions of the text are given below.

The Brahmana householder should tether, nourish and protect his cattle (kine) and should take great care to tend the calves, because in due

course of time they grow to full stature. (Vol. II, Sl. 7)

The kine should not be sent afar for pasturing because if they are sent too far for grazing their wanderings may not prove safe. (Vol. II, Sl. 8)

The householder should milk the cows in the morning as well as in the evening. They do not, as a rule, make increase in their yield of milk if the milking man is changed. (Vol. II, Sl. 9)

Eating mere cast off stubble they yield milk day after day, which pleases the gods. Why should, then, the cows not be worshipped? (Vol. II, Sl. 10)

The cow is the very congregation of all the gods, for in her head sits the god Brahma, on her shoulders Siva, on her back Visnu, on her feet the Vedas and whatever other gods are left, they occupy every hair on her body. The lord Hari (Visnu) is pleased with devotional attentions paid to her. (Vol. II, Sl. 11-12)

Why should the cows not deserve worshipping when their touch removes sin, their milk provides nourishment and, if given as gifts, they lead the way to heaven? (Vol II, Sl. 13)

Why should homage not be paid to cows when the very dust raised by their hoofs destroys the sin of man? (Vol. II, Sl. 14)

What that pertains to the cows is not worthy of respect asks Parasara, when even her dung and urine wash away the sin of one's father? (Vol. II, Sl. 15)

A cow should not be milked without her calf, nor when she is pregnant. One who milks her prior to ten days after her delivery, goes to hell. (Vol. II, Sl. 16)

Good people of the three castes, who seek happiness, should not draw milk from a cow who is weak, diseased or in heat or has given birth to twin calves. (Vol. II, Sl. 17)

Cows (milked when) in heat, too numerous moles (on the body), a fickle-minded woman and fraternal quarrels—all these lead to the extinction of a family. (Vol. II, Sl. 18)

If the entire earth with its mountains, woods and forests be put on the one side and the cow, who benefits here and hereafter, on the other, then, surely, the cow would be worthier of the two. (Vol. II, Sl. 19)

Caste people should properly maintain the venerable cows from whom they take toil. He who nourishes and worships them rejoices (in heaven) after departing life. (Vol. II, Sl. 20)

The cows should be tied (to their posts) with their face towards the south or towards the north, but never towards the east or the west (Vol. II, Sl. 21)

In the shed (or stable) in which cows, bulls or horses are stalled, a sharp iron sickle should always be kept. (Vol. II, Sl. 22)

Cows should be given away as gifts (to the Brahmanas); they should always be protected, nourished and cared for. Those people who beat or drag them, are wicked and their limbs burn in the hell and they are

asphyxiated with asthma. (Vol. II, Sl. 23)

The cowherd should not turn a cow going astray with a stick: he should only urge her on the 'gee, gee-ho!' and should prevent her by shouting, 'Don't, don't be afraid.' (Vol. II, Sl. 24)

One who touches a cow and ambulates round her keeping her always to his right, earns the same merit as if he had gone round the whole earth with its seven continents. (Vol. II, Sl. 25)

One who feeds her daily with fodder consisting of grass and water, undoubtedly earns the same merit as would accrue by performing a horse-sacrifice (*Asvamedha*). (Vol. II, Sl. 26)

(The merit of) baths taken at all the holy places or in the oceans and lakes of the whole world, does not touch even the sixteenth fraction of the one taken with water in which the horn of a cow has been bathed. (Vol. II, Sl. 27)

How can sins pollute them whose houses are adorned with the presence of cows with young calves like their very wives with young children? (Vol. II, Sl. 28)

The Brahmanas and the cows belong to one and the same family which has been split into two. In the one half, reside the holy *mantras* (incantations) and in the other are deposited the oblations. (Vol. II, Sl. 29)

With the help of cows the sacrifices continue uninterruptedly, with the help of cows the gods are established in their high position, and by cows were the Vedas recited with their six auxiliary sciences and the *Pada* and the *Kramapathas*. (Vol. II, Sl. 30)

The people who dwell amongst cows, in whose front there are bulls and at their back as well as in their heart is nothing else but kine, are blessed on this earth and the like of them are hard to find even in heaven. (Vol. II, Sl. 31)

At the root of the (cow's) horn sits Brahma, in its middle sits *Kesava* (i.e. Visnu) and at the end sits Siva—thus, the triad of gods resides there permanently. (Vol. II, Sl. 32)

At the tip of the (cow's) horn are all the holy places as well as personages and all the gods reside in her body. Thus cow is the very embodiment of all the gods. (Vol. II, Sl. 33)

At the top of her forehead resides the goddess (Parvati), in her nostrils the god *Kartikeya*, and in her ears the two Naga (serpent) chief *Kambala* and *Asvatara*. (Vol. II, Sl. 34)

In the eye of that divine *Surabhi* (cow) and the sun and the moon, in the teeth the eight *Vasus* and in her tongue sits the god *Varuna*. (Vol. II, Sl. 35)

The Sarasvati resides in her lowing, Yama and Yaksa (Kubera) on her temples, the *risis* (sages) in her pores and the water of the Ganges in her urine. (Vol. II, Sl. 36)

The Yamuna along with other goddesses, resides in her dung. Twenty-eight crores of gods dwell in down. (Vol. II, Sl. 37)

In her stomach resides the *Garhapatya* fire: in her heart, the Daksina fire; in her mouth the *Ahavaniya* and in her sides the *Avasathya*. (Vol. II, Sl. 38)

Therefore, one who restrains his temper in controlling the cows, attains great prosperity and is glorified in the heavenly world. (Vol. II, Sl. 39)

One should not step over feeding trough nor should one avoid her stench. The more one inhales her the more merit he earns. (Vol. II, Sl. 40)

One who gives as a gift (to a Brahmana) a milk-yielding young cow with her calf alive, his merit equals to the (erection and) dedication of a Siva temple or the gift of the whole world. (Vol. II, Sl. 41)

By the Sutra period, cow has acquired the status of high sacredness. Apastamba (1, 2, 20, 21, 30) says that "one should not void excrements facing cows or stretch out his feet towards them." If one kills a cow wilfully, it was considered to be a serious crime and the killer was to be severely punished. Even, if the killing was by accident or one was responsible for the killing indirectly, he was to undergo seven austerities (Apastamba Samhita, Ch. I. The Parasara Samhita, Ch. IX. A Sambarta Samhita and also the Agnipurana. Ch. CCXXVII). The law laid down in this connection by the Arthasastra is even more drastic. "Whoever hurts or causes another to hurt, steals or causes to steal a cow should be slain."

Brahaspatimiti (Chapter X, II) prescribes still more severe and cruel punishment for theft of a cow. The suspected offender is first made to draw ploughs and then, if the guilt is proved, they were severely punished. A ploughshare made of iron having weight of twelve *palas*, was heated to redness and the thief would be made to lick with his tongue. If he is not burnt in this process, he would be acquitted.

In this connection, the following lines from Agnipurana as quoted by Gangopadhyaya in his book 'Agriculture and Agriculturists in Ancient India' will be found interesting:

"The cows are holy and blissful and the universe owes its existence to the bovine species. Hallowed is the touch of a cow and hallowed is the ground she stands upon (Cf. Vasistha III, 57; Manu IV, 124, Baudh. 1, 6, 13, 19). Cows offer the best sustenance to all sorts of animals (Cf. Satapatha Brahmana III, 1, 2, 14). The cows are the holiest of the holy, the best of all auspicious sights (At Bodh Gaya and other places, we find that a cow with a suckling calf' as an auspicious sight, acquired a large place in fine arts). The pools where of a cow would drink should be deemed as a sanctuary. The man who gives morsels of food every day to a cow, is sure to ascend heaven after death. The man who provides a cow even belonging to another with similar morsels of food merits a similar salvation; while the man who does anything for the welfare of the bovine species in general goes to the region of Brahman after death. The man who makes the gift of a cow, (Vishnu in XCII, 5, says and in the Brhaspati

Samhita (edited by Pandit Panchanan Tarkaratna) we find in verse 4, (Cf. Also Vasistha XXIV, II), or sings any hymn in her praise or rescues her life from jeopardy or from imminent peril, ensures the salvation of all souls any way related to him in life" (Cf. CCCXII).

Thus ancient Aryans had always borne in their hearts a tender solicitude for the well-being of their cattle and awarded by the Sutra period, a peculiar religious veneration to the cow.

USE OF BULLS AND BULLOCKS

Bulls and bullocks were widely employed as draught animals. Their usefulness is distinctly portrayed in the following extracts from *Braht-Parasara Samhita* (cited in *Vacaspatya-Kosa*):

Why should the bulls be not worshipped?—they who grow all kinds of food-grains but themselves eat only grass and sustain the whole world!

Why should the bulls be not worshipped?—the gift of one of them being equal to that of ten cows and in whom is embodied the very image of *Dharma* (religious virtue) on this earth.

They should be carefully tended and yoked in a proper manner. One who takes toil from them without tending them, goes to a hell full of horrors.

A bull with an extra or a deficient limb, or with spots on the body, or otherwise suffering from a bodily injury should not be yoked by a Sudra. If he does so, he would be ruined.

A person should avoid milking cows which are afflicted with malignant diseases. But he should carefully tend all of them, for tending would bring him blessings.

God created these bulls for (growing) the food-grains, because with food-grains are regaled the three worlds with their mobile and immobile life.

The Creator has created the bull and the cow for procreation (of the bovine species). With the harvest grown by them (i.e. oxen) all the beings are sustained. (Vol. II, Sl. 42).

One who tends and rears them with care, he so to say, is the sustainer of all the worlds. (Vol. II, Sl. 43)

The reward that accrues to one for rearing the oxen is ten-times the merit that the wise have declared to accrue in protecting the cows. (Vol II, Sl. 44).

The entire animate and inanimate world is supported by oxen. Hence an ox should always be protected and well-fed. (Vol. II, Sl. 45).

Brahma (the Creator), intent on the welfare of the world has made an ox the very image of *Dharma* (Virtue) on this earth capable of producing the food-grains and sustaining the three worlds. (Vol. II, Sl. 46).

They roam about in remote and far off places and eat with relish wild grasses which are unfit for (human) consumption. Who would not, then, worship the oxen? (Vol. II, Sl. 47).

They make the cultivation of crops possible, they thrash the harvest and they carry it to far off places. What other animal would, thus, be superior to an ox? (Vol. II, Sl. 48).

They draw and bring loads from afar by means of the strength of their shoulders, they do not demand food-grains for their food, and they preserve the lives of others with their own lives, nourish them and make them flourish. (Vol. II, Sl. 49).

The gift of one ox means the giving away of ten cows and is equal to the gift of the whole earth. Therefore, no other animal than an ox deserves veneration. (Vol. II, Sl. 51).

Having been instrumental in growing the food-grains, they (oxen) themselves eat grass and then carrying the entire harvest (to its destination) they do not complain even if they are fatigued. Oh, the entire living creatures are sustained by the oxen. (Vol II, Sl. 52).

The nostrils of an ox should not be pierced for three or four days after it has become strong-limbed and should never be pierced before that time as long as he is weak. (Vol. II, Sl. 53).

Professionals should make the nose-pins, twelve *angulas* in length from the *Khadira* or *Sheesham* wood and should have a pair or three of them. (Vol. II, Sl. 54).

Krishi-Parasara by Parasara contains some useful hints about the attention to be paid to draught cattle. Translation of some of the portions of this book are given below:

One should do cultivation in such a way that the oxen are not wearied. Crop raised by the fatigue of the draught animals is condemned by the gods and the *Manes*.

Cultivation done by overworking the animals, though yielding a four-fold harvest to the cultivators, nevertheless proves futile and perishes with everything else.

He, who works the animals to exhaustion, ultimately wanders on earth's four quarters in great misery under the curse of poverty.

Black, red or black and red bulls are commended for yoking to the plough. Therefore at the commencement of tilling the land one should take care to select bulls of this kind and smear the sides of the mouths with butter or ghee.

A bull that is rogue or whose horns or hoofs are broken or whose horns are either too short or too long (?) should, as far as possible be avoided in ploughing.

Standing erect and facing the east he (i.e. the cultivator) should make the offering of milk and then he should worship the plough and put wreaths round the (neck of the) bulls.

O Lord of the gods and the husband of Sachi (i.e. Indra)! accept our offering consisting of white flowers, curd, milk and ghee, and pray, send good rainfall.

In the course of ploughing, he should avoid striking and hurting the

tail and the ears of the tired oxen and also refrain from beating them too often.

Atri, Parasara, a pastamba and others say: "One who yokes 8 oxen to a plough is a pious man. One who yokes 6, is just a business man. Cruel are those who employ 4 and those who employ 2 are but beef-eaters". (Apastamba, 1, 2, 3; Agni-purana CXLII, 4).

Gautama in IX, 23, enjoins that a cow suckling her calf must not be interrupted (See also Manu IV, 59; Ap. 1, 31, 10, 18; Vasistha XII, 33 and Visnu LXIII, 2). Baudhayana in II, 3, 6, 13 says that the rope to which a calf is tied must not be stepped over; and in the Manu Samhita, IV, 162, we find the injunction that cows must on no account be offended. We have already seen that any act of violence against the bovine species in general was highly condemned (The Indo-Iranians also deprecated all violence against the cattle. See the Zend-Avesta, Yasna XII, 2). The Arthasastra in Book II, Chapter XXVI, explicitly lays down the rule that a calf, a bull or a milch-cow shall not be slaughtered, and in Bk. II, ch. XXIX, says, (i.e. he who sells a cow shall pay to the king ¼ the value of the cow. (Dadistan-i-dinik in ch. LIII while referring to the sale of cattle for slaughter and foreign eating, enforces certain restrictions to the sale so that the national interest might not suffer. (Quoted from Gangopadhyay's book 'Agriculture and Agriculturists in ancient India').

