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FODDER IN INDIA



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FODDER IN INDIA

A TREATISE ON
GRASSES AND CROPS, THEIR CHARACTERISTICS
AND CULTIVATION
Etc

BY

HARRY T. GILLING
(Government Grass and Dairy Farms)

CALCUTTA
THACKER, SPINK & CO

1915

DEDICATED
TO
MY SISTER EDITH.

Semper fidelis.

INTRODUCTION.

THIS little work is neither the first nor the last word on Agriculture or Fodder: it is by no means entirely original, but it is a small summary of information collected from notes, various works, and pamphlets on the subject, and the practical experience and observation of the writer extending over many years on the plains of India. It is intended to assist beginners and students by providing a few facts, scientific and practical, *as a basis for further research*; but it is principally by constant observation, intelligent enquiry, and practical experience that knowledge will be gained: and it is to these that the student must turn for *details* which will not be found herein, for several reasons, one being that detail will rarely be found to work out the same in any two places, at any rate if any distance apart: another is that it does not seem wise to tempt the novice to learn by heart after the manner of the parrot, rather than by practice, observation, and enquiry from his local superiors, cultivators, etc.

Should this small work find a reasonable appreciation, I shall, time and opportunity permitting, endeavour to write a more elaborate work on this subject going more fully into statistics and details, examples, etc., with the possible collaboration of other scientific and practical agriculturists.

THE FARM,
SHAHJEHANPUR, U. P. }
May 1st, 1914.

HARRY T. GILLING.

FODDER IN INDIA.

CHAPTER 1.

THE "Supply of Fodder in India" for milch and draught animals (more especially as regards this book, the supply for horses, mules and bullocks belonging to the Government), **Necessity for Fodder Supply.** is one of the most, if not the most, important considerations of the day ; and by the use of the term "Supply of Fodder" must be included sufficient quantities for 'bad' as well as normal years, *i.e.*, it must include 'Reserves of Fodder' of some kind or another to meet any emergency be it famine or war, fire or water. There are many products from the land which could be bought and stored cheaply in good years as a provision for horned cattle and to some extent mules ; but these same products or by far the most of them are not fodder for horses and could not be used as such for any length of time. Horses require grass either green or dry, and it is with the provision of this grass which I principally intend to deal herein.

Some fifteen years or more ago the Military Grass Farms were opened in and about a few cantonments, and since then they have **Institution of Military Grass Farms.** been gradually expanding and improving, until to-day there is no cantonment where mounted troops are stationed without a Military Grass Farm in some shape or form. Further, this Department has taken up all arrangements for fodder supplies to Government animals on the Line of March, Camps of Exercise, Artillery Practice Camps, Staff Rides, Mobilization Reserves, etc., etc. Although the arrangements, considering the difficulties of the

country, the frequent bad years, the enormous quantities required, and the comparative newness of the department, are undoubtedly good, there still remains room for improvement in both "quality and quantity," to a great extent perhaps the shortcomings in quality are due to the constant enormous quantity required ; be that as it may, our business is to remedy the evil.

Prior to the days of Military Grass Farms there were grass farms of sorts scattered here and there over India which it is unnecessary to discuss, but which in their day answered their purpose more or less.

The Indian Cavalry Regiments also *mutatis mutandis* had their own farms and fodder arrangements as to-day ; in days to come let us hope that the Military Grass Farms Department will take over these farms and the fodder supplies of these regiments also. But the bulk of the fodder supply was made by purchase through contractors, with all the attendant evils, the unfortunate quadruped being by no means the least sufferer. Fodder contractors have nowadays ceased to exist as such in most places, and it should be the constant aim of all concerned to finally complete their extinction.

**Object of Grass
Farms.**

This being done farm managers will, together with their farm staff, supplement the produce from farm lands by the utilization to the full of encamping grounds, which should be permanently acquired, any other rukh or forest lands available, and the resources of their district, taking the full benefit of good years for accumulating 'reserves of fodder': the results of which procedure will be a sufficiency for all calls of an economical fodder of good quality. Encamping grounds which are fairly central, handy, and if possible near the railway, may very conveniently be used as receiving depôts and for small reserves all the year round. In this way a supply of fodder is immediately available for troops or the line of march, etc., etc., and also which is a great consideration the farm, the manager, and his staff become well-known in the district to all concerned and

the depôt becomes known as a market for the disposal of fodder where a fair rate and immediate payment can be obtained ; besides many of the encamping grounds can easily be brought under grass cultivation.

CHAPTER II.

IN establishing a farm a smaller area of good land is preferable to a large area of poor land, but in using the expression 'poor,' land which is capable of considerable improvement is not implied, but rather *usar*, *piror*, and *mattiyar* lands which are hardly reclaimable or insufficiently so to make it worth while. Always be on the look-out and prowl in your own district and try to snap up any bit of land at all possible, if it is not to be bought get the longest possible lease with hopes of a renewal ; but do your prowling quietly, keep your mouth shut and your ears wide open ; do your acquiring gradually and on strictly economic lines ; don't take up more land than you can satisfactorily work. In few places, if any, are the grass farm lands sufficiently extensive to produce all that is necessary for requirements, not to mention the necessary reserve, which necessitates the procedure of leasing and purchase as recounted in the foregoing chapter. Other things being equal, the nearer farm lands are to cantonments and regimental lines the better, at the same time for manuring purposes, and certain forms of cultivation you will have a freer hand the further away from regimental lines. It is often indeed quite an advantage to have your land outside cantonment boundaries and the scope of sanitary authorities altogether. Land up to 10-12 miles distant if worth anything should certainly be taken up for cultivation of either grass or crops, and for *rukhs* and forest lands up to 50 miles is no too far, and further if on or near the railway. Grazing lands are usually preferable to cultivated

Establishing a Grass Farm.

Arrangements for Supplementary Fodder.

land—cheaper, more immediately productive of a grass crop ; on the other hand crop lands are expensive to buy and expensive to put down to grass, and much slower in giving any return. Of course one is not always able to pick and choose.

CHAPTER III.

THERE are several excellent publications about 'Soils,'

Soil.

and the student will be well advised to

peruse one or more of them carefully for a

better understanding and more minute detail than will be

found herein, although sufficient information is given for

forming a foundation and immediate need. Soil then is the

upper surface (crust) of the earth, formed from the disinte-

gration of rock with an intermingling of animal and vegetable

matter in a greater or lesser state of decay. It comprises a

depth of only from 2" or 3" up to 1' 0", rarely more and usually

less. Sub-soil is found immediately below soil, and where

Sub-soil.

the "soil" is of considerable depth, say

over 10", "sub-soil" hardly enters into

our calculations being beyond the depth usually cultivated in

India, and beyond the question of moisture, including

drainage, is but little used by the roots of grass or crops.

The general average constituents of soil are : sand, clay,

calcic carbonate, humus, gravel ; and

Classification of Soils.

soils are usually classified as follows :—

Sandy Soil	containing	under 10 p. c.	clay.
„ Loam	„	from 10-20 p. c.	„
Loam	„	20-30 p. c.	„
Clay Loam	„	30-50 p. c.	„
„ Soil	„	over 50 p. c.	„
Humus	„	5 p. c.	decayed vegetable matter.

