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THE IMPERIAL DEPARTMENT OF AGRICULTURE IN INDIA
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PLATE I

SIMLA HILL CULTIVATION.

BY J. MOLLISON, M.R.A.C.,

Inspector-General of Agriculture in India.

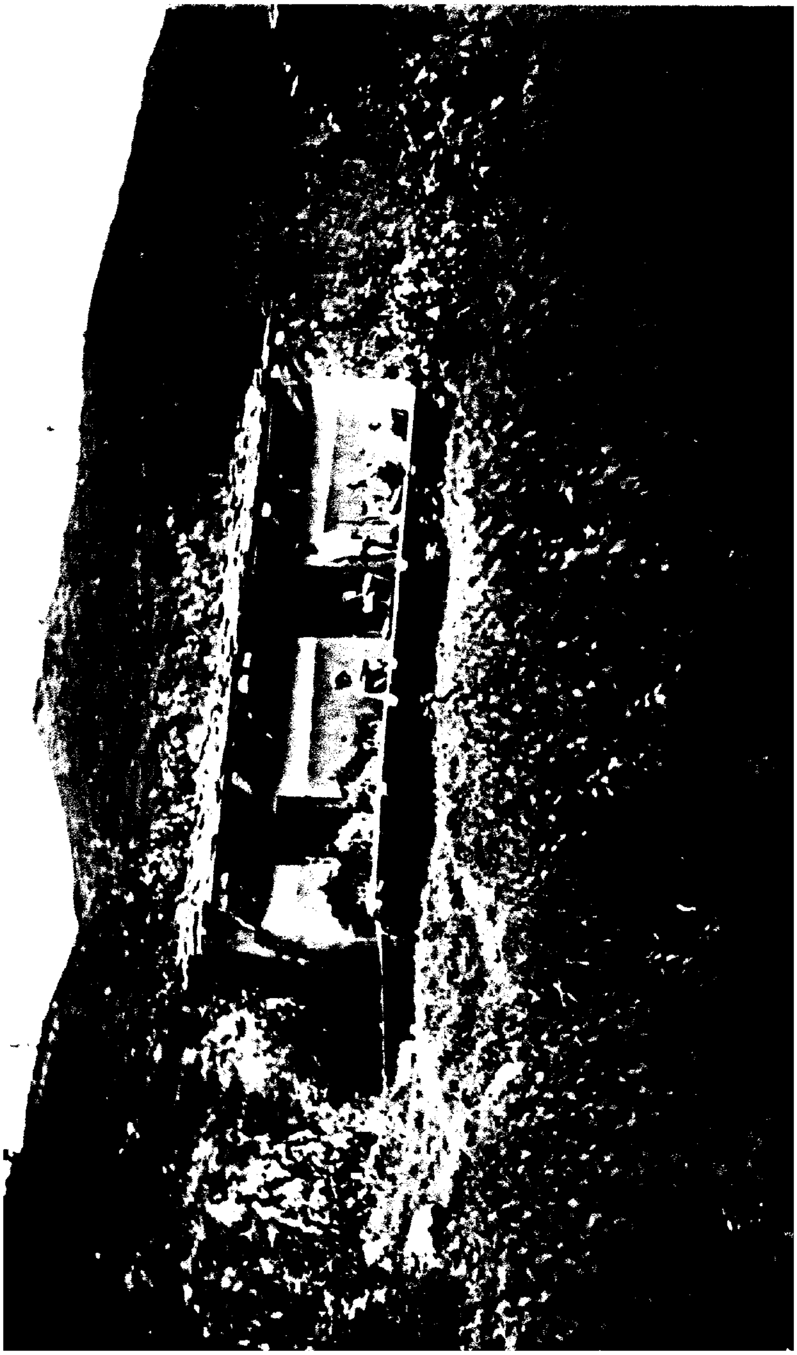
THE Simla hill district has a total area of about 100 square miles. It occupies the Southern slopes of the great central chain of the Western Himalayas, and extends North and East from the Punjab plains in the Umballa District to the magnificent snow-clad peaks of the main chain. The annual rainfall is about 70 inches, of which the greater portion falls between June and September. July and August are generally the months of heaviest rainfall. The rains cease about the middle of September. A spell of genial weather follows. Snow usually falls several times in January and February. Hailstorms are common in March, April and May, and occur with considerable disaster to fruit trees occasionally in June. The mean temperature in Simla is 55°, that of January and February 41°, and that of June, the warmest month, is 67°. The lowest readings reached in the course of the year vary between the freezing point and 13° below it.

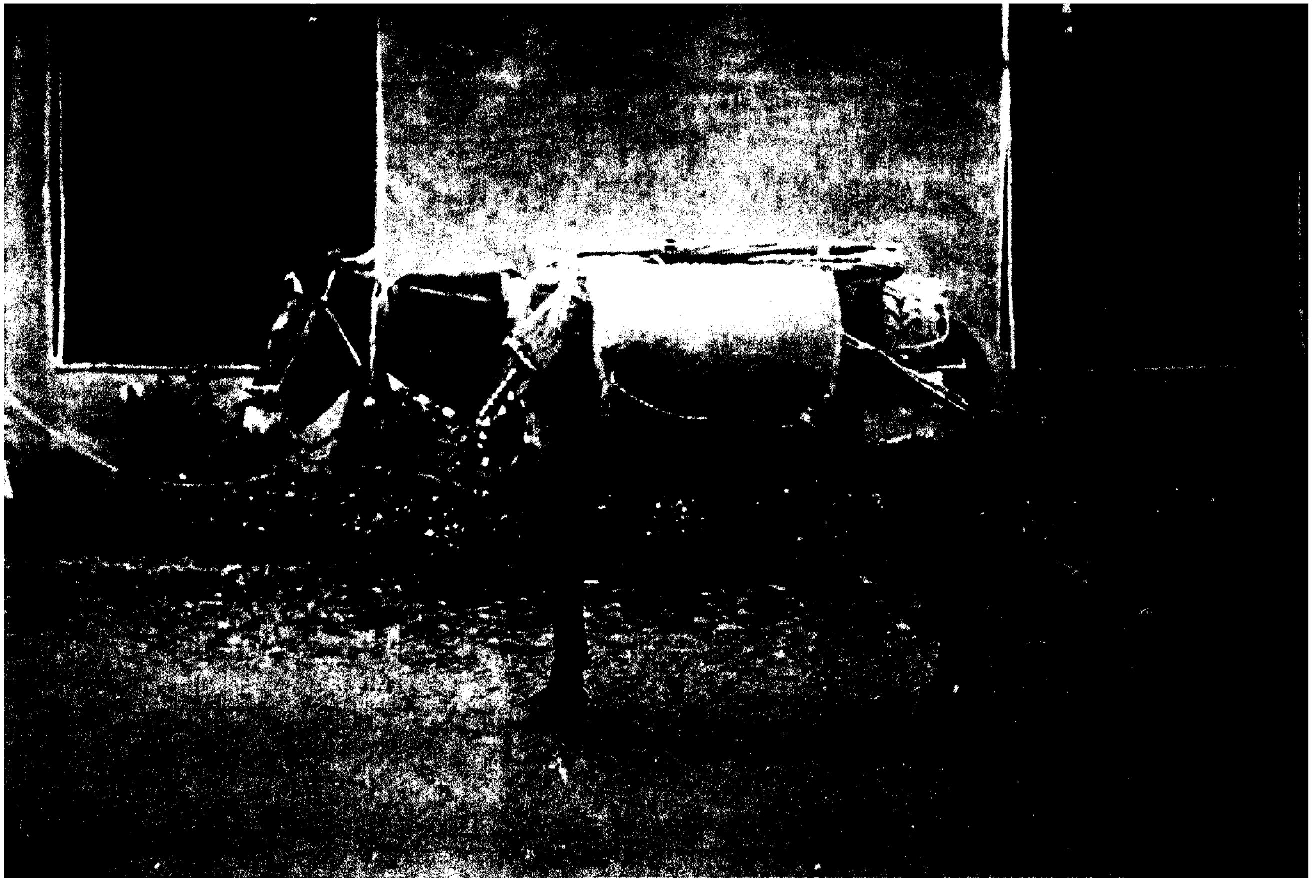
Most of the inhabitants in the Simla hills are agriculturists. These include the Brahmins of the lower order—the Kanāyats who are Rajput descendants—the Kolis and other low castes. The higher order of Brahmins and the Banyas are extensive landowners but do not directly cultivate. The Brahmin and Kanāyat cultivators are well-to-do. Their modes of life are similar and very comfortable. The Koli cultivators are poorer and have to live simply and economically.

The cultivated land mostly consists of terraces which have been formed at large initial cost. The shapes and sizes of the terraced fields depend upon the natural slopes and contour of the hillside. Where the natural slope is steep, the fields are fairly long and very narrow. In all cases the necessity of preserving a level surface for retaining rain-water and for irrigation, restricts the size and shape of each terraced field. Where the natural slopes are not very steep, the cultivated land is not levelled. The sloping fields are small, and erosion during the rains is prevented by stone and earthen embankments and by diverting the flow of natural drainage channels. Some fields are fenced with stone walls about 3 feet high or by hedges, the foliage of which is pruned for feeding cattle, sheep and goats when grazing is scant. Many fields, however, are unenclosed. Irrigation for the terraced fields is arranged for by tapping natural springs, by *bunding* hill streams, and by leading the water in open channels often long distances. In many cases numerous channels take off from a single stream. The majority are projected and maintained by the people themselves. There are no wells.

The dimension of a homestead indicates the circumstances of the cultivator. His holding generally surrounds his dwelling. The homesteads are generally scattered singly or in little groups in places where cultivation is possible. They are dotted here and there from the lower depths of the valleys, to the grassy uplands which in winter are much exposed to bitter cold. The arable holdings vary from 6 to 12 acres, and this area supports usually about 6 individuals, and with the common grazing a considerable number of cattle and other live-stock.

It is a satisfying sight to take a bird's eye view from the higher ridges of the agriculture of these parts particularly when the autumn tints prevail. The flag-roofed houses cosily built into the hillsides, the kale yards and the little orchards of each homestead, first catch the eye. The deep red patches of amaranth form a pleasing contrast to the little fields of yellow ripening corn. The autumn-sown crops helped by irrigation are fresh and green, whilst the pasture lands have taken a tawny hue. The little black cattle—the buffaloes, the sheep, and the agile goats are industriously seeking pasturage along the network of





PACK MULE.

Bemrose, Collo, Derby.

HILL COOLIE

foot tracks on the steeper slopes. These tracks possibly mark the footprints of cattle and sheep and goats, which have grazed on these hills centuries ago. Plate I is a rough sketch of a hamlet. The tall trees are pines from which the side branches have been ruthlessly removed for firewood—a common practice in the hills. Plate VIII represents a more typical hamlet. The terraced fields in the foreground are occupied by maize. The dwellings are scattered promiscuously over the hillside, each usually being isolated as in plate II. These isolated homesteads are guarded by large hill dogs which are dangerously fierce when approached incautiously by strangers. It is rare to find many homesteads close together; even the villages are small. The homesteads are grouped into circuits. Each cultivator usually builds his own house in a sheltered situation. The walls are built of stones, and are plastered inside and out with mud, and then limewashed. Each house has usually two stories. The basement is used as a cattle shed and general storing place for implements, fuel, etc. The family lives on the upper floor. The compartments are small, low and dark. This arrangement is a protection against cold but is quite insanitary. The roof is either covered with flat slate-like stones or with earth of a consistency which does not usually allow rain to penetrate. The cost of a house for an average family may vary from Rs. 500 to Rs. 1,000 each.

Hillside grazing is common to a circuit or to a group of families, but the grazing and hay obtained therefrom is not sufficient for the cattle and other stock. It is supplemented by grass and leaves gathered in forest areas. Some forest area is assigned to each group of families, but this does not lead to forest conservancy. Each landholder pays a small tax, not exceeding Rs. 2, for the right of cutting fuel.

The hill cultivators and their families are assiduous workers. The terraced fields are skilfully tilled. Crop after crop is taken in rapid succession. The fields are mostly double cropped each year. The best land, however, produces as many as three crops in 12 months The fertility of the land is, to some extent, maintained by washings from the higher slopes, but fairly heavy dressings of ordinary manure are frequently given. This is possible for various reasons. The cultivator almost always lives on his holding, and the waste of domestic life goes on to the land. The number of farm animals which he keeps is much over the average of arable areas of like extent in the plains. The fodder and litter gathered in forest areas are considerable. The grazing lands are extensive and the manure from cattle, sheep and goats is to a large extent conserved. The intensive cultivation requires heavy manuring and the cultivators are fully alive to this necessity. The dung heap of each holding is usually some distance from the homestead. The cattle pens are littered with grass, leaves and small branches of trees, and this litter with the dung, the absorbed urine and the household waste, is carried to the general manure heaps every second or third day. This manure decays sufficiently to be applied at two seasons in the year, *i.e.*, for the Kharif as well as for the Rabi crops. Sheep and goat manure is considered to have high value. The professional shepherds bring their flocks down from the higher hills to the cultivated areas at particular seasons, and are paid liberally in cash or kind for folding the arable fields at night.

The farm implements are necessarily light to suit the draught capacity of the small active work cattle. They are efficient for keeping the land clean, for fine tilth, but are not heavy enough for deep cultivation. The ordinary bullock-power and hand-tillage implements are illustrated in plates IX, X, XI and XII. The former, though miniature, resemble those of the plains in general construction. Seed drills are not used, but seed is broadcasted or planted very evenly by hand. Numerous ploughings are given for spring-sown crops, but for second autumn-sown crops the plough is not used so often. The preparatory tillage is always careful. Most of this work is done by the plough (Plate IX), but a tined harrow (Plate X) and the leveller or clod crusher (Plate XI) are freely used. The latter, when used after sowing, helps to cover the seed and to form an even surface for irrigation. The terraced fields are generally so small and so level, that

[illegible]

Bemrose, Collo., Derby

HILL COW.

Bemrose, Collo., Derby.

HILL SHEEP.

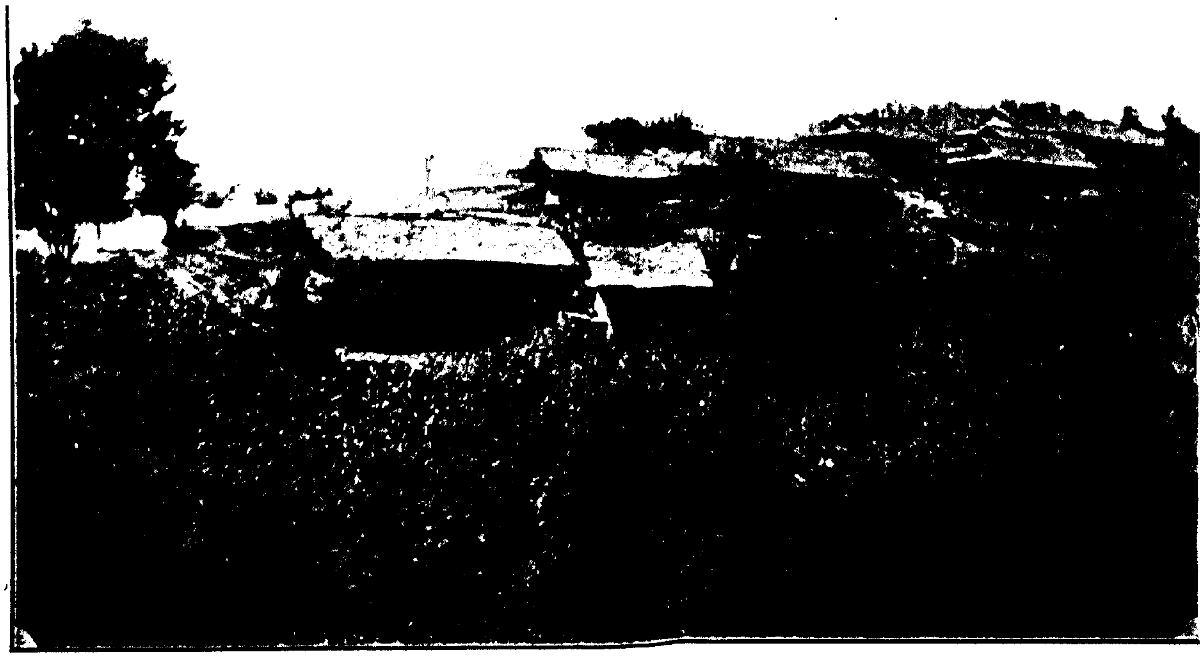
compartments for equal irrigation are only occasionally required. The crops are carefully handweeded. All grain crops are reaped with a sickle, tied into bundles and carried in headloads to the threshing floors to be threshed out under the feet of bullocks. Each floor is roughly paved with flat stones or with hard beaten earth, is surrounded by a low masonry wall and has a diameter of 15 feet or more. Bullock carts are not used in hill cultivation.

The arable produce available for sale is conveyed from the homesteads of the valleys by bridlepaths to the main roads and market centres by coolies or by pack animals. The general carrier of light weights is a cooly with a basket (Plates IV and XIII). The pack mule (Plate III) is often very heavily laden. The Hill coolies can carry astounding weights for long distances at a halting pace of 2 miles an hour or less. A heavy load is carried usually in a sack on the bent back and shoulders of the cooly, and is kept in position by a thick soft rope which is slung round the package and is supported on the cooly's forehead. Pack mules, pack ponies and pack cattle are chiefly used for carrying the agricultural produce which is exported. The long single files of these pack animals are very characteristic of the traffic of the main roads and byeways of the Simla hills. They not only carry agricultural, forest and other produce to the markets of the plains, but to a considerable extent they return laden with the merchandise of the cities of the plains and bring back spices, salt, tobacco and many other luxuries or necessaries. The principal *Kharif* crops are cereals: maize (makka), rice (dhan), kodra (*Paspalum scrobiculatum*), mandal (*Eleusine coracana*), urid (*Phaseolus radiatus*), mung (*Phaseolus mungo*), potatoes (alu), amaranth (*Amarantus paniculatus*), sesamum (til), turmeric (haldi). The chief *Rabi* crops are the cereals: wheat (gehun), barley (jau): the pulses: gram, lentil, and san (*Dolichos lablab*) and the oilseed sarson (rape seed). Walnuts, mulberries, peaches, apricots, apples and pears, are the more common fruits. In the rains a large variety of vegetables are grown in odd corners near the homesteads. They are chiefly native vegetables, but they include cabbages, cauliflowers, turnips, carrots, French beans, English vegetables of fine quality can, with careful cultivation, be grown very successfully up to an altitude of 6,000 to 7,000 feet. The cultivation of fine varieties of fruit could be very largely extended. Potatoes of good kinds and of excellent quality are now produced in large quantities in the Simla hills. The cultivation is extending. The export trade of potatoes to the plains has been stimulated by the Simla-Kalka Railway and provides much transport work to coolies and owners of mules, ponies, buffaloes and bullocks.

In nearly all agricultural operations the women of the lower castes work quite as hard as the men. The older children help them to feed and tend the cattle, gather fodder and firewood, manure the fields, weed the crops, reap and carry home the harvest. The men do all bullock-power tillage, sow the seed, thresh and winnow the grain, carry the produce to market, and sell it. The women of the higher agricultural classes attend almost entirely to domestic duties only, and unlike those of the lower castes are not helped in their cooking by the men.

The staple cereal food-grains of agriculturists in good circumstances are wheat, maize, barley and rice, with the pulses, gram, urid, mung, arhar, math. Maize is the chief food between September and May, and wheat, or wheat and barley mixed, for the rest of the year. Potatoes are very generally eaten, also native vegetables, and a few of the more common English vegetables. Well-to-do families owning buffaloes and cows use a good deal of *ghee*. The poorer people are satisfied with linseed and rapeseed oil. Rock salt is the chief form of salt used. Men and women smoke tobacco, but the higher ranks refrain from doing so openly.

The income derived from cultivation by a large family on a small holding is supplemented by that from subsidiary occupations, as for instance selling fuel and grass obtained in forests, carrying the agricultural produce of the larger landowners to market, and in grinding grain. Plate XIV illustrates a flour mill which is common in the hills. It is worked by water power. The water is diverted from a stream, and by channel and wooden lade is



A. J. I.

A TYPICAL HAMLET.

PLATE IX

HILL PLOUGH (HAL) SIMLA DISTRICT.