COW-SHED

Parasara in Krishi-Parasara says that by keeping the cow-shed clean and beautiful, the cattle not only remain happy but also become healthy. He gives in his book some useful suggestions for keeping the cow-shed neat and clean. Translations of the important portions pertaining to the cleanliness of the shed are given below:

The animals of a cultivator, whose cow-shed is strongly built and is clean and free from dung, thrive even without very nourishing food. (Sl. 17)

What can nourishing feed do to (strengthen) the animals when every day they come out of the shed with their bodies besmeared all over with dung and urine? (Sl. 18)

A cow-shed measuring five by five (?) is good for the healthy growth of the cattle. If it is constructed on a place broadening outwards, it is sure to bring destruction to the cattle. (Sl. 19)

If a cultivator, by mistake, constructs the shed on a land that is broad in front and narrow at the back, then he brings ruin on his cattle through his folly. (Sl. 20)

The washings of rice, hot scum of the boiled rice, fishbroth, cotton-seeds, and husk, if kept in the cow-shed, prove baneful to the cattle. (Sl. 21)

A broomstick and a pestle placed in the cow-shed, prove fatal to the cattle, so also does the tying of a goat there. (Sl. 22)

If the householders evacuate their bowels in the cow-shed full of

streams of cow's urine, how can they expect the safety of the life of their cattle? (Sl. 23)

If one wishes the prosperity of his cattle, one should not even by mistake allow the cowdung to be removed on Sundays, Tuesdays and Saturdays. (Sl. 24)

Barring the above three days one may give away the cow-dung to anybody. The removal of cowdung on Tuesdays and Saturdays is detrimental to cattle. (Sl. 25)

Wealth does not remain in house in which the phlegm, urine or dung of the cows or mud and dust from their feet does not fall. (Sl. 26)

A shed in which a burning lamp is not placed at the dusk time, remains bereft of wealth and splendour and the cattle, casting a look on that (gloomy) place, begin to low. (Sl. 27)

A plough drawn by eight oxen is consistent with virtue (or religion), the one drawn by six oxen is that of business like people, the one drawn by four is of cruel people and that drawn by two oxen is of those who eat beef. (Sl. 28)

Invariably there is all round prosperity from land that is ploughed ten times, wealth from that ploughed five-times, mere subsistence from that ploughed three times and debt from that which is ploughed only once. (Sl. 29)

A person who ploughs his land twice can produce food barely for his own sustenance and he is incapable of making any offering to *Manes*, gods and guests. (Sl. 30)

"To safeguard against the breaking out of diseases, the cow-house should be occasionally fumigated with vapours of *devadaru* (*Pinus deodora*), *vacha* (oris root), *mamsi* (pulp of fruits?), *guggula* (a fragrant gum resin) asafoetida and mustard seeds mixed together (The Agnipurana. Ch. CCXCII, 33 and 35); and "A pinyaka tree (*Asafoetida*) should be planted in the cow-house with a view to improve its general sanitary condition."

CHAPTER XII

TENDING OF CATTLE

Tending of cattle was regarded as a sacred duty by the people in ancient India. Krishi-Parasara contains elaborate rules of looking after the cattle. Translations of the important portions of this book are given below.

The three *Purva* (*Bhadrapada, Phalguni,* and *Asadha*), *Dhanistha, Ardra* (?), *Naindragni* (?), Mercury and *Sata-bhisaj*—all these constellations are auspicious for the releasing and bringing back of the cattle. (Sl. 106)

In the three *Charas* (?), under the *Rohini* constellation, on the day preceding that of new moon, on the fourteenth lunar day, under the *Sravana, Revati, Hasta, Ardra* and on the eighth day of the lunar month the cattle should not be let out nor let in their own shed. For, by doing so the cattle and other animals perish. (Sl. 107-108)

On Sundays,————, and Tuesdays the letting out and in of the cattle is prohibited (?). For, by letting out, there is disaster for the cattle and by letting in there is disaster for the owner. (Sl. 109)

DISPOSAL OF DUNG

A successful cultivator should worship the heap of cowdung in the month of *Magha,* and on an auspicious day he should turn up the manure with spades. (Sl. 110)

Reducing the manure, which is drying in the heat of the sun, into the powder, he should deposit it in pits in each field in the month of *Phalguna.* (Sl. 111)

Then at the time of sowing, he should dress the field with manure. For, without manuring the crop neither thrives nor yields fruit. (Sl. 112)

TAKING OUT COWS FOR GRAZING

The three *Purvas, Dhanistha, Jyestha, Krttika, Mygasiras,* and *Satabhisaj* are the constellations that are always auspicious for letting the cattle in and out. (Sl. 37)

One should not take the cattle out or introduce them into the shed under the constellations—the three *Uttaras, Rohini, Pusya, Sravana, Hasta* and *Citra,* as well as on the day preceding the new-moon day and on the fourteenth and eighth days of the lunar month. His cattle and other grazing animals perish who transgresses this injunction. (Sl. 38-39)

If the cattle are taken out on Saturdays, Sundays or Tuesdays (for grazing for the first time) then calamity would befall them and if they

are led into the shed on those very days, then it would befall the owner of the house. (Sl. 40)

THE SUPERINTENDENT OF CATTLE

In Kautilya's Arthasastra (Bk. II Ch. 46) are recorded the duties of the superintendent of cattle and the ways in which he should deal with them. Translations of the relevant portions are given below to enable the reader to have an idea of the importance attached to the tending of cattle in olden days by the Indians.

The superintendent of cattle shall have under his control (1) herds maintained for wages, (2) herds surrendered for a fixed amount of dairy produce, (3) disabled and abandoned herds, (4) herds maintained for a share in dairy produce, (5) classes of herds, (6) strayed cattle, (7) cattle that are irrevocably lost, and (8) the total produce of milk and ghee. (Sl. 1)

The group of a cowherd, a buffalo-herdsman, a milker, a churner and a hunter may be entrusted with a hundred cattle each for grazing on wages in cash. For, if they are paid in the shape of milk and ghee, they would starve the calves to death. This arrangement of rearing the cattle is called *vetanopagrahika,* i.e. 'herds maintained for wages'. (Sl. 2)

One person may be engaged to rear a hundred cattle consisting of an equal number of aged cows, milch-cows, pregnant cows, heifers and calves. In return he may be required to give to the owner annually 8 *varakas* of ghee, one *pana* per head of a cattle and the branded skin (of dead cattle, if any). This system is known as *Karapratikara,* i.e. 'herds surrendered for a fixed amount of dairy produce'. (Sl. 3)

Persons may be engaged to rear a hundred head of cattle consisting of an equal number of each of the diseased cattle, crippled cattle, cattle habituated to one particular milked, cattle that are hard to milk and cattle that kill their own calves. In return they may be required to give a stipulated share in dairy produce to the owner. This system is called *bhagnotsrstaka* i.e. 'disabled and abandoned herd. (Sl. 4)

When the owners pay one-tenth of the dairy produce of the cattle in return for their protection to the superintendent in whose care they are kept for fear of hostile cattle-lifters and predatory foresters, the arrangement is called *bhaganupravistaka,* i.e. 'herds maintained for a share in the dairy produce'. (Sl. 5)

Suckling calves, weaned calves, tameable ones, draught oxen, bulls for crossing cows, for yokes, riding purposes and pulling carts, steers for beef, buffaloes both for loading and traction, suckling female calves, weaned female calves, heifer, pregnant cows, milch cattle, cows and buffaloes that have not calved or are barren, and their very young male and female calves a month or two old—(are the different classes of cattle). They should be branded as soon as they are a month or two old. Cattle which have remained (unclaimed) in the pound for a month or two, should also be branded. Branded marks, natural marks, colour, distinction of horns

and other distinctive signs of the cattle when they are young, should be registered by the superintendent. This system is known as *vraja-parya-grain,* i.e. 'classes of herds'. (Sl. 6)

When an animal is carried away by thieves, or mixes into other people's herds or strays unknown, it is called *nasta,* i.e. 'lost'. (Sl. 7)

When an animal sinks in a quagmire, falls from a precipice, dies of disease, old age or drowning in water, or when it is killed by the fall of a tree or river-bank or the blow of a staff or stone, or is devoured by a tiger or bitten by a snake, or is carried off by a crocodile, or is burnt in a forest fire, it is termed as *vinasta* or 'irrevocably lost'. Cowherds should endeavour to keep them away from such dangers (?). (Sl. 8)

In this manner the superintendent should keep complete information about the cattle. (Sl. 9)

A person who himself kills or steals the cattle or instigates another to do so, should be punished with death. (Sl. 10)

(An official) who converts a private animal into state-property by branding it with royal mark shall be punished with the first amercement. (Sl. 11)

When a person recovers a local cattle stolen away by thieves, he shall receive the promised reward, but when he rescues a foreign cattle, he shall receive half of it. (Sl. 12)

Cowherds should apply remedies to young calves, old and diseased cattle. (Sl. 13)

They should graze the cattle in pastures which are set apart for various seasons and from which thieves, beasts of prey and dangers from enemies have been driven away or dispelled by hunters aided by their hounds. (Sl. 14)

For the purpose of scaring away snakes and tigers and as a means of knowing the whereabouts of the cattle, sounding bells should be tied round the (neck of) timid cattle. (Sl. 15)

Cowherds should lead their cattle (for drinking or bathing) to such reservoirs of water as are provided with even and spacious descents and are free from mice and crocodiles, and should protect them (all the time from dangers). (Sl. 16)

They should report (to the superintendent) whenever an animal is caught hold of by a thief, a tiger, a snake, or a crocodile, or dies of disease or old age. Otherwise they shall have to pay the price of the animal. (Sl. 17)

When an animal dies through some cause, they (i.e. the herdsmen) should bring the branded skin (to the superintendent as testimony), if it is a cow or a buffalo; the branded ears, if it is a goat or sheep; the tail and the branded skin, if it is a horse, an ass or a camel. They should also collect the hair, the hide, the bladder, bile (or gall-bladder ?), sinews, teeth, hoofs, horns and bones. (Sl. 18)

They may sell the fresh or dried meat (of the animals). (Sl. 19)

They may give the butter-milk to dogs and hogs (for drinking). (Sl. 20)

They should bring some (of the butter-milk) in a bronze vessel for their rice-meal. (Sl. 21)

They may use the coagulated milk for soaking in it the fodder and oil-cakes. (Sl. 22)

One who sells an animal, shall pay one-fourth of the value of the animal (to the superintendent). (Sl. 23)

During the rainy season, autumn, and the dewy season they should milk the cattle both the times (morning and evening); and during the winter, spring and summer, only once (i.e. in the morning). He who milks the cattle a second time during these seasons shall be punished by having his thumb cut off. (Sl. 24)

If he allows the milking-time to lapse, he shall forfeit his remuneration for that time. (Sl. 25)

The same punishment (i.e. forfeiture of remuneration) shall hold good in case of negligence of the opportune time for putting a string through the nose of the animal, for taming them, for yoking them, for breaking the new animal (to work with an old one), or for training them. (Sl. 26)

A 'drona' of a cow's milk will yield one 'prastha' of ghee; the same quantity of buffalo's milk will yield one-fifth more; and that goats and sheep will yield two-fifths more. (Sl. 27)

The exact quantity of ghee (in all kinds of milk) can be ascertained by churning, for increase in the yield of milk and ghee depends on the nature of the soil and the quality of fodder and water. (Sl. 28)

When a person causes a bull attached to a herd to fight with another bull, he shall be punished with the first amercement. (Sl. 29)

He who injures such a bull shall be given the highest punishment. (Sl. 30)

A hundred cattle should be grouped in herds of ten each of similar colour and put under the care of cowherds. (Sl. 31)

The cowherds shall take their cattle for grazing to far or near regions of the pasture according to the strength of their herds and their own capacity to protect them. (Sl. 32)

The goats, etc. shall have their wool shorn once in six months. The same rule shall apply to the herds of horses, asses, camels and pigs. (Sl. 33-34)

For bulls with nose-strings which are as good in speed and drawing or carrying loads as horses, half a *bhara* (=2000 *palas*) of green grass, twice as much of straw, one *tuta* (=100 *palas*) of grain, five *palas* of salt, one *kudumba* of oil for rubbing over the nose and one *prastha* of it for drinking—serve as ordinary feed. In addition, they may be given one *tuta* of flesh, one *adhaka* of curds and a pottage of one drona of barley or *Phaseolus radiatus*. Further, a *drona* of milk or an *adhaka* of liquor in-

stead, a *prastha* of oil, ten *palas* of jaggery and a *pala* of dried ginger should be mixed up into a drink and given (daily as digestive and appetiser). (Sl. 35)

The same commodities less by one quarter each will form the feed for mules and big asses, and twice the quantity of these commodities for buffaloes and camels. (Sl. 36)

For draught oxen and cows yielding milk, the food shall be provided in proportion to the duration of time the oxen are put to work and the quantity of milk which the cows yield. (Sl. 37)

All cattle should be fed with fodder and water to their satisfaction. (Sl. 38)

This concludes the description of the rearing of the herds of cattle. (Sl. 39)

A herd of 100 head of asses and mares shall contain five stallions, that of goats and sheep ten rams, and those of cows, buffaloes and camels shall contain four breeding males each. (Sl. 40)

CHAPTER XIII

PROTECTION OF CATTLE AND USE OF ANIMAL FOOD

Eating of flesh of animals was not usual in the past. But however under certain unavoidable circumstances its consumption was allowed by society. Instances of taking flesh except on ceremonial functions are available in ancient literature. Taking of animal food is strictly forbidden in ancient laws under the threat of expiable sin and eternal perdition unless taken in conformity with the law, i.e. Vedic rites and sacrifices (Visnu LL. 59-78; Manu, IV, 83-52; Yajnavalkya, I. 980f).