Gravel in varying small percentage will usually form some part of any or each of the above kinds of soil. A sub-soil may consist of one or more or all in varying percentages of rock, clay, sand, gravel, calcic carbonate, or humus.

Taking into consideration the many kinds of soils with their varying constituents, qualities, and special aptitude for raising particular crops, also the vast variety between soils of one district and another all bearing definite local names, it would be not over-wise perhaps to lay down as a hard and fast rule any particular soil as the best for grass cultivation, specially when, as is so often the case, you have to take what you can get, although it may be remembered that you can, with time, convert one classification of soil to another, or in other words make your own soil. However, in the opinion of the writer, for grass cultivation the soil to be desired is a clayey loam (dorassa), and for the following reasons:—Clay has a most retentive power of moisture, and will retain and furnish the roots with water in times of severe dry weather, even drought; a clayey loam will retain applications of plant food (manure) far much longer than a coarser soil; moisture and manure what more do you ask for growing grass. Not always being free to choose you must make the most of what you have got, and the writer does not imply for a moment that grass will only grow on a clayey loam, far from it. For a perfect soil many elements are necessary, and for satisfactory results the following are essential: nitrogen, phosphoric acid, potash; and because plant roots are unable to absorb their food except in solution there must be sufficient moisture to dissolve these elements but not excessive moisture, otherwise all the air will be driven out of the soil with a consequent loss of oxygen which, it seem unnecessary almost to write it, is necessary to all forms of animal and plant life (possibly with a few rare exceptions). If you are faced with a 'Sandy Soil' or 'Clay Soil' on which to cultivate grass don't waste any time trying anything else, but "trench" with bazaar or city rubbish or, if there are no objections on sanitary grounds, night-soil. It is not considered that there is any advantage, for our purpose, in

**Suitable Soils for
Grass Cultivation.**

**Essentials of a Good
Soil.**

**Treatment of Sand
or Clay.**

trenching a greater depth than 9" at most, and this is the depth the writer advises for lasting and most satisfactory results; but here again local conditions as to the quantity and quality of the manure available—a depth of 6" only will do very well perhaps, and anything less than 4" is hardly worth while.

All grass lands are enormously benefited by occasional

**Necessity for Plough-
ing Grass Lands.** very light ploughing and harrowing during the winter months and before the monsoon, especially when the lands

have been grazed after the harvest, but the lands must never be left with furrows and clods. The reason of this benefit is that perfect "capillary attraction" is maintained, and an open soil with the consequent constant supply of moisture evenly distributed and freedom for the grass roots, the necessity for both of which conditions is most essential to satisfactory farming, though a fact unfortunately very often lost sight of. The soil requirements for crops and cereals other than grass will be referred to later in the chapters concerned.

CHAPTER IV.

A WET "cold" soil is an abomination, though it will, under certain conditions, produce
Cold Soil Useless. cereal crops of a sort; for our purpose and grass cultivation it is quite useless. To remedy this state of things we must "till" the soil, and as this may not always be sufficient then we must "drain." The reverse circumstances are a "dry" soil, and again the remedy is tillage, accompanied by "banding" in a greater or lesser degree according to the 'lie' and level of the land.

Let us commence with drainage. On economical grounds
Drainage. managers of grass farms in India will generally have to be content with what for which I have no better name we will call "natural artificial" drainage—a paradox indeed, but the intention is to distinguish between tile or pipe draining (pakka)

and simple draining by digging and levelling up. Strictly speaking of course any system of drainage not provided solely by nature is artificial.

It would be difficult to lay down any fixed rule for draining. Everything depends upon the general physical features of the land to be drained and also upon the soil texture ; but when you make a start “ don’t spoil the ship for a hap’orth of tar ” ; don’t try to make water run up hill, it won’t, although the writer has seen such a phenomenon or what appeared to be such in England ; always commence your drain at the ‘ end ’ (*i.e.*, where the surplus water is to run off, or the mouth of the drain) and work your way back to the first wet plot ; don’t join up your laterals square (*i.e.*, at right angles). Great depth is not always necessary. Commencing at $2\frac{1}{2}'$ increasing to 3' at the outlet will usually meet the case ; but all the same dig for a good “ fall ” and the fall in your main must be as great and preferably rather greater than in your laterals ; a “ fall ” of 1—50 will answer well as a rule but as aforesaid it can be no hard and fast rule.

It will be to advantage before starting to read through some chapters on drainage in one of the agricultural works which abound, if you don’t care to buy (it will be money well spent) there should be no difficulty in borrowing one of these books, or try the local club library.

Nothing perhaps is more universally neglected, or shall we say overlooked, possibly in ignorance, than ploughing and harrowing “ grass-lands ” : even a few turns with a home-made brush harrow will often make a lot of difference to out-turn and an “ even ” crop—*experientia docet*. On many grass farms as soon as the harvest is over the lands are immediately let out under various arrangements (in my opinion all bad and some worse than others) for grazing ? (what’s in a name), the argument being that it is good for the land because it manures it (as a rule even the manure is carried away), and also that it means cash realizations. There is

**Tillage of Grass
Lands.**

**Grazing not Bene-
ficial.**

a passion for these realizations otherwise grazing would "never" be allowed except with great restrictions, under strictly scientific and intelligent arrangements, and for a limited period—and why? The cattle come on in hundreds, and I should not be far out in some cases if I said thousands. Some are paid for many are not. They wander at their will often accompanied by goats and destroy and pollute as much as they eat. The soil is trampled down, and very often puddled, after which baking into a hard iron-like surface, any shoots or roots (which may be left) are thereby done to death from frost, damp, inclement winter weather, and the following scorching summer sun, simply because the capillary arrangements are absolutely ruined, the banding is severely damaged, fences and trees are destroyed, in addition the chances of disease, and the moral damage to preservation, protection, and conservation of farm lands at all times. But the loss may be called a "negative" one and not prominently noticeable to the ordinary observer. A few hundred rupees are received and credited as a set off against the year's expenditure, and every one is satisfied (especially the cattle owners and a few others)—although the loss, negative of course (*sic*), may amount to more than one thousand rupees, and is often incalculable. But enough, and to get back to tillage. After the harvest and the raking up, what is left on the ground is short broken grass and much seed. Of the latter some will rot and form manure, the remainder will germinate later on ; all the former will rot and form manure. After the first decent shower of late rain, or winter rains (and don't wait for a deluge), get your country ploughs and harrows on to the land, run them across both ways, this procedure will enable the roots to secure moisture and keep alive. It will cover up delicate young shoots, enable the land to absorb the water quickly and prevent waste of rain by evaporation, assist in decomposing the aftermath (referred to above) leaves and other organic matter due to autumn falls, and stimulate the "capillary" tendency, that most important of all considerations in farming. If time, labour.

and bullocks can be spared this process should be repeated after the winter rains before the surface has time to bake ; it is hardly possible to overdo this particular job if done intelligently. Don't plough during actual rainfall or *immediately* after it ; don't plough deep, 3" is ample and rather less will do ; don't leave clods and deep furrows (there should be none), level off with a pahata or sohaga (roller) if necessary.