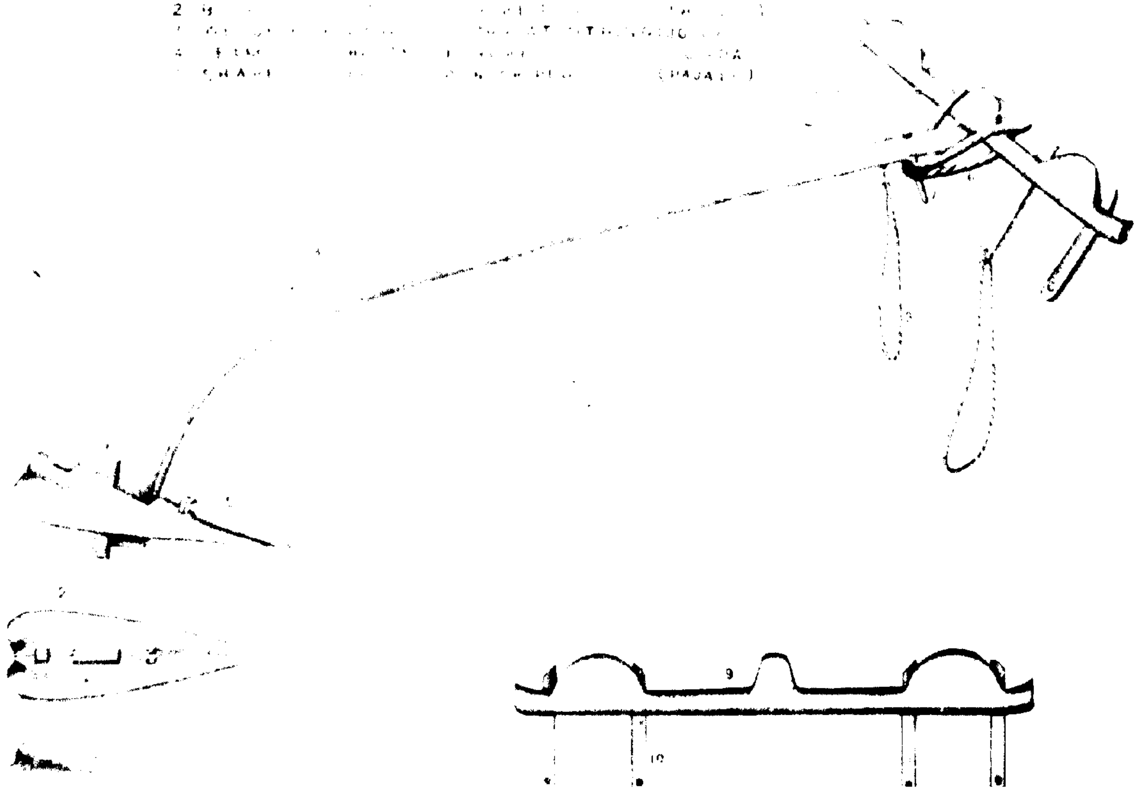


PLATE X

HARROW (GAHAN OR DANDAL), SIMLA DISTRICT.

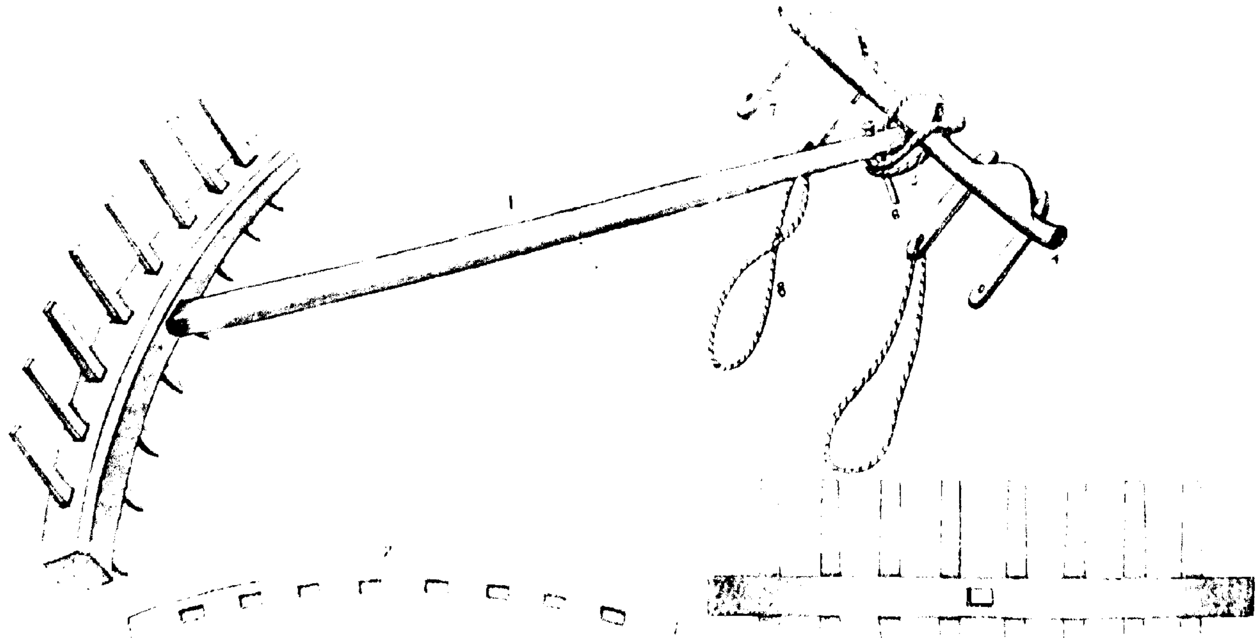
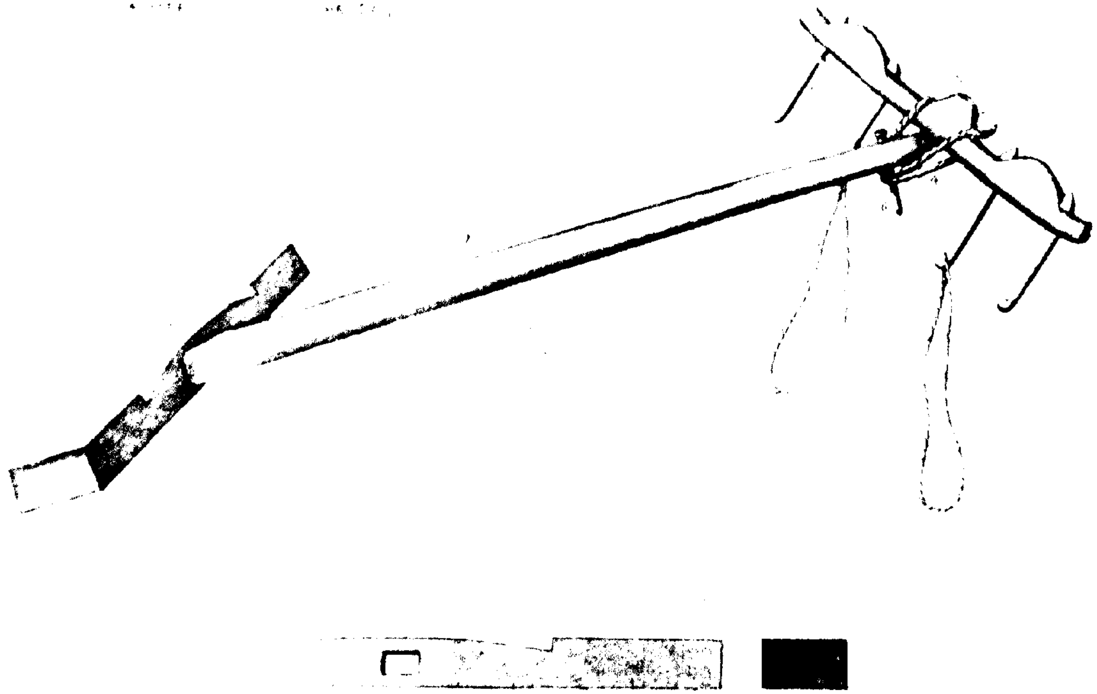


PLATE XI.

LEVELLER MOI SIMLA DISTRICT.



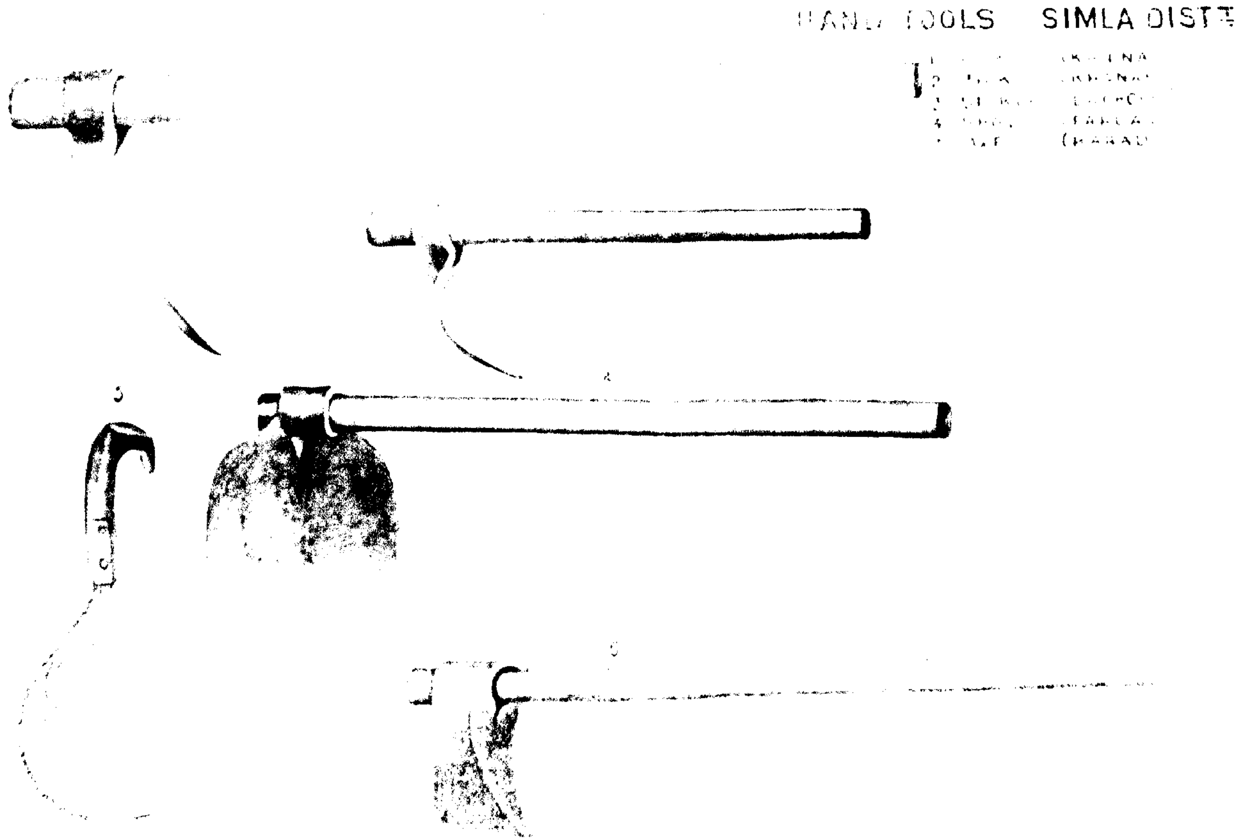
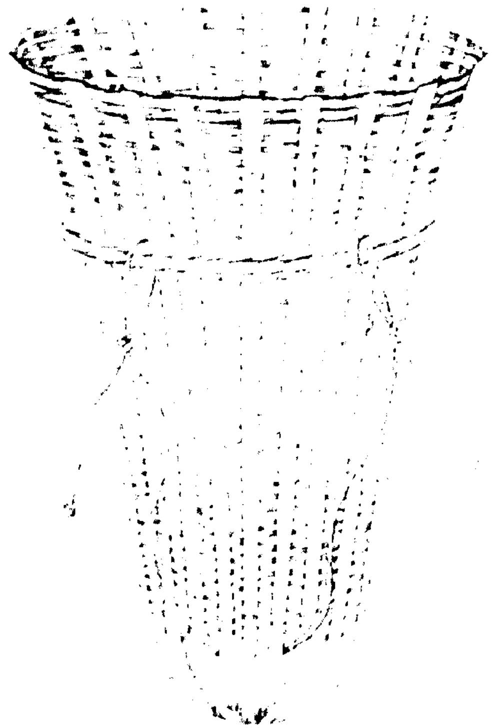
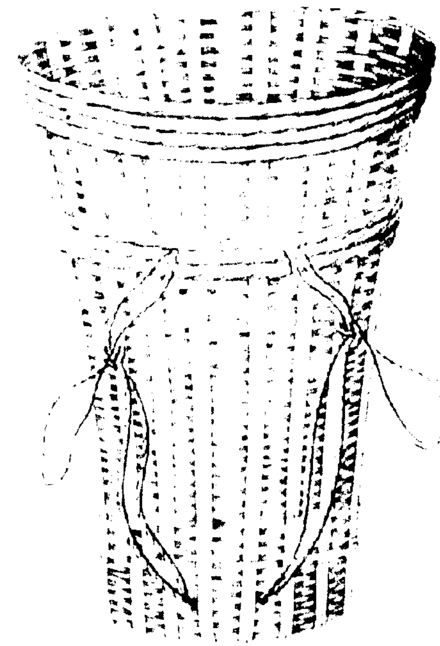

HAND TOOLS SIMLA DISTT

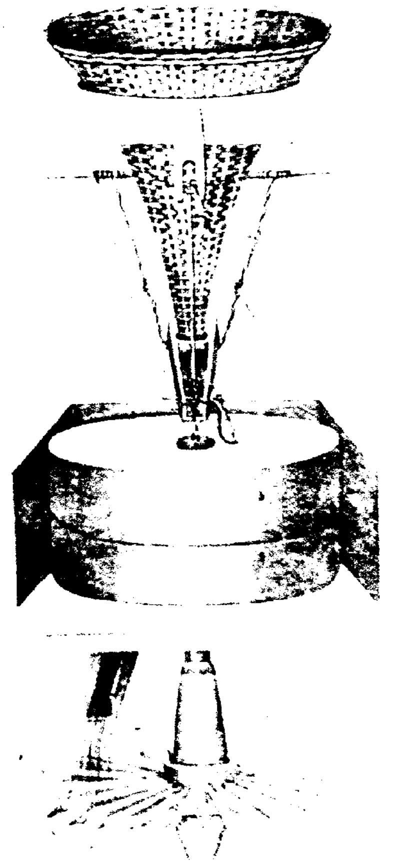
PLATE XIII

BASKETS SIMLA DISTRICT.

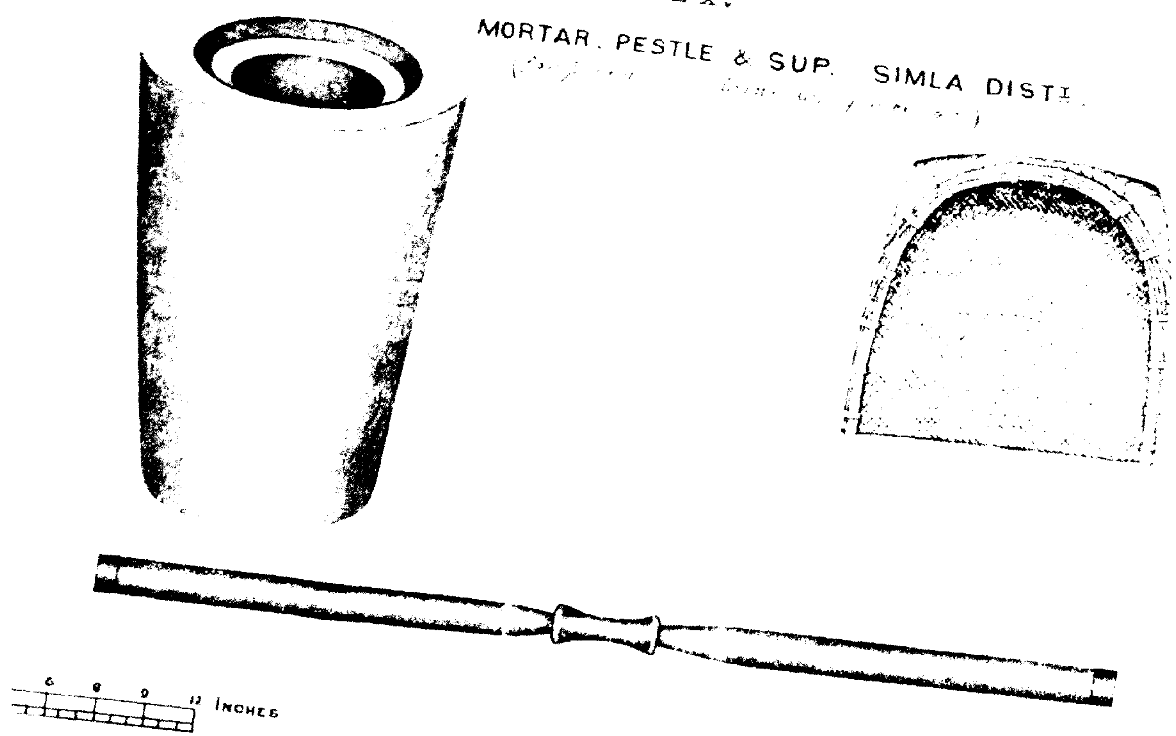




GRINDING MILL (GHARAT) SIMLA DISTT.



MORTAR, PESTLE & SUP. SIMLA DISTT.



carried with sufficient fall and force to work a turbine wheel which moves the nether grindstone. A mill including the hut over it costs about Rs. 30. The grain which is usually ground is wheat, barley, maize and gram. The usual rate for grinding is two annas per maund of 82 lbs.

Plate XV illustrates the mortar, pestle, and sup used for pounding and winnowing rice and other grains. The women use the sup very deftly in separating chaff and husk from grain and in sifting husk from pounded grain or flour.

Plates V, VI, VII, respectively, illustrate a hill buffalo, a hill cow, and hill sheep. The hill cows and work cattle are compact, active, little animals, not unlike the Kerry cattle of Ireland, in size and general conformation. They vary in colour, but the majority are black or very dark brown. A good cow is worth about Rs. 30, but only yields about 3 seers (6 lbs.) of milk when in full profit. The buffaloes are much smaller and more active than those of the plains. A milk buffalo costs Rs. 40 to Rs. 50 and gives about 5 seers (10 lbs.) of milk daily for a few months after calving.

The hill mules are very sturdily built and of very fair size. Many are well over 13 hands in height. They are worth 60 to 80 rupees each. A good donkey mare is worth Rs. 150 or more.

THE CATTLE AND SOME AGRICULTURAL FEATURES OF THE KURNOOL DISTRICT.

By C. BENSON, M.R.A.C.,

Late Deputy Director of Agriculture, Madras

THE Government of India, in their Resolution of December 1881 on the Report of the Famine Commission, expressed the opinion that the primary duty of the Provincial Agricultural Departments then being organized should be an analysis of all districts, village by village, in order to determine in which portions of the country agriculture is precarious and also to ascertain what agricultural defects exist. In Madras, some years ago, this task was entrusted to me and took the form of a general survey rather than more precise village to village analysis.

The only district dealt with was Kurnool. It was for purposes of enquiry divided into fairly homogeneous tracts or agricultural divisions regardless of the artificial boundaries of administrative areas, and the condition of these tracts was submitted to a detailed analysis as time and means permitted. From an agricultural point of view, the advantages of adopting such a system are many and obvious, particularly in illustrating by facts and statistics the teachings of Indian rural economy. I propose to show something of what I then learnt, especially about the farm livestock of the Kurnool district.

This district has an area of over 7,500 square miles, one-third of which is occupied by forests. The greatest length from north to south is 80 miles and from east to west 110 miles. Over such a wide area it is natural that great diversity should exist, and this diversity is increased by the fact that the district is traversed from north to south by two ranges of hills— of no great height it is true—but sufficient to intercept and modify the flow of the monsoon currents and hence the rainfall and its distribution. Added to this, the soils are many and varied, and thus the agricultural conditions of different parts of the district are also diversified. In no respect are they more so than in regard to cattle-breeding and management. In some parts cattle are largely bred: in others, there is practically no breeding at all, and the ryots depend for their work cattle on imports from the neighbouring district of Nellore (or Ongole).

Speaking generally, the district stands from about six to sixteen hundred feet above sea-level, with hills in some places exceeding 2,000 feet in altitude. It is occupied almost throughout, except on the north-west, by sedimentary rocks which largely influence the character of its soils. The irrigational facilities are mostly poor and not capable of great development: though in some tracts the underground water-supply is good and might be more largely used than it now is. The rainfall is moderate and precarious. It is only within comparatively recent years that access to the district by rail has been provided, whilst other communications are poor in many parts, though their quality depends largely on the nature of the soil in different localities. The population, though at first sight appearing to be extremely sparse, is not so in reality, for the incidence is reduced by the large area of forests that exist. The population is fairly uniform throughout the district as a whole. In parts there is much good soil, but the precarious character of the rainfall has rendered the Kurnool district one of the worst 'famine' districts in the Madras Presidency, and agriculture is carried on there under great difficulties.

It is not with agriculture generally that I propose to deal in this paper, but with the cattle of the district. And in this choice I think there is reason, for on his cattle the ryot depends almost entirely. They are the motive force for nearly all tillage operations and the source of the greater part of the manure he uses, and thus they are of outstanding importance in the rural economy of India. Little effort, however, seems to have been made to collect accurate details about cattle in any Province in India. I have long been convinced that, in Madras at least, the data available for forming an opinion of the tilling and manuring forces of cattle were utterly defective any figures the village accountants chose to submit being accepted without check or question. One of the first things that was before me, therefore, was to obtain fairly full and fairly accurate statistics on this matter. It involved much labour and the detailed checking of many hundreds of returns. The result was not without its value, for I believe that, in my account of the Kurnool district, I placed on record data which should serve as a general check on livestock statistics as prescribed by village accountants.

In the course of my survey, I divided the district into nineteen agricultural tracts. Some of these were of comparatively small area, one, the conditions of which are governed by the existence of a large irrigation tank, being only 13,750 acres in area; but most of them exceeded a hundred thousand acres in extent, whilst some were three or four times as large again. Each of these tracts differed in some important agricultural character from those adjoining it, though differences of soil chiefly influenced the grouping adopted.