PROTECTION FROM ECONOMIC VIEW

In his book 'Social and Rural Economy of Northern India', A. Bose gives a very exhaustive account of cattle preservation both from the ethical and economic points of views. Important excerpts from the book are reproduced below.

But the doctrine or sentiment of ahimsa could not arrest animal carnage,—among the Brahmanas for sacrifice, among the ruling classes for sport and among the lay public of all grades for food and articles of luxury and use—such as skin, feather, bone, horn, hoof, etc. (Jacobi: J. S., I.p.12).

In the Mahabharata a long lecture on the virtues of ahimsa and abstention from meat-diet (XIII. 115 f.) is followed by exceptions made in favour of sacrifice and hunting for the royal race. Of Brahmanical protest against animal sacrifice there are only faint traces and even these half-hearted and conditioned apologies may have been inspired under Buddhist influence (Mbh. XII. 264; 338. 4 ff; XIV. 91). The law-givers legislated for the guidance of Brahmanas alone. Manu even allows a Brahmana to adopt the calling of a butcher (mamsavikrayin, III. 151) in exceptional circumstances. Buddha himself allows fish and flesh to his disciples on the three conditions of not having seen, heard or had suspicion (Mv. 31. 14; Mn. 55). Of checks against destruction of animals for the above purposes there are only meagre evidences. The social stigma attached to the professional hunter and purveyor in flesh (nisada, kirata, heddaka, luddaka) in the Epics and the Jatakas may have been a partial safeguard and Megasthenes' observation of hunters "Who alone are allowed to hunt" (Str. XV. i. 41) probably reflected the general relegation of hunting professional to those degraded castes. (Apart from the despised classes who took to hunting as a means of livelihood, sport as an enjoyment is found confined to kings and chieftains. We hardly come across agricultural and mercantile classes indulging in it; and if and as soon as they take to it

for living they get the brand of degradation). An anecdote in the Mahabharata tells how Ydhisthira spared the remnant of the fauna in a forest where the Pandavas lived by hunting and repaired with his party to the Kamyaka forest abounding in wild life (II. 256). To save animals from death at the altar, Buddha's voice was no doubt effective for a time. Restrictive measures were taken by strong monarchs under Buddhistic influence—such as Asoka and Harsa. But these were directed only against unnecessary cruelty and wanton slaughter and they did not dare to interfere in consumption of animal food as such nor did they attach in their injunction any special sanctity on animal life.

Strabo's remark on Megasthenes' authority that the Brahmanas "eat flesh but not that of animals employed in labour" (XV. i. 59), whatever truth it may contain, reflects at any rate a sound economic sense which in some quarter regulated animal diet. The ordinances of Asoka himself are not purely altruistic. He is solicitous for the food, comfort and medical treatment of cattle as of men (R.E. II; P.E. VII) and he boasts of having conferred various benefits on bipeds and quadrupeds, on birds and aquatic creatures even to the "boon of life" (a panadakhinaya, P.E. II). But in his famous abstinence ordinance where the following animals are declared inviolable—*suka* (parrot), *salika* (maina), *aluna* (?), *cakravaka* (ruddy goose), *hamsa* (wild goose), *nandimukha* (a kind of bird), *gelata* (?), *jatuka* (bat) *ambakapilika* (queen ants), *dali* (terrapin), *anathika maccha* (jelly fish), *vedaveyaka* (?), *gamgapuputaka* (?), *samkujamaccha* (skate-fish), *kaphata sayaka* (porcupine), *pamnasasa* (squirrel?), *simala* (?), *samdaka* (wild bull), *akapinda* (iguana?), *palasata* (rhino), *seta kapota* (white dove), *gama kapota* (domestic dove), he adds the significant clause "which is neither useful nor edible" (ya patibhogam no eti na ca khadiyati, P.E. V). That the spirit of the edict is not less economic than altruistic is further proved by the forest law—"forests must not be burnt either uselessly or in order to destroy living animals". Other prohibitions are against pregnant and milch goats, ewes and sows with young ones below six months and against the preserves in fishing ponds and elephant parks on the three *caturmasis*, on the Tisya full moon during three days, *viz.*, the 14th, the 15th and the first tithi and unfailingly on every fast day. Feeding of live animals with live animals, caponing of cocks, castration of bulls, goats, dams, boars and other livestock on certain days and branding of horses and bullocks on the same days are forbidden. The keynote of these regulations is the checking of cruel practices and preservation of the different species, and if the emperor's heart ever yearned for total abstinence all he could do was to set his own example by rigorously curtailing meat-diet in his own kitchen (R.E. I).

The author of the Arthasastra is fully aware of this risk of unscrupulous drainage of animal resources and lays down practical rules for their protection. Animal produce engages his attention as much as other forest produce (II. 17). His list of inviolable birds echoes Asoka's edicts

and betrays equal care for the protection of the wild fauna against extermination (II. 26). With this view again, he gives directions for the comfort, health and safety of the livestock. Elaborate rules of dietary are framed for the guidance of the superintendents of cattle, horses and elephants with reference to their age, maternity, nature of work or use derived from them. The details of stable construction are worked out with vigilant eye to the comfort and sanitation of the beasts. A host of attendants and paraphernalia are assigned to the horse and elephant stables—trainers, feeders, cooks, watchers, grooms, vets, drivers, binders, sweepers, and so on (II. 29-32).

The preservation of the four-footed, feathered and finny races is sought with assiduous care in other rules of the economist. For this specific purpose the *abhayaranya* is set apart and none are allowed to "entrap, kill or molest deer, bison, birds and beasts protected thereunder". One-sixth of live animals shall be let off in forests under state protection. Discrimination is made, moreover, in the amount of fines against the killing of innocuous creatures that do not prey upon others (II. 26). Young elephants (bikka), elephants that would breed (mugdha), tuskless elephants, diseased elephants and suckling cubs (dhenuka) comprise the immunity list formed to ensure perpetuation of the prized stock (II. 31).

Greek writers testify to the prevailing practice of letting off young and old elephants and those of weak constitution in the forest from the camp (Str. XV. i. 41, 43; Arr. XIV). Elephants are reserved in special forests (nagavana) and for the killing of an elephant one pays with his life (Arth. II. 2). Grooms and drivers are threatened with fine at the slightest breach of rules inculcated for their comfort. "Leaving as much as in equal to twice the circumstance of the tusk near its root, the tusks shall be cut off once in 2½ years in the case of elephants born in countries irrigated by rivers (nadija) and once in 5 years in the case of mountain elephants" (II. 32). The reason for this jealous attention is given as—"It is on elephants that the destruction of an enemy's army depends" (VII. 11).

In the case of domestic creatures, needless cruelty and victimisation is guarded against. Animals are to be slaughtered for flesh only in the abattoir (parisunam) on pain of fine (II. 26); the rule seems to have been observed in current practice according to the evidence of the Pali canonical works. Cruel pastimes among herdsmen such as bullfighting stand outlawed (cf. Jat. IV. 250). Fines are enjoined for neglecting nasal perforation in proper time for stringing draught beasts to the yoke. Milking of cattle is allowed twice a day during the rains and the autumns, but in the dry winter and summer seasons only once on pain of the cowherd losing his thumb. Once in six months sheep and other animals shall be shorn of their wool. (II. 29). Stud bulls, bulls let out in the name of village deity (gramadevavrsah) and cows within ten days of calving are exempt from penalisation for trespass. Trespassing beasts from reserve forests

"shall be brought to the notice of forest officers and.. ....driven out without being hurt or killed". Ropes and whips only are to be used in case of stray cattle and any injury to them incurs the penalty for assault (III. 10). Livestock is protected along with other properties of a householder by laws of torts. "For causing pain with sticks, etc., to minor quadrupeds, one or two *panas* shall be levied; and for causing bleeding to the same, the fine shall be doubled. In the case of large quadrupeds not only double the above fines, but also an adequate compensation shall be levied (III. 19).

The importance of the protection of animal trade is fully realised. In assessing the toll dues on merchandise, bipeds and quadrupeds are placed in the scale of maximum preference along with other commodities the duties of which are charged between 1|5 and 1|15 of value. The *gopa* or village accountant is entrusted not only to keep a register of citizens but also of bipeds and quadrupeds in a village. The spies are likewise deputed to ascertain the total number of men and beasts (II. 35).

SACREDNESS OR IMPURITY OF ANIMALS

It is interesting to note that in early Indian literature, secular or sacred, no consistent attempt is made at proscription on the score of sacredness or impurity attached to particular beasts. The inviolability of cow as a divine creature is not an ancient custom and probably originated in later days of syncretisation with foreign barbarians, crystallising still later when Hindu society was reconstructed on hidebound dogmas and practices. In its rules on cow slaughter, the Arthasastra wants the immunity of only calves, milch cows and stud bulls (II. 26). Among Asoka's list of inviolables "which are neither useful nor edible," is included the "*samdaka*," the phrase is a pointer to the rendering 'wild bull". In the Vedic, Buddhist and classical Sanskrit literature, there is no dearth of allusions to cow-killing or the taking of cow's flesh. The epithet 'aghnya' occurs in the Rigveda with reference to cattle, but practice is all to the contrary. In the Satapatha Brahmana, Yajnavalkya is fond of tender beef (III. 1. 2. 21). According to Panini 'goghna' means a 'guest' because a cow is killed for him (III. 4.73). Apastamba permits the slaughter of a cow at the reception of a guest, at the worship of the *manes* and at nuptial celebrations (Grhyasutra, 1. 3. 9; cf. Sat. Br. III. 4. 1. 2; Manu, V. 41; Vas. IV. 8; Sam. II. 16. 1; Vis. LXXX. 9; Yaj. I. 19). In the beginning of Act IV of Bhavabhuti's Uttararamacarita a heifer is stated to be slain by Valmiki in honour of Vasistha's visit to his *asrama*.

In the Buddhist works the 'goghataka' is a familiar figure and his profession, according to the Dasabrahmana Jataka was widely followed by straying Brahmanas (IV. 361. ff.). Slaughter of ox for flesh was very common (Sut. III. viii. 7; Jat. II. 50, 135; VI. 111) and there were special slaughter-houses for beef (gavaghatanam, Mv. V. 1. 13). Even cows did not necessarily find exemption (An. IV. 137; Ch. Dhp., p. 60; Apast. I. 5.

17. 30). The suttas present this very unedifying spectacle at the most prominent place of the town or village; "As the cattle-butcher or his apprentice, when he has killed an ox or cow, displays the carcass piecemeal at the crossing of the four highroads as he sits" (goghatako va goghatakantevasi va gavim vadhitva catumahapathe vilaso patibhajitva nisinno assa, Dn. XXII. 6; Mn. 119).

It rather appears that beef was the commonest of flesh consumed. Similarly there were no strictures laid on grounds of impurity. Swine and fowl often figure in animal husbandry of the lay and clerical folk even in Sacred Books. Asoka's exemption of pregnant and mother sows indicates that there was no ban on the use of bacon or ham. In the Mahaparinibhana Sutta Buddha is offered a dish of pork (If sukaramaddava is not fungus. See Rhys Davids' note in Questions of Milinda, I. p. 244) by Cunda the artificer's son (also Ud. VIII. 5). Like the cattle-abattoir, there was the swine-abattoir (sukarasunam, Mv. VI. 10. 2) and the pigsticker (sukariko) was the dealer in ham in the market as the goghatako purveyed beef. In the Ramayana 'as well' pig and fowl appear as appetising food in the menu of a feast arranged by as good a saint as Bharadvaja (II. 91, 67; 70). In the Chinese Dhammapada a Brahmana is taking fowl without the least sense of wrong (p. 150). In the Milinda a remarkable cocklore is evinced (pp. 366 ff.). The testimony of the Jatakas (I. 259, IV. 364; Dn. XXIII. 31). In a Vinaya list of unpalatable and inedible food to which the people fell only in famine, occur, elephant, horse, dog and snake (Mv. VI 23, 10 ff.). Fowl, swine and cow never come in the list of animals and birds forbidden even for the Brahmana's table (Sat. Br. I. 2. 1. 8; Ait. Br. II. 1. 8; Apast. I. 5. 17. 29 ff; Manu, V. 11. 18; Yaj. I. 172; Mbh. XII 37. 24-26). It is only as late as in the Si-yu-ki that beef and ham are classed among non-edibles (Watters', p. 178). High-crested cocks born of Vrtra's blood (sikhandah) occur as non-eatable to the twice-born and the initiated in the Mahabharata, XII. 281. 60. In view of the evidences adduced and the composite character of the Santi-parva, this may be supposed to be a later priestly interpolation, or reflection of a local custom. Of course tame cocks and pigs occur in an exhaustive list of animals prohibited for the Snataka Brahmana in Gaut. XXIII. 5 and Manu XI. 157).