Tillage as an adjunct to drainage will hardly be comprised in the foregoing. For improving or reclaiming wet or cold land the

Reclamation.

ploughing must be as deep as possible and as frequent, and English or modified English ploughs should be used, until a fine tilth is obtained. As previously stated draining may also be necessary in the case of wet land, and in the case of either wet, cold, or dry lands the addition of long green manure in conjunction with the ploughing is very desirable. Broadly speaking then for "reclamation and drainage" purposes very deep ploughing is required ; for "grass cultivation" shallow ploughing and the harrow ; for "crop cultivation" medium ploughing and the pahata or sohaga ; but in all cases avoid ploughing always at the same depth or you will create "plowpan," *i. e.*, a hard caked surface immediately below the depth you are ploughing at which will interfere seriously with capillary attraction, and also prevent the roots striking downwards for food and water. The alpha and omega of successful crop cultivation is constant tillage before and after the rains at varying depths to form a good seed-bed, and enable the young roots after seed germination to obtain a constant and ample supply of water with a minimum of difficulty, as well as to escape from the scorching rays of the sun in the greater depth.

Dry Farming.

Banding or gatha-banding may be conveniently taken in this chapter. It is almost equally as important in India as drainage and tillage, and is part of the system of "dry-farming." It is a system providing for the retention

Gatha-Banding, Terracing, and Levelling.

of water, and incidentally plant food, manure, etc., on the higher and drier tracts of land. By this method the land is laid out in plots or pattis or gathas, which for convenience in every way are usually rectangular: of various sizes according to the level and irregularity of the land to be dealt with, by means of small banks (bands) and ditches of from 6" to 2' 6" in height or depth, as a rule about 1' 0" is a convenient size, but the manager must use his judgment, the more irregular or steeper the land the bigger the bands and the smaller the area enclosed. It will be found useful to gatha-band in fixed areas, working in acres from $\frac{1}{2}$ to 3 acres per plot on bad land and 4 to 10 acres on good fairly level land. Bands should meet the prevailing flow of water square on, not at an angle, the ditch may be on either side or both, if only on one side that which is facing the flow. Briefly it may be said that the main object of banding or terracing land is to make each plot or area enclosed deal with its own rainfall.

CHAPTER V.

THERE are more opinions than one on the question of

Manuring.

“manure and manuring,” but we must all agree on the object of it which is to provide plant life with food; but, equally with human beings and animals, various plants have their special requirements, as the saying goes “one man’s meat is another man’s poison” so what is food for grass is not “the” food for rose trees and *vice versâ*, bearing in mind of course that we are always aiming at the best results. Ordinarily for grass cultivation green or long manure is the article required, the idea being to protect the surface soil and young shoots, and to keep the soil “coarse” and open equally as much as to feed the grass which on good land requires, once it is established, but little nutriment apart from what it obtains from rain and atmosphere and the chemical constituents of the soil. Grass

once established is not "hungry," and excessive feeding will make it coarse and abnormal which is not desirable (a similar result will be obtained by feeding a baby to its fill with "patent" foods—excellent as an advertisement but not desirable as an olive branch), true you will get more weight (outturn) and also more "complaints"—we are seeking "quality." On the other hand crops require short or rotted, quick acting manure, in a condition to immediately yield up its nutriment when the seed has germinated and the young roots require strength: they are hungry and growing and want lots of food of the best. There are occasions when "crop-lands" also require long green manure which will be dealt with in a later chapter.

When putting down "grass-seed" a light dressing of short manure is, of course, desirable and advisable, but except on quite poor land not absolutely necessary.

The cheapest, quickest, and in the writer's opinion the best system of manuring for grass cultivation is "top-dressing," and where it is available in plenty with "stable-litter," this is usually cheaper than any other kind of manure, and where the situation of the land makes it a consideration it is the least objectionable, two or three good showers settle it down or remove any smell. Failing this, bazaar rubbish, city rubbish, and sweepings of all sorts are excellent top-dressings, but usually contain a medley of pots, tin cans, bricks and stones, etc., all of which have to be picked up again and buried, or they may be used for filling up holes, etc. Spoiled hay, bedding, and silage are also good dressings and will help. About $2\frac{1}{2}$ " deep will be found a satisfactory depth for spreading, this depth settles down nicely and evenly, a greater depth is rather too heavy, more expensive and not necessary, while less usually results in patches and is easily washed away—at the same time cut your coat according to the cloth. About 150 country cart loads will cover an acre. The cost will vary according to local conditions, especially distances, but for stable-litter Rs. 80 should always cover it. The others will come more expensive

Top Dressing.

up to Rs. 150 per acre, but you will be amply repaid even at this price. The other methods of manuring

Trenching.

are various forms of "trenching" which however, except in cases of reclamation, or on sandy soils and clay which "must" be trenched, I think are quite second to top-dressing simply because of the area involved and the extra time and money required. Night-soil of course must be trenched and is the best form of manuring, but it is almost a thing of the past, at any rate so far as grass farms are concerned. The cinders and ashes from incinerators are a very beneficial dressing either for grass or crops. If you trench you must "level" and "sow" after it, when the monsoons begin, this is expensive if properly done and if not properly done is worse than useless, and lastly it is not immediately productive. Certainly the trenching system when well done makes a farm to be very proud of, and on a small one of 200-300 acres the writer would certainly trench a foot deep; but most of our farms are large and getting larger, and managers have not the time to give to special work of this kind. We require quick returns on the most economical lines and top-dressing is the best way to get this. A few words more than on top-dressing:—Don't start until you have gatha-banded even on the most level land, and repair your bands annually; don't top-dress on high lying undulating land (hillocky) if it is like that shallow trench about 3" deep and try to

White-Ants.

level up a bit by degrees. If you are troubled with white-ants sprinkle a few baskets per acre of quick lime and they will soon leave you alone. The small cost is well spent when you remember what a white-ant (dimak) will do, and eat; don't drag cart loads of manure about your plots in the rains, you've lots of time before and after and make much of it. Cow-dung (gobar) and dairy-litter are not for grass cultivation, save them for crops if you grow any; if these commodities are very cheap and you have to use them they should be trenched 4"—6", they are not a bit of use as top-dressing most productive

of weeds also extravagant. Stock manuring or grazing are to be strongly deprecated. If you are *bound* to do it, have the animals very carefully tended, no goats, and a small plot at a time; when they move on to the next plot light plough or harrow the previous one; don't let the dung be taken away, count the animals as often as you can, not always at the same time of day, and charge the highest rate you are allowed to discourage the practice. When they have been over all your plots once clear them off altogether, and repair bands, etc.