I propose to deal in this paper in detail with two only of the 19 tracts. Of these, one, with an area of nearly 424,000 acres, is a wide open plain of *regada*, or black cotton soil. The country is fertile and the people comparatively prosperous. It is almost treeless except where the villages cluster along the main watercourses, and irrigation is confined to one or two tanks. Irrigation from wells is scarcely practised, there being about 177 acres of crop grown without for every acre irrigated from a well, and the soil is not generally of a character suitable for irrigation. The principal crops of the tract are a late variety of sorghum and cotton. At the time of my survey, about 17 per cent. only of the total area was not available for cultivation, and of this nearly half was included in village forests and grazing reserves. Besides such area and a very small proportion of the occupied land left untilled, there was no public grazing easily accessible to the ryots. Forests at no great distance are, however, grazed by ryots' cattle in times of drought. Within the tract, at the time, 96 per cent. of the arable land was in occupation, and of this the normal proportion cultivated from year to year was 94 per cent. Nearly the whole of this cultivated land depends on rainfall only. The average assessment of the unirrigated occupied land was then very slightly over one rupee per acre. The holdings averaged about fifteen acres each, 12 per cent. of the area was held in occupancies of about three acres, and 25 per cent. in holdings of the average of 15 acres. The tract shows quite a number of large holdings for Southern India.

The other tract with which I propose to deal has an area of about 320,000 acres, generally of thin poor soils, though a few patches of superior quality exist. This tract forms a plain lying outside the Eastern Ghats with valleys running up into the Nallamalais. The tract is almost bare of trees and is surrounded generally by the bare foot-hills of the Nallamalais. The accessibility of the higher jungles on those hills encourages the keeping of stock. Besides the more distant jungles alluded to, of the total area there was at the time of my survey some 27 per cent. reserved from occupation, of which nearly half was then included in village forests and grazing reserves. 66 per cent. of the arable area was then in occupation; therefore, rather more than half the total area included in the villages of the tract was available for public or 'common field' grazing; and besides this, on an average of years, over 20 per cent. of the land in occupation was not tilled. The greater part of the cultivated land in this tract depends chiefly on rain, about 5 per cent. was irrigated from works, and more than 10 per cent. from wells. The well irrigation is a very important feature of the tract. The quality of the land in occupation is shown by the rate of assessment, *viz.*, 8 as. an acre. The value of well-irrigation has not enhanced the assessment. In this tract crops are earlier than in that previously mentioned; nearly two-thirds of the sowings occur before the end of August, a good deal, however, of really late sown crop is also raised, as the tract receives a fair amount of rain during the north-east monsoon. Cereals, of which the most important are Sazza (*Pennisetum*), Korra (*Setaria*) and early sorghum, pulses—chiefly horse-gram (*Dolichos*)—castor and cotton are the chief crops. The two latter occupied about 15 per cent. of the cropped area. The holdings are small, averaging all round only ten acres in extent. More than half the area had holdings that averaged about seven acres: only 34 per cent had holdings which averaged about 18 acres. There are practically no large holdings in this tract.

From the description given above, it will at once be recognized that the two tracts, which I named respectively the Kundér and Dupád tracts, are, agriculturally, as the poles asunder, and this is even more marked when matters relating to livestock are considered.

In the first place, with regard to the areas kept under cultivation by a pair of working cattle, in the Kundér tract, this is as much as 34 acres and in the Dupád tract only 13. To some extent this is explained by the fact that in Dupád there is so much irrigation from wells, but that is not the only or the chief reason for this remarkable difference. On the rich cotton soils of the Kundér tract, the tillage is most astonishingly superficial and slight, though in this respect it is more complete than is the tillage in other parts of the district and in Bellary, which adjoins it on the west. In the Kundér tract, tillage, though the plough is used to a considerable degree, is mainly dependent on the drill and harrow (Guntaka), whilst in Dupád the plough is much more generally used, and the consequence is that the tillage in the former area is quite shallow and is not corrected by occasional deeper tillage as in the Bellary country. In the tilling force itself there is a difference, for whilst in the Kundér tract only about 3 per cent. consists of he-buffaloes, in Dupád the proportion of this kind of stock is as high as 18 per cent. To some extent this difference is attributable to the larger proportion of irrigated land in the latter area, even though the buffalo is not a suitable beast for use on the thin stony or gravelly soils that occupy the greater part of it.

When the next particular detail is alluded to however, the difference between the two tracts is more clearly shown ; for whilst in the Kundér tract the proportion of breeding cattle to working cattle is as 126 to 100, in Dupád it is as 221 to 100. In the latter area the proportion of breeding cattle is possibly understated, as many of the cows are sent off to the higher jungles for grazing and cannot readily be counted. The proportion of breeding cattle to work cattle in the Kundér tract is enhanced by the large number of she-buffaloes which are kept. In this tract, we found nearly twenty thousand breeding she-buffaloes and only about 5,400 cows. In Dupád, on the other hand, there were about twenty-four thousand cows and less than thirteen thousand she-buffaloes. Of the progeny of the she-buffaloes, only some six hundred were reserved in the Kundér tract for working, the unirrigated land being almost invariably cultivated with oxen. The small number of these bred locally was altogether inadequate to local requirements, which are met by importation from the east chiefly of Nellore, or Ongole cattle. These cattle are bred in the northern part of the Nellore district and in the adjoining parts of what is now called the Guntur district. They are brought over when from 18 to 24 months old, in droves which travel through the district from east to west, and are sold on an instalment system, the payments being spread over three years, so that the debt on a young bull is cleared by the time he comes into full work. During their growing years these young bulls—they are not castrated till their fifth year—are carefully fed and looked after, being treated very much as members of the ryot's family, and the better the condition of the owner the better fed will the young stock be. Besides an abundant supply of sorghum straw, these young bulls receive about half the ration of artificial food allowed to the tilling cattle, and green fodder when it is available. In consequence, it is perhaps on the rich cotton soils of the Kundér tract that this noted breed reaches its greatest development. These cattle, owing to soft feet, are better suited to black cotton soils than to gravelly soils or for road work.

My account of the Kurnool District gave, I believe, the first close estimate of the numbers of young stock kept or raised in any district in India. I arrived at the conclusion that ordinarily we should find about 135 young cattle for every 100 breeding cows kept, and that in the case of buffaloes the proportion is rather lower, owing to the greater delicacy of the buffalo calf. In the two tracts which I have taken for detailed reference, we found that the proportion of young stock to cows was as 143 to 100 in the Kundér tract, and as 94 to 100 in Dupád; the low proportion in the latter being attributable to omissions, and the high proportion in the former to the importation of young working cattle not ready for the yoke. In the case of young buffalo stock, the proportions in both tracts were almost identical, being 108 in the Kundér and 110 per 100 buffalo cows in Dupád. The importance of obtaining accurate data on these points lies not only in the matter of how supplies of tillage cattle are maintained, but also in the demand for grazing, if they are to be reared locally. In Kurnool, the cows and young stock (except the imported young bulls alluded to above) have, under all circumstances, to trust almost entirely to what they can pick up on the common pasture for their food. The she-buffaloes, on the other hand, like working cattle, form part of the ryot's family; and whilst in milk, receive great care and attention. Dry and young buffaloes are, however, not specially fed, but they are housed at night and get a little straw to eat.

The importance, therefore, in the economy of any tract or district, of the grazing areas accessible thereto, is at once apparent. These include the lands reserved for communal purposes, the unoccupied arable land, and what, at the time of my survey, were called "village forests and grazing reserves." Taking all the cattle as full grown,* the numbers maintained, including the working cattle, were 82 head per 100 acres of grazing area in the Kundér tract and only 44 in Dupád. In the former tract, they were mostly working cattle and she-buffaloes; in the latter, breeding

* After reducing the young stock by one-half.

cows formed the largest item. But the difference in the practice of the two tracts is more definitely shown by the numbers kept in proportion to the areas cultivated. These were 22 only in the Kundér tract and 100 in Dupád per 100 acres normally cultivated. These figures show that, whilst the people in the Kundér tract devote their attention to tillage (with the keeping of buffaloes primarily for milk), those of Dupád to a very large extent depend on cattle breeding for their subsistence.

I have now to deal with the manuring capacity of the stock in the two tracts. In so doing, and to form a rough estimate, it is necessary to note the number of stock kept, calculating young animals at half. If, then, we allow a little more than one load of dry dessicated manure per head as the annual amount available, we get the following results :

Number of stock kept 523,139 --giving 600,000 loads per annum. Total area under crop annually about 1,700,000 acres. This gives 30 loads available for 17 acres once in five years, or less than 2 loads per acre. As, however, the gross amount available for ordinary dry land must be reduced by the amount taken annually for the irrigated and garden lands, the remainder really available for ordinary 'dry' lands may be determined somewhat as follows :

Total amount available	600,000	cart loads.
Amount required for 30,000 acres manured annually	300,000	cart loads.
Remainder available for 1,650,000 acres occasionally manured	300,000	cart loads.

That is, about one cart load is available per acre once in five years for most of the land. In other words, only 60,000 acres of the land is manured in a year from this source and 1,370,000 rarely, the latter being the land most remote from the villages.

In working out the extent to which manuring from this source is possible, allowance may be made for the conditions influencing the probable amount available and the demands thereon in each tract. Thus in Dupád considerable allowance has to be made for the practice of driving off the young and breeding stock to the jungles for pasture ; and a deduction must also be made there for the demand made for the irrigated and garden lands before any estimate can be made as to how much of the ordinary 'dry' or unirrigated land is manured. Nevertheless, the stock kept in proportion to the whole area under cultivation is the safest measure of the extent to which manuring is generally carried out. In the Kundér tract, the total stock kept was only 22 per 100 acres cultivated, whilst in Dupád it was one for every acre, and whilst I estimated that in the former tract 14,000 acres could be manured from this source, in Dupád I put the figure at 10,000 acres yearly. Adding on the manuring power of the sheep and goats, of which very large numbers are kept in Dupád, the total manuring power available, whilst reaching to only 6 per cent. of the cultivated area in the Kundér tract, was as high as 26 per cent. in Dupád; but, after making the necessary allowances mentioned above, I was inclined to place it at 15 per cent. of the cultivated area in Dupád, while in the Kundér tract I placed it at not more than 5 per cent. of that land. These estimates are, it must be remembered, based on an application of five cart loads per acre only, or its equivalent in manure from sheep and goats.

Whether my estimates of the outturn of cattle manure per head is low or not, and it was based on very extensive and minute enquiries, the conclusions are, I venture to think, of some considerable value, and apply in Southern India to the possibilities of manuring dry or unirrigated crops, which are those on which the bulk of the ryots depend for their subsistence.

In some parts of the Kurnool district, on or around the foot of the two ranges of hills, considerable herds of breeding cattle are kept by professional cattle breeders, the Lambadies, who in former times did a great trade as carriers with pack bullocks. In the same localities, as well as in another, where there is a large amount of grazing available, such breeding is pretty extensively practised by the ryots. She-buffaloes are kept almost everywhere and their produce, in ghee, is considerable, especially in the tracts where the black cotton soils prevail.

He-buffaloes are not largely used for tillage, except where 'wet' cultivation exists or where there is much irrigation from wells, but they are generally used by the quarrymen and woodmen for hauling stone and timber. Bullocks form almost entirely the tilling power of the district and are generally remarkably good. Nellore cattle preponderates in the greater part of the district, except on its western side where locally bred cattle are chiefly used. In the eastern parts also, locally bred cattle prevail, but these often show the Nellore type strongly.

Within the district, besides the usual mongrels, two distinct breeds are to be found: one on the stony hills or table-lands in the south-west of the district, and the other in the jungles lying about and to the north of the Kistna river. The former, which for convenience may be called the 'Erramala' breed of cattle, are of medium size, very active and spirited. They carry long sharp-pointed horns, which in good specimens should meet at their tips. They are renowned for their hardiness and endurance, and when well trained, they are excellent for fast road work. They are not much seen at the plough but are used as pack bullocks. The soundness of their feet enables them to travel long distances by road or on hard gravelly soils without needing shoeing. The latter breed, which may be termed the 'Dupadi', resembles the Erramala cattle in type and character, but are rather smaller. The prevailing colour is pale red. These cattle are remarkably shapely and are of great power and pluck. They are brought southwards for sale from the Kistna Jungles and are largely used by their breeders, the Lambadies, in carrying salt and firewood. The more nearly the locally bred cattle approach in character to either of these two breeds, the more valuable they prove. It is seldom that the cattle in the central or western parts of the district show much sign of Nellore blood. These local cattle are far hardier, more active, and longer lived than the Nellores, and stand a rough life and hard usage well, whilst, on hard work, they do not need nearly so much artificial food to keep them in condition. They form the bulk of the tilling cattle on the lighter soils and of the cart bullocks on the roads.

In choosing cattle, great attention is paid to colour. Local cattle having the colour of a grain of wheat are the most valued; the whites, reds, and blacks following in the order given. Cattle with short legs, horns, and neck are preferred. A saying goes "purchase without further enquiry a bull with thin horns." The value of a spirited animal is also recognised, for it is said, "a willing bullock is hardest worked," or that "one word is enough for a good man, one stroke for a good bullock." As to the relative qualities of bullocks and buffaloes, it is said that "a good working buffalo is not equal to a dull bullock."

As to the housing of the cattle, over the greater part of the district one-half of the ryot's house forms his dwelling and store rooms, the remainder his cattle byre. Ventilation, especially at night when the door is closed, is practically non-existent. The floor is usually paved with slabs of slate and soon becomes uneven, and the provision made for carrying off the urine of the stock is most ineffective. From June to March, most cattle are housed thus at night, but during the hotter months, the men sleep in the open and the cattle are, as far as possible, tethered outside. In those parts of the district where good building stone for the construction of the usual flat-roofed houses is not to be had, the ryot either shares a portion of his thatched hut with his cattle, or provides another, equally good, for them. The walls of these sheds are usually made of wattles and thus they are well ventilated, but the floors are even more defective in regard to the preservation of the urine, than in those parts where stone is available. The housing alluded to is provided for the tilling cattle, the young bulls, and the she-buffaloes. When the number of cows kept is small, they are similarly housed with their calves, but when the numbers are considerable, they are penned in an open yard. The professional breeders tie their cattle up in rows in the open, the camps being moved from place to place as convenience dictates, the chief point being the water-supply in the dry weather, but in the rains accessibility for grazing is the only consideration. Thus, these breeders spend their time between the jungles on or around the hills and in camps in the plains, after the harvests are over.

As regards the working cattle, the management varies slightly according to the accessibility or otherwise of grazing, but they are seldom sent any considerable distance for grazing and are usually herded separately from the other stock. The ryot recognises that "it is straw that makes the ox grow fat." When grazing is available, the cattle are turned out at the early hour when the ryot rises and grazed till about 8 A.M., and again after the day's work, till as late as 8 P.M. when they are brought in and tied up. Elsewhere they are first fed at about 4 A.M. and do not generally go out to work until the drivers have taken their early meal. At midday they get a feed of sorghum straw. They are brought in at about 5 P.M., and, after being watered, are tied up for the night and given a feed of sorghum straw, and their mangers are filled with a mixture of korra (*setaria*) straw and *pottu* (a mixture of the pods of leguminous crops and other chaff), when the ryot goes to bed. This also is the feed given first thing in the early morning when it is followed by another of sorghum straw. During the time when green grass can be collected in the fields, a considerable quantity is brought in to feed the bullocks and she-buffaloes at night. They are given also the stunted and damaged plants of cereals as the crops ripen. Altogether, from various sources, in an ordinary season, the ryot obtains a certain amount of green fodder during six months of the year for these two classes of stock.

But in Kurnool, every ryot endeavours to give his working cattle some artificial food also. From April to June, this is usually horse-gram (*Dolichos biflorus*), which is given at night after having been pounded and soaked in water. Later in the year, cotton seed is given, or, in places where that is not easily available, the grain of sorghum or of *korra*, the latter being given in addition to cotton seed in some cases. Cotton seed is always pounded and soaked and often greatly diluted with water; whilst, if horse-gram is not to be had in the hot weather, cotton seed is given in the form of a thin gruel and the coarser parts are reserved for the buffaloes. The cattle of the richer ryots get these artificial foods all the year round, but those of the poorer only during the busy season. The allowance of horse-gram is about 3lbs. and of cotton seed about 6lbs. for a Nellore, and about half these amounts for a country-bred bullock or a young bull.

The working cattle and she-buffaloes are usually watered in the house, at least at night, and for this a trough is provided there into which all the water used for household purposes drains. At the bottom of the trough, the pounded cotton seed is placed, and the water used in washing grain before consumption is used to mix with it, any edible refuse being added and the whole mixed up together. The cattle, which only drink from the surface, are allowed first access, then the buffaloes, which bury their noses in the water and seek the coarser portions at the bottom.

It is perhaps natural that the ryot pays attention first to his tilling cattle, and that when fodder runs short they suffer least. In times of scarcity the ryot will try to keep his tilling cattle alive though the other stock may starve and die. Work cattle usually last from 8 to 10 years ; the local bred bullocks work at least two years longer than the Nellores. They are not shod for field work, but only when regularly employed on the 'made' roads, and it is not usual to pierce them for nose-ropes, although there is a Telugu saying that "a bullock without a nose-string and a child brought up by a widow are uncontrollable." Lameness is rare and cases of sore-neck are seldom seen.

The keeping of cows for breeding is governed chiefly by considerations of free grazing, and, speaking broadly, in the black cotton soil tracts of the district, cows are not kept except by wealthy men or Brahmins. Grazing of some sort is, however, fairly abundant in many parts of the district, and in these there are few ryots who do not own cows, whilst the wealth of some and of professional breeders in this respect is great. Ordinarily the ryots do not milk their cows, although the saying goes that "field produce is not as profitable as keeping milch cows," but value them solely for the calves they produce. But where large herds are maintained, as by the Lambadies, during the rains when there is abundance of grass to encourage a free flow of milk, cows are milked once a day and ghee is made from the produce. Although the cow is valued for her offspring, little care is bestowed on her. Still less is given to the sire. Tradition says that at one time special bulls were kept for breeding, but now such bulls are to be found only with the owners of large herds. Among the Lambadies a wife brings, as her dower, a bull that remains as the lord of her husband's herd until a promising young bull dropped in the herd replaces him.

Cows and the young stock have to depend almost entirely on what they can pick up, although occasionally they may get a little refuse straw from the working cattle. All the cows of a village are usually grazed together in the "common field," or, during the cropping season, may be sent off to jungles to graze and are kept there. In these herds, there is always a number of young immature bulls, and the cows are mostly covered by these. From their earliest days, the calves go out to pasture with their dams, but are generally tied up at night. The cows yield but little milk, and the calves and heifers receive very little attention. Young bulls, when about three years old, are taken into the ryot's house and treated like the working cattle till they are emasculated and yoked. The Lambadies sell off their young bulls when about a year old, and thus only selected bulls are used by them as sires.

Heifers usually take the bull in their fourth year. The cows generally calve once in eighteen months. Most of the calves are dropped in May and June or in September and October, but there is no very clearly defined general breeding season. Little is done by the ryot to help the cows to rear good strong calves. The value of the cow-buffalo is shown in the saying "there will be no want in the house where the churn and the spinning wheel are at work." In Kurnool, milk-buffaloes are, after the tilling cattle, the most important—there are in the district even more she-buffaloes than breeding cows. They are almost all of one breed, a small black one, which has a good local reputation for milk and butter. In selecting a milch-buffalo, the ryot looks for a dark skin, short legs, and thin thighs, and an udder which, with the teats soft and well set, is not itself soft and flabby; and the advice given is that you should "look at the mother before you marry the daughter, (and) milk a buffalo before you buy it."

The buffalo begins to breed after its third year and a good one drops a calf annually, the usual calving season being September. For three days after calving, these cows are tied up and allowed no green fodder, but are given warm gruel made from sorghum grain, with a little garlick added, and are washed daily with warm water. The whole of the first milk (colostrum) is not given to the calf, a portion being drawn, and for the first three days after birth, the calves are given a piece of cotton soaked in castor oil to suck. From the fourth day until they begin to eat grass, the calves are frequently given a few morgosa (*Melia Azadirachta*) seeds in butter to kill worms. They are very delicate and considerable numbers are lost during their first year, but afterwards they gradually become more and more hardy. They are usually kept tied up in the house until they are fully able to graze.

Cow-buffaloes, three days after calving, are put on a ration of about 4 or 5 lbs. of cotton seed, horse-gram, sorghum, or sazza. This ration is ground or pounded, soaked, and greatly diluted as already described. The concentrated food varies with what is available, and with it is given such green fodder as is procurable. If green fodder cannot be had, *korra* straw and *potta* is given. Cotton seed is held to give the best quality and the largest amount of ghee, whilst though it is said that "the thicker the milk the more the butter," sorghum grain is held to produce thicker milk, but not so much ghee as cotton seed. Effect is given to the saying that "milch cows and children in arms need similar care."

Good cow-buffaloes will remain in milk for nine months after calving; for the first six months after calving they are milked twice daily, at morning and night, and it is only during the last three months that they are milked once a day. Two seers of milk a day is held to be a fair yield. From this 15–22 tolas of butter are said to be obtained, whilst 32 tolas of butter give 22 tolas of ghee. The ghee is a perquisite of the women of the family; consequently "the milking capacity of a buffalo is only made known after her death" to her masterful owner.

It frequently happens that difficulties arise in milking cows that have lost their calves, because the saying is true that "unless the calf sucks, the cow will not let down her milk." Thus, the usual practice is to milk with the calf alongside its dam.

Dry and young buffaloes do not receive any special food, though they are housed at night and may get some straw then. The heifers are for the most part retained, but young bulls are sold off to drovers who take them into the districts to the south for use on 'wet' land. If it is found that a heifer does not take the bull properly, she is put to work until she does so. Special buffalo bulls for breeding are rarely found and no more care is exercised in this respect than in the case of neat cattle.