PROTECTION AND DEIFICATION OF COW

From the Vedic times, however, and throughout the Smritis and the Epics there was a vigorous attempt for the prohibition of cow slaughter and protection of the invaluable cattle-wealth; but of deification of cow there is hardly any strong evidence. In the Ramayana cow-killing (IV. 34. 12; Mbh. VII. 17. 31; 73. 27) and milking a cow just delivered (II. 75. 54) are sins. In the Mahabharata the good old days are mournfully recalled when the Vaisyas fed with care all cattle that were lean and never milked kine as long as the calves drank only the milk of their dam (phena-

pamsca tatha vatsan na duhanti, I. 64. 22). "Does not milk dry" is a favourite analogy on judicious taxation by kings. Among the glories of Cedi is that lean cattle are never used for draught but are well-fed and fattened (I. 63. 11) and it is only in the dark days of kali that men will employ cows and one-year-old calves for drawing the plough and carrying burdens (III. 189. 27). The reason for this solicitude is that the cow is the foremost of all quadrupeds as surely as the Brahmana is among the four castes (VI. 123. 34; XII. 11. 11). Hence Skanda is appointed leader of divine hosts for the well-being of cows and Brahmanas (gobrahmanahitaya ca, III. 228. 23; XII, 21. 18; Baudh. II. 2.4. 18).

But cattle is the chosen victim for sacrifice in large scale (I. 74. 130). In king Rantideva's kitchen 2,000 cows and 2,000 other animals are killed daily and the meat distributed so that the fat of these animals form the river Carmanvati (III. 207. 8f; VII. 67. 5; XII. 29. 123; XIII. 66. 43). The reason for this is thus given:

" 'The sacred fire is fond of animal food'—this saying has come down to us. And at sacrifices, animals are invariably killed by regenerate Brahmanas and these animals, being purged of sin by incantation of hymns, go to heaven".

Agnayo mamsakamasca ityapi sruyate srutih
yajnesu pasavo brahman vadhyante satatam dvijaih
samkrtah kila mantraisca te' pi svargam avapnuvan.

III. 208. 11f; cf. VII. 67. 4; Manu, V. 40-42; Vas. IV. 7; Vis. LI. 59. 78; Yaj. I. 180 f.

Aelian describes with the characteristic bluntness of a foreigner this pious benefaction of the animal race on the part of the priesthood:

"In the country of the Indian Areianoi there is a subterranean chasm (Obviously the sacrificial pit. Cf. Jat. I. 300) down in which there are mysterious vaults.....Hither the Indians bring more than thrice 10,000 head of cattle of different kinds, sheep and goats and oxen and horses; and every person who has been terrified by an ominous dream, or a warning sound or prophetic voice, or who has seen a bird of evil augury, as a substitute for his life casts into the chasm such a victim as his private means can afford giving the animal as a ransom to save his soul alive" (XVI. 16).

Obviously there were two contradictory forces at work. The utility of cow was appreciated but its slaughter for greed was not checked any more than the goat is spared today from an understanding of the value of its milk. That the cow was the foremost of creatures was the very reason why it should be sent over to propitiate the gods. Buddha's spirited denunciation of sacrificial rites voiced the necessity of cow-protection on economic grounds. He rebuked the silliness of Brahmanas who had fallen from their older virtues and taken to the evil practice of cow-sacrifice. (The Brahmanas were, by the way, never opposed to cow-sacrifice; the fictitious allusion is meant only to emphasise the sermon). Knowing that

cows are our benefactors like our parents and givers of food and strength the Brahmanas of old abstained from cow-killing:

"Yatha mata pita bhata anne va pi ca nataka:
gavo no parama mitta yasu jayante osadha
annada valada c'eta vannada sukhada tatha
etam atthavasam natva nassu gavo hanimsu te"
—Sut. II. vii. 13 f.

At the instance of Brahmanas of a later date the king sacrificed many hundred thousand cows. (ibid., 25). The result was that while formerly there were 3 diseases, they now multiplied to 98 (ibid., 28).

Without doubt Buddha was no man to deify cows. The utility of cow is the motive behind the inviolability preached in didactic works. The cow was no fetish of the Indo-Aryans as the Horus or Set was of the Egyptians (There is a similitude in the evolution of the cult of the Apis and Mnevis bulls, the representatives of the gods Ptah and Ra in Egypt where these animals were deified and venerated in the Saite age of national decline and the deification of bull, the animal of Siva, during the foreign subjection of Hindu states. The Siva with his bull is represented in the coins of the Kusanas and Scytho-Sassanian kings and in a coin of Sasanka, king of Gauda. But it is for the first time and as late as in a coin of the Huna Mihiragula that a bull-emblem of Siva is seen with the legend 'jayatu vrsah' on the reverse. For reference see D. R. Bhandarkar: Lectures on Ancient Indian Numismatics, p. 18. Did the deification of the cow originate in Indian source and of the bull come from foreign source?). If the cow is sometimes found held sacred and adored, the explanation is to be sought in this utilitarian principle rather than in deification (cf. Mbh. XIII. 51. 26. ff; 69. 8). The injunction that touching a cow with feet is sin (Ram. II. 75. 31; Mbh. VII. 73. 30; Mbh. VII. 73. 30; XIII. 93. 117; 126. 28 ff.) is to be read with the crimes indicated for cruelty to cows. This utilitarian feeling ultimately led to the abolition of cow-sacrifice and the fitter use of cow in gift (Mbh. XIII. 66. 44). (This statement in the Anusasanaparva with a lengthy homily of 13 chapters on the greatness of cow is most probably a later interpolation reflecting a time when cow-sacrifice was on the wane. For later, in this very parva, gift of beef to the pitrs is enjoined (88. 7).). The farthest point toward the sacredness of the cow is noticed in a Jataka passage. An auspicious bull all white (sabbaseto mamgala usabho) belonging to the gamabhojaka is killed by snake-bite and the villagers "all ran together weeping, honoured the dead with garlands and buried him in a grave" (sabbe ekato va agantva kanditva tam gandhmaladihi pujetva avate nikhanitva, IV. 326). But such honour is bestowed on the horse and the elephant in no less outspoken manner. The mamgalahatthi (1. 320) is even more prominent than the mamgala usabha and has, moreover, the virtue of bringing rain against draught (VI. 487 ff. Cp. Kurudhamma-C). The hatthimamgala or elephant festival is a common affair in the Jatakas. A king used to honour an elephant

by having its stall perfumed with scented earth, coloured hangings put round a lamp with scented oil, a dish of incense set there, a golden pot set on its dunghill, coloured carpet spread on its stand and royal food of many choice flavours (Jat. III. 384. Cf. IV. 92). A highbred elephant of the mleccha king Salva was frequently worshipped (supujito) by Dhartarastra's son (Mbh. IX. 20.3). A horse is seen honoured by a king exactly in the manner of the elephant just referred to (Jat. II. 291). In the Bharata war, war-horses are bathed and garlanded (VII. 112. 56). A colt installed as horse of state is sprinkled with ceremonial water (Jat. II. 287). "During the period of the caturmasya and at the time when the two seasons meet waving of light shall be performed thrice. Also on new moon and full moon days, commanders shall perform sacrifices to bhutas for the safety of elephants" (Arth. II. 32). "Horses shall be bathed, bedaubed with unguents and garlanded twice a day. On new moon days sacrifice to bhutas and on full moon days the chanting of auspicious hymns shall be performed. Not only on the ninth day of the month asvayuja, but also both at the commencement and close of journeys as well as in the time of disease shall a priest wave light invoking blessings on the horses" (ibid., 30).

These silly rites performed to ward off evil spirits were nevertheless meant to safeguard the interests of state, to protect the sinews of war against all sorts of danger and not to appease animal divinities held in superstitious veneration or fear. They were indispensable in war and sport as the cow was the prized supplier of milk, curd, butter and ghee. If it was sin to touch the animal with feet, here worked the same Indian psychology which deters the workman from kicking his tool. The cow's udder, the sheep's wool, the elephant's tusk are all subject to protection laws against the cupidity of improvident owners. This sense of utility of animal labour and animal produce accounts for the culture of animal lore and the improvement of veterinary science to which Aelian (XIII. 7), Asoka and the Arthasastra are outstanding but not the only witnesses. The theoretical background of animal preservation in ancient India was the theological doctrine of ahimsa and the economic doctrine of protection. The tribal totems of primitive communities among other races which hardened into fetishes or exalted gods of cities or 'nomes' and enjoyed inviolability on grounds of sacredness even when the clans passed beyond the totem stage, were foreign to the Indo-Aryans whose rituals rose beyond animistic level and were fixed on elemental and astral divinities from the earliest traceable times."

BREEDING OF CATTLE

The following excerpts on breeding of cattle are quoted from "Agriculture and Agriculturists in Ancient India" by R. Gangopadhyay.

"In the Agnipurana we find the king enjoined to preserve the breed of cattle in the country. There were certain restrictions on castrating bulls. Emperor Asoka issued an order that,

".....Athamipakhaye
desaye pumnadasaye tisaye puna
vasume tisa catumasisu sudivasaye
gone no nilakhilaviye ajake edake"

this is to say, a bull, a goat or a ram must not be castrated on the 8th, 10th, 15th and 13th day of each fortnight, neither on the *Punarvasu* day, on a festival day and in every fourth month of the year.

Brahmanical bulls were inviolable and were objects of special attention on certain festive occasions. They were marked on the right flank with a discus and on the left flank with a trident. In the *Brsotsarga* ceremony which was to take place on the day of the full moon in the month of *Karttika* or *Asvina,* the bull was set at liberty. It was first marked as above and then washed, adorned and brought near with four young cows which were also washed and decorated. To the right ear of the bull, the mantra "The father of calves" was pronounced and also the mantra "This young bull I give you as husband" was uttered into the ears of the cows. Visnu in chapter LXXXIV directs that the bull must be the offspring of a milch cow having young ones living. It must not be deficient in any limb and it must be one who protects the herd. In the Matsya-purana, chapter CCVII, we find the instruction that the bull must have elevated shoulders and hump, a soft and straight tail, tender cheeks, broad back, shining eyes, sharp horns, thick hair on the tail and eighteen nice teeth. Further, the bull must be well-built, bellowing like the thunder clouds, high in stature and walking like an infuriated elephant.

The bulls so set at liberty were public property. They were the breeding bulls and that is why the ancients were so particular as to their physical fitness. The Arthasastra says that a herd of ten head of either cows or buffaloes shall contain four male animals (and in Sukadum Nask of Dinkard, Bk. III, we find particulars about the time of allowing admission of the bull to the female).

But the manner in which the stock were fed was most important in so far as the breeds depended primarily upon it. In Rv. X; 27, 8, we find that they were fed on barley and corn, and in the Agnipurana, we find a calf marvellously thriving on a food consisting of masa (*Phaseolus radiatus*), sesame, wheat, clarified butter, the cream of milk and salt.

For bulls which are provided with nosestrings and equal horses in speed and in carrying loads, half a *bhara* of meadow grass, twice the above quantity of ordinary grass, one *tula* (100 palas) of oil cakes, 10 *adhakas* of bran, 5 *palas* of salt, one kudumba of oil for rubbing over the nose, one *prastha* of drink, one *tula* of pulp of fruits, one *adhaka,* of curd, one *drona* of barley or cooked *masa,* one drona of milk or half an *adhaka* of *sura* (liquor), one prastha of oil or ghee (clarified butter), 10 *palas* of sugar, and one *pala* of the fruit of *srngavera* which may be substituted for milk, The same commodities less by one quarter each will form the diet for mules, cows and asses and twice the quality for buffaloes and camels."

Every village was again, provided with common pasture lands and wood lands. Common rights in forestry and pasture were very important; and in all royal grants of villages, special provisions were always made for them. We find Manu enjoining that "on all sides of a village, a space one hundred dhanus or three samya throws (in breadth) shall be reserved for pasture and thrice that space round a town". In the Arthasastra (Bk. II, ch. 2) also, the king is directed to make provision for pasture grounds on uncultivated tracts. A part of the fodder was picked up by the cattle themselves from these grazing lands; and the forest lands which by the way, supplied fuel to the people and saved much of the cowdung now-a-days employed for the purpose with a consequent loss of available manure, were also available to them. Herds of cattle were taken out to graze by professional graziers to whose interest and to those of their charge, the law-books gave due attention. The herdsman was to take cattle to pasture when the night was over and take them back in the evening after they had eaten grass and drank water (Manu VIII, 230). In olden days as now (sounding bells) were attached to cattle, so that in case they strayed in forests, their whereabouts could be known by the sound of the bells. Sometimes grazing grounds lay within the confines of "forests which were severally allotted for various seasons and from which thieves, tigers and other molesting beasts were driven away by hunters aided by their hounds (see the Arthasastra, Bk. II, ch. XXIX). The Arthasastra directs that "cattle shall be grouped in herds of ten similar colours while they are being grazed." The cow-herds were expected to have a knowledge of the diseases from which cattle might suffer and also the remedies. They were wholly responsible for the safety of cattle while on pasture-grounds, and if an animal was lost due to the negligence of a cow-boy, he was bound to make good the loss (Manu VIII, 232; The Arthasastra, Loc. cit). If an animal died a natural death, he was to surrender the skin of the dead animal, its fat, bile, marrow, teeth, hoofs, horns and bones (the Arthasastra, Loc. cit). As for remuneration of herdsmen, Manu says, "for tending hundred cows, a heifer shall be given to the herdsman as wages every year; for tending two hundred cows,—a milch cow; and he shall be allowed to milk all the cows every eighth day" (VIII, 231).

After the crops had been harvested, cattle were grazed on cultivated fields and current fallows. The weeds on cultivated lands, plants growing up from the seeds falling before the harvest, the stubble and the grasses on field borders and long water channels were also available to cattle in olden days as now. Fodder crops were cultivated and made into silage—an old process in India as the word *sujavas* (Rv. VI, 28, 7; VII, 99, 3) in the Rigveda indicates. The cultivators also provided hay for his stock.