Artificial manures are not cheap, they are not so beneficial to the land (especially grass lands) as natural manures; excepting "lime" Artificial Manures. no manager of a grass farm should dream of using artificial manures, apart from experiments or under specific orders, unless natural manures are *absolutely* unobtainable. The writer is not pre-historic or pessimistic, neither would he attempt to farm in England or the Colonies and not use artificials. If you don't go with the times you will be left. But we are in India and we are most of us working many hundred, up to a few thousand, acres, also everything else apart at home or abroad when available "natural manure is the best." Mind you scientifically applied if suitable to the soil conditions; artificials will give you a "big yield," but it is quantity more than quality; coarse, unpalatable, biologically unsound grass; artificials as it were are "tonics" and should be used as such, made useful as stimulants but certainly not as alternatives to nature. On the other hand, as already written in the chapter on soils, certain chemical elements are necessary for plant life, and if any of these are deficient in your soil they may be replaced satisfactorily by the agency of suitable artificial manure. Artificial manures are much more beneficial to quick growing crops (especially root crops) than to grass, but in any case their benefit is not lasting and their use for our purposes in India are not ordinarily economical. There are various pamphlets and hand-books on artificials, read them advisedly and intelligently and don't be led away; and

don't buy "mixtures" which are 25 per cent. or more sand or some other make weight—buy your requirements separately and mix for yourself.

CHAPTER VI.

"CLEANLINESS is next to Godliness." We all agree to this, then don't forget your farm, keep it

Weeding.

clean ; if its importance could be measured by words many chapters might be devoted to the subject of "Weeding." Grass crops and cereal crops must be clean and weeded systematically, a dirty farm means a bad farmer, to neglect weeding on the score of economy is both false and foolish, sooner or later it has to be done or you will have more weeds than grass, the longer it is left the more difficult the work and the greater the expense. How many "issues of green grass" in the monsoon season are utterly damned by weeds ? Can you possibly expect to issue green grass containing 20—50 per cent. of weed ? No wonder there are complaints and no wonder that horses refuse to eat such a ration ; and hay containing a similar percentage though not so noticeable and therefore perhaps "shoved through" can only be called fourth class and the reverse of a credit to the farm, the manager, and the department.

Silage containing weed is possible and usually good

Vide Chapter XII.

and edible, but this is only a "get out ;" it would be better if it were entirely good clean grass or crops, besides ensilage is quite a secondary consideration as a rule on most Military Grass Farms except as a means of disposal of our "surplus" green grass in the rainy season. Clean your plots for all you are worth, and rest assured it will more than repay you in the long run, give you peace of mind and an easy conscience if your heart is in the work. Admitted it is hard, very hard, to leave your farm after 3 or 4 years' good, conscientious work and everything in tip top order, to go and take over a neglected show,

a jungle perhaps, which has been running itself for years, unfortunately such things do happen. All the same this is no excuse for you to do likewise, it's easier to run the show like that and you may say "what's the good," but if your heart is in your farm you can't do it.

There are innumerable kinds of weeds, with as many names which need not be mentioned. For our purpose all are bad, some worse than others, as they grow to a great size and spread at an alarming rate; root them all out all the year round, the best time is perhaps when the ground is soft after rain, summer, and winter, especially after the first monsoon showers when the grass crop is starting to grow in earnest. Weeds are an abomination; they choke, oust, and kill off good grass and ruin your crop quality. One rupee per day per acre occasionally spent will save you five or six rupees or more if once the weeds get out of hand. The ploughing of grass lands as written of in a previous chapter will greatly help to keep down weeds, otherwise the weeding must be done by hand pulling and with the khurpa. For weeding crops hand pulling, the harrow, and the cultivator. It may be borne in mind with advantage that weeds, which are mostly gross feeders and quick growers do an immense amount of damage in a bad monsoon year by drawing moisture from the soil and giving it off through their leaves—the quantity of moisture lost in this way is very considerable.

CHAPTER VII.

ARBORICULTURE is worthy of interest and some little consideration in agriculture, but does not concern the grass farmer in India to any great extent, and the trees are rarely the property of the farm, so planting and rearing to any appreciable extent is usually not worth while. But trees along your farm roads, on boundary lines, around stables, bullock lines, and other

Arboriculture.

buildings are a blessing to man and beast always, while a few scattered over your plots at about one to the acre will help the grass and be more than welcome both in harvest time and at others when there is work doing. If you have any rights over the trees the wood loppings will provide some fuel and a certain amount of timber for the workshops; but remember we are out to grow grass and crops, not timber, and arboriculture must be quite a side issue. Different provinces and districts grow different trees. A very few are common to all. The following are a few of those most usually found and those most useful to us as grass farmers :—

Shisham.	Khikar	or	Babul.	Nim.	Pipul.
Bamboo.	Mango.		Ber.	Tut.	

One or more of these will grow in any province or district. Don't plant trees too closely for avenues or roadsides, 30' between is near enough unless in arid districts with a low water level, 18' to 21' will do very well where thick shade is wanted for open bullock lines, etc., and one tree or at "most" two per acre on the grass plots.

CHAPTER VIII.

THE names of the various grasses to be found in India are legion, and whether the mere fact of knowing them all, including their Latin equivalent, is of much value remains a matter of opinion. The writer does not intend to tabulate them here but merely to note on those most useful to our purpose and more generally found, and refer the reader to one or more of the treatises upon grasses mentioned in a later chapter. A few grasses (*e.g.*, Doob) grow more or less, according to climate and rain showers, all the year round, but the great majority appear only in the monsoon period, and with one or two exceptions hardly last for the hay crop, even if they

made good hay, but they augment the quantity for "green issues" and for ensilage :—

Dub or Hariāla.	Janewah.	Jirga or Palwan.
Anjan or Dhāmma.	Musēl.	Parbāh or Suriala.
Bharui or Barroo.	Dāb or Kusa.	Siuri.
Kharmakra.	Sewain or Sainvkāi.	Sanwah or Sanwak.
Chupraila.	Bhulani.	Lapetwah.
Makraila.	Etc.	Etc.

Dub.—This is the usual name but it is variable and may be heard of as khabbal, dābra, rām ghas, hariāli, hārāla, dhobie ghas, etc. It grows anywhere, sometimes in slightly different forms, and with cultivation yields an excellent out-turn of excellent fodder green or dry. With the exception of December and January it grows all the year round with reasonable showers. Dub may be sown anytime between March and September, but in dry districts is liable to be burnt up in the early stages if not watered until the rains commence. This by no means always happens and should not prove a deterrent to early sowing other things being equal ; it can be propagated from seed during the rainy season or, if irrigation is available, sown broadcast mixed with sand about 25lbs. of seed per acre, after sowing brush harrow lightly. Another method is by "dibbing" small clumps of dub with roots, *i.e.*, making holes in the ground 2" to 3" deep and 9" to 1' apart in parallel lines put in the clumps pressing some good earth around the roots leaving the small tufts of grass above ground : water freely for a few days if no rainfall. A third way, and perhaps usually the best, especially when sowing on a large area, is to plough about 3" deep, scrape up the soil into heaps all over the plot to be sown, chisel some healthy strong growing dub from wherever available and while fresh throw it down evenly over the plot, cover lightly at once 1"-2" with the loose earth from the heaps, and unless wet run a roller or pahata over it. It is not much use trying to sow dub unless the soil is rich naturally or has been manured for the purpose.

Janewah.—Will grow on most lands that are at all fertile, but is not fond of a sandy soil. Where not already growing it can easily be introduced by seed and will gradually spread itself and quickly if the litter is taken from the horse lines where the grass is fed (as of course it should be); with cultivation (*vide* chapter on manuring) janewah will grow up to 3'-3½' high, is excellent fodder either green (if cut early), dry or as silage. If not quite so popular it certainly runs dub very close for first place, and if well 'got' and well stacked will keep and improve with keeping as hay for a long time if *perfectly* covered or thatched and with a sound bottom. Janewah can be propagated during the early rains from well-gathered properly matured seed. It yields an excellent out-turn in fewer cuttings than dub.