With regard to the epizootic diseases which attack his stock, the ryot though in a general sort of way he likes the principles of segregation, an affected village being taboo, does not include prevention in his ideas. Within his village, the sick and the healthy live and graze together, and the carcasses of the beasts that die are thrown on some waste spot near the village, often near the wells or ravines draining into the principal source of water-supply, whilst the hides are secured by the chucklers as a perquisite.

THE UNITED STATES DEPARTMENT OF AGRICULTURE: ITS ORIGIN, GROWTH AND PRESENT CONDITIONS.

BY T. F. MAIN, B.Sc., F.H.A.S.

Deputy Director of Agriculture, Bombay.

THE Indian Agricultural Department is but on the threshold of its existence. One is naturally inclined to speculate a little upon its future and to enquire what work it will be likely to perform, and to what extent it will be a real benefit to the agriculture of the country. If analogy be of any use under these circumstances, we have a very interesting example in the United States Agricultural Department.

In the space at my disposal I shall endeavour to show how this department was developed and also refer to some of the work accomplished. I am indebted chiefly for this information to a historical sketch compiled by Charles H. Greathouse. I have taken numerous quotations from his Bulletin. The sketch explains the objects of the Department and its organization and also describes its various divisions.

Previous to 1860, little attention was given to scientific agriculture in the United States. The patent office distributed seeds, and collected and published agricultural information. At this time the United States Agricultural Society was active in urging the establishment of a separate Department of Agriculture. In 1862 an Act was passed which provided for an independent department with a Commissioner at its head.

Washington really started the United States Agricultural Department and Franklin helped its progress by practical activity. The former proposed the formation of a branch of the National Government to care for the interest of farmers.

The Department as it is now constituted embraces many divisions, and its gradual growth is a most instructive study. The Weather Bureau took its origin from the observations of the Smithsonians, who devoted a great deal of time to the publication of Meteorological data. In 1872 the Government provided a Meteorological Department and the Department began to publish Agricultural Statistics. In 1863 the Department of Statistics was established. In 1904 a Bureau organization was provided.

During Commissioner Newton's time the Department Library and Museum were started. This Library was not officially recognised till 1871 when a librarian was appointed. The first books were obtained from the patent office. Additions have since been made by exchange and purchase. The Library now contains 92,000 volumes and is probably the best separate collection on agriculture and allied subjects in the world.

Although the Agricultural Department was separated from the patent office in 1862, it was not provided with separate buildings and other accommodation till 1867. It comprised at this time the Divisions of Chemistry, Gardens and Grounds, Entomology, Statistics and Botany. About this time the control of quarantine for animals was transferred from the Treasury to the Commissioner of Agriculture, and in 1884 the Bureau of Animal Industry was established by Act of Congress with a grant of $150,000 to deal with pleuro-pneumonia and other diseases.

The Hatch Bill became Law in 1887. It dealt with the form in which the results of experiments and investigations should be recorded, and for this purpose the office of experiment stations was established.

In 1889 the Department was raised to the first rank in the executive branch of the Government. Its work was "treated slightingly by many Congressmen, and was considered merely as a means to reach many constituents with small favours by the distribution of seeds and books. The clerkships and the positions in the Department were regarded as patronage to be given to political adherents, with little regard for fitness." "But Commissioner Le Duc, when appointed by President Hayes, took up the duties with such earnestness that Congressmen were impressed with the seriousness of the work for which the Commissioner asked appropriations and the Department was granted more funds." "The head of the Department owing to persistent public opinion was given a place at the President's Council Table."

The Hon'ble Jeremiah M. Rusk was selected by President Harrison as his Secretary of Agriculture in 1889. In re-organising the Department he divided the work into two main classes: executive, under his own immediate charge, and scientific, under a specially appointed Assistant Secretary who had scientific agricultural attainments.

In 1893 the Hon'ble J. Sterling Morton became Secretary of Agriculture. He developed the Department considerably, and gave much time to the extension of publications and of the Library. He introduced farmers' bulletins. The Division of Statistics was developed. The Division of Agrostology and an agency to obtain new foreign plants from all parts of the world were formed. The Hand-book of grasses of the United States was published. The Weather Bureau was much extended, a cyclone service was established and exchange of data with other Governments arranged for. The Forestry Division made good progress.

Competitive examinations for service in the Agricultural Department were introduced.

Secretary Wilson took office in 1897. The Department has advanced extensively under his direction. The budget allotment for the Department in 1907 was \$9,932,940 against \$2,448,332 in 1897.

Since 1897 notable changes have been made in the work of the Department, particularly as regards enquiries into plant diseases, plant breeding, seed and plant testing and investigations regarding fruit growing. A Bureau of Forestry has also been established.

"Other branches of the Department which have been changed within the period indicated from a divisional to a Bureau organization with large increase of activities are the Bureau of

Chemistry, Bureau of Soils, Bureau of Entomology, Bureau of Statistics and Bureau of Biological Survey."

The Division of Foreign Markets was organized separately from the Division of Statistics in 1898 and a Solicitor for the Department was provided in 1905. Secretary Wilson has given much attention to the encouragement of home industries and sugar, silk and tea industries have thereby greatly benefited. "Agricultural explorations for discovering new crops, new varieties of old crops, new methods of cultivation and farm management, new species of desirable domestic animals, new modes of combating diseases of animals and plants and injurious insects, formed important features of the period from 1897 1905. Great progress has been made in the studies of plant breeding and soil investigation. Special attention has been paid to such points as food inspection, methods of storage for foreign markets, forest development and management, and a special point has been made of the encouragement of agricultural education by school garden work and prize competition."

One of the most important pieces of work done by the Department in recent years has been the establishment in 1903 of practical and direct relations between the Department and farmers' institutes through the appointment of a special agent of the office of Experiment Stations to co-operate with the State and County officials interested in this line of Agricultural Education. "Great advances have been made in the study of meteorological phenomena. Instruments and apparatus for recording weather data were improved and standardised and climatic statistics gathered, compared and used in making forecasts, then put in form for future use. The number of stations was increased, including points on the Caribbean Sea and the Gulf of Mexico, in Bermuda, the Bahamas and the Azores, until the real direction of important progress has changed from practical extension of this kind to a study of scientific problems, such as the study of the movements of the atmosphere at much higher altitudes than heretofore commonly reached. For this purpose the establishment of a great National Observatory for weather study has been begun at Mount Weather, Virginia, a suitable point in the Blue Ridge Mountains, 50 miles from Washington. The watching of storms and floods was continued and efforts were made to render more efficient service to sea-faring interests and to farmers and business men in over-flowed districts. It has been impossible of course to prevent losses by floods, ice gorges and hurricanes, but the known saving effected has exceeded several times over the cost of the entire weather service."

"Crop reporting has been continued and improved and the issue of frost warnings extended. The function of the statistical service of the Department was clearly defined as the rendering of assistance to the farmer in receiving a fair price for his products. The reporting of crop prospects was improved and the spread of the information, when gathered, studied, and printed, was made more effective, especially by a system of posting card announcements of results in the 92,000 post offices of the country. The study of foreign markets was continued, and reports of trade relations with important nations, based on a study and analyses of Treasury reports of exports and imports, were published. *The Crop Reporter*, an eight-page quarto monthly paper, was established in 1899 as a means of communication between the Bureau and its thousands of correspondents. A special agent was maintained in London, chiefly for the purpose of reporting European crop conditions and prospects to this paper. Great progress has been made in the study of animal and plant diseases and likewise in Economic Entomology."

"The editing, illustrating and publication of results reached by the several branches of the service grew with the extension of the Department's activities. No effort has been spared to present facts of practical value in actual farming in terms perfectly plain to farmers of every position in life, so that all may receive the benefits paid for by all. At the same time statements of progress in scientific research have been issued in technical language in limited number for the benefit of persons associated more or less directly with Department scientists in their investigations. The illustration of these books was directed to making clear the statements of the text. The Year-Book Series of the Department, which had recently been started when Mr. Wilson came into office, was continued and improved. It has received the commendation of American farmers and farm journals as well as European authorities. The distribution of Department publications to farmers constituted an important feature in connection with these publications. Press notices, lists of new and of all available publications were issued to keep the people informed as to what information and aid could be obtained. At the same time methods of keeping records of where valuable books have been sent, as well as of enquiry as to where they are needed, were combined to secure the greatest usefulness from these books to the farming world. The demand for these publications has so far exceeded the supply that it has been necessary practically to do away with all free distribution except to persons who contribute by service rendered to the Department work. Sales of them have increased notably in recent years. Special efforts by indexing were made to keep easily in reach of farmers and students such information as has been secured by the Department."

"The Library of the Department affords a means for the study by persons fitted for independent investigations of what has already been done in the leading Agricultural problems that is hardly equalled anywhere else in the world."

"The need of specially trained assistants in the Department work and the existence of unusual opportunities for study joined to make practicable a system of admission of young men and women into certain branches of Department work at low salaries with the purpose of continuing their studies along their chosen lines. From these student assistants, the Department has selected a number of capable officials whose service has justified the establishment of the system."

The investigation of the Cotton Bollworm weevil has resulted in the establishment of experimental farms in the cotton regions with the consequent wide introduction of improved and diversified farming.

Again, Congress, through the exertions of the Agricultural Department, has passed bills for the protection of game, and a special survey and study of birds and mammals is being conducted.

As mentioned above, the first special buildings for the Department were erected in 1867. In that year Congress appropriated $100,000 for the construction of an office building. This was ready for occupancy in 1868; about the same time houses for use in the propagation of plants for distribution were constructed along with conservatories and a grapery for testing foreign grapes. The total cost of these buildings was $140,000. In 1881 after the Atlanta Exposition, the Museum received so many additions that it was found necessary to provide more room. Accordingly $10,000 were appropriated for the construction of a building. Various other additional buildings were found necessary as the various sections of the Department increased, but up till 1897 not more than $210,000 had been spent on buildings. In order to keep pace with the rapid development of the various departments, buildings had to be constantly added from time to time till in 1903, Congress appropriated $1,500,000 for a magnificent building which provides accommodation for all sections of the Agricultural Department. This building is only now approaching completion.

During the last decade numerous experimental stations have been established all over the country as well as in Hawaii, Porto Rico and the Philippines.

So much for the development of Scientific Agriculture in the United States Department of Agriculture. Now, let us turn to the work which it has accomplished and analyse the value of the results obtained in comparison with its cost to the nation. The layman usually expects results in less time than is necessary for accurate investigation. Instances of this are common in India, and sceptical people in India should study American results. The American Agricultural Department has been in existence for nearly fifty years, and the list of work accomplished should influence the opinion of those who doubt the value of agricultural science. I propose to mention briefly some of the more striking achievements.

"The Department up to May 1st, 1906, cost $60,110,836, or less than $1,500,000 a year. The chief question is what return did the nation get for its money. It is claimed that the Department has spread information which has enabled agriculturists, (I) to pay their taxes more easily, (II) to protect their property, (III) to largely increase the value of their property."

About the time the work of the Department began it was necessary to import large quantities of agricultural products. This was partly due to careless and ignorant methods of culture. Artificial fertilizers and even farm yard manure were little used and the rotation of crops was little practised.

Certain census figures indicate the increasing effectiveness of superior cultivation. In 1839 the production of corn (maize) was 23 bushels for each person in the United States; in 1899 it was 34 bushels. This does not, of course, show with certainty that there was a corresponding increase in the production for each acre cultivated, but a comparison of the crop of 1879 with that of 1889 justifies that inference. The comparison of the production of wheat gives a similar result. The quantity raised for each person in 1839 was 5·3 bushels; in 1890 it was 7·4 bushels.

It is impossible to estimate the monetary saving to the country of the work done, but the saving has been immense. The suppression of diseases of cattle and sheep has increased the foreign trade of the country enormously in exports of live animals and probably of tinned meats. The Division of Chemistry has shown the way to a large economical increase of production of cane sugar, and the introduction of the beet sugar industry is flourishing. I could point out many other agricultural investigations which have been profitable to the country. This is perhaps unnecessary, but I can say that investigation regarding plant breeding, injurious and beneficial insects and plant diseases have given results which are quite beyond calculation as regards profit to the country. The California Orange Industry was rescued from annihilation by the introduction from Australia of the enemy of the Fluted Scale Insect; and the establishment of the Smyrna fig industry was rendered possible by the introduction and culture of the *Blastophaga* insect, whose activities are necessary to the production of the finest class of fig. The introduction of new varieties of crops and of new agricultural methods has in many cases been immensely successful.

Specific examples of money saved through the warnings of the Weather Bureau are numerous and easily established. Frequently throughout a year the services of the Weather Bureau cause savings in all sections of the country which are far in excess of annual expenditure.

I have only referred to a tithe of the advantages of the United States Department of Agriculture. It returns to the country full value for its cost.

DRY-LAND FARMING IN THE MADRAS PRESIDENCY.

By H. C. SAMPSON, B.Sc.,

Deputy Director of Agriculture, Madras.

DRY-LAND farming in the Madras Presidency offers great scope for investigation and improvement. In many districts such as Bellary, Cuddapah, Anantpur, Kurnool, Guntur and Nellore, the implements in use are admirably adapted for dry-land farming, but in the south, the plough and the land-hoe are the only common implements used for dry-lands.

Successful dry-land farming is intimately connected with the conservation of soil moisture, and the object of this article is to show how far this can be accomplished by judicious tillage under the conditions prevailing in the Madras Presidency. Before discussing the subject further it is necessary to explain the meaning of the term "soil moisture" as well as its sources and how it may be retained or lost. Soil moisture is the water which is held in the soil after the surplus has been allowed to drain away. This is necessary to dissolve the plant food which is in the soil and to convey it to the plant roots, but the surplus or drainage water is inimical to the healthy growth of plants as it prevents the aeration of the soil.

The sources of soil moisture are rain, subsoil water and atmospheric moisture.

Rain is the chief source, and it is of the greatest importance that the land should be prepared to receive it. A hard-baked surface cannot absorb much water; therefore, the surface should be loosened by tillage so that the rain can penetrate the soil. Subsoil water is another important source. Not only does the subsoil relieve the soil of its surplus water, but it can replenish the soil moisture when helped by proper cultivation.

Besides these two main sources, the soil can by its hygroscopic properties, not only absorb moisture from the air, but can retain this in considerable quantities if a good tilth is secured. Thus, in parts of Madras the heavy dews which are experienced are of great value.

The retention of soil moisture can be assisted by surface cultivation which gives a loose surface soil or dry mulch. Deep cultivation and a firm soil will assist in keeping the soil particles together and thus cause a more even distribution of moisture through the soil.

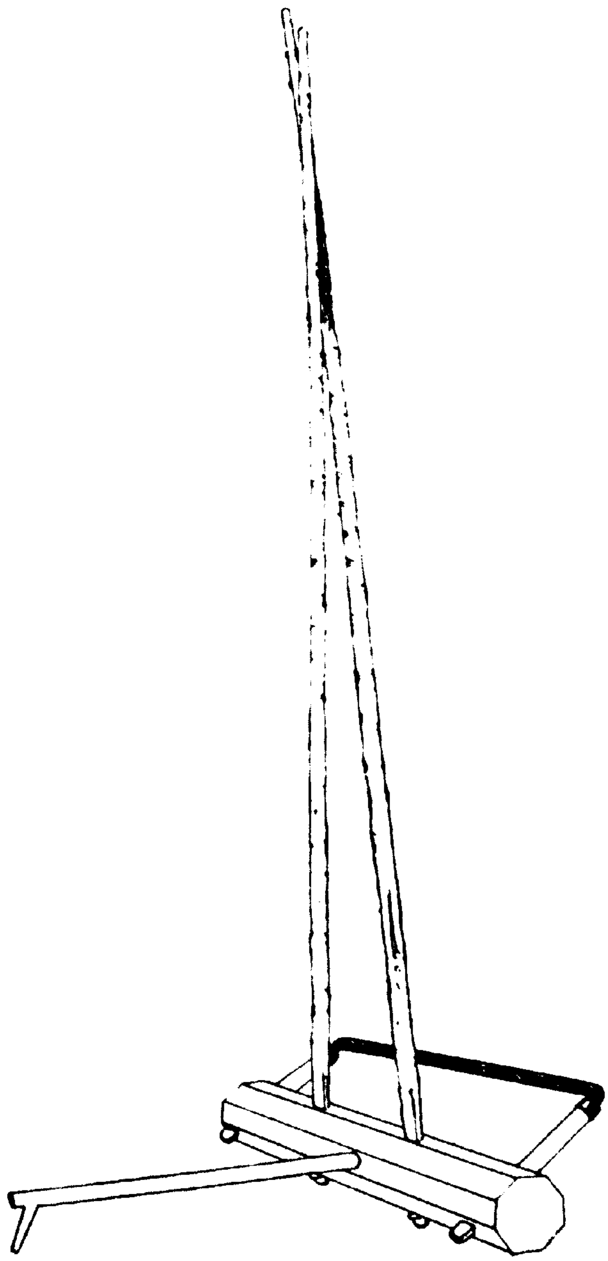
The following description will show how these principles are carried out in the dry-land cultivation of Madras. For this purpose the Presidency can be roughly divided into two tracts. In the former draught implements other than the plough are used and in the latter the plough is, as a rule, the only draught tillage implement.

The former includes the black cotton soils of Bellary, Cuddapah, Anantpur, Kurnool, Guntur and part of Nellore, as well as the lighter soils of these and of the Kistna district.

In the black cotton soil of this tract two types of plough are used. One, a heavy wooden plough which has now been largely superseded by a heavy iron one, and the other a much lighter wooden plough. The heavy plough is only used once every five or six years and is followed by a very heavy bullock hoe, known as a "Barra-Guntaka" which works to the same depth as the ploughing. What benefit is derived from this latter operation is difficult to see. The plough works the soil to a depth of a foot or more. Ploughing is done during the hot weather and huge dry clods of earth are poised up and beneficially exposed to the air. In other years either the light country plough or the bullock hoe called a *Guntaka* is used for preparatory cultivation. (Plate XVI.)

In the lighter soils of this tract this deep ploughing is not practised.

PLATE XVI.



A. J. J.

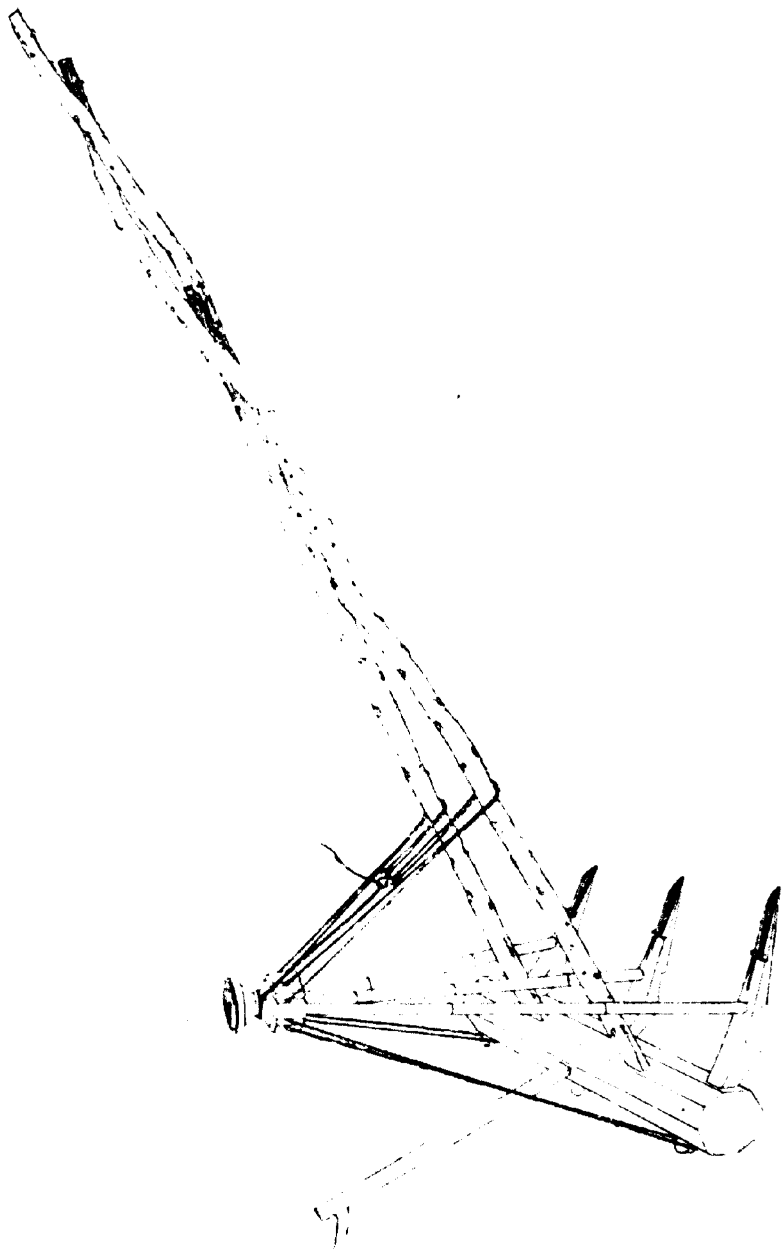
GUNTAKA OR BULLOCK HOE.

Preparation for Sowing.—This work is usually done with the bullock hoe or *Guntaka*. If worked after the land has been ploughed, it is a very useful implement. It makes a fine firm seed-bed and brings any larger clods of earth to the surface which are broken down by subsequent rains. The practice of working the soil with the *Guntaka* without previous ploughing is sometimes practised. This is objectionable as only the surface is loosened and the soil below remains hard set and lacks aeration. Occasionally, when the rains are very late, some such method of cultivation has to be resorted to, but the "Gorru" or seed drill without the bamboo sowing attachment is preferable to the *Guntaka*. (Plate XVII.) In some places this is weighted with stones and worked across the land in both directions and thus a large area can be worked in a day and often the ploughing rain can be utilised for sowing the crop.