In the Rigvedic period, milch kine were thrice milked during the day—in the morning, at noon and in the evening. Dr. Das says: "It was usually the duty of the grown-up daughters (*duhitr*) to milk the cows, as *duhitr* literally means the milker" and draws a picturesque and animat-

ing scene in this connection (Vide Rigvedic culture, p. 123). In a later period however, we find that definite rules were laid down restricting the time of milking to once or twice according as the seasons were later part of winter, spring and summer or the rainy season, autumn and the earlier part of winter respectively. One *drona* of cow's milk was known to yield one prastha of butter and that of buffalo milk one seventh prastha more; and the purity of milk was ascertained by churning. The Arthasastra says that "increase in the supply of milk and butter depends upon the nature of the soil and the quantity or quality of fodder and water". And to increase the supply of milk, the Agnipurana instructs to give the cow morsels composed of the severed sticks of asvagandha (*Physalis flexuosa* Linn) and sesame (*see* Chapter CCXII, verse 35).

Thus, it may well be surmised that in ancient days, cattle breeds were fine, milch kine more productive and plough-cattle more efficient than they are generally in modern days.

CHAPTER XIV

MEDICAL TREATMENT OF CATTLE

In ancient India people had sufficient knowledge of the diseases of farm animals and the methods of curing them. Though in the light of the modern advances made in the field of veterinary science the techniques adopted for the diagnosis of the disease of an ailing animal and its treatment in the olden days may appear to be quite crude, yet they make an interesting study. Translations of some important passages from *Vishnudharmottara Mahapurana* (500-700 A.D.) are given below to acquaint the reader with the old medical practices of treating the diseased animals.

Puskara said: Listen, O Rama, hereafter I shall briefly describe the medical treatment of cattle, which is important and is beneficial to them. (Sl. 1)

Oil, in which the pounded mass of ginger, *Bata* and *Jatamamsi* has been cooked and rock salt (*Saindhava*) and honey added, should be applied to the roots of the horns of the cattle; or in the same way ghee mixed with the powder of *Simi* (?) should be applied. (Sl. 2-3a)

Oil in which *Manjistha,* asafoetida and rock-salt have been cooked or cow's milk should be applied to the roots of their ears. (Sl. 3b-4a)

Having ground honey, rock-salt, conch, *Tagari* (?) long pepper and *Siha* (?) in the goat's milk, the physician should make pills of the mass. These pills rubbed in ghee and honey make an excellent collyrium for the eyes. (Sl. 4b-5)

The powder of the roots of wood-apple tree; *Apamarga, Dhataki, Patala* and *Kutaja* when rubbed into the gums (lit. roots of the teeth) removes tooth-ache. (Sl. 6)

O Rama, ghee in which the ingredients recommended for removing tooth-ache have been cooked, heals the diseases of the mouth, and rock-salt is useful for the ailments of the tongue. (Sl. 7)

Ginger, the two species of turmeric, and the three myrobalans are indicated in sore throat. And the recipe consisting of ginger, the two species of turmeric, the bark of *Kutaja, Apamarga* and *Vidanga* mixed with salt removes the diseases of the mouth and allays the morbid heat of fever. (Sl. 8-9)

For pain in the heart of bladder, for disorders of the wind and for injuries and bruises it is good to give the cattle the (powder of) three myrobalans dissolved in (melted) ghee as a drink. (Sl. 10)

For curing all the diseases of the heart in cattle, O Rama, oil in which *Satapuspa, Kutaja* and *Citraka* have been cooked should be administered to them. (Sl. 11)

In dysentery the two species of turmeric and *Patha* (?) should be administered and in constipation *Padmacarini* (turmeric ?) mixed with ghee should be given. (Sl. 12).

In all leprous diseases and diseases of the horns as well as in cough and asthma, ginger and *Darvi* (?) should be administered. (Sl. 13)

For the reunion of fractures *Priyangu* mixed with salt is useful. In wind disorders cattle should be administered oil in which *Sata-puspa* has been cooked, for it is a specific remedy for such troubles. Pea soup mixed with honey is to be given in disorders of phlegm. (Sl. 14-15)

In all bilious disorders, the specific remedy is cow's ghee in which liquorice has been cooked and it should be administered when such troubles arise. (Sl. 16)

In derangements of the blood produced by bile, doses of the juices of *Sakhotaka* are recommended. In obstinate bleeding, the cattle should be given wheat-flour, Masa and mustard—all whipped in water and mixed with jaggery to drink as it is good in such cases. (Sl. 17-18)

The ointment prepared from sesamum, *Ambhakaruha* (lotuses ?) yellow orpiment and ghee is excellent for applying on the open wounds of the cattle. (Sl. 19)

Ailing calves should be made to drink *Patha* stirred in butter-milk or turmeric dissolved in milk for alleviating their suffering. (Sl. 20)

Masas, sesamum and wheat (ground and) made into balls in ghee and milk of cattle and seasoned with salt are very nourishing to the calves and strength-giving to the bulls. (Sl. 21)

Fumigation with incense prepared from *Devadaru, Vala, Jatamamsi,* asafoetida, mustard and bdellium mixed with a little ghee is auspicious and wards off the evil influence of all planets. A bell fumigated with the same incense should also be tied to (the neck of) the cattle. (Sl. 22-23)

Asvagandha, sesamum and a particular kind of sorrel called *Cukra* is useful for clearing the bladder. Butter-milk mixed with *Asvagandha,* and sesamum are also useful for the bladder, and with this prescription, scion of Bhrgu race, the milk of the cow is increased. (Sl. 24)

O Rama, oil-cake is considered to be an elixir for the cattle. Wet grass and cold-water for drinking should be eschewed from their feed. (Sl. 25)

At night lamps should be lit in the cattle-shed. (Sl. 27)

As a prophylactic measure salt should be regularly given to cattle after every fortnight, for it prevents constipation, colic and want of appetite. It is also beneficial to sheep and goats. (Sl. 28)

Since time immemorial cow has always been very sacred to the Indians. She has not only been regarded as a Mother but also as the supreme benefactor of the entire human race. Therefore even from the very early times treating of the ailing cow has been considered to be most essential duty of every individual. Jadudutta gives the following account of the medical treatment of cows in his book *Asva-Vaidyaka.*

By this the blood vitiated by derangement of humours is purified. Then with his body purged of morbid matter and restored to strength by means of balls of food, he (i.e. the horse) should be fed on young grass in the month of Sravana by which he becomes as sturdy and hard as adamant. (Sl. 4-5a)

If a horse suffering from excess of blood (plethora) happens to graze on young grass, his blood disorder gives rise to biliousness which results in his death. (Sl. 5b-6a)

If a horse suffering from excess of blood in the nose feeds on young grass along with oil, etc., he is soon affected with disorders of phlegm and meets his end. (Sl. 6a-7a)

If an anaemic and dried up horse feeds on young grass, he becomes affected with acute disorders of wind and soon meets his death. These are said to be the symptoms arising from the disorders of blood. (Sl. 7b-8)

Wise men should also become aware of the symptoms of disorders of all the humours. When a horse is afflicted with the derangement of bile and vitiation of blood then he gets itching sensation all over his body and scratches it continuously. He longs for going under the shade and particularly to a pool, and is eager for drinking and taking food. (Sl. 9-11a)

Having thus come to know that the horse is suffering from disorders of blood and bile, one should have his blood let from a vein and then give him jaggery mixed with black and long pepper and ginger. (By that he becomes purged of morbid affection and free from disease. (Sl. 11b-12)

If flow of tears and paleness round the eyes is observed in a horse suffering from disorders of bile and blood, death is sure to claim him soon. These are the symptoms of the eyes arising from disorders of bile and blood. (Sl. 13-14a)

When a horse is affected with disorders of phlegm and blood, he always keeps his muzzle lowered, coughs again and again, refuses food and does not rouse to activity (i.e. remains sluggish). (Sl. 14b-15)

He who does not respond to the whip nor to the nudge of the heel, nor to the saddle (?) and he who swivels profusely at the nose and loves to keep warm should also be given jaggery mixed with dry ginger after blood-letting. In this way his whole blood will be purified. (Sl. 16-17)

Nasal Applications

Like cough and asthma, nasal affection (?) too arises from disorders of wind, bile and phelgm. Nasal affections become fatal, therefore, medicines through the nostrils should be administered. (Sl. 1)

Long pepper, rock-salt, *Sara* (cream ?), dry ginger mixed with jaggery.....are useful in removing the phlegmatic disorders of horses. (Sl. 2)

The *Culika* (?)—salt introduced into the nose always serves as a curative measure in disease. (Sl. 3a)

Refined sugar, sandal-water and barley-meal, if used as nasal douche,

relieve the wind-disorder in the veins. (Sl. 3b-4a)

Fresh ginger along with *Mrduka* (?) and mixed with *Vaca* and *Ksara,* if injected into the nose, relieve the wind-disorders and other ailments of the horse. (Sl. 4b-5a)

Sugar, honey, *Saira* (? or *Sara*?) and *Patola* (cucumber) mixed with *Pala,* if introduced into the nose during autumn, are calculated to remove the ailments of horses. (Sl. 5b-6a)

Vaha, Usmanaka (?), *Kustha,* dry ginger, *Kasamardika*—all mixed in a small quantity of cold water should be introduced into their nostrils. (Sl. 6b-7a)

Guduci, Kaumudi (?*Mallika* creeper ?), and *Tali* (toddy ?) mixed in well-water and introduced into the nostrils of good horses during winter, keeps them healthy. *Apamarga* is one of the best nasal applications that keep off all diseases. (Sl. 7b-8)

Pure mustard oil which has been thoroughly boiled with cow's urine gives strength to the secreting vessels which have become loose (or weak) by cohabitation. (Sl. 9)

Nasal douche of cow's urine mixed with salt is extremely beneficial in affections of the throat and keeps off all maladies. (Sl. 10)

The urine of a goat with the root of *Apamarga* used as nasal douche or nasal application prepared from the fat of fish are useful for the affections of the mouth. (Sl. 11)

Garlic, *Pippali-mula* (root of long pepper ?), *Gandaka* (onion ?) and *Nagakesara* if injected into the nostrils with mustard oil, are effective in curing the ailments of the horses. (Sl. 12)

Nasal douche early in the morning with pure water kept overnight is useful for the eyes and serves as a tonic both for men as well as horses. (Sl. 13)

A horse suffering from inflammation of the throat ejects the food (being unable to swallow it). One should consider a horse afflicted with cough to be *Galasalukin* (?).

All the diseases of the mouth arise from the disorders of phlegm and blood. I shall now explain the treatment by which such affections of horses are mitigated. (Sl. 18)

Oral Affections

First of all a wise-man should puncture the palatal vein (or artery) and then cut off with a knife the protuberance of flesh from the gaping mouth of the horse. (Sl. 19)

In stiffness of the tongue, the physician should have the tongue washed and then push it back with six powdered salts. (Sl. 20)

In the morning drinking water mixed with liquor and *Punarnava, Vaca, Sigru, Karanja* and *Nimba*-leaves relieved by long pepper, ginger, *Vidanga* and a little salt, should be properly given along with hay. (Sl. 22-23)

One should feed him with well-strained decoction of *Karanja* and

Nimba leaves and Tiktamudga (?) mixed with oil, black and long pepper and dry ginger. (Sl. 24)

It is useful to clean their mouth with cow's urine and soft twig on which is sprinkled the powder of black and long pepper and dry ginger. (Sl. 25)

In cases of inflammation, a wise-man should apply from dry ginger, long pepper, *Vaca,* mustard and fresh ginger. (Sl. 26)

Drink prepared from *Guggulu* dissolved in the decoction of three myrobalans is beneficial and, in food, barley should be given and Masas etc. avoided. (Sl. 27)

A wise-man should pluck out the redundant teeth growing over other teeth with pincers and afterwards carry out the above-mentioned treatment. (Sl. 28)

He should also extract the teeth that are worm-eaten and should put plaster in the cavities left by the redundant teeth (as well as the decayed ones). (Sl. 29)

Eye Diseases

Hereafter I shall describe the diagnosis of eye-diseases as prescribed by the sages in former scientific works. (Sl. 1)

Lachrymation, *Prasannandha,* nyctalopia, *Timira* (catarrh ?), *Munjaka* (?), *Munja-jala* (?), *Patala* (film), *Budbuda* (?) flow of peas, *Kacaksa* (?), flow of blood, *Cipita* (?), *Vartmaroga,* and *Abhisyanda* (?)—these are the diseases of the eye arising from the vitiation of wind, bile and phlegm. I shall now explain their symptoms and treatment in due order. (Sl. 2-4)

If clear drops of tear continuously flow from the eye while seeing, the disease is called 'lachrymation' caused by the disorder of wind. (Sl. 5)

A horse whose eyes are apparently sound but who does not see anything, he is called *Prasannandha* and is incurable. (Sl. 6)

One who sees clearly in the day-time but does not see at night is said be afflicted with 'nyctalopia', a disease caused by the disturbance of wind. (Sl. 7)

Sometimes he sees the object and sometimes he does not see it—from these symptoms a wise-man should conclude that he is suffering from 'Timira'. (Sl. 8)

Ghee mixed with the three myrobalans and well heated should be given (internally) and after that samtarpana (dressing ?) of the eyes should be done. (Sl. 9)

The horse should be laid on the ground and should be secured well with strong ropes. Then an enclosure with the paste of *Masa* flour be made round each eye and then the eye should be filled with ghee or milk. This is the usual method of *Samtarpana* of the eyes. (Sl. 10-11)