Anjan.—There are two varieties, black and white, of almost equal value, the black for choice. It is indigenous to black cotton soils, is commonly found in the N.-W. P. and the Punjab but under cultivation is not restricted to these parts. It is an excellent grass for "green-issues" as it grows very quickly from the commencement of the rains. It also makes excellent hay when cut in time as it ripens very early and soon gets burnt up especially on poorer soils and in years of scanty rainfall and early cessation: on a rich soil it grows most luxuriantly and yields a heavy crop; it fails on a sandy soil. Anjan is easily propagated from seed sown as soon as possible after the first good rainfall, sow broadcast after a light ploughing.

Musēl.—A sweet scented grass, found in scattered patches in most grass-growing districts. If cut in time it makes a very fair hay but cut at all late it is distinctly woody: it is rather difficult to propagate and is probably not worth while.

Parbāh.—The well-known and equally detested "spear-grass," but notwithstanding when cultivated and cut before the flower (spear) "opens" it makes beautiful

hay of good colour, fine and most appetizing—but once the spear opens it is damned. Unfortunately, this generally happens as it really wants cutting before the remainder of the crop is ready, and this does not get done as a rule, “hence these tears.” Parbāh may be grown from seed without trouble, and the effect of manuring (especially top-dressing) on it is most noticeable; but perhaps for the foregoing reasons it is wiser not to encourage it, as the spears are “distinctly dangerous” to horses, and even mules, the mouths of these animals particularly the underlip being much damaged, while if swallowed in any quantity the spears are liable to cause colic. Remember parbāh or spear grass keeps a fresh green colour long after it ought to have been cut, and this may tend to mislead.

Barroo.—A most excellent grass for ensilage and perhaps preferable to any other, and it yields a very heavy outturn; but apart from ensilage it should be avoided and discouraged as its self-propagating propensities by roots and through seeding are tremendous and it will very quickly oust everything else. If you have got it, it is very difficult to get rid of (and so far as the writer knows there is only one way), if you haven't got it see that you don't, or you'll be very sorry. To get rid of it *dig it clean out* and burn.

Dāb.—Or Kusa makes very fair silage and good bedding but not worth cultivating.

Siuri.—A fine stemmed grass somewhat like dub, excellent for green issues, and on rich land will last for the hay crop, but is certainly monsoon grass.

Kharmakra.—A fine stemmed grass, with three or four thick nodules, appears in the monsoon and is excellent for the green issue.

Sewain.—A monsoon grass, fine with three or four rows of seed heads, a good green fodder.

Sanwak.—Very similar to sewain but with thicker and heavier seed heads, very nutritious, will not make the best hay even if it lasts until harvest time.

Chapraila.—A very early monsoon grass, quite good for green issue, but growing rather coarse and with a broad leaf is not always liked by recipients ; the seed heads grow out from all round the stem after the style of a fir tree.

Makraila, Lapetwah, Bhulani, Gen Bandri, etc., are all good for green issue or ensilage. On rich land they all grow quickly and in a good season are very full of moisture and inclined to be coarse, and therefore not over welcome on the ration stands, in which case it is as well if possible to use them for silage. At any rate be tactful if you have to issue them and if you have got it put in a fair share of dub (always welcome). In seasons of only light or moderate rainfall, or with grasses from the poorer land you will have no trouble, as a rule, if you are clear of weeds, fair, and reasonable.

CHAPTER IX.

WITH varying local conditions, and equally varying opinions which are not necessarily constant for even a month on the same ration stand, it is impossible to make hard and fast rules about "issues" and methods of making issues, but the following suggestions will act as a general guide. Green grass during the monsoons must never be cut with a khurpa (*i.e.* cheeled) it must either be with the Daranthi (saw edged sickle), the jhaban or hassia (smooth edged sickles) rather like a scythe blade and acting in a similar way with the coolies body or arm as the handle, or with a mowing machine. If you attempt to cheel on wet land, particularly manured land, your grass will be full of mud and roots from the very start—and you are spoiling your plots. Avoid dirt or any appearance of it at all costs ; don't let the grass get too long before cutting for green issues or it will turn yellow at the bottom and at least look unpalatable ; keep clear of weeds ; it is a great point to start in

time (as soon as the grass is long enough to get hold of at all), the grass is growing all the time and growing fast. If not using the mowing machines cut by weight, or patts if it is more economical for the farm this way, and the cutting is more easily regulated as regards the quantity required daily. In small stations you can generally finish cutting early enough to issue in the evening. If you can manage this do so. In large stations it is almost always out of the question, but load up your carts over night and have them on the ration stands just after daylight which will give you time to unload and have the grass well shaken up and free from the smell and steam caused by fermentation, before the time for drawing rations arrives (usually 6 A.M.). A green grass issue is never "over-popular," and this word is hardly sufficiently expressive where a *full* green ration is in question. There are several reasons for this state of affairs and all more or less reasonable at any rate from the recipients point of view, and the farm manager while doing the best he can for his farm must be reasonably sympathetic, tactful, and not over selfish. Then matters will generally run smoothly. Don't try to be *too* smart, don't try to rush in anything at all for issue, rubbish, weeds, dirt, and *some* grass, such attempts generally fail entirely sooner or later and most certainly do more to "damn the green issue" and get folks backs up than anything else; by all means keep in view the interests of your farm, your outturn (fearful word) books, etc.; but study the old horse a bit too—it's his grub; most Officers Commanding will meet you all the way or at least a good bit of it if they see you are "playing the game," not all for yourself and making the farm at the expense of the regiment and the horses. Any surplus left on a ration stand or a plot should invariably be siloed and on no account be again tendered for issue on the morrow. This can be easily arranged. You may say it's no worse and easily "mixed in!" We know all about that, it may be clever. It's not "cricket."

The foregoing remarks apply equally to issues of "green monsoon crops" of which the following are those with which we are mostly concerned :—

Juar—(Impi), Bājra—(millet), Makāi—(Indian corn), Makra, Moth, Mung. It should be borne in mind on military grass farms that crops never *take the place of* grass, but as a supplement, or grown on any unsuitable grass lands which, however, will grow crops, don't let land lay idle if it will grow "anything."

Juar.—Sow at the commencement of the rains, for fodder purposes from 60—80 lbs. of seed per acre. Discretion must be used, and the quality of the land, moisture, etc., studied. If sown too thinly the stems will be too thick and coarse for fodder. On the other hand, if sown too thickly, air will be kept out and the lower parts will dry up and not mature properly. Generally speaking, the more moisture, the more seed per acre. Juar likes a good loam, and will do well on a clayey soil ; it is usually followed by wheat. It makes excellent silage.

Bājra.—This is a relative of anjan grass. it may be sown later than juar and will be ready for harvesting sooner. It requires considerably less moisture for growing than other kharif crops, and grows quite well on a poor and light soil—for fodder purposes sow 40—50 lbs. per acre, as fodder it is useless for horses : it is usually followed by barley. It will silo.