Sowing.—The seed is sown with the drill. This practice has many advantages over broadcast sowing. It regulates the space for each plant. Sowing can be done when the land is comparatively dry as the drill can be set to sow at the depth where there is most moisture. Good germination is assured and there is a considerable saving of seed.

After cultivation.—Several implements are in use in different parts for this work, but the best are the *Dunthelu* which is used in the Bellary District and a small *Guntaka*, which is a similar implement with a wider blade and in the case of cotton and red gram is often used after the cereal catch crop has been reaped. The others work deep and throw the soil up round the plants forming ridges and furrows. The *Dunthalu* consists of a set of three to six small bullock hoes which are attached to a wide yoke pole and is drawn by two bullocks. (Plate XVIII.) Each hoe or *danthi* has an iron blade some 9 inches wide, which the driver guides between two rows of the crop. The hoeing is done after a good rain has fallen, but as a rule the farmer does not seem to realise that the operation is just as necessary when the surface has caked after a light rain, and in consequence, this implement is seldom worked more than two or three times.

PLATE XVII.

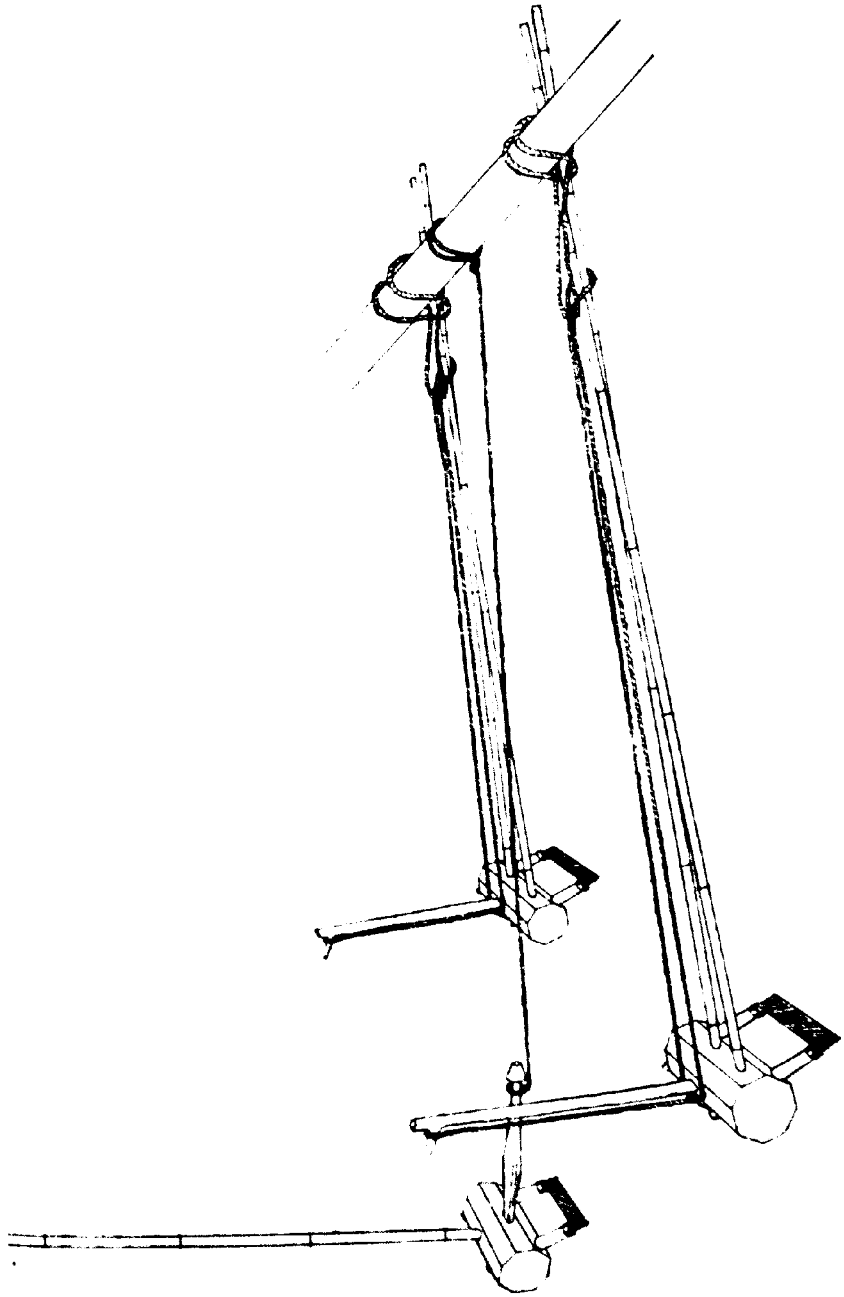


A. J. I.

GORRU OR SEED DRILL.

Throughout the Tamil country and in Malabar the plough is, with few exceptions, the only tillage implement for dry cultivation. In Malabar the conservation of soil moisture is not so essential owing to the heavy and continuous rainfall during the growing season. Ploughing commences with the close of the monsoon and is continued afterwards until the early sowing rains commence in April and May. In the dry Eastern Tamil country the rainfall is limited and does not admit of repeated ploughings before the sowing rains. The land is usually left untilled until a ploughing rain falls, when as large an area as possible is ploughed. About four ploughings are usually given. The ryot then waits for a sowing rain when the seed is sown broadcast and lightly ploughed in. The subordinate pulse crop, usually *Cajanus indicus* or *Dolichos lablab*, is sown immediately afterwards, the seed being dropped behind a light plough. In a few districts the value of a firm seed-bed is appreciated, and after sowing, the soil is made firm by dragging a roughly made brush harrow across the ploughing. In parts of Tinnevelly also the ryots cultivating red soil have an implement made like a large wooden rake which is used to break the surface crust and assist the growth of the young crop. When the crop is established, the plough is worked through it. This rough and ready method of cultivation gives a good crop in good seasons, but if the rain fails, the result is often a partial or complete failure.

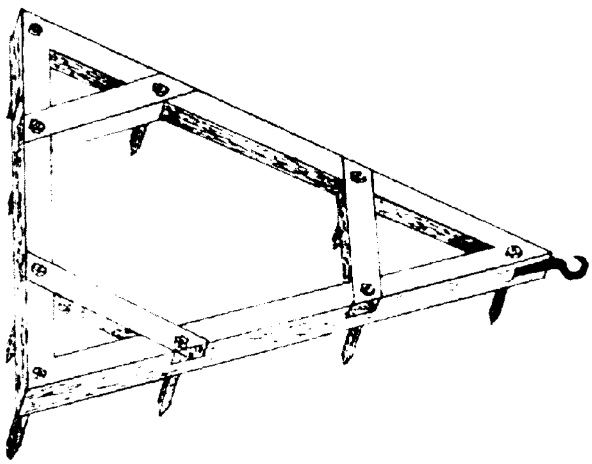
In parts of South Arcot this practice of ploughing through the crop has been entirely given up in favour of the more efficient practice of hand hoeing. Here the dry cereal is considered as a catch crop for the groundnut crop, the seed of which is dibbled in after the cereal is well established. The land is often hoed two or three times. The first hoeing includes weeding and thinning, while the others are mainly for loosening the soil surface, and is done even if the land is perfectly free from weeds. The introduction of the harrow into the Tamil country would be an immense advantage. If used instead of the plough, the surface soil alone would be loosened and thus the soil moisture would be better conserved. The ground would be left level instead



A. J. J.

DHUSTHALU.

of in ridges and furrows, which are always objectionable in the case of a dry crop as the ground soon dries out and subsequently rain runs down the furrows before it can soak in. If the harrow were used instead of the hand hoe, the cost of the work would be greatly reduced and the farmer would be able to



HARROW.

complete the work in less than a quarter of the time. The time that this operation takes is of great importance on the lighter soils. A harrow made in the shape of an equilateral triangle has been found to answer this purpose well and is not too expensive or too elaborate for the ordinary cultivator. This and other implements used in dry cultivation are illustrated.

THE AGRICULTURAL CONFERENCE AT AHMEDABAD IN NOVEMBER 1907.

By HAROLD H. MANN, D.SC.,

Principal, Agricultural College, Poona.

PROVINCIAL Conferences in India for the discussion of agricultural matters are comparatively new and their utility is disputed. Many believe that they can serve no useful purpose and lead to little else than impracticable and irrelevant talk. The Ahmedabad Conference gave me an opportunity of judging whether such an opinion could usually be justified.

The Conference was presided over by the Senior Member of the Governor's Council in the Bombay Presidency (Mr. J. W. P. Muir-Mackenzie) and contained representatives from nearly every interest in the province which had even a remote connection with the culture of the land. It comprised merchants and millowners from Bombay and Ahmedabad, upon whom a large part of the cotton growers of Western India depend for their market; exporters of cotton or other produce whose agents penetrate into every corner of the province; landowners, large and small, from Gujerat, Kathiawar, the Deccan, and even from Kanara and the Southern Mahratta Country; representatives from local Agricultural Associations and genuine agriculturists—actual tillers of the soil. The agricultural needs of particular localities were clearly defined, and the discussions showed what were the real difficulties of the cultivators. They, moreover, indicated many lines in which the Department of Agriculture might be of direct and immediate use to the agricultural interest. I came away feeling that, for me at any rate, the Conference had furnished much food for reflection and basis for action.

In this article I shall merely discuss one or two matters that were brought before the Conference, and indicate some conclusions to which I have come, after a careful consideration of what passed there, combined with independent information. I am hopeful that such a statement will induce some of those who may not be in accord with my conclusions to indicate in a future number of the Journal their reasons for coming to a contrary opinion.

On the first day the very important discussion on the improvement of cotton completely overshadowed other proceedings. It was complained that the efforts of the Agricultural Department in this direction were painfully slow, and that little result had been obtained after a good many years of experiment. Doubt was expressed, moreover, as to the possibility of maintaining the purity and hence the quality of any new variety or type of seed that may be introduced. It was further stated that there had been great difficulty in getting manufacturers to give a fair price for small quantities of an improved staple, and that cultivators were, therefore, discouraged from growing new kinds. The manufacturers complained that they had no means of knowing where and when improved staples were being actually cultivated.

Round these points the whole discussion ranged. Mr. Gammie was able to give a complete answer to the complaint regarding the slowness in the production of improved types. In Bombay the false method of "field to field" selection was adopted and proved a failure many years ago. This might have been anticipated, since in many districts the best fields then contained, as they do now, a very complex mixture of different types of cotton, and these types themselves consist of good, bad and indifferent plants. Mr. Gammie stated that he had found it necessary, before even beginning the systematic selection and crossing of cottons on any large scale, to obtain, examine in detail, and define the very numerous varieties of cotton in the Bombay Presidency. This had taken years. Then selection and crossing were begun, and now there was a prospect that after next year some of the new varieties which have been produced, could be distributed for experiment on a fairly large scale.

Neither Mr. Gammie nor any speaker at the Conference mentioned a difficulty which must follow as soon as improved stocks are brought into general use. This is the necessity for continuing the selection continually, for if this is not done, reversion to the average characters of the type from which they are produced will inevitably occur. Nearly all plants are apt to deteriorate in this country. An improved cotton hybrid will speedily degenerate unless its standard of quality and productiveness is maintained or improved by continual selection.

In other countries the difficulty is got over, in a measure, by the existence of professional seed growers, who are selectors-in-general to the community. A farmer may use his own seed repeatedly, but ultimately he goes elsewhere for it, and obtains it, directly or indirectly, from a special seed merchant. Here in India we have no professional seed growers on a large scale. For exotic crops the usual remedy is to import fresh seed at frequent intervals.

For indigenous crops which can be easily selected, like Jowar, the cultivators have, in many places, done the selection themselves. But for crops like cotton, where the seed cannot usually be imported every year, and where the selection, plant by plant, not only for staple, but also for percentage of lint, for weight of crop per plant, and so on, is difficult, selection is by no means generally carried out.

There are only two remedies, so far as I can see. One of these is to train cultivators in cotton seed selection by means of frequent short courses at the experimental farms, or similar short courses in their own villages; the other is for Provincial Governments either to organise seed farms themselves on a considerable scale, or give expert assistance to outside capitalists who may be induced to become seed growers on a commercial scale. The first method is admirable as far as it goes. I feel that too much cannot be made of its importance. But it is slow in action. It is necessary not only to teach how to select but to make the cultivators realise the importance of selection.

A number of speakers at the Conference emphasised the fact that deterioration of cotton, due to admixture of varieties, was largely caused by the extension of steam ginning factories. The general opinion was that pure types of cotton could not be maintained in these districts, where mixed types are grown, if cultivators depended upon ginning factories for their seed. Steam gins are usually so arranged, that without very elaborate care it is practically impossible to give back unmixed to cultivators of small holdings their own seed. Large cultivators can arrange so that several gins and the adjoining floor space in a factory, can be cleaned out before their cotton is put in. Thus, there is a fair chance that they get back their own seed reasonably pure. There was a decided feeling at the Conference that it would be well for the cotton industry of any district if we could get back to the system of hand ginning which has almost entirely died out, or failing this, if pure types of cotton were ginned under the direct supervision of officers of the Agricultural Department, or by genuine seed merchants.

It seems necessary, therefore, that a system of seed growing and ginning for sale must be part of the organisation of the cotton industry if real improvement is to take place. The same reasoning applies equally to any other agricultural crop in which selection cannot be made with considerable ease. In this article it is out of place for me to describe fully the requirements for seed growing, but alternative methods might be suggested as follows :—

(I.) Should Government initiate large seed farms ?

(II.) Should selected cultivators be subsidized and their work controlled or guided by trained men of the Agricultural Department ?

(III.) Can outside capitalists be induced to take over such large seed farms as are initiated by Government and extend them as a specialized Indian industry ? These suggestions demand careful consideration, and a criticism by practical men of their advantages or disadvantages would doubtless be welcomed by the Agricultural Department.

There was a good deal of animated discussion at the Conference as to the means of securing a fair price for improved cottons. Many of these better types are recognised as being more difficult to grow : a longer staple usually means a longer growing season : often the percentage of lint to seed is lower : and it is only if the cotton obtains a distinctly higher price in the market that it will pay to grow the better variety. On the other hand, it was urged on behalf of the manufacturers that small quantities, though recognised as being superior, were no use to them. Unless at least five bales* are marketed together, they could not give a better price. Now, five bales of cotton are usually beyond a single cultivator's power to produce. So that till a considerable area is under an improved cotton, no better price is obtainable. The difficulty is considerable. The cultivator says : "Unless you give me a better price for my lint, I cannot grow the improved cotton." The manufacturer replies : "Unless you give me at least five bales, I cannot give a better price."

This difficulty has been got over in the case of Egyptian cotton in Sind, by the establishment of a public auction at Mirpurkhas, where all the small quantities of cotton can be auctioned together. The extension of this method in other parts where improved cottons are introduced, is one way out of the difficulty, if it is found feasible. Otherwise the only method seems to be for Government or others to arrange temporarily for combined marketing. It was also suggested that a fund should be raised by the trade, to be aided from the money placed in the hands of the Government by the British Cotton Growing Association, to be given as a bonus to cultivators growing improved cotton. This might be possible, but I am not very sanguine.

* This amount was mentioned as their minimum by the millowners of Ahmedabad.

Another proposal came from the millowners of Ahmedabad, that a sample room (which they were willing to provide) should be opened at Ahmedabad where all the improved cottons could be on view, and data given as to where they were being grown. If this information was in their hands, they could send their agents to the places where the cotton was being grown, and purchase various lots themselves on the spot. The suggestion appears to be a very practical one. The required samples should consist of at least ten pounds of cotton lint, and be renewed as needed, and should be freely open to public inspection. If such a sample room were opened, and well managed, it would at least enable buyers to collect from the growers a sufficient quantity for practical trade trials.

Such are the principal points of the discussion on the improvement of cotton. The questions of the maintenance of an improved stock, of the prevention of mixture with inferior varieties at the gins, and of the marketing of small quantities of improved cotton, seem to have been perhaps those of the first importance. Whether any of the suggestions I have recapitulated or made are sufficient to deal with these undoubted difficulties can only be decided in the future. But they certainly give a basis for action, and action of some kind will certainly be necessary, by one or more of the parties concerned, if these very real difficulties are to be solved.

Just as the question of the improvement of cotton was the chief matter for discussion on the first day at the Ahmedabad Conference, so on the second day the most interesting and profitable time was given to the question of the functions and best method of the working of agricultural associations.

It may be well to preface an account of the principal points in the discussion by saying that there are not as yet any number of such associations in the Bombay Presidency. Three district agricultural associations exist at present. These are at Ahmedabad, Dharwar, and Broach, and there are a number of smaller associations organised in talukas in Gujerat and the Deccan. But, generally speaking, the idea has not yet taken root, and the work which the associations are to do, when formed, has not hitherto been very clearly understood or defined.

In attempting to consider, in the light of what was said at Ahmedabad, the probable line of most useful development of what I may call co-operative associations for the improvement of agricultural methods and practices, it was striking to observe how unanimous the speakers were as to the necessity of building up from the smaller units to the greater, that is to say, from the village association (where possible) to that of the taluka, and from the latter to one extending its services to the whole of a district. This position was stated by men from Gujerat, from the Deccan, and from the south of the Presidency. The opinion was, in fact, the echo of what has been found in almost all, if not in all, efforts of every kind to benefit agriculturists everywhere, including co-operative banking. In respect to the latter, the most recent writer says :—"Organise downwards from the top, and in such matters, you are bound to fail. Organise upwards from below, and, if only you are judicious in your measures, you will succeed." I am confident that this is the right method, and that the attempt to form a central agricultural association, whose existence shall afterwards induce the formation of smaller local and village associations, is usually bound to fail.

Several speakers insisted on the necessity of not pressing the formation of local associations with any semblance of a Government order. If local ideas are largely influenced by official opinion, we may have again, at once, all the evil effect of building from above. A body of men who unite for any purpose by instruction, or even apparently by instruction, from a superior authority, will also limit their activity to the further instruction received. I am confident again that the speakers were right in this matter, and that, unless the people feel it is a co-operative and not an official effect, little or no development of useful functions will take place. In this connection, as a result of a conversation I had with the representatives of existing associations, I would be inclined to doubt whether the regular appointment of a Government officer, especially a revenue officer, as chairman, is wise if the organisation is to succeed. It is all a question of personality. In some cases the Mamlatdar in the case of the smaller bodies, or the collector in the case of the larger, will be naturally the leader: in others he will always be suspected, and the association will be still-born. I am aware that the appointment of these men as officers to correspond with the Department of Agriculture is usually very advantageous. They are accustomed to such correspondence, and their representations are more easily understood and perhaps carry more weight. But if we really mean the local associations to fulfil their primary purpose in improving the agriculture of the villages, this advantage must, where necessary, be at least partly sacrificed.

A suggestion was made at the Conference that, where such still existed, the village organisation should itself become the agricultural association. No new name would be imposed, no sense of strangeness would be felt, only that this organisation would be asked to fulfil some extra purposes. "That would be a more natural procedure to adopt," said Mr. Wood, "than to create some new bodies, impose upon them occidental names, and put before them long sheets of printed bye-laws." The idea seems an admirable one, but in any case, as is at once obvious, "the long sheets of printed bye-laws" would be fatal to an agricultural association or to anything else in Indian village life. There seems a good deal to be said for the suggestion, also made at the Conference, to let the formation of agricultural associations follow the introduction of co-operative credit societies. The latter introduce the idea of co-operation under a regular inspection, and once such a society is successful in a place, the people will be ready for a further development of the idea. This has been even more recently emphasised by Mr. Stanley Reed of Bombay in a paper read at the Indian Industrial Conference at Surat. He said:—"At a recent conference at Ahmedabad a decided preference was expressed for village, or at most taluka, associations. I would only say that this is one of those questions in which it is desirable to hasten slowly, and if it be agreed that a start should be made with village societies, those villages should be selected where the co-operative credit movement has taken the firmest root."

Regarding the organisation of agricultural associations, we have, then, in summary the following points :—

(1) The unit of organisation should be as small as possible, a village by preference, but where this is impossible, a taluka.

(2) The organisation should not be forced, and should have as little as possible of the Government order about it.

(3) While officially patronised, its organisation should be essentially popular and co-operative.

(4) Existing village organisations should be used, wherever possible, rather than have the introduction of a new body with a new name.

(5) Co-operative credit societies, firmly rooted, are the best introduction to an agricultural association.

Turning now from the organisation to the functions of an agricultural association, it was universally recognised at Ahmedabad that they must be solely agricultural if they are to do their best work. The improvement of agricultural methods was seen to be as much as an association was capable of dealing with. And if this be the case, perhaps the most important function of the local organisation is to keep the central body, which stands for the improvement of agriculture in the whole province, *i.e.*, the Department of Agriculture, in touch with the actual cultivators in the field. Here has been the weak point hitherto in the agricultural organisation of many Indian provinces, if not in most. One of the speakers particularly emphasised the present lack of touch, in Gujerat at any rate, between the Agricultural Department and the agriculturists. And the local agricultural association must be the link, if any is to exist.