Another easier method of *Samtarpana* is also prescribed. A wad of cotton dipped in ghee should be inserted in the eye. (Sl. 12)

Over that and over the eye a loose bandage should be tied. Over the bandaged eye some more ghee should be poured. (Sl. 13)

The *Timira*-afflicted eye should be daily anointed with the pencil prepared from the blue lotus, sandal-wood and antimony. (Sl. 14)

Symptoms of Sores

Sores are said to be of two kinds—those that are extraneous (i.e. wounds) and those that are caused by internal morbidity (abscesses). I shall describe their symptoms as well as treatment according to scientific works. (Sl. 1)

A wise-man should understand that a sore arising from internal disturbance manifesting itself in inflammation and suppuration is called an 'abscess' or boil and that produced by the blow of a weapon, etc. is called a 'wound'. (Sl. 2)

An abscess or boil, which is slow to ripen and can tolerate touch for a long time, is caused by some disorder of the wind, and that which ripens quickly and is accompanied by itching and burning sensation is due to disorders of the bile. (Sl. 3)

A boil that appears in the form of a protruberance, white in colour, hard to touch, and with dull pain is caused by disorders of phlegm and is slow to ripen. (Sl. 4)

That (boil) which exhibits all the symptoms should be considered to be due to the disturbance of all the three humours, and the one which shows the symptoms of the two, to be due to the disorders of two humours. (Sl. 5)

A learned physician should according to the nature of the case in due order first have a malignant boil cleared (of pus) and then attempt its healing. (Sl. 6)

A boil which has opened and subsided but still gives stinking smell and is surrounded with pustules should be declared unclean, and the one with contrary symptoms should be taken to have been cleaned. (Sl. 7)

Danti-mula (roots of sunflower ?), the two species of turmeric, *Citraka*, ginger, garlic and rock-salt—all ground together in sour gruel are prescribed for the clearing of all kinds of malignant boils of pus. (Sl. 8-9a)

A ball of ground sesamum and meal, rock-salt mixed with curd and the ball of Tila-oil-cake mixed with the leaves of *Nimba*, honey and rock-salt should be applied by a wise-man for clearing the boils of pus. (Sl. 9b-10)

When a boil has been cleared of pus, the ball of *Nimba* (leaves) and sesamum, without the addition of honey and rock-salt is one of the excellent healing agents. (Sl. 11)

A physician should dust the powder of the barks of pomegranate, emblic myrobalan, *Agasti*, and *Kapittha* over a protruding boil which has been cleared of pus. (Sl. 12)

When a boil has healed the following powder prescribed by the sages should be applied for causing the hair to grow (on the scar). (Sl. 13)

One should gather the hoof, skin, bone, hair, teeth, horn and nails of cattle like the cow and also the shell of a tortoise, and should reduce

them to ashes by roasting them in the fire in a sealed container. That ash mixed with ghee and oil, when applied, proves to be the best of hair-growers. (Sl. 14-15)

Oil in which *Nerium odorum,* plantain, *Arka, Snuhi,* thorn-apple, Citraka and Bhallataka (marking nut) have been cooked, is an excellent healer of a sinus. (Sl. 16)

Grinding *Agara-dhuma* (soot ? or a plant ?) in cow's urine, a wise-man should carefully fill the cavity of the ulcer with it in order to mitigate its virulence. (Sl. 17)

If a sinus is so stubborn that it does not become clear of pus then it should be cauterized—a process also recommended for (the treatment of) boils arising from bilious disorders. (Sl. 18)

A wise physician should foment a fresh bleeding with (the sauce of) esculent roots like the radish preserved in acid (i.e. vinegar). After that he should put over it the pounded mass of *Madhuka* mixed with honey and ghee, bandage it and pour ghee over it. (Sl. 19-20)

He should then continue applying the ground barks of five trees (viz., *Nyagrodha, Udumbara, Asvattha, Plaksa* and *Vetasa,* mixed with ghee and keep the patient on dry food and scanty water. (Sl. 21)

If the wound begins to suppurate, the aforesaid processes of treatment prescribed for boils due to disturbed humours should be repeated till it gets healed. (Sl. 22)

Now we shall narrate the chapter on two kinds of sores—thus said the revered Palakapya.

This question was put to the sage, sanctified with rigid penances, the friend of the learned and the well-wisher of the elephants. (Sl. 1)

What are the different causes of sores, their appearances, the authorities on the subject, the secret of surgical operation, and means of letting out pus or blood? (Sl. 2)

What remedies are there for the successful treatment of sores and what are the sources of those remedies according to scientific works? (Sl.3)

With what means the sores of elephants are generally made to throw out pus and how do they turn into blind sore even with a slight neglect? (Sl. 4)

What are the causes that make some of the sores intractable (or malignant?) and though easily healed, they fester again and again. (Sl. 5)

What are the precautions by which they (i.e. the elephants) are not afflicted in the forest with sores caused by the disturbance of bodily humours and by what means they get healed without the aid of physicians. (Sl. 6)

Then the great sage *Palakapya* explained to the king the entire set of rules concerning the subject of sores. (Sl. 7)

According to the *Sastras,* the origin (*Yoni*) of sores (and wounds) is three-fold and their nature (*Atma*) too is three-fold. Their internal matter (*vastu*) is eight-fold and their position (adhisthana) two-fold.

(Sl. 8)

Two fold is their outer appearance (*akrti*) and *Yoni* (?) and their flow is two-fold. Surgical operation on them is also of two kinds and remedies of three kinds. (Sl. 9)

According to the verdict of the *Sastra,* its (?) *Yoni* should be considered three-fold. The origin (*Yoni*) of the remedies of sores, O king, is said to be five-fold. (Sl. 10)

Of the elephant, O king, there are nine (varieties of sores) according to the place of the pain (and tenderness). Thus, in short, is the topic of this chapter. Now, the characteristics will be given in detail. (Sl. 11)

The origin of sores is three-fold from which they grow, and are characterised by inflammation, open cut or burning sensation. (Sl. 12)

According to the *Sastra* inflammation is of two kinds—one caused by bodily morbidity and the other accidental. (Sl. 13)

Inflammation by internal morbidity may be caused by the derangement of wind, phlegm or bile or of all the three together. (Sl. 14)

Accidental inflammation, too, is of various kinds, for instance by contact with poisons or by other substances or by hurt. (Sl. 15)

Pain in the inflammation is caused by wind, suppuration is caused by bile and flow by phlegm. The nature of the sore depends on the severity of derangement of a particular humour. (Sl. 16)

A sore that is small, round and hard is called a 'knot' (granthi), one that is big and has extensive swelling is called Vidradhi (abscess) and is like the head of an elephant. (Sl. 17)

Now, the origin of the Vikrta (wounds) will be described. They may be caused by abrasion, bite, or injury. (Sl. 18)

Abrasion may be caused by the attribution of a rope, etc., bite may be caused by a snake, etc., and injury may be caused by anything sharp which makes a cut on the body of the elephant (Sl. 19)

Sores are of four kinds according as they require cutting off or piercing through by means of various implements or require incision or letting alone (to ripen and burst ?). (Sl. 20)

Again, the cutting too is of five kinds called, *Chinna, Vicchinna, utsrsta, avakrsta* and *darita.* (Sl. 21)

Amongst them *chinna* is the cutting off of the part (ablation ?) altogether. *Vicchinna* is called the impact of a blow. (Sl. 22)

The splitting of the ear, tail or trunk into two is called *darita,* and *avakrsta* is the one that goes deep down in the flesh and bone. (Sl. 23)

The country of *avakrsta* is called *utkrsta.* In this way the *chinna* has been divided into five kinds. (Sl. 24)

Of the *Viddha,* too, there are four varieties called *nividdha, anividdha, viddha* and *uttrundita.* (Sl. 25)

APPENDIX I

PUBLISHED LITERATURE FOUND IN INDIAN LANGUAGES

The lists of "particular" literature published in different Indian languages mainly in Sanskrit which were consulted during this study, are given below, subject-wise and in chronological order as far as possible.

Agriculture

NAME OF LITERATURE	PARTICULARS
Atharva Veda (1500-500 B.C.)	VIII, 13.9-12, giving reference to the legend of Prithu Vainya, traditionally known to be the originator of agriculture.
Kautilya's Arthasastra (321-186 B.C.)	II, 41, on Sita-dhyaksa (Superintendent of Agriculture); II, 46, Go-dyaksa (Superintendent of cattle); , Kupyadhyaksa (p. 121) (Superintendent of forest produce); , Tulsmana-patasa (p. 127) (Superintendent of weights & measures); , Vivitadhaksah (p. 177) (Superintendent of Pastures); , Sutradhyaksah (p. 140) (Superintendent of weaving).
Charaka Samhita (100-500 A.D.)	Sutrasthana, IV, 1, 36, 37 on Botany, giving classification of plants etc.
Susrata Samhita (200-500 A.D.)	Sutrasthana, Chap. XXXVIII and XLVI, giving classification of plants and Chap. LXIII, on Botany.
Vishnu Purana (about 500 A.D.)	Book I, Adhyaya 13, giving the mythological story of Prithu-Vainya, the originator of agriculture in detail.
Brhat Samhita of Varaha-Mihira (about 500 A.D.)	II, 55, on Vrksayurveda (Science of Plants and plant-life); II, 21, on rain clouds; II, 22, on Bharana or rain support days; II, 23, on rains; II, 27, on winds; II, 28, on immediate rain; II, 29, on Kusumalatadhyaya (indication of yield of crops from blooming of flowers); II, 40, on Sasya Jataka (Vegetable Horoscopy); II, 53, on Dakargala, i.e. ascertaining the presence of water in a dreary region.

Agnipurana (500-700 A.D.)	Canto—262 on Vrksayurveda
Visnudharmottara Mahapurana (500-700 A.D.)	II, 20, on Vrksayurveda
Krisi-Samgraha or Krisi-Tantra of Parasara (500-1000 A.D.)	A systematic text on Agriculture, written in the later time. Published in Bengali characters with Bengali Translation.
Upavana-vinoda or Vrksayur-veda by Sarangadhara (1120-1330 A.D.)	A systematic text on plants and plant-life, or Arbori—horticulture. A section of an Anthology known as Sarangadhara paddhati.
Sri Siva Tattva Ratnakara by Basava Raja of Kaladi (1698-1715 A.D.)	Kallola (Section) VI, Chap. X and XI, dealing with Agriculture and Horticulture; Kallola II, Chap. I, dealing with measurement of land; and Kallola III, Chap. II, dealing with rain.
'Ved men Krisi' by Sri Pada Domodara Satvalekar (1923)	A booklet written recently, giving extracts from Vedas about Agriculture.
Vacaspatya Kosa (Vol. II) (Sanskrit Dictionary)	Quoting profusely from the text of Krisi Sam-graha of Parasara, Brhat-parasara Samhita, etc. under the word 'Krisi'.
Krisi-sasanam by Dasaratha Sastri with Raghava Bhasya and Narayaniya Bhasya in Hindi.	Notice of this work is given in the Catalogue of Sanskrit works in British Museum-1906-1928.ED. 1928, p. 238 b.), published in Marvadi Machine Press, Nagpur, 1920. (not available).
Muni Bhovabodhini by Nara-yana-Gajapati Bentalori.	Sanskrit work in Telugu Script with Telugu translation.
	Animal Husbandry
Kautilya's Arthasastra (321-186 B.C.)	II, XXX, Asvadhyaksa (Superintendent of horses) and III, XXXI, Gajadhyaksa (Superintendent of elephants), dealing with Animal Culture and Veterinary practices.
Brhat Samhita of Varaha-Mihira (about 5[illegible]0 A.D.)	Chap. ' Go-laksana, Chap. , Asva-laksana, Chap. , Chhaga-laksana and Chap. , Hasti-laksana, giving characteristic marks of various animals.
Agnipurana (500-700 A.D.)	Chap. 292 in Gavayurveda (Medical treatise on cows or cattle); Chap. 289, on Asvacikitsa (Medical treatise on Horses); and Chap. 287, on Gajacikitsa (Medical treatise on Elephants).

Visnudharmottara Mahapurana (500-700 A.D.)	II, 43, on Go-cikitsa (Medical treatise on cows or cattle); II, 46, on Asvacikitsa (Medical treatise on horses) and II, 48, Hasti Cikitsa (Medical treatise on elephants).
Asva-vaidyaka by Jayadutta Suri	Published in Bibliotheca Indica series, 1886; a comprehensive text on Animal (horse) Culture and Veterinary Science for horses.
Asva-cikitsa Sastra by Nakula	Published in Bibliotheca Indica series 1887; a comprehensive text on Animal (horse) Culture and Veterinary Science for horses.
Hasty ayurveda by Muni Palakapya	Published in Anandasrama series 1894; a comprehensive text on Elephant Culture and the Veterinary Science for Elephants.
Matanga lila (Matanga Cikitsa)	Trivandrum Series No. 10; the chapter on this heading deals with Elephant Culture and Veterinary practices for elephants.
Maha Garuda Purana	Chap. 207, dealing with Veterinary Science.
Vrsa-Kalpadruma or Pasu-Cikitsa	A recently written book on Ancient Veterinary Science (Published in 1915).
Manusallasa	Chapter on 'Asva-Vaidyka' (Veterinary concerning horses) (p. 81), Gaja-cikitsa (Veterinary concerning elephants) (p. 85 and Gajausadi Nigantu (list of herbs used) (p. 90).
Siva Tattva Ratnakara by Basava Raja of Kaladi	Chapters on Animal Culture and Veterinary Science, Kollola VII, Chapts. II, XII & XIII.