Mākāi.—Not so good as juar as a green fodder, but it is sometimes asked for and is available before juar is in season. It requires a heavy rich soil and must be weeded ; hardly a suitable crop for grass farm production ; usually followed by gram, if anything.

Moth and Mung.—These are pulses, usually sown along with juar or bājra about 10 lbs. per acre, they will be ready first—excellent fodder for bullocks.

CHAPTER X.

THE monsoon or 'kharif crops in a dry state do not concern us very much perhaps, but are worthy of consideration for times of stress and shortage. Juar generally known as "charri" is a perfectly sound fodder in its dry state, an excellent supplement to the grass ration, but should not if avoidable be made a substitute as on account of its coarseness and hardness it is *not the equal* of a good dry grass ration even when 25—20 lbs. Not more than half the ration should be juar unless *quite* unavoidable. When cutting juar for storage as dry-fodder it should be cut before the seed ripens, or as an alternative the seed-heads should be cut off before cutting down the crop. In this way the natural moisture is retained in the stem and leaf to a great extent making the fodder more tender and succulent. In both cases the crop should be cut while retaining some greenness. When the crop is allowed to ripen while standing and then the seed heads removed the stalk and leaves are known as tándá or kárbi and, in this state, to make the fodder edible it should be chaffed or chopped. The foregoing remarks apply generally to bājra as well, but it must be borne in mind that it is only a fodder for horned cattle and should not be tendered for issue to horses.

Other monsoon crops, perhaps not yet universally known or grown, are amber cane and Australian millet. They are sown at the same time or rather later than juar, and the former is superior to it. Horses and cattle are particularly partial to it as a green ration, but the seed is more expensive. Both are sown and grown similarly to juar but only 20—30 lbs. seed per acre; they require rather more moisture than juar to do their best, and are liable to be a failure if there is a partial failure of the monsoon, unless irrigated. Australian Millet must be cut before it shows *any* signs of ripening, otherwise it is very dangerous.

Lucerne is not a kharif crop, and will be dealt with later, but it grows all the year round under suitable conditions; with very heavy rainfall and on heavy low-lying positions it is liable to rot at the roots and die off unless the drainage is very good.

Before leaving the monsoon crops it may be a help to know that if the early rains fail, monsoon or kharif crops may be sown on suitable land up to about August 15th, *i.e.*, on land which is not naturally over-dry. Of course a diminished out-turn must be expected, but the writer has sown as late as the end of August (29th and 30th) and had a four-anna crop. It is generally accepted that to be a success a kharif crop must have at least one month's reasonable rainfall. Another point, juar, amber cane, and the millets if sown early in 'anticipation' of the early rains will take very little harm for several weeks without a shower if sown on *an absolutely dry seed bed*; but if the soil is at all moist so as to give the seed a start then it will all perish about 10 days after being sown unless there is rain. When seed is cheap and you have a large area to get sown it is sometimes worth the gamble, and when the monsoon fails after a shower or two you will have scored a big point.

CHAPTER XI.

THE winter or rabi crops are many and various. We will confine ourselves to a suitable selection for Military Grass Farm purposes; and once again remind the reader that the primary object to the almost entire exclusion of all others is, as regards Military Grass Farms, to grow good grass for hay and green issues, crops of other kinds being treated as quite a side issue. Our selections then are Oats, Barley, Wheat, Rye Grass, Mustard, Shaftal, Lucerne, Barseem, Gram, Kuria, Kasumba, Taramira, Carrots.

Oats—Known as Jai, Jawi, sometimes Gandal. There are at least 7 varieties at this date, perhaps more. One variety is more suitable than another just according to conditions, surroundings and congenial soil—a variety that may flourish in Peshawar will possibly fail entirely in Lucknow or Dinapore. The main consideration is “good seed” and it will pay you to test your sample, a very simple matter; having bought your seed to avoid any chance of oat-smut wash it in a 4 per cent. solution of formalin before sowing; this process applies also to barley and wheat. Never try to sow oats without plenty of moisture in the soil, firstly on account of germination, secondly to attain a good or even fair crop, and don’t sow too much seed per acre in the hope of getting a bumper crop ‘cause you’ll be disappointed. Oats are shallow rooted and more liable to the effects of dry weather than other cereals. A rich moist soil is required and the land should be ploughed in preparation several times during the summer and once again in the autumn before sowing, followed immediately by the pahata unless very wet; if the soil is found dry at a depth of 4’ when you come to sow not more than 60 lbs. of seed per acre should be used, and except under exceptional conditions of moisture never more than 80 lbs. per acre. Oats should be sown any time after the first week in October. With the above conditions and a good, indifferent, or bad season the out-turn will be 150—200 maunds per acre green, or 20—40 maunds of oat-hay. If the crop is to be issued green cut in good time before signs of ripening; if for oat-hay cut as soon as the milk is well into the ear and before it solidifies; cut clean and free from weeds and dirt or roots leave lying on the ground in sheaves or pulas as cut for two or three days, then set up in stooks or cocks for at least a full “dry” week, before stacking: tie up the sheaves or pulas round the middle before stooking; any less drying than the above even in a dry season will set up

fermentation in the stack and spoil your oat-hay, with possibilities of a bonfire.

Barley—Known as Jau ; there are several varieties but differently to oats they will any one of them probably grow in any place suitable to barley, but as we are considering the crop as one for *fodder* more than grain the “beardless” varieties of barley are the best. Test your seed and wash in formalin (see oats). Barley will do quite well in a light soil not over-heavily manured ; in making this statement the writer means that where in these circumstances barley will yield a reasonable crop, oats will fail and wheat do little better—prepare the land as for oats but fewer ploughings will do if handicapped for time. Barley may be sown from the end of October until December, the writer has sown on Christmas Eve and known of sowings in early January ! However, it can wait till the last oats and wheat first in the order written and depending on the ploughings as soon as you like after October 7th ; barley grows fast and ripens early and with fair rain will do well sown late, but all the same we are out for “straw” (*i.e.*, Bhoosa) and this wants time and rain, particularly rain ; sow about 100 lbs. of seed per acre, and if mixed with wheat seed for cutting for green issues 2 of barley to 1 of wheat. If cut in good time (*vide* oats) makes quite useful hay for hard times, barley in any form is essentially a horse’s food :—
“Jau kachche, pakke, daddare, jo joban turiyan.”

Wheat—Known as gehun or kanak. There are very many varieties, and the remarks above anent barley may apply here with most of the varieties, some of them are more fastidious. The treatment for smut does not always succeed with wheat, but the cost of the process is not great and worth trying. Test your seed sample before buying. Plough the land for wheat as many as ten times if possible before sowing, sow in early November (after the oats) about 100 lbs. seed per acre ; wheat

• prefers a heavy soil, and it will not follow a kharif crop so well as barley or oats, a fallow is best suited. Wheat does not make any sort of hay and must be issued green (khasil or khawid).

Rye Grass (or Rye), try, if you like, experiment, but in the writer's opinion and experience, in India rye is best left alone, "the game is not worth the candle." I have heard that rye grass has done well at Bangalore.