But here a difficulty arises. If the local organisations are to be small, as already recommended, the touch cannot be maintained by correspondence ; it must be by the personal and frequent presence of thoroughly sympathetic officers of the Department, who are themselves practical agriculturists. If correspondence can be fully replaced by personal presence, then I shall have better confidence in the success of agricultural associations as a means of agricultural development. The men who can do it must be sons of the soil, be well educated in the science and practice of agriculture and be otherwise well chosen : the areas they have to cover must be comparatively small ; they must be very keen on their work. Such men already exist in Bombay, and more will be produced when the Agricultural College at Poona is thoroughly established. Divisional Inspectors of the class above described will have, as part of their duties, the function of bringing the local associations into regular touch with the Department. But ultimately more men than these will be required if the movement is to be a thorough success.

Such a man, as I have described, as the adviser of the local people, will, if he is the proper man for the work, give just the impetus which is required to make a village or taluka association an actually working body. And with this impetus, the next step is to the organisation of agricultural shows and demonstrations of clearly known improvements. These two things should go hand in hand. The demonstrations, if successful, as they must be, would probably be an integral part of the local show. Adequate prizes could be arranged for produce, for standing crops and for animals, and so give a spirit of emulation among the people. The special officer of the Department, whom I have described, must be present, and demonstrate the demonstrations, if I may be excused the term. Further, he must carry from show to show some machine, within the capacity of a cultivator or a village association, which would, from his own personal and intimate knowledge, be an improvement on the system in vogue on that countryside. These shows would be very local, the more local the better in many respects. They would themselves do good as shows, but they would be even better as a means of bringing actual improvements to the door and notice of the cultivators. They would not replace the larger and more elaborate shows at important centres, but they would have a function, an important function. Of them the local agricultural association is, however, as it were, the foundation-stone.

A good many speakers at the Conference emphasised the importance of short courses in specific improvements which should be given at the experimental farms or elsewhere. It would be probably impossible to arrange for these directly in connection with smaller associations, but these latter could and would select the men who would be most likely to profit by them, and send them to a centre for the purpose.

Beyond this such local associations have a large number of useful functions, many of which were indicated at Ahmedabad. They give (generally through the Divisional Inspector or the more numerous men who will replace him) intimation of a plant disease, or an insect pest, and indicate that they want help. They select the best men to whom new seed, new manures, and new implements are sent for demonstration. They report difficulties through deterioration of land, which can then be closely investigated. They are the body to whom agricultural information is sent, whether published in the form of vernacular leaflets or through the vernacular press. And, in general, they form, as I have said above, the link between the Department and the people.

This, on the whole, is how I interpret the trend and meaning of the opinions expressed at the Ahmedabad Conference. There was much enthusiasm, an enthusiasm which should, I think, be utilised. Many of the suggestions demand much elaboration and modification at the hand of the man who carries them out. The key, however, to the rapid progress of agricultural improvement in the Bombay Presidency lies, I was made to feel at the Conference, in the development of co-operative agricultural associations, together with the getting together of a body of advisers who can go from place to place, are thoroughly imbued with a belief in agricultural development, and are keen agriculturists themselves. The whole of this must be backed (and I think that fact is already realised) by consistent and constant scientific investigation into the difficulties, as they arise.

In the present paper I have only indicated, and more or less inadequately discussed, the two principal questions which formed the programme at the Ahmedabad Conference. Other important matters were raised, but their consideration was not thorough enough to make it profitable to summarise the ideas that were expressed. Their discussion on a more satisfactory basis will, no doubt, be taken up again at one of the future Conferences.

NOTE ON AGRICULTURE IN JAPAN.*

By SIR F. A. NICHOLSON, K.C.I.E., I.C.S. (*Retired*).

Reviewed by E. SHEARER, M.A., B.Sc.,

[*Imperial Agriculturist, Pusa.*]

In this Note, which has resulted from an extensive tour in Japan, undertaken primarily to study fisheries, we are presented with facts and figures in relation to Japanese Agriculture which, to use the author's expression, *command* attention. "The gross area of Japan proper is 94,000,000 acres. Of this the greater part is mountainous and hilly, and in the north endures a long winter. . . . . With all the labour industriously applied during thousands of years only 12,778,124 acres or 13·53 per cent. of this area was arable land under cultivation in 1905. The rest is not at present cultivated, and by far the greater area never can be. . . The crops on this small area *plus* fish from the sea and some poultry and eggs, practically feed the whole Japanese nation, for meat, milk, butter and cheese are not articles of their diet : . . . . The average annual net imports from 1895—1905 would not feed the country for two weeks. The population in 1905 was 47,812,702, so that it subsists on an area of 0·267 acres per head, an area which, for a self-sustained nation, is probably of unparalleled minuteness. . . . . Yet the Japanese are the reverse of starved : they are particularly strong, sturdy and well-nourished : beggary is hardly existent and emaciation not visible." When we consider in addition that even the arable area of Japan is, according to many presumably competent observers, naturally of low fertility, that it "has paid very high rentals to a non-labouring or leisured class, has kept its soils not only unexhausted but fertile, and has done all this without imported food or manure, almost without cattle, and wholly without any manurial or

* Printed at the Madras Govt. Press, Price Re. 1

'artificial' fertilisers even from within its own borders," the importance of a study of the Agriculture of Japan will be admitted. Japan is essentially a country of small cultivators. "In 1901 farms below 2 acres formed 55 per cent. of the whole number, those between 2 and $3\frac{3}{4}$ acres were 30 per cent. and those above $3\frac{3}{4}$ acres were 15 per cent. . . . . The average occupancy for the country is only 2·55 acres." About two-thirds of the occupants are tenants or part tenants, the remaining third peasant proprietors. Taking state assessment and local rates together, rural land bears an average annual assessment of Rs. 9·3 per acre. Since the Russo-Japanese war this has been increased by 60 per cent., temporarily it is true, but with little hope of its ever falling to its old level. In addition, two-thirds of the farmers pay rents for their lands, which, as is commonly the case in countries of small cultivators, are often rack-rents. As in India, the farms are made up of scattered fields, but a measure recently passed to encourage consolidation of holdings, is being largely taken advantage of, the Agricultural Associations playing an important part in the necessary work of arbitration and exchange.

In Japan, with the exception of the north, the conditions of temperature and rainfall are almost ideal for the growing of crops, as will be seen from the subjoined table.

Average rainfall and average mean temperature in Tokyo by months for the period 1875—1902.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
Rainfall in inches.	2·18	2·62	4·36	5·16	6·12	6·68	5·28	4·64	8·20	7·28	4·36	2·21	59·[illegible]
Mean temperature in Degrees (Fahrenheit).	36·86	38·48	44·42	54·32	61·88	68·72	82·58	85·82	71·60	60·44	50·18	41·36	

The country, moreover, everywhere abounds in streams and springs fed from the mountains and hills of the interior. But i[illegible] climatic conditions are favourable, Japanese agricultural practice is such as to take full advantage of them. "There is *no* slovenly cultivation, no carelessly worked areas: all seems on a general level of excellence and is like one vast, well-worked garden. The soil generally of dark loam, is absolutely clean: weeds are not to be seen at any time among the crops: all stones are removed so that every square inch may play its part." Tillage is carried on almost entirely without the aid of cattle or other draught animals which are only now slowly being introduced into a few districts. Before sowing, a perfect tilth is obtained on every field by continued digging, and while the crops are growing, there is constant interstitial digging or hoeing up to the time of harvest. A striking feature of the tillage is the ridge and furrow system, which is universal on the uplands. When a field is ready for a crop, the seed is carefully sown in lines, some two feet apart, and as the crop grows, the lines are gradually earthed up from each side, so that eventually ridges and furrows are formed. The furrows are kept constantly stirred and cleaned, and when one crop is approaching maturity, something else is sown in them, and this in turn, when the first crop is removed, is gradually earthed up, ridge and furrow changing places. "It is claimed for the system that it permits or rather compels deep cultivation with complete aeration and commingling of the soil, that it is economical of seed; it allows free tillering and full development of the plant owing to free ventilation and sunlight and to the supply of fresh earth not only in the deep seed-bed but by the frequent earthings up: it permits the planting of one crop while another is growing: but its chief merits seem to be that it permits easy and thorough tillage during crop, the absolute removal of all weeds, the formation by tillage of that mulch of fine earth so essential for maintaining moisture in the undersoil, the easy watching of every plant in the crop, and the ready application of small doses of liquid manure whenever necessary."

But that which most impresses an observer, familiar with Indian conditions, is Japanese manurial practice. As there are only a little over 1,000,000 each of cattle and horses in Japan, and sheep and goats are practically non-existent, the manure supplied by live stock is altogether an insignificant quantity. The great source of manure is human excrement or night-soil, and the care exercised on the collection, preparation, conservation and application of this excellent manure is extraordinary. Whether in town or country none of it is lost to the land. All is carefully collected and stored at the homesteads or in the fields in vats with closely thatched roofs, which not only protect the contents from sun and rain but prevent over-free circulation of air and consequent loss of ammonia. Night-soil is never applied fresh to the land. After fermenting in the vats for not less than ten days, it is found to be converted into a semi-fluid mass and is considered ready for use. It is applied to crops diluted with water from one to ten times its own bulk, the first dose on the spots where the seeds are to be sown or seedlings planted, while subsequent doses are given to each plant as required, the last at the time when the plant is coming into flower. No crop is grown without manure, and every plant or group of plants receives its specific dose, not only once, but several times during the growing season. It will be conceded that such a system of conservation and application, exceedingly laborious as it is, involves a minimum of waste. The total value of the night-soil thus saved in Japan, after allowing for inevitable loss and wastage of all sorts, is estimated to be, in terms of units of nitrogen, potash and phosphoric acid, at current rates, not less than about Rs. 800 lakhs per annum, and in terms of increased produce resulting from its application, it must be a great deal more.

Equal care is bestowed on the preparation of compost. It is "absolutely universal as a manure; it is the solid or dry complement of the equally universal liquid X (night-soil) and is a practical illustration of the 'waste nothing' principle of Japanese farming. Every scrap of organic matter is carefully searched out and collected, animal excreta, always excluding human, but including those of fowls and of pigeons which are often kept for the purpose, leaves, weeds, straw and all sorts of vegetable refuse from the town, farm or house, such as potato peelings, radish tops and so forth, dead silkworms and their pupæ, slaked lime and shells, bones of all sorts pounded small, wood and straw ashes, indigo refuse, astragalus grown after a paddy crop, loamy earth, etc., are all pressed into service. These materials are piled up in the yard or under a shed; usually a layer of vegetable matter first, then animal dung, then lime, powdered shells and wood ashes; the mass is then moistened with the liquid drainings from the stables, if any, or more generally with human urine, covered with earth and allowed to ferment together in a mass which is usually sheltered from the rain by stout straw mats if not under a shed. The mass is occasionally turned over, and is left until the whole has decomposed into a fine rich nutrient earth (the Japanese name is 'manurial earth') which is passed through a sieve and used as a fine powder, especially at sowing time; the coarse matter which does not pass the sieve forms part of the next heap. Occasionally it is said that the mass is burnt, the resulting black earth being used in the same way."

Fish manure has long been appreciated in Japan. The quantity manufactured in 1904 was 133,600 tons, the value of which, calculated on the same basis as night-soil, would be over Rs. 100 lakhs. Of late years, on account of the increasing demand for fresh fish, especially in the towns, the quantity available for fertiliser has gradually been diminishing, while the price of fish manure has more than doubled. Government is, however, fully alive to the importance of fish as a source of food-supply and manure, and strenuous efforts are being made to develop the fisheries.

Oil-cake is another important fertiliser in universal use. Not only is there no export of oil seeds or cake, but there is a large import of cake from China amounting in 1903 to 212,000 tons, costing about Rs. 75 per ton, and the imports are steadily going up.

Green manuring has within the last twenty years become a regular practice, chiefly on rice lands. Just before the paddy is harvested, seeds of *astragalus lotoides* or *sinicus*, a papilionaceous plant, are broadcasted on the land. After the paddy is removed, the astragalus grows rapidly without any further cultivation, and in May is either turned in where it stands or more commonly cut, and carried to other fields or the compost heap.

Heavy crop returns are the natural corollary of favourable climate, thorough tillage, and sound manurial practice, but in Japan the yields are even heavier than we expect. Thus in the case of paddy, which occupies annually more than half the total arable area, the normal yield, for the whole country, is over 30 maunds per acre of unhusked rice. In some provinces the average is said to be over 40 maunds, while yields of from 50 to 60 maunds are said to be not unknown. Sugarcane, which is grown on a comparatively small area, is said to give an average yield of 8 tons of *sugar* per acre, an enormous figure. It is difficult to get at the yields of the millets, pulses and cold weather cereals, because of the almost universal practice of growing these crops mixed, but some idea of the general productiveness of the soil may be gathered from the fact that with prices not varying much from those ordinarily prevalent in India, the average value of agricultural produce for the whole country was in 1902 Rs. 123 per acre.

The forests of Japan play an important part in agricultural economy. Out of a total area of 52·5 million acres of forest, 18·5 million acres are "private" forests, belonging either to private individuals or the village communes, and held in 21 million plots, so that each plot averages 0·88 acre. They are thus the wooded plots attached to the various holdings, sometimes intermingled with the cultivated fields, sometimes distant and forming continuous woods. They provide not only the firewood and timber required for domestic purposes, but are also largely drawn upon for material for compost heaps and green manuring. Scientific sylviculture has in the past been little understood, and the timber produced has been relatively low in quantity; but in this, as in other respects, the Japanese have shown themselves progressive, and under the stimulus of Government a new era of forest management has been entered upon.

Nothing better illustrates the thoroughness which is characteristic of the Japanese nation than the manner in which the

Government has initiated, developed and organised, agricultural education and research, and the response of the people to the lead of Government. Sir Frederic Nicholson estimates the total expenditure, Imperial and Local, on agriculture and agricultural education at not less than Rs. 80 lakhs per annum. Agricultural education begins in the higher elementary schools, in a large number of which the pupils are taught Agriculture and Natural Science. *All* teachers in Japan receive instruction in these subjects at the normal training schools. In close connection with the elementary schools are 1,436 supplementary schools which give more extended instruction in agriculture. These are either evening schools, or give short courses in the winter months or during slack seasons, and are largely attended. Next come 118 regular agricultural schools of two grades. In the lower grade schools, of which the pupils must be over 12 years of age, there is a three years' course with 27 hours of study per week, exclusive of practical work. In the higher grade schools, the pupils must be over 14 years of age, the course is more advanced, and extends over three or four years with a two years' post-graduate course, if desired, for specialisation in particular subjects. To both these classes of schools are attached experimental and demonstration farms, which serve for the instruction not only of the pupils, but also of the agricultural population in their neighbourhood. The teachers, too, regularly deliver lectures on agricultural subjects to farmers at various centres. Both the agricultural schools proper, and the supplementary schools from which they often develop, are of local origin and are supported by local funds aided by moderate Imperial grants. Nearly all the pupils which pass through them either return to the land, or become teachers or agricultural officials. Finally, there is the Agricultural College of Tokyo and the Colleges at Sapporo and Morioka, with fully equipped laboratories and experimental farms, where agricultural experts, teachers, and agricultural officials, are trained. The work of the schools and colleges is largely supplemented by the experiment stations, one large central station with several branches, and numerous local stations. The latter cost about Rs. 6 lakhs per annum, 75 per cent. of which is met from local funds. In connection with the experiment stations, there are no less than 300 itinerant lecturers, who give instruction in agriculture and allied subjects

In close touch with the experiment stations are the Agricultural Associations. Probably in no other country are these so general and so well organised as in Japan. They are divided into Prefectural, County, and Village Associations, "of which there were recently 46, 579 and 11,968, respectively, as compared with 47 prefectures, 638 counties and 13,509 towns and villages." Taking the Village Associations first, "before any Village Association can be formed not less than two-thirds of the persons qualified shall consent, provided that such two-thirds own not less than two-thirds of the cultivable land: but when such association shall have been formed, *all* persons qualified for membership must join it." The funds of the association are derived from the subscriptions of the members. Each Village Association within a county elects a deputy, and these deputies together constitute the County Association. The Prefectural Association is similarly made up of deputies elected by County Associations. Finally, the Prefectural Associations elect deputies who together form a kind of Central Agricultural Council.

The work undertaken by the Village Associations is extensive. They are responsible for reporting to Government on the agricultural conditions of their areas, and for furnishing agricultural statistics. They undertake seed selection and distribution, establish common seed-beds for the members, combine for the destruction of insect and other pests, initiate agricultural experiments and introduce agricultural improvements, purchase manures wholesale for the members, conduct competitive exhibitions of agricultural products and implements and of growing crops and award prizes or honours, give assistance in sericulture and other home industries, make provision for agricultural education in schools, or, by lectures, assist in the consolidation of fields, publish bulletins, and, in various other ways, promote the interests of the members. The County Associations assist and to a certain extent guide the Village Associations, while the Prefectural Associations stand in a similar relation to the County Associations.

Such, in brief, is the position of agriculture in Japan. If we compare the agriculture of Japan with that of India, we have, of course, to deal with conditions, which, in many respects, are widely different in the two countries. Thus, there can be no doubt that Japan owes much of its prosperity to its wonderful climate. No country can better than India appreciate the advantages of a rainfall, which, while assured, plentiful, and well distributed, is seldom excessive. In India, when the season is really favourable, surprisingly good crops are to be found even in districts where the land commonly grows two crops a year, is indifferently tilled and receives little or no manure. Crop yields in tracts which are independent of rainfall, through being commanded by irrigation, compare not unfavourably with those of Japan. Again, practical certainty of good crops, if it sometimes encourages carelessness and laziness, equally often serves as an incentive to good husbandry. On the other hand, the soil of Japan is probably naturally less fertile than that of large tracts of India, the holdings are smaller, and, on an average, probably pay more in the shape of assessment and rent than is common in India. But granting these differences in conditions, there is much that the Indian ryot can learn from the Japanese peasant. We have described the thorough character of the tillage universal in Japan. The methods in detail are mostly unsuited to Indian conditions. To perform all the processes of cultivation with spade and hand hoe is only possible on very small holdings, and can give a return commensurate with the labour employed only where conditions ensure a high yield per acre. The ridge and furrow system is employed with advantage in "garden" cultivation, but for climatic as well as other reasons could not be generally adopted. But what we can aim at in India, as in Japan, is that the tillage should be the best possible under the circumstances. In India there is much good cultivation and much bad. If the methods in use in the best cultivated tracts could be made more general over the country, a great step forward would have been taken. The system of drilling seed and giving subsequent interculture of crops by bullock hoes, which is the common practice over large tracts of the Central Provinces and Bombay Presidency, and in Gujerat especially, has reached a high pitch of excellence, is capable of great extension. It is economical of seed, ensures a better distribution of plants on the ground and saves time and labour, both at the time of sowing and in the after-cultivation of the crops. The cost of drills and hoes is nominal.

Many large iron ploughs are in use in the black cotton tracts of Madras, Bombay and the Central Provinces. They do excellent work in these heavy soils, but are too heavy for the cattle of the average small cultivator, and in any case are beyond his means. There is, however, room for a more extended use of the lighter patterns of improved plough. They are moderate in cost, and while they cannot entirely replace the indigenous wooden plough, for breaking up and pulverising the soil, they are in point of time and labour much more efficient than the latter.

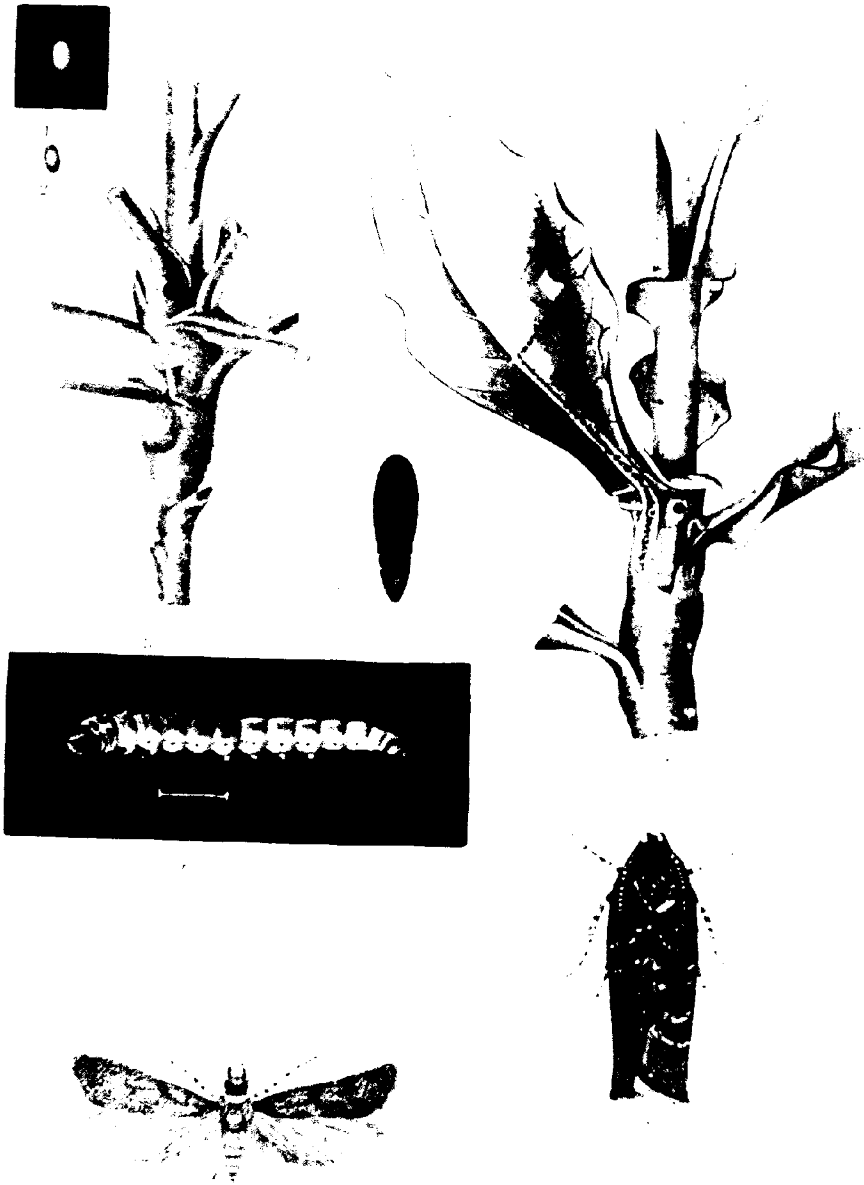
But it is as regards the use of manures that India offers the greatest contrast to Japan. If the night-soil of Japan is worth Rs. 800 lakhs per annum, that of India must be worth six times as much. Yet only an infinitesimal fraction of it is allowed to have anything like its full effect on the soil. The question is bound up with the social habits and prejudices of the people, but fortunately there are signs that the prejudices on this subject are breaking down, and in the future we may look to a more extended use of this valuable manure. The cattle manure annually produced in India with its 80,000,000 cattle and buffaloes, may be worth anything from Rs. 150 crores to twice or three times that sum according to the methods of conservation employed. Only a small proportion of this ever reaches the soil, the great bulk of it being consumed as fuel. The waste, deplorable though it may be, is to a great extent inevitable under present conditions, and can only be obviated by the general establishment of forest reserves, which, again, is a very large question.