N.B.: The above lists include the texts on the subject as well as some important references to different aspects of the subjects from some well-known published works.

General literature giving scattered references relating to our various subjects

Hymns of Rigveda	I, 127, 6; I, 110, 5; XXI, 161, 10; IV, 57, 1-8; IV, 75, 8; IV, 5, 78; IV, 16, 11; VI, 53, 99, VI, 28, 7; VII, 49, 2; X, 19. 4-8; X 34, 13; X, 32, 5; X, 31, 9; X, 101, 3-4; X, 102, 8; X, 117, 7.
Hymns of Atharvaveda	VII, 18 (for rain etc.); VII, 11 (against injury to the grain by lightning); VI, 79 (for abundance at home); III, 17 (for successful agriculture); II, 8 (against the disease Ksatriya with a plant, etc.); II, 26 (for safety and increase of kine); III, 24 (for abundance of grain); IV, 21 (praise of the kine);

	XII, 1 (in praise of earth); (refer verses 36, 42, 45); VI, 142 (recited during the sowing of the seed); VI, 79 (recited for procuring the increase of rain); VI, 50 (recited in exorcising vermine infecting grain field).
Hymns of Yajurveda Vajasmeyi Samhita, and Taittiriya Samhita	*See* Reference Vol. I, p. 145.
Satpatha Brahmana	VIII, vi, 2, 2; I, 6, 1, 3.
Epics-Ramayana Mahabharata (500 B.C.-200 A.D.)	*See* Reference Vol. I, p. 150.
Panini's Astadhyayi (about 350 B.C.)	*See* "India as known to Panini" by V. S. Agarwala, pp. 194-209, 210-17.
Buddhist literature (500 B.C. to 500 A.D.)	Kullavagga, X, 1, 6, giving reference to Blight and Mildew; Kullavagga, VII, 1, 2 giving reference to farming operations; Mahavagga, VIII, 12, 1, giving reference to the shape of rice fields in Ray-fashion; Different Jatakas, such as Dasabrahmana Jataka Salikedara Jataka, etc. Sutta Nipata, Vinaya Pitaka, etc. Mahavamsa containing references to Veterinary practices.
Jain Canons (500 B.C.-500 A.D.)	Stray references in Brhatkalpa Bhashya Uvasagadasao, Abhidana Rajendra Kose, Theragatha, Nayadhamsa Kaha, Brhat Kalpa sutras, Avasyaka Tika, Majjihima, Anuyogadhara Sutra, Vyavohara Bhasya, Suysgadanga, Pannavana, Pindanijiutti Nairyukti, Acsranga, Attaxadhyayanana Sutras, *Ibid.* Tika, Jambu Tika, Tandula Tika, Mahavamsa Tika, Kelyana Vijaya, Vira Nirvana, Rayapassniya, Ovaiya Sutras, Vivagasya, Nisitha Cu.
Purana Literature (300 B.C. to 700 A.D.)	(*See* "Life in Ancient India as depicted in Jain Canons" by J. C. Jain).
Visnu Purana	
Brahma Vivarta Purana	Chap. Janams-khanda 102; giving useful trees and useless trees. (Badraprada Vrksa and Nisiddha Vrksa).
Padma Purana	Various references.
Harivamsa Purana	-do-
Brahmanda Purana	II, 7-160.

Mahavaraha Purana	Gokarana Mahatava giving merit achieved by planting trees (Vrksaropana phalam).
Matsya Purana	Adhyaya 227, Vrksachbedana-dosah, (sins accruing from cutting down trees).
Vayu Purana	79, 71.
Naradiya Purana	
Barhaspatya-Arthasastra (500-1000 A.D.)	Giving references to territorial divisions in ancient India.
Surti literature (200 B.C.-200 A.D.)	
Manu-Samhita	VIII, 230, laws relating to cattle.
Narada smrti	VI, 10-17, laws relating to cattle.
Brhaspati smrti	-do-
Yajnavalkya smrti	II, 164 -do-
Apastamba smrti	II, ii, 28 Hindu laws relating to Agriculture
Gautma smrti	18-28 (SBE, 2 p. 240) -do-
Baudhayana smrti	1, 5, 10 -do-
Vasista smrti	II, 33. -do-
Paraskara Grihya Sutras	(SBE. Vo. 30) Some stray references in Chapters 23, 24, 25, 26.
Kausaka Sutras (Bloomfield's edition)	26. 41-43; 27. 1-4 II, 20 (Ploughing festival); XXI, 1-11 (Cattle-charm); XXIII, 17 (on ploughing); XXIV, 1-2 (rite for sowing); XLI, 1-7 (for procuring rain); LI, 17-22 (freeing fields from harmful vermins).
Sukraniti or Sukraniti-sars	Some references about Agriculture and cattle.
Manosollasa, Vol. I & II by Someavara Deva	Gaekwad's Oriental Series, LXXXIV and....., giving stray references.
Abhilasita Cintamani (part I)	Madras University Series No. 69, the same work as Manosollasa under a different name.
Sanskrit Kosas	
Amarakosa (near about 800 A.D.)	Chapters called Bhumivarga, Vanaushadhivarga and Vaisyavarga give a comprehensive glimpse of the Art of Agriculture, such as classification of soils and land, implements used etc.

Sabda-kalpa-druma	Some references about the subject under the word Krisi.
Medini Kosa	-do-
Kavya-mimamsa, Gaekwad's Oriental Series No. 1	Extracts giving the Divisions of Ancient India together with their products (pp. 93-94 of the text and pp. 132-137 of notes).
Samarangana Sutradhara Parts I & II Gaekwad's Oriental Series (1000-1100 A.D.)	Extracts concerning land, construction of stables, Veterinary Hospitals, etc.
Raghuvamsa of Kalidasa	Some references on the subject.
Mrichakatika of Sudraka	-do-
Hemachandra's Abhidana Cintamani	-do-
Rajatarangini by Kalhana (12th century A.D.)	Some references to Agriculture, famines, products, etc.
Rajatarangini continued by Jonaraja, Srivara, Prajya Bhatta and Suka in the later ages.	-do-
Ghagh and Bhaddri by Ram Haresh Triphati	Poetical sayings on Agriculture in Hindi verses.
Khanar-vacana	Khana's Maxims in Bengali.
Dakvacanamrts	Poetical sayings by Dak of Mithila refering to Agriculture.
Gramodyoga Sabdavali	
Sanskrit Worterbuch by Dhthingk and Rodulph Roth	Sanskrit-German Dictionary; giving a number of references under the words 'Krisi & Iti'.
Gunaratna's Commentary on Saddarasna Samuccaya	
Bhava Prakasa	

Manuscripts on Krisi-sastra and Vrksayurveda

Kasyapamuni-kathita Kesapiva-Krisi-Sukti	Manuscript No. 28-Kr. N, available in Adyar Library, Madras, XXXVIII. 1.8, 63419, a comprehensive text on Agricultural Science, assigned to Muni Kasyapa.
Vrksayurveda	Ms. No. 9 K. 18, 700 (3) (No. 44), available in Adyar Library Madras; A comprehensive text on plants and plant-life and Horticulture. A number of verses in this Manuscript are already published in the text-Upavana-vinoda.

Manava-vrksayurveda	Manuscript (in Mss. Collection No. 195), available in Vallabha Vaisnava Matha Library, at Nathdwar, Rajasthan; a comprehensive text on Agriculture, horticulture, Botany, etc., in 22 cantos (1600 verses).
Visva-vallabha by Sri Misra Chakrapani	Manuscript (in Mss. Collection No. 195), available in Vallabha Vaisnava Matha Library, Nathdwar, Rajasthan; A text in 9 Cantos on Agriculture and Horticulture, Botany, etc.
Vrksayurveda by Surapala	Manuscript, Oxford No. 324 B(Ms. Walkar 137), available in Bodleian Library, Oxford University, Oxford (London); a text on Horticulture and Botany.
Vatika Vidhi or Puspavatika vidhi	Ms. No. 538, available in Ganganath Jha Research Institute Library, Allahabad, a short treatise on Gardening and Manuring.
Vrksaurveda section in Manusollasa	This part of the manuscript is not as yet published in the texts which have appeared in the two publications, viz., Oriental Research Institute (Abhilasitarthacintamani), and the other Gaekwad's Oriental Research Institute (Manusollasa).
Vrksa-dohada	Manuscript No. 11305, in Grantha script, available in Saraswati Mahal Library, Tanjore; A short treatise on fertilizers and gardening practices.
Kautuka-cintamani	Manuscript No. 770, 10762A (B)|11041, D, in Grantha available in Saraswati Mahal Library, Tanjore (S.I.); containing a section on manuring and gardening.
Dajvajna-visva by Lolla Lachhmi Dhar and Kancass Yalla-yarya	MS. D. No. 13434 (in Telugu Script) and Ms. transcript copy No. 7865, Vol. No. II, available in Government Manuscript Library, Madras containing a section on gardening and manuring (pp. 676-702).
Vrksayur-jnanam	Manuscript available in Saraswati Bhavan Library Udaipur (Rajasthan); a text mostly written in Rajasthani on horticultural practices and manuring, and grafting.
Krisi Paddhati of Parasara	MS. No. 3168, available in India Office Library, London. A text on Agriculture in Bengali Script. This is a manuscript copy of the same work which is published under the title Krisi-samgraha of Parasara, of course, with some different readings.
Krisi-parasara	Copy of the manuscript of the above treatise (item ii) in Nagari script, available in Bhandarkar Oriental Research Institute, Poona. Different

	readings have been observed in the text given in this manuscript.
	This MS. in Bhandarkar Oriental Research Institute is a copy of a MS. in the Mandlik Section in the Wadia Library, Fergusson College, Poona. The Mandlik MS. is itself a copy made on 4th Feb., 1884 from a Bengali original in the Sanskrit Pathashala, Calcutta.
Krisi Paddhati by Parasara	MS. No. 6475, available in India Office Library, London. This is another copy of the manuscripts as under items 12 and 13. This will be essential for the purpose of re-editing this treatise for publication in Nagari Script, not yet available as a whole.
Krisi-Samaya Nirnayah or Krisi-sastra	MS. R. No. 5278, available in Govt. Manuscript Library, Madras; a treatise on Agriculture.
Vrksayurveda by Varaha Mihira	MS. No. 7927|a (3757 d), available in the India Office Library, London. This is another copy of the chapter on Vrksayur-veda in Brhat Samhita, already published.
Vrksayur-veda-dhyaya with Bhattotpala's Commentary	Manuscript (in MSS Collection No. 195), available in Vallabha Vaisnava Matha Library at Nathdwar, Rajasthan; A text on Varaha-mihira's Vrksayurveda (a chapter of his Brhatsamhita) with the commentary.
Upavana-vinoda	MS. No. 986 of 1887-91 in the Government Manuscript Library at the Bhandarkar Oriental Research Institute, Poona. This is a copy of Ms. of Upavana-Vinoda (a published work) having some additions and alterations and also different readings.
Sarangadhar-Paddhati, Upavana-Parichheda	MS. No. 7662, available in Government Oriental Manuscript Library, Trivandrum (Travancore). This is another copy of the text as already published under the title Upavana Vinoda, of course, with some additions and alterations and different readings.
Vrksayurveda by Parasara	Notice about this manuscript together with detailed information, about it, was found in an article in the Journal of Royal Asiatic Society of Bengal (letters), Vol. XVI, No. 1, 1950. It deals with Botany and Horticulture (it could not be obtained as yet).
Vanamala by Jiva Natha	Notice about this Manuscript is given in the Catalogue of MSS, in Mithila by Ananta Prasada,

	Vol. III (p. 386), under item No. 328. The manuscript deals with meteorology and rains, necessary for agriculture. It could not be found as yet.
Vrksaropana Subhasubha-vicar	MS. available in Darbhanga Raj Library, Darbhanga. It deals with good and bad effects of planting different trees.
Vivahara Pradipika by Hudrahastaka Harapati Thakur (1500 A.D.)	MS. available in Darbhanga Raj Library in Maithili Script, containing a section on Bijavapana (process of sowing seeds) and a section on Krisikarkarmani (acts to be performed by Agriculturists). It gives some minor information.
Crama-Vasa-Vicar	MS. available in Darbhanga Raj Library (concerning proper conditions in village habitants).
Narada Silpa Sastra	Ms. No. 13515, available in Gaekwad Oriental Research Institute, Baroda. Ms. contains sections on Grama-Simanta laksana (Borders of villages), Gramadi-sthala Samikarana laksanam (levelling the village lands), Marga laksana Kathanam (Roads for villages), Jalasaya-tataka laksana kathanam (water reservoirs, tanks, etc.), Pranali-setu laksana kathanam (canals, dams, etc.) Mahagrama-laksana kathanam (characteristics of a large village) and so on.