Mustard—Known as sarson, is useful as cattle fodder mixed with bhoosa or other food. It grows anywhere and is usually sown mixed with wheat or barley in the proportion of 5—1, or may be sown alone in single rows or between plots.

Vetches, Shaftal.—A species of clover. It may be grown in a small way as a "fancy fodder," it is very luscious, but requires irrigation, unless under exceptional circumstances.

Barseem.—As Shaftal an excellent fodder, but one which with possible exceptions can only be dealt with in quite a small way, where canal irrigation is available; perhaps something extensive might be done even in India? Barseem requires a rich clayey loam, plenty of moisture, and some rainfall. (See official pamphlet on this by Major Marriott.)

Lucerne.—As the two foregoing but more hardy and consequently more commonly found in India. Under satisfactory conditions (*i. e.*, constantly moist soil) it will live through the hot weather without irrigation as it is very deep rooted, and then thrive again in the cold season; with regular irrigation, constant cutting, and weeding it will flourish all the year round, and with a couple of top dressings of manure during the period will last six or seven years without re-sowing; to this extent it is perennial. If grown from seed (and only the very best should be used) and treated as above, lucerne will yield up to 600 maunds per acre per annum of green fodder; it is more usually issued green in India but makes excellent

hay if carefully “got” before it actually flowers ; if it is intended to bale it it is better to chaff it first a sowing to its nature it breaks up very much. There are several methods and as many opinions as to the best way of sowing lucerne. Though rather more expensive, the writer is in favour of “ridges” For this method 10 lbs. of seed per acre are required. Sow in October on well manured land thoroughly ploughed and as deeply as possible, the ridges should be $1\frac{1}{2}'$ apart and $1\frac{1}{2}'$ high, for choice they should run E. to W., but in any case must be at right angles to the water irrigation channels : you must have a fine tilth. Unless you intend to do the thing really well and give it every chance, better leave the cultivation of lucerne for some one else. It will not grow itself and anything much less than the out-turn mentioned above won't pay, and lucerne containing 20—50 per cent. weeds is an abomination.

Maina, Senji, Methra, and several other cold season crops, and if not suitable to the grass farmer for cultivation as fodder, it is well to remember they have their use as legumes, and any one of them or a mixture of some may, without disturbing grass lands in any way to their detriment, with advantage be shallow sown thereon to its undeniable benefit if done intelligently, simply because they constantly enrich the soil, whereas grass crops are equally constantly impoverishing it ; this may truly be looked upon as an example of the “science” of grass farming.

Gram—Known as chenna or chhola, something of a paradox gram while a hardy crop is yet exceedingly delicate, it will grow with a minimum of cultivation on any soil from sand to clay, though for choice it prefers a stiff soil ; it requires little or no weeding ; but it is very susceptible to damage from climatic idiosyncrasies. Gram may be issued green to horses and cattle, not recommended for horses however, or only in very small quantities ; but fed to farm bullocks when the grain is in the pod it will save their grain ration for the time, and

they will benefit from the change. Gram is sown about the second week in September, 80—100 lbs. of seed per acre according to the quality of the soil.

Kuria, Kasumba, Tāramira, Toria, Ulsi, Til and others, usually sown along with other crops, but according to the purpose for which they are required, are “oil-seeds” have their various uses, and for our purpose are worth consideration where time and conditions permit as tonics, but we need not go into any detail of them here, as being somewhat out of the sphere of grass-farming.

Carrots—Known as gajār, are sown about the end of September, a ‘deep’ ploughed sandy loam which is not over rich as carrot seed germinates slowly and if the soil is too rich weeds will get such a start that they will quite spoil, possibly entirely oust, the carrots; in India about 20 lbs. of seed are required per acre if anything rather less; when the seedlings are well up as they will not transplant must be thinned out; weed as much as possible. A usual yield will be 60 maunds of carrots per acre; the carrot tops are *exceedingly valuable* as fodder, most palatable, so if you can use them for issues along with the bottoms your out-turn will benefit *very* appreciably (on paper). Carrots will not silo. When feeding carrots to your own live-stock, horses or bullocks, save on your grain ration by feeding day about grain and carrots alternately.

The writer has heard of an out-turn of 250 maunds of carrots per acre—presumably including “tops.” This must have been an exceptional crop for India, though not at all unusual in England; and he would like to know something more about it, also the cost of production.

Bhoosa.—A by-product of the various cereals and a most valuable and very extensively used fodder for horned cattle—mules and camels, and in a lesser degree for horses in the absence or scarcity of grass or hay, but horses must be inoculated to its use very gradually and with only the best quality, and under ordinary circum-

stances they should never be given more than a $\frac{1}{4}$ of their fodder ration of *bhoosa*, otherwise an attack of colic more or less severe will inevitably follow. The two main classes of *bhoosa* are (i) *white bhoosa* made from wheat, barley, rye and oat-straw, (ii) *missa bhoosa* made from the leaves and stalks of gram and the leaves of arhar, orrud, mung, etc. This variety is principally fed to camels, apart from village cattle. The great points to remember in the making or purchase of *bhoosa* are that (i) it must be clean, dry, and of good colour, (ii) it should not be more than one year old, (iii) it should be small (pieces not more than 1" in length, or less) and not coarse or knotty. Other valuable fodders of the *bhoosa* class are paddy straw and ragi straw to which the foregoing principles apply *mutatis mutandis*.

CHAPTER XII.

Ensilage.—A method of storing green fodder of almost

Use of weeds to be discouraged.

all descriptions including weeds (but not entirely), for feeding, principally, to horned cattle, when green fodder is out of season, in times of shortage, and to utilize surplus and other green grass which might be wasted otherwise in the monsoon season. Silo pits may be of any size to suit circumstances, as far as possible the size should be so arranged, that once a pit is opened it will be finished in a week or ten days; every day that a pit is open the silage is deteriorating and what is equally important to the farm manager is losing weight. Whether the authorities allow sufficient margin for loss in conversion between green weight and silage is not for me to discuss, but if you are going to keep within the margin you must be about and awake both when filling and issuing pits. As a guide to size a pit 30' × 12' × 6' will on the average hold 1,500 maunds of green grass and turn out 1,000 maunds of silage (a depth of 6' will

be found more satisfactory than any other being neither too deep for convenient filling and emptying, not too shallow to accommodate any length or breadth). There has been much written and more said about siloing, the best teacher is experience, and the following points gathered from the writer's own are for the help of the student :—A silo pit cannot be dug in any soil, *e.g.*, black-cotton or sand, which naturally would allow water to drain into the pits. When once made, be quite sure your pit is water-tight top, bottom and sides, probably a clay or clay loam is the best land for silo pits. Pick out high lying spots, hillock tops, etc., and make a *shallow* surface drain all round each pit with an outlet on the lowest side : all grass or crops for silage should be cut clean not cheeled, or your silage is ruined with dirt and roots. Rain falling does not interfere with filling pits, but the pits must be clean, empty and dry as possible when the filling begins. Fill your pits as quickly as possible, and if you can cover the same day it is as well, but do it properly, fill evenly and tread down well all the time you are filling, and pile up a full 8' above the level of the top of the pit. You will have to complete the covering again later on when the grass has settled down, throw the earth on the sides and ends first, then on the top. Monsoon grasses off newly top-dressed land do not make good silage, unless allowed to dry a little outside first, and they never make the "best" silage : still it has to be cut and utilized and with a little care makes quite edible fodder. Once pits are made they must be inspected constantly, especially when there is rain, and repaired, cracks and holes filled in, and no water standing near to drain in. Silage is particularly liable to deterioration by rainfall when pits are open for issuing, and the whole cover or top should not be taken off at once but in strips day by day. The actual loss by conversion of green grass to silage is 40 per cent., the loss after opening pits by dryage, opening, carting and sometimes by rainfall is variable but can hardly be less than 5 per cent., often more ; the authorities will not