The present large export of oil-seeds and of bones constitutes a severe drain on the country. The use of oil-cakes for feeding and manure is, however, becoming more and more general: and as the resources of the people improve, there will no doubt be not only a much diminished export of oil-seeds, but a much wider utilization of the seeds of forest trees, many of which, though at present of little commercial value, possess valuable manurial properties. Bones are most usefully employed as a manure in the form of superphosphate, but the present high price in India of the sulphuric acid used in the manufacture of superphosphate encourages their export. As regards compost, there is not the same mass of compost material available in India as in Japan, but comparatively little effort is made to utilise such material as there is. Green manuring is practised to a considerable extent, especially in "garden" cultivation, but might, with advantage, be more generally employed.

We would call special attention to one feature of Japanese agricultural policy, *viz.*, the encouragement of consolidation of holdings. This is a question which must sooner or later be taken up in India. The difficulties in carrying through the work would undoubtedly be enormous, but not greater than they have been in other countries. The advantages of consolidation are patent to all, the average cultivator included. Some of the more obvious are economy of labour and of space, in Japan it has been found that there is sometimes a saving of as much as 5 per cent of land through the breaking down of division boundaries the better distribution of manure, the greater care of fields and crops, the fostering of individuality and the loosening of the bonds of village tradition and prejudice.

With regard to agricultural education and research and the organisation of agricultural associations, we are a long way behind Japan; but with the Department of Agriculture now being organised, we may expect much more rapid progress in this direction in the future.

Sir Frederic Nicholson's Note has been written primarily for Madras, but his wide knowledge of Indian agricultural conditions and his admirable presentation of the salient features of Japanese agriculture makes it possess an interest for all students of Indian agriculture. We await with interest the second edition of the Note in which he has promised to give suggestions for Madras.



TOBACCO STEM BORER.

THE TOBACCO STEM BORER.

(Gnorimoschema heliopa, Low).

By H. MAXWELL-LEFROY, M.A., F.E.S., F.Z.S.,

Imperial Entomologist, Pusa.

The cultivated tobacco plant in India is attacked by few pests, and these chiefly are insects which only attack this crop sporadically, and which have a large range of other food plants. There is, however, one insect which is a specific pest to this plant and to no other. This insect is figured in all stages in Plate XIX. The moth is shown with expanded wings as if flying in Figure 9 (the lines below indicating the real size), while in Figure 7 is shown the moth as it rests on a plant, the wings being wrapped round the upper part of the body. The moth is too small and too much like other small brown moths to be easily recognised, but the Figure 8, showing in outline the sickle-shaped palpi curving over the front of the head, will assist identification.

The moth flies about at dusk and after, and lays eggs on the young tobacco plants. An egg, eight times the real length, is shown in Figure 1; it is, when first laid, greenish yellow, but slowly darkens to the browner tint shown in Figure 2. A single moth was seen to lay 58 eggs, but normally each probably lays more. In the cold weather the egg hatches in a fortnight to three weeks, and in warm weather (March) in eleven days. These eggs cannot easily be found as they are laid singly on the leaves, stems or leaf stalks, usually on the lower side. From the egg there hatches a caterpillar, a tiny almost white insect of the form shown in Figure 5, but measuring only $\frac{1}{25}$th of an inch in length.

This caterpillar very soon after hatching, eats into the leaf or stem near where the egg was laid; it goes completely inside, not mining close to the surface; if it enters the leaf, it works down a vein to the midrib, along the midrib towards the stem, until usually it reaches the main stem of the shoot. Figure 4 illustrates this, the larva having gone in at the white spot on the left leaf, and tunnelled down to the stem, its track being just visible as a dotted line. It lives secure within the stem, gradually increasing in size until it measures nearly half an inch. Such a full-grown caterpillar is shown in Figure 5, magnified five times in length.

The caterpillar lives and feeds in the stem for a period varying from six to ten weeks in the cold weather; one was found to take eight days in actually reaching the stem through the midrib; when there, the caterpillar eats the tissue of the plant and, if such a plant is cut open, little tunnels are found in the tissues; as a result of this attack, the stem swells, and one sees the bulbous swelling on the growing plant, shown in Figure 3. This is the external sign of the insect's presence and it only forms when the caterpillar has been in the stem for at least three weeks, sometimes longer. When the caterpillar is fully fed up and full grown, it bites a hole through the epidermis of the plant, so as to allow of the exit of the moth and then, to prevent enemies getting in, it webs up the hole with silk and grass; these holes are shown in Figures 3 and 4 and, if closed, show that the insect is within; the caterpillar then lines its tunnel with silk and turns to the chrysalis, the resting stage shown in Figure 6. It is, of course, impossible to see what is going on inside the plant, but in four cases that were specially treated, the chrysalis period was found to be about four weeks in the cold weather, less than three weeks (18 days) in warmer weather.

At the end of this time the moth comes out of the chrysalis, bursts through the webbed-up hole and emerges to the open air to mate and lay eggs. Moths only come out at dusk and rest by day hidden. It is uncertain how long they live, but if they find mates and growing tobacco, they lay eggs in three or four days and a fresh brood starts.

In the cold weather, when the insect is breeding in tobacco, the whole life from egg to egg occupies from three to nearly four months and, so far as the tobacco crop is usually concerned, there is but one brood in it. The insect lives by choice in either young plants or in young shoots; one finds it abundantly sometimes in the plants after transplantation, and later, in the shoots that spring up from the stumps after the tobacco is cut.

As a general rule, the presence of one caterpillar in a young plant does no more than make the plant weak, stunted and poor. The plant dies only when several caterpillars are in it at once, and this occurs but seldom where tobacco is grown as a crop. Loss of crop comes then not so much from the death of the plants as from the unthrifty weak plants which yield little, and where tobacco is an important crop and in the field successively more than once in the year, there is sometimes enough of this pest to considerably diminish the outturn. The insect has been found in all the important tobacco growing districts in India and is known in Ceylon, Java and other places.

Like other insects, this one is prone to attack the most choice special varieties as readily and sometimes more readily than ordinary indigenous kinds, and it has possibly been a factor that determined the rejection of some varieties that would have done better had not their growth been checked. It is impossible to estimate the loss in the tobacco cultivation at present; it is probably small but constant.

My object in this paper is to draw attention to this insect and to its life history, as it is the sole specific pest of tobacco. Little can be said about prevention because what can be done must be by common sense methods based on a knowledge of the life history of the insect. From the practical point two measures are important: the first is to watch the young crop and pull out and burn all plants that show swellings; that checks the pest's multiplication and it may be seen early enough to put in other plants in place of those taken. The second is to thoroughly eradicate the tobacco stumps after the tobacco is cut, so that they cannot send up shoots in which the insect can breed and so multiply. In Behar the brood in the shoots from the cut stumps in April and May is sometimes a large one, tiding the insect over until the rains and probably materially adding to its number for the next crop.

When tobacco grows wild, the plant should be eradicated as this is the original source of the mischief. This precaution is, however, not one that is of much real importance. What other food plants this insect has is uncertain; very possibly it breeds also in other solanaceous plants, but it has not been observed on any other cultivated plant. It would certainly have been found, did it breed in any.

In tobacco-growing districts in India where this borer is well known, as in Gujarat, the cultivator has a remedy; it consists in making a vertical cut in the swollen part of the stem with a sharp knife; the explanation given is that this lets in air which is good for the diseased plant and the cultivator regards the swelling in the stem in much the same way as he would a tumour on his own person, *not connecting it with the presence of an insect at all*. Experiments made with this treatment show that unless the knife actually reaches the caterpillar inside the stem, the treatment produces no result; if the caterpillar is killed, which happens very seldom, the plant does thrive better than if the caterpillar had not been destroyed, but a strong plant is not produced practically speaking, the mischief is done by the time the swelling can be seen and no cutting will produce a good plant. Where there are several caterpillars in one stem, as often happens, cutting has no effect whatever unless so vigorously done as to kill the plant.

NOTES.

FLAX CULTIVATION IN BENGAL. The Director of Agriculture, Bengal, has issued a note describing the results of the preliminary experiments in Bengal with Russian (Riga) flax seed distributed in 1906. The most promising results appear to have been obtained at Bankipore, where the outturn of green plant was $2\frac{1}{2}$ tons per acre. Elsewhere owing to late sowing and an unfavourable season the crops were less promising. A sample of flax grown at Bankipore was sent for examination to the Imperial Institute, London; the Director reported that the fibre was longer and coarser than the standard samples from Belgium. The clean fibre obtained from the Indian straw had an average diameter of 0·00094 inch, the diameter of a standard sample of Belgian flax being 0·00086 inch. The fibre was found to contain in parts a considerable amount of woody tissue. The Director of the Imperial Institute suggests that in order to ensure the best quality of fibre, the crop should be harvested when the lower half of the straw has turned brownish yellow, and not when ripe. We have now full and practical advice from the Flax Expert on this and many other plants which are essential to the successful cultivation of flax in Bengal, and we attach much greater value to the results of the local experience gained by this officer than to advice given from the Imperial Institute.

In a preliminary note on flax cultivation in Behar, the Flax Expert to the Behar Indigo Planters' Association suggests that the most desirable length of flax is from 28 to 35 inches. Longer fibre is less valuable. He states that in Belgium 300 to 370 lbs. of seed is sown per hectare (hectare = 2·4711 acres), adding 50 lbs. of seed where the soil is poor. The crop should not be forced by heavy manures but should be grown, however, on land in good condition. He suggests that seed should be sown by drill in Bengal. He further gives his opinion about retting, necessary machinery, the quality and class of fibre as compared with Belgium and the approximate value per ton of fibre and output per acre.

This note will be largely amplified by the results of work in 1907-1908, when published. These will tend to show that a profitable new industry is possibly being established in Bengal. All initial trials will necessarily be conducted with imported expensive seed, as the indigenous varieties are believed to be quite unsuitable for flax. The value of acclimatization and of plant to plant selection will be studied. We already know a good deal about how this crop can be most economically grown and otherwise dealt with. We, however, need in particular better knowledge regarding the most suitable water and temperature for the retting process in India. —(EDITOR).

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MILKING MACHINES. One maker claims to have sold 1,500 machines of one pattern in Australia, capable of milking 3,000 cows. In the *Agricultural News* for 19th October 1907 appears an account of a new type of machine recently put on the market in the United States of America. It is said to consist, in the first place, of a large pail with a tightly fitting lid. From nozzles on the lid are given off two India-rubber tubes, about 3 ft. long, each of which terminates in four funnel-like India-rubber cups, which fit tightly on the teats of a cow, two animals being milked at once. Two pipes pass round the cow stalls, one being a vacuum, and the other full of air at high pressure. An essential feature of this milker is the pumping apparatus, mounted on the lid, which in alternate pulsations connects the pail, and consequently the India-rubber tubing, first with the vacuum (the result of which is to create a suction, and so to extract the milk), and secondly, with the air pressure pipe, which releases the teat preparatory to again applying the suction, the extracted milk meanwhile passing from the cups, through the tubing and into the pail.

This type of machine corresponds in action to a machine introduced within recent years in England. The writer saw one at work in a large dairy in Scotland. It replaced with excellent results 15 hand milkers who dealt with 150 cows, and who had to work seven days per week and were consequently paid very high wages.—(EDITOR).

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CASSAVA.—The Cassava plant serves two useful purposes. Its roots which swell into large tubers of a yellowish colour yield Cassava meal, Cassava starch and tapioca. The many branches into which the plant expands afford good food for cattle. Another characteristic of this plant is that its roots need not be lifted from the ground at the same season, but may be allowed to remain as a reserve stock of food with slight fear of being spoiled. It is a very productive plant, one acre of Cassava, under certain favourable conditions, yielding more nutritive matter than six times the same area under wheat. The plant grows to a height of from 4 to 8 feet and has noded stems. Its tubers are from 1 to 3 inches in diameter and usually over one foot long. It flourishes most in a well drained sandy loam. The tubers decay if the ground is water-logged. The soil should be well ploughed to a depth of 6 to 12 inches. Full-grown stems of the plant should be cut up into small pieces from 4 to 6 inches in length. These cuttings may be planted in the furrows and covered over like sugarcane cuttings, or may be set in the ground in a slanting position with about an inch above ground. The cuttings should be planted four feet apart in rows which must be also 4 feet distant from each other.

Hoeing and weeding are necessary only till the plants grow up, as its many branches afterwards hinder the growth of weeds. Generally from 8 to 12 months must elapse before the roots will be ready for lifting. The tubers when lifted should first be well washed and then immersed in cold water for a night. The dark coloured rind should then be peeled off with a sharp knife. The peeled tubers should be cut into small pieces, washed and crushed into a pulp which should then be put in a cloth bag and, after subjection to heavy pressure to force out any poisonous juice, be washed, sifted and dried.—(EDITOR).

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THE BEHAR PLANTERS' ASSOCIATION WORK IN 1906-7. The report of the Association covering the season 1906-7 is distinctly encouraging. The Association has been strengthened by the addition of some 14 concerns. The report mentions the grant of Rs. 50,000 made by the Bengal Government for the Sirsiah Research Station. During the period under review Mr. Bergtheil brought out two interesting publications (1) Method of Estimation of Indigotin in Commercial Indigo, (2) Report on the Results of a Practical Dye-test of Natural against Synthetic Indigo. Another interesting publication "Treatment of Java-Natal seed with concentrated sulphuric acid" has been published by Mr. Briggs. The Association received a grant of Rs. 6,000 from the Bengal Government to meet the expenditure for the employment of a flax expert, and it is stated that Mr. Emil Van der Kerkover has been engaged on agreement for one year. He will report fully on the possibilities of growing flax in Behar before the expiration of his agreement. A further grant of Rs. 1,500 was made by the Bengal Government to assist purchasers of flax seed through the Dundee Chamber of Commerce. A passing reference is made to Dr. Leather's field experiments with phosphates, Dr. Butler's report on plants suffering from "Okta" and Mr. Lefroy's report on the "Psylla" disease.—(EDITOR).

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REMARKS ON THE SUGGESTION BY MR. PUNNET REGARDING THE APPLICATION OF THE PRINCIPLES OF MENDELISM TO THE IMPROVEMENT OF JUTE.—For two years, work has been proceeding in jute improvement, as yet only by simple selection; but it is hoped to commence cross-breeding experiments very soon. We are endeavouring to extend the cultivation outside of Bengal, because Bengal is approaching its limits of production and the method of simple selection has proved extremely useful in connection with acclimatization. In one case it has been possible in a single year to produce greatly improved results, in a new tract, by sowing seed selected from only the tallest and straightest plants of the previous year's crop. Simple selection is, therefore, undoubtedly of value under such circumstances.

When we come to the question of cross-breeding, we find we are on much more difficult ground. There are probably nearly a hundred so-called races of jute (*C. Capsularis* and *C. Olitorius*) in Bengal. It is possible to distinguish at once, of course, between red races and green races, early races and late races: but it is practically certain, for instance, that at least some early green races with different vernacular names are identical in every respect botanically and agriculturally. It is obviously necessary, therefore, before commencing any cross-breeding work to decide which of the so-called races are identical and which are not. Mr. Burkill, the Reporter on Economic Products, and the author have given a good deal of attention to this point during the last two seasons, and Mr. Burkill has visited practically the whole of the jute-growing districts during 1904, 1906 and 1907 for the purpose of making observations. The plots at Pusa and those at Burdwan have also been under strict observation, the latter since 1902. The results are encouraging: and it is hoped that, when taken in conjunction with chemical and microscopic examination of the respective fibres, a sound basis for further work will soon be arrived at. We hope as a result of this year's work to be able to start with a definite programme for raising new races next season. While this work promises to be of very great scientific as well as practical interest, the intrinsically inferior nature of jute fibre, when compared with other fibres in India, renders it doubtful whether it is wise to attempt to improve the quality of jute beyond a certain point, if the outturn of fibre per acre cannot also be increased by the methods of improvement adopted. Other plants are already under examination whose fibre is certainly much finer in quality than jute and which give promise of yielding such a return per acre as will enable them to compete with the higher priced samples of jute. Inherent in these fibres are some of the qualities which we are seeking to develop in jute.—(ROBERT S. FINLOW).

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AMAN PADDY.—The manurial experiments at the Burdwan Farm from 1891 to 1906 have proved that for Aman Paddy 3 maunds of bone-meal and 30 seers of saltpetre per acre have given the largest yield. This manure yielded an average outturn per acre of $50\frac{3}{4}$ maunds of grain and $73\frac{3}{8}$ maunds of straw, as compared with an average of $19\frac{1}{8}$ maunds of grain and 32 maunds of straw from comparative unmanured plots. Six maunds of bone-meal alone per acre gave on the average $45\frac{1}{2}$ maunds of grain and $71\frac{1}{8}$ maunds of straw; whilst an application of 3 maunds of bone-meal gave on an average 42 maunds of grain and $60\frac{1}{8}$ maunds of straw. The outturn yielded by 3 maunds of bone-meal alone compared with 3 maunds of bone-meal plus 30 seers of saltpetre shows that the addition of 30 seers of saltpetre repays its cost many times over. It has been proved that it is not economical to apply more than 3 maunds of bone meal.

In the same period 50 maunds of cowdung per acre gave an average outturn of $40\frac{1}{4}$ maunds of grain and $55\frac{3}{4}$ maunds of straw. But 100 maunds of cowdung produced on an average only $41\frac{1}{2}$ maunds of grain and $55\frac{1}{8}$ maunds of straw. It is believed, therefore, that a heavy dressing of cowdung is wasted. An economical dressing appears to be 50 maunds of cowdung or 3 maunds of bone-meal plus 30 seers of saltpetre. It is further suggested that if artificial manures are not available, green manuring should be practised.

Experiments during the last three years in planting paddy seedlings at different distances, showed that a distance of from 9 to 15 inches apart, gives the best outturn. This experience does not apply to those parts of India where seedlings are usually planted in clumps some four or six inches apart.—(EDITOR).

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INDIGO RESEARCH.—Mr. Eugene C. Schrottky, who has recently been employed by the U. P. Government to demonstrate at Gazia the merits of up-to-date methods of indigo manufacture to the planters of the United Provinces, has published in the form of a leaflet, the results of his indigo research work in the season 1907, carried on in private factories at Buthnaha, Turcouliah and Sathi. Aiming at a better fermentation of the plant, a more perfect separation and a larger gain of the dye, he tried the glucosode and the alkali and acid processes and also the establishment of a second steeping of the indigo plant. He asserts that the glucosode process not only yields for 100 maunds of green plant, 4 to 5 seers of 65 per cent. indigo more than the average yield by the ordinary process, but it has another advantage in respect of giving good returns, even when the plant is not ripe for manufacture or when the moisture in the plant is so diluted by rain-water as to retard the progress of fermentation. Manufacture of indigo by this process can, he says, be carried on at any time between March and November. The most suitable temperature of the steeping water for glucosode vats is 95° to 86° F. The best separation of the dye can, it is said, be effected by the alkali and acid process. In this process the quality of indigo can be kept entirely under command by the proper use of acid in sufficient quantities to redissolve the organic and mineral matter precipitated with the dye and by regulating the quantity of water used to remove again the soluble impurities from the fecula. The fermented liquor worked upon with the glucosode process resists decomposition, and a second steeping of the plant can be easily effected. Mr. Schrottky says that the second steeping process yields 40 per cent. more dye and the three processes together, though expensive (owing to use of chemicals, etc.), "leaves the planter a most handsome margin of profit." My department does not, necessarily, endorse Mr. Schrottky's views, but I am very glad to give them publicity in this Journal.—(EDITOR).

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IMPROVED SEED MAIZE. By G. L. Sutton.—*Agricultural Gazette of New South Wales*, Vol. XVIII, Part 10.