List of some manuscripts of minor importance bearing on agriculture consulted or noticed

Vrksadaya	Quoted by Hemadri in Raghuvansa; given in T. Aufrecht's Catalogus Catalogoram.
Vrksodyayana	Dh. K. 194; Notice given in the Catalogus Catalogoram of T. Aufrecht.
Vrksotsava	MS. No. 5947; available in Royal Asiatic Society of Bengal (Library). Stated to be extracted from Matsya Purana.
Brhat Upavana Vinoda	The notice about this MS. was given by Prof. Rajeshwar Sastri of Sri Vallabha Ram Saligram Sangaveda Vidyalaya, Kasi, Banaras. The Ms. is said to be in possession of the retired Prof. F. Ram Prasad Shastri of Nagpur University. Upavana Vinoda which has already been published is said to form a part of this large work.
Gandhasara of Gangadhar	MS. giving a number of plants and their products; available in Bhandarkar Oriental Research Institute, Poona.
Bhojana Kutuhala of Raghu Natha	MS. No. 594; available in the Bhandarkar Oriental Research Institute, Poona. It gives references to

	Sitaphal and Ramphal, the names of the two varieties of custard apple, which shows that from very early times the trees have been grown and honoured by Hindus. There are references to many other plants in the Manuscript. Another copy of the same manuscript is available in Ganga Nath Jha Oriental Research Institute.
Tadagadi Vidhi	MS. No. 3406; available in Royal Asiatic Society of Bengal (Library).
Kupa Pratistha	MS. No. 3407.
Dravyanamakar	MS. No. 745; available in Ganga Nath Jha Oriental Research Institute, Allahabad.
Vrksa-sastra Samgraha by T. Venkata Ramaya (1895)	Published text based on ancient literature, in Telugu, available in Venkateshwara Oriental research Institute, Tirupati.
Asvayurveda of Vagbhatta S|O Vikrama (1651 A.D.)	Or Shalihotara; Ms. No. 581 a treatise on medical science for horses; available in Bhandarkar Oriental Research Institute, Poona.
Asva-sastra or Asvacikitsa by Sukhanand	Ms. No. 427; available in the Bombay Branch of the Royal Asiatic Society, a small treatise on the nature, classification and treatment of horses. Its notice is given in the Descriptive Catalogue of Sanskrit from last page; Sanskrit and Prakrit MSS. in the Library of the Bombay Branch of R.A.S., compiled by M.D. Velankar.
Asvayurveda by Gana	Notice given about the MS. T. Aufrecht's Catalogus Catalogoram.
Sara Samgraha by Gana	-do-
Asvayurveda-Sara-Samgraha by Vahada S|O Vikrama	-do-
Asva-Sara	-do-
Asvayurveda or Siddhityoga-Samgraha by Garga Mishi	A copy of the manuscript found in Saraswati Bhavan Sanskrit Library, Banaras. Notice about the manuscript is given in T. Aufrecht's Catalogus Catalogoram.
Hasti Vaidyaka by Virasena	Notice about the MS. is given in T. Aufrecht's Catalogus Catalogoram.

Gajayurveda, Gaja-cikitsa and Gaja-vaidya	These Mss. are the same as Hustyayurveda by Muni Palakapya, is already published in Ananda-Sama Series. Notice is given in T. Aufrecht's Catalogus Catalogoram.
Asva Sastram	MS. No. 927; available in Saraswati Bhavan Sanskrit Library, Banaras.
Sara Samuchcha	MS. No. 119; available in Bhandarkar Oriental Research Institute, Poona.
Salihotra	MS. No. 865 in Mevari (a Rajasthani dialect). It gives the diseases of the horses and their treatment. It appears to be based on the local practices followed by attendants of stables of old Rajas (contains painted illustrations).
Asva Laksana	MSS. with painted illustrations about horses, showing their various types, their colours, characteristics, etc. (number of plates 86).
Shalihotra	MS. No. 386, dealing with Veterinary practices in the local dialect. It gives numerous prescriptions regarding the diseases of horses.
Asva laksan by Visnu Dass	MSS. No. 746, an illustrated work on Veterinary Science for horses (New Ms. No. 842)
Salihotra, or Hayadarpana	MS. No. 272, -do- (Date 1853).
Asva Sastram or Shalihotra	MS. No. 1453 in Sanskrit; a treatise on Veterinary Science for horses.
Asvayurveda or Asvavaidykam	MS. No. 617, -do- (date of Ms. V. 1727).
Salihotra	MS. No. 1492 on Veterinary for horses, (date 1974-incomplete).
Salihotra-samhita	MS. No. 1932, -do- (V.S. 1553).
Salihotra	MS. No. 416; in old Hindi, -do-
Salihotra	MS. 386, -do-
Asva laksana	MS. No. 841, a voluminous work on Veterinary Science for horses, with painted illustrations.
Salittara by Nakula-pamva	MS. No. 286, -do-
Asva-vaidyasamgrah	MS. No. 16; in old Kannada Script and language dealing with Veterinary Science for horses; available in Saraswati Bhandar Palace, Sanskrit Library of Maharaja of Mysore.
Asva Vaidya Samgrah	MS. No. 1356, a text on Veterinary Science for horses, in old Kannada Script.

Karati Kastuka	MS. No. 247, on Veterinary Science, available in Darbhanga Raj Library.
Hagayurveda	Available in Bhandrakar Oriental Research Institute. Poona
Asva-sastra by Shalihotra	MS. on Veterinary Science for horses available in Venkatasvara Oriental Institute, Tirupati.
Gaja sastra	-do- (for elephants).
Shalihotra	MS. No. 1499; available in Saraswati Bhavan Library of Maharaja of Udaipur.

Manuscripts published

Pasva Vaidya Samgraha by N. Narsingh Iyangar	Published in 1895.
Go-Vaidya Sara Samgraha	Edited by B. N. Nanjopa in Kannada, published in 1917.
Asva Sastra Samgraha by Krishna Rao	Compiled on the basis of Persian and Marathi manuscripts, published in 1916.

South Indian literature on the subject

Agriculture plays an important role not only in Sanskrit and North Indian literature, but is also given a unique place in the South Indian Literature as is clear from the following list of works in Tamil, Kannada, Telugu, etc.

Tirikkural	In Kanada, Published in Govt. Mss. Library The sacred aphorisms of St. Thiruvalluvar; one of the earliest Tamil works; assigned to the first or 2nd century B.C., containing sections on 'rain' and 'agriculture'.
Lokopakara in Kanada by Chavanda Raya (about 1025 A.D.)	An encyclopaedic work in Kannada. It contains a section on Science of Agriculture and Plant Life. (Published in Government Oriental Mss. Library, Madras).
Rattamata Sastrasu	A work in Kannada; dealing with forecast of rain and other agricultural matters.
Naladiyar	(four hundred quotations in Tamil); gives some references to agriculture.
Vyavasaya Prasmotara, or Vyavasayakramu or Vyavasaya Sastra Carita	Work in Telugu; gives a section on Agriculture in questions and answers.
Sasyananda	MS. in Telugu, implying 'pleasure of crops'.
Pairu Madava Vivara	MS. (transcript copy) No. 363|163, copy from an old MS.; on the mode of cultivation.

Krisi-giti	(published); deals with cultivation of Coconut, palms, cereals; in Malyalam.
Dravya-guna-Samgraha	Gives description of various kinds of trees and plants, etc.; in Malyalam.
Erelupadu by Kamber	A Tamil poem of 11th century A.D.; on the greatness of the plough and ploughmen.
Parananaru	A compilation of Tamil sangam texts (second century A.D.)
Manimakhalai	A well-known Tamil grammar; claimed to be a work of 5th century B.C., gives some stray references to agriculture.
Karanapathu	40 stanzas on clouds, in Tamil.
Tolqappiam	A well-known Tamil grammar; claimed to be a work of 5th century B.C.; gives some stray references to agriculture.
Krisi-patta	In Malyalam, on Agriculture.
Vrksayurveda of Saranga-dhara	The well-known Sanskrit work on horticulture, in Malyalam script with Malyalam translation.
Munibhavabodini by Naraln Gajapati Dantalori	A Sanskrit work dealing with Agriculture in one of the sections in Telugu script, with translation in Telugu.
Vrksa-sastra-samgraha by T. Venkataramaya	Published in 1895; written in Telugu, dealing with Agriculture and Horticulture.
Krisi-jnana-pradipika by Sri Nagabhusonaghans-matha-dharya	A work, written in 19th century (author's date 1826-1884 A.D.), on Agriculture, based on Agamasastra and Puranas, in Kannada.
Pathuppattu, Kurinjippattu and Silappadikaram	Tamil classical poems, assigned to the period from 500 A. D| to 600 A. D.
Asva Sastras by Abhanava Chandra	In Kannada, Published in Govt. Mss. Library Madras; a work on Veterinary Science for horses.
Vrksayurveda of Sarangadhara	Published in the Malyalam script, with Malyalam translation (Travancore).
Dravya-guna-anumaya	Deals with properties, good or bad, of various kinds of cereals, products of sugarcane etc.

APPENDIX II

In addition to several manuscripts referred to in Appendix I, the following publications have been consulted in writing the monograph.

1. A.N. Bose, 1945, Rural Economy in Ancient India (Parts I and II), Calcutta University.
2. A. Krishnaswamy, 1952, Combined Annual Progress Report (1951-52) and Final Report (1.6.49-31.3.52) of the Scheme for "the Collection of Information on Indigenous Veterinary Medicine from Ancient literature and Sanskrit Manuscripts", I.C.A.R.
3. A.K. Yegna Narayana Aiyer, 1949, Agriculture and Allied Arts in Vedic India.
4. G.P. Majumdar, 1935, Upavana Vinoda, Indian Research Institute publication, Indian Positive Science Series No. 1.
5. ————————1951, The History of Botany and Allied Sciences (Agriculture, Medicine) Arbori—Horticulture in Ancient India (c. 2000 B.C. to 100 A.D.) (Extract "Archieves Internationales d'Histoire and Sciences," Number 14—pp. 100-133).
6. G.G. Joshi, 1955, Bharatiya Krishisastra Bangmoyasuti, Sahitya-Samsar, 19th February and 30th April.
7. J.C. Ray, 1948, Life in Ancient India, Messrs Sen, Ray & Co. Ltd., Calcutta.
8. K.A. Chowdhury and S.S. Ghosh, 1951, Plant Remains from Harappa, Ancient India, No. 7 (January, 1946) pp. 3-18.
9. ————————, 1954 & 1955, Plant Remains from Hastinapur, 1950-52, Ancient India, Nos. 10 & 11, pp. 121-137.
10. Nityendra Nath Sircar, 1950, An Introduction to the Vrksayurveda of Parasara, Journ. Royal Asiatic Society, Bengal, Vol. XVI, No.1 pp. 123-139.
11. P.K. Gode, 1946, History of the Art of Grafting Plants, Indian Culture, Vol. XIII, No.1 (July-Sept.), pp. 25-34.
12. R.K. Mookerji, 1957, Hindu Civilisation, Parts I and II, Bharatiya Vidya Bhavan, Bombay.
13. R. Gangopadhyaya, 1932, "Some Materials for the Study of Agriculture and Agriculturists in Ancient India", N.C. Mukherjee & Co., Serampore.
14. S.P. Raychaudhri, 1941, Agriculture in Ancient India, Dacca University Studies, 101-126.
15. ————————, 1953, Agricultural Practices in Ancient India, I.C.A.R. Review Series No. 4.
16. ————————, 1941, A Short Account of the Agricultural Methods Practised in Ancient India, Science and Culture, Vol. 7 10-17.
17. ————————, 1936, Translation of Krishi Sangraha (A short compilation on Agriculture) by Mahamuni Parasara, Imperial Bureau of Soil Science, Monthly Letter No. 59.
18. S.S. Ghosh, 1961, Further records of rice (Oryza spp.) from Ancient India, Indian Forest, Vol. 87, No. 5, pp. 295-301.

APPENDIX III

The following centres were visited by Dr.R.K. Kaw, Research Assistant under the scheme for consulting the available literature.

1. The Central Archaeological Library, New Delhi.
2. The Libraries of the Delhi University.
3. The Libraries of Calcutta University.
4. The Asiatic Society of Bengal, Calcutta.
5. The Belvedere National Library, Calcutta.
6. The Library of the Hindu University, Banaras.
7. Saraswati Bhawan Library, Banaras.
8. Vidyapith University (Library), Banaras.
9. The Library of the University, Bombay.
10. Bombay Branch of Asiatic Society, Bombay.
11. Bharatiya Vidya Bhavan, Bombay.
12. Coma Oriental Institute, Bombay.
13. The Bhandarkar Oriental Research Institute, Poona.
14. Wadia Library of Fergusson College, Poona.
15. The Deccan College of Post-graduate and Research Institute, Poona.
16. The Adyar Library of the Theosophical Society, Madras.
17. The Library of the Madras University and the Government Oriental Manuscript Library, Madras.
18. The Connemara Public Library, Madras.
19. The Libraries of the Travancore University, Trivandrum.
20. The Oriental Manuscript Library, Trivandrum.
21. The Saraswati Mahal Oriental Research Library of Maharaja of Tanjore, Tanjore (S.I.)
22. The Library of the University of Nagpur.
23. The Library of the Allahabad University.
24. The Library of the Sanskrit College, Raghunath Temple, Jammu.
25. Ganganath Jha Research Institute.
26. Saraswati Bhawan Library, Udaipur.
27. Vallabha Vaisna Matha Sanskrit Library, Nathdwara (Rajasthan).
28. The Kashmir Research Department, Srinagar.
29. The Public Library, Srinagar.
30. Gaekwad Oriental Research Institute, Baroda.
31. The State Record Office, Baroda.
32. Library of the Mysore University.
33. Oriental Research Institute, Mysore.
34. Saraswati Bhandar Library, Maharaja Sanskrit College, Mysore.
35. Central College Library, Bangalore.
36. The Library of the Bythic Society, Bangalore.
37. Venkateshwara Oriental Research Institute, Tirupati (S. I.).
38. The Libraries of Patna University.
39. Jayaswal Research Society (Bihar Research Institute).
40. Darbhanga Raj Library, Darbhanga.
41. Mithila Institute of Research and Post-graduate Studies in Sanskrit, Darbhanga.