In this article Mr. Sutton deals with the methods of improving seed maize according to the latest scientific knowledge on the subject. In most countries where maize is grown selection of some sort takes place. Thus, in Australia the seed from the largest cobs only is used; in South Africa, the seed from the middle portion of the best cobs is considered best. These methods especially the latter, are no doubt very good, but, as Mr. Sutton points out, they take no account of the influence of the male flowers on the seed. Every seed derives its origin from two units—the male "pollen" and the female "ovule or egg," each of which contributes equally in the formation of the character of the seed.

In the case of maize the male flower is generally called the "Tassel" and the female flower the "Silk." Each of the hairs in a "silk" flower is attached to an ovary containing an ovule. The seed is formed only when pollen from the male flower is carried by the wind on to the silk, each pollen grain fertilizing one egg. Now, it is apparent, since the laws of reproduction are the same in plants and animals, that if pollen from a weakly or sterile plant falls on the silk of another, the resulting seed is bound to be poor though the female flower may have been a very good one. Hence fine ears or cobs do not always produce fine seed, as an experiment at the Ohio Experiment Station shows. In this station 24 different ears were selected of the same size and germinating capacity. The grain from each ear was planted in a separate row, so that each had the same chance. The yields from the three best rows were at the rate of 114, 112 and 104 bushels per acre respectively. The row which yielded least produced [illegible] bushels per acre. There were 58 barren stalks in this row.

The improvement of seed by intelligent breeding is carried on by farmers themselves in the United States and the yield thereby largely increased. The method is roughly as follows: A number of fine cobs are selected and seed from each planted in separate rows. The area of experiment should be half a mile away from any other maize as pollen is carried a long distance by the wind. When the flowers appear, the "tassel" is removed from alternate rows leaving only mother plants. This ensures that all seed in a "detasselled" row will be the result of cross-fertilization. All sterile plants (*i.e.*, those without female flowers) should be removed from all the rows as they are undesirable males to breed from. For the following year the best cob from each "mother" or "detasselled" row should be selected and sowing proceeded with on the same lines as above. It was found at Cowra, the New South Wales Experiment Station, that after the first year no sterile plants appeared. The article is well illustrated by plates and should prove interesting to maize growers, especially in Behar.—(W. ROBERTS).

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A PREMIUM FOR PURE COTTON FIELDS. In the year 1906 an experiment was instituted in the districts of Kurnool and Cuddappah (Madras) of giving a premium of annas 2 per acre on all practically pure cotton fields. The object in view was to induce the ryots to cultivate a pure crop of any of the four varieties, Yerrapatti, Tellapatti, Gadag and Cocanadas, generally grown in the districts. The rewards were given after the crops had been declared to be pure by inspecting officers with special knowledge of particular varieties. In some cases inspecting officers had received special instructions from the officers of the Agricultural Department. The rewards have had some effect in inducing the cultivators to pay some attention to seed selection. The acting Government Botanist recommended that the reward to be effectual must be 8 annas per acre for the growers of Gadag cotton on black soil and Yerrapatti on red soil, but it has not been thought advisable to follow the recommendation. The experiments will be continued. It is, however, doubtful if there will be much practical outcome. (EDITOR).

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EGYPTIAN COTTON IN THE NORTH WEST FRONTIER PROVINCE. With a view to test the suitability of the North-West Frontier Province for growing Egyptian Cotton, the Revenue Commissioner arranged in 1906 for preliminary trials with the seed supplied by the office of the Inspector-General of Agriculture in India. The trials were made at eight places in the Province on land which was carefully cultivated, manured and irrigated. The plants in all cases grew to a height of about 7 to 8 feet and flowered, but dried away in the month of October without yielding any cotton.—(EDITOR).

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THE SEED OF NYMPHÆA LOTUS.—The seed of *Nymphæa Lotus*, which is very plentiful in the Koller Lake, is known in the Kistna District, Madras, as *Allyalu*, the whole plant being called *Alli*. The plant occurring in the Koller Lake bears white flowers. It is met with, though not abundantly, in other parts of the Presidency. While the seed and the fleshy root of the plant are used as articles of diet by the lower classes of people inhabiting the villages bordering on the Koller Lake, their dietetic value is quite unknown elsewhere. A Christian gentleman who had recently returned to India from Japan referred, in a lecture delivered on the manners and customs of the Japanese, to the fact of lotus roots being used as food by the Japanese. Whether these people use lotus seed as food is not known.

The *Waddis*, *Malas* and other low classes of people go out on rafts or in hollowed trunks of the palmyra, in the Koller Lake in November and December, to gather various products, of which the fruit of *Nymphæa Lotus* is the chief. The fruit is roundish and brownish red. It is kept soaked in cowdung in a basket for three days, when it is pounded and the seed separated. The seed somewhat resembles *ragi* when thoroughly husked, and is of dirty white colour. It is boiled like rice and thus eaten or ground to flour and made into cakes. It is considered specially good for people suffering from beri-beri. It is very palatable, but is not so nutritious as rice, cholam or other grain. It is extensively consumed, specially in times of scarcity, by the classes of people above referred to. Last year, the price of the seed in the villages bordering on the Koller Lake, was so high as Rs. 40 per candy of 500 lbs., that is, half the price of paddy.

The root of the plant is cooked and eaten as curry. (C. K. SUBBA RAO).

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COTTON WILT IN THE CENTRAL PROVINCES.—This disease was noted on the Experimental Farm, Nagpur, this season, and this is apparently the first authentic instance of its appearance in these Provinces.

A field of Bani cotton, a local variety of rather fine staple, was first attacked. This crop was growing on a piece of land in rather high condition which had been cropped with Juar the year before. The cotton plants were very vigorous and healthy-looking, and gave promise of an excellent crop. The first signs of disease were noted at the end of August, when scattered plants were noticed to turn yellow, the leaves to wilt and the whole plant to die and dry up. An attacked plant was often noticed to have completely died within twenty-four hours. On pulling up diseased plants a ring of the bark at the point of junction of the stem and root was found to have turned brown and to be in a decomposed state, while immediately above this ring the base of the stem was covered with large unhealthy-looking swellings which in a later stage are frequently attacked by white ants: these insects being at first suspected of having caused the injury to the plant. Specimens of the diseased plants were forwarded to Dr. Butler for examination and have been identified as suffering from the cotton wilt disease (*Neocosmospora vasinfecta* Smith). Meanwhile, on the other parts of the Farm, Jari and other Indian varieties had been attacked to a less extent, but it was curious to note that American Upland varieties, which were growing round the edges of the first attacked plot, were not attacked, nor could a single instance of an American cotton plant suffering from this disease be found. In less than three weeks, this disease was entirely stamped out by cutting and burning the diseased plants, and this result was helped, no doubt, by the early cessation of the rains.

On wider enquiries being made, cotton was reported to be diseased in several places in the Nagpur District, and in the Saoner tract where, owing to the recent cotton boom, this crop is grown without proper regard to rotation, it was estimated that nearly 5 per cent. of the crop had been killed in places by this disease. Cultivators state that this disease has been occasionally seen for the last three or four years, but has only been common this season. The curious part is that in this District also it is not found on the American cottons. Heavily manured crops are most frequently attacked, and possibly the disease has lately become severe owing to the abandonment of a proper rotation for cotton in certain of the more favoured cotton tracts of this Province.—(G. EVANS).

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DESTRUCTION OF RATS BY RATIN.—A special preparation called 'Ratin' for the destruction of rats and mice was tried in Germany with successful results. To test whether it would be of use in India, experiments were made by the Civil Veterinary Department both in the field and in the Laboratory. The results have been disappointing, the preparation having been found to be ineffective. This experience is corroborated by the results of the experiments conducted on an extensive scale by the Plague Department and in the Mysore State. The ineffectiveness may be due to the ratin having lost potency as it only keeps good for about two months after manufacture.—(EDITOR).

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EXPERIMENTS ON WELL-SINKING IN THE AHMEDNAGAR DISTRICT.—A simple system of well-boring has been tested by the Collector of Ahmednagar (Bombay Presidency). A cast-iron or mild steel Jumper bar is used. This tool is not expensive. It should be 13 to 17 inches long and 1¼ inches in diameter. The top has a hook whereby the implement is raised from the bored hole. At its lower end is a steeled chisel. The chisel should be twisted slightly by a cooly each time it descends. Thus the sub-strata are broken up and excavated and removed in water. Five men are required for this system of boring.

For deep boring a rope passed over a pulley should be attached to the hook of the bar. The depth, thus reached, is usually below the depth of existing wells. This work in two days costs about Rs. 5. The results and personal experience indicate that additional supplies of water can, in many parts of India, be easily and cheaply obtained by boring 20 or more feet below the floor of existing wells. This does not of course hold good in all districts.—(**Editor**).

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Jute Experiments in South Behar. At the instance of the Director of Agriculture, Bengal, an interesting trial was made with jute in 1906, by a member of the Patna Divisional Agricultural Association near Itarhi in the Buxar Sub-division of Shahabad. The land selected only measured about three-eighths of an acre. The soil was a low-lying soft loam adjoining a big pool of water. The seed was sown in April in beds laid out for irrigation. Five or six waterings were given till the commencement of rain. No manure was applied. The land was, however, naturally fertile. The rains were favourable. The plants grew to a height of 10 feet and more. The plants were retted in September and the fibre extracted by hand in the ordinary way. The total yield per acre was 21 maunds of fibre valued at Rs. 168. The cost of all the operations amounted to Rs. 25 only, so that the net profit per acre was Rs. 143. Paddy was grown on the same field after the removal of jute, the outturn of which was found to be 16 maunds per acre valued at Rs. 40. These promising results have encouraged the member to continue the experiments on an extended scale this year, and he hopes to be soon in a position to say what the general prospects of jute are in the Shahabad District.—(**Editor**).

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Method of Breeding Plants for fixing the character in a single generation said to have been invented by Dr. Nelson of Sweden. The Svalof Experimenters have found that the fluctuating variability is of little use in the production of new varieties of cereals, but all the varieties at present cultivated are made up of large numbers of unit species differing widely among themselves in Botanical and Economical properties. Once isolated, these unit species merely require to be propagated before being placed on the market.

There was also found to be an association of characters between the small morphological characters on the exterior of these unit species and important economic properties. Thus, observation showed that in Barley stiff spreading hairs on the scales are correlated with good malting qualities; a fact of the utmost importance in the initial selection of a new race. Of course, there is a vast amount of book-keeping and laboratory work entailed in the discovery and recording of these associated characters, and a large staff of experts is kept for the purpose at Svalof; but, once these correlated characters are known, it is only necessary to search for the correlated botanical marks in order to improve any given local variety in any character in which it may be deficient.

The results obtained at Svalof are published at intervals in Swedish. The Agricultural Station there is not supported by Government, but is a commercial undertaking for the improvement and distribution of seed grain. There is an account of the work of the Svalof station in *De Vries' Plant Breeding (London: Kegan Paul, Trench, Trübner & Co., Ld.)* De Vries also gives a chapter on Corn breeding, and devotes a long article to Burbank's Horticultural Novelties, in which article he shows what use Burbank has made of hybridization on scientific lines and of associated characters. At the end of the book he has some very interesting remarks on correlation and the geographical distribution of plants. In fact, this is quite the most useful book that has recently appeared on plant breeding.

The following is a list of the recent works on the subject published in English:—

Royal Horticultural Society

Report of Third International Conference on Genetics. Spottiswood & Co.

Royal Society—

Three reports of the Evolution Committee. Harrison & Sons, St. Martin's Lane.

Mendelism. By R. C. Punnett. (2nd Edition.) Macmillan & Boures, Cambridge.

Plant Breeding. By Bailey. Macmillan.

Recent advances in the Study of Evolution and Heredity By Locke.

Journal of Agricultural Science for R. H. Biffin's work.

Of these the reports of the Evolution Committee of the Royal Society are of purely scientific interest, as they contain an account of the original work done by Bateson and Punnett (Saunders & Co.) on the subject. The Royal Horticultural Society's report is of distinctly practical interest, as is Mr. Biffin's work in the Journal of Agricultural Science.

Of the books, Bailey's Plant Breeding is somewhat out of date, as most of it has not been re-written for some ten years, and in its earlier pages merely gives an account of the old empirical formulæ adopted by breeders, before the present scientific methods had been introduced. (WOODHOUSE).

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WELL BORING IN CHINGLEPUT DISTRICT. During three months, ending 30th June, 1907, very useful results were obtained in well-boring in the Chingleput District, Madras. Fourteen second borings were made in existing wells. In these borings pipes were placed which reached to artesian water. Forty-one borings were made in existing wells and seventeen in new wells. In almost all cases the borings resulted in increased water. The existence of artesian water was more easily ascertained by boring in old wells than in new wells. The extent of artesian water has not yet been definitely determined in any district of the Punjab. Therefore cultivators cannot yet be advised where to dig in order to tap this extra water-supply. An iron pipe of 4 inches diameter, which may be required for successful artesian boring, costs about a rupee a foot. The expenditure in boring to artesian water may amount to Rs. 20 or Rs. 30 for each well.

Well-boring has become popular in the Chingleput District. Private enterprise has then been stimulated and valuable practical results are likely to follow.—(EDITOR).

LITERATURE.

United States Department of Agriculture, Farmers' Bulletin No. 257. Soil Fertility. By Milton Whitney. In this Bulletin, which is an address to a farmers' club, we have stated in popular form the conclusions at which, after several years' investigation, the Bureau of Soils in the U. S. Department of Agriculture have arrived regarding the question of soil fertility. These are absolutely revolutionary in character. In the first place, they hold that the examination by them of hundreds of soils of all sorts in the United States has established that the composition and concentration of the soil moisture with respect to the common plant foods—nitrates, potash, phosphates, lime—is practically the same in all soils, and that this composition is constantly maintained. If, then, there is in general a sufficiency of plant food immediately available to crops, to what can ordinary infertility in soils be ascribed? This question is answered by restating and greatly extending the old excretory theory first propounded by De Candolle and for a time supported by Liebig. We cannot here examine the experiments on which this theory is based, but we may admit that as far as laboratory experiments go, the Bureau of Soils have brought forward sufficient evidence to establish the fact that toxic substances are excreted by the roots of growing plants, that these substances are deleterious to plants of the species by which they were produced and often to a considerable extent to closely related species, but are frequently innocuous to other families or orders of plants, and that they are destroyed or neutralised by the application of such fertilisers as farm yard manure and green manure and of such non fertilisers as carbon black, ferric hydrate and pyrogallol. But when from the results of these experiments and their conclusions regarding the constancy of the composition of soil moisture, they argue that the chief function of cultivation and of fertilisers is not to make available or supply plant food but to break up toxins, we confess that we shall require much stronger evidence before we can agree with them. When they have demonstrated in the field over a series of years that by the application of carbon black or ferric hydrate alone they can produce crops equal to those grown after a full dose of fertiliser, we shall be convinced.—(E. SHEARER).

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ANNUAL REPORT OF THE BOARD OF SCIENTIFIC ADVICE FOR 1905-1906. The Board of Scientific Advice was constituted in 1902 to co-ordinate official scientific inquiry and to ensure the proper distribution of the work of research among different departments of science. The Board advises the Government of India on questions of economic and applied science, especially on the questions of industrial development. The present report, covering the period from April 1st, 1905, to March 31st, 1906, summarises the work of the several departments which deal with scientific investigation.

"Economic and Industrial Chemistry" records the examination of several wild and cultivated Indian varieties of Ficus. The result of the examination has proved that only "Ficus Elastica" yields satisfactory India-rubber. The most interesting part of the report is that which records the results of analysis to ascertain the value of particular stuffs as famine foods. Among the articles submitted to this chemical analysis were the following: roots of *Costus Speciosus*, the seeds of *Ormosia Travoyana*, roots of *Sterculia Villosa*, and some edible earths. The first two were found to be fairly nutritious, while the rest were found to have no food value in them. The report notices the experiments made to ascertain the conditions under which cyanogenetic glucosides are found in excessive quantity in Sorghum and other cultivated plants. The general idea that the presence of these glucosides is associated with certain varieties of these crops is not supported, since the same variety may contain at different stages of growth very different quantities of its characteristic glucosides. The immature plant of *Andropogon Sorghum*, generally held to be poisonous, was found to be entirely free from any poisonous element when cultivated at Pusa. The report takes note of the construction at Pusa of four gauges designed to measure the amount and quality of the water which drains into the subsoil.

In the section devoted to Botanical Survey mention is made of an interesting book by Professor J. C. Bose, on "Plant Response as a means of Physiological Investigation" and of an important Memoir on "Root Parasitism" by Mr. Barber.

In the domain of Agricultural Botany Mr. Gammie has contributed an important paper on "Indian Cottons." Further enquiry carried on to ascertain the cause of the deterioration of the jute fibre has brought to light the fact that the deterioration of the fibre is due in large extent to fraudulent watering and that the shortage of supply induces buyers to purchase even the most inferior qualities. The report briefly notices the attempts made to ascertain how far outbreaks of insect-pests can be checked by the dissemination of disease amongst them. Of the fungus parasites occurring in harmful insects, the locust fungus has been credited with the power of destroying locusts in South Africa. A series of tests with this locust fungus was carried out on the Bombay and North-Western locusts and some species of grass-hoppers destructive to crops. The results were unsuccessful, but now it is understood that the true locust fungus was not that which was introduced for the purpose of these experiments, and therefore there is a very good reason for failure. Note is also taken of the failure of experiments to check the green bug of Coffee by means of a fungus parasite imported from the United States of America which attacks various scale insects.

The whole of the section on "Forest Products" affords instructive reading to those who have both sufficient means and enterprise to develop new industries. In this section are mentioned the important investigations made at Rangoon for utilizing in the form of pulp, inferior kinds of timber and bamboos for the manufacture of cheap paper. The paper produced is poor in quality. It may only therefore pay to manufacture pulp on a large scale from bamboos and export it to Europe.

The bamboo pulp is decidedly of high quality and leaves a margin of profit even after the payment of freight and other charges incidental to its export. We are further told that investigations are in progress to ascertain how the cultivation of the lac insect can be improved and extended, and what is the best season for gathering lac. (EDITOR).

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REPORT ON THE WORKING OF CO-OPERATIVE CREDIT SOCIETIES IN THE MADRAS PRESIDENCY IN THE 15TH MONTH ENDING 30TH JUNE 1907. During the period under report, 36 new societies were registered. Of these 24 were rural and 12 were urban. All the rural societies were based on the principle of unlimited liability. Most of the new societies were started in districts in which similar institutions were already in existence. The aggregate number of members rose from 2,733 to 6,439. Of this number 31 per cent. were agriculturists, and 37 per cent. were those who partly followed agriculture and partly other occupations. Besides the paid-up share capital of these societies, fixed deposits were borrowed on interest from 5 to 9 per cent. More than two-thirds of these deposits were contributed by the members themselves. The amount lent by Government was nearly as much as the share-capital and fixed deposits of these societies.

Certain concessions granted by the Madras Government have raised the prestige of these societies in the eyes of the public and have created a feeling of confidence and security. The annual reports of the societies with the registrar's audit reviews thereon are published in the District Gazettes, and are supplied free of charge to all rural societies. Remittance transfer receipts are issued at par so that remittances can be sent without extra charge. The societies' strong boxes can be kept in Government treasuries for security. (EDITOR).

NOTICE.

The Memoirs of this Department, dealing with scientific subjects relating to Agriculture, will appear from time to time as material is available. They will be published in separate series, such as Chemistry, Botany, Entomology and the like. All contributions should be sent to the Editor, the Inspector-General of Agriculture, Nagpur, Central Provinces, India. Contributors will be given, free of charge, fifty copies of their contributions.

BOTANICAL SERIES.

Vol. I, No. I. The Haustorium of the Santalum Album—Early Stages by C. A. Barber, M.A., F.L.S. Price, Re. 1.

Part II.—Cases of Irregular Penetration by C. A. Barber, M.A., F.L.S. Price, Rs. 3.

Vol. I, No. II. Indian Wheat Rusts by E. J. Butler, M.B., F.L.S., and J. M. Hayman. Price, Rs. 3.

Vol. I, No. III. Fungus Diseases of Sugarcane in Bengal by E. J. Butler, M.B., F.L.S. Price, Rs. 3.

Vol. I, No. IV. Gossypium obtusifolium, Roxburgh, by I. H. Burkill, M.A. Price, Re. 1.

Vol. I, No. V. An Account of the Genus Pythium and some Chytridiaceæ by E. J. Butler, M.B., F.L.S. Price, Rs. 4-8.

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Vol. II, No. II. The Indian Cottons by G. A. Gammie, F.L.S. Price, Rs. 7-8.

Vol. II, No. III. Note on a Toxic Substance excreted by the Roots of Plants by F. Fletcher, M.A., B.Sc. (*In the press.*)

Vol. II, No. IV. The Haustorium of Olax Scandens by C. A. Barber, M.A., F.L.S. Price, Rs. 2-8.

Vol. II, No. V. Haustorium of Cansjera Rheedii by C. A. Barber, M.A., F.L.S. (*In the press.*)

CHEMICAL SERIES.

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Vol. I, No. V. Construction of Drain Gauges at Pusa by M. H. ARNOTT, M.INST.C.E., with a Preface by J. W. LEATHER, Ph.D., F.C.S. Price, Rs. 3.

Vol. I, No. VI. The Loss of Water from Soil During Dry Weather by J. WALTER LEATHER, Ph.D., F.I.C., F.C.S. Price, Rs. 2.

ENTOMOLOGICAL SERIES.

Vol. I, No. I. The Bombay Locust by H. M. LEFROY, M.A., F.E.S., F.Z.S. Price, Rs. 2-8.

Vol. I, No. II. The more Important Insects injurious to Indian Agriculture by H. M. LEFROY, M.A., F.E.S., F.Z.S. Price, Rs. 3.

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