Monsoon and immature grasses not best silage.

allow you this margin (*vide* office records), and it is up to the manager to make it less or answer questions, possibly pay! The writer can only help the reader by telling him that it is possible to have a surplus! *Quod erat demonsrtandum.*

Much more might be written about ensilage, the temperatures for "sweet," "sour," and "burnt" silage—chaffing crops for silage, etc, etc., but perhaps enough has been said above for ordinary grass farm purposes and to meet the purpose of this book.

CHAPTER XIII.

Hay is not necessarily dry grass or rather *vice versâ*, but is made by carefully drying and
Fermentation. saving grass or crops, and then maturing them in stacks for some time where in order to make "hay" they must undergo a certain amount of fermentation without some fermentation you have only dry grass or dry crops: theoretically the longer grass is in stack, the better the hay that will turn out, all other things being equal and subject to certain limitations. The points of good hay are that it should be (1) free from dirt and roots, (2) a fine green appetising colour, (3) well preserved, (4) sweet smelling and slightly aromatic, (5) in the case of grass a mixture of fine cultivated grasses. But what generally passes for hay in India is "dry-grass" of varying qualities from excellent rarely often good down to bad. Owing to rapid consumption, want of extensive weather proof storage accommodation, climatic considerations to some extent only, frequent bad seasons, etc., interfering with the accumulation of a large reserve it is not often possible to make the best hay.

Nevertheless the aim of the grass farmer should certainly be to get "hay" if possible, and once a manager has established his station reserve there seems no reason with the proper conditions to hand and the necessary interest why hay should not be forthcoming. The following observations may be of help to the beginner. By all means do things

as economically as possible, but there is a growing tendency to cut down rates *nām-ke-waste* out of all reason, it is generally done at the expense of the land, the expense of quality, the expense of the horse, and the expense of the farm's good name by causing recurring complaints. All this is obviously wrong, and there should be a limit to the cutting down business. *Everything* in India is dearer than it was a few years ago, especially labour. I am not by any means advocating high rates, but certainly the best article available of its kind at a "fair" price; what you lose on the swings you'll gain on the roundabouts, and don't forget 20 lbs. of good hay or even *good* dry grass, and 6 or 7 lbs. of grain fed with intelligence will keep a horse much more "fit" than 10—14 lbs. grain and 20 lbs. of rubbish. Fodder is cheaper than grain anyway, even at one rupee per 100 lbs. To

Cutting.

resume, owing to the large area to be cut, the difficulties in obtaining labour at a minimum rate, the objection to the extensive or exclusive use of mowing-machines owing to the reduced "out-turn," sometimes, of course, the nature of the land will not allow of machines being used: not often, the consequence is, especially on the larger farms, that the grass crop is rarely cut in time (*i.e.*, when in flower, but before the pollen can be shaken off, and while still green); if harvesting could be begun and carried on to the greatest possible extent on October 1st and finished by November 15th or earlier there would be little to grumble at as regards quality in most years; there is always the tail-end of the monsoon to be remembered when you are starting, and except, perhaps, in years when there appears to be a failure of the later rains or returning monsoon, it seems very risky to start any serious operations before the 1st of October, but there may be occasions when it is worth the gamble! Any considerable fall of rain immediately before or during the harvesting means heavy dews resulting in the discolouration of cut grass, therefore each day's cutting should

Cocking.

be cocked in "monkey-cocks or wind-rows" over-night and

if fine spread out again next day *after* 10 a.m. ; truly this means a little more work and incidentally a little more cost ; the second night after cutting put your grass into proper “cocks” (10—15 mds. or more), it won't be quite dry and will ferment just a little, this is one of the features of “hay,” the cocks should be made round and tidy with “pointed tops,” not squat and flat-topped ; leave the grass here for a full week and then start stacking, and speaking of stacks made on the grass plots let me say here that I much prefer a “round stack” of only moderate size (10,00 mds.), and so you go on over the whole farm cutting ; making cocks, large cocks, stacks every one on their own job, and if you've nursed your land, your bullocks, your machinery, etc., and your native staff the whole harvest will be a most enjoyable picnic. Work early and work late but pay fair and play fair, be everywhere every day and see you get your money's worth. This seems the best way and with modifications to suit local conditions wants a lot of beating ; there are others, this is one and economical—start cutting and leave the grass when cut ; after the second or third day, when there is a decent quantity down send round your carts with 3 or 4 coolies to load, and send the grass either straight down to the ration stands or straight to the site for your stack or stacks—the results on paper will very possibly be good ! but you will have no “hay” ; just now the procedure of issuing direct from the ground is sometimes necessary in the future, when you have attained that much to be desired “Station reserve” it will never be “necessary.”

Dry Crops—Should be cut in pulas, gathas or sheaves and be left lying when cut (in fine weather of course) 3 or 4 days, being turned over daily ; the pulas or sheaves will then be stocked carefully heads upwards with a view to their getting a maximum of air and wind right through, with a minimum of wet in case of inopportune rain, the stooks should be kept standing according to the condition of the crop at cutting and the prevailing weather conditions from 14—30 days. After this stack in round stacks on good sound

platforms of some kind, and it is absolutely necessary to thatch. Carrots should be stacked on a platform with a 2' layer of sand below them, cover them all over with sand (dry of course) and thatch or plaster over with mud and *gobar*, etc.

CHAPTER XIV.

Carting.—Whether using farm or hired carts it is economical to arrange hay-cocks around stack sites so as to reduce distances to a minimum. Where hired carts are used, especially in large numbers, the number employed should be constantly checked. During the haymaking, if the grass is destined eventually for ground issues or for stackyards, the larger the hay-cocks are the better, when it has to stand for any considerable time; the grass comes out more compact, is better to load, enables a bigger load (*i.e.*, greater weight per load), a certain amount of dryage and wastage are avoided, also less damage will be done in case of showers, and the quantity out per plot will be more easily checked and controlled. Carting may be paid for by maundage, daily labour, pulas, loads, or area; local conditions and prices will be the best guide to the best system together with the nature of the work in hand.

Stacking.—Excepting for the large stackyards as used in connection with Rukh Farms and those attached to or in the vicinity of regimental horse lines in which cases large rectangular stacks of from 10,000—20,000 maunds or more should be built, the writer is a great advocate for small stacks, round ones for choice, holding about 1,000 maunds. They are easier to build, cheaper to build, easier to thatch and more weather-proof when thatched, stand firmer and steadier against sand and rainstorms, a convenient size for issues, less loss is entailed in case of fire, a very great consideration, for I think I may safely say without fear of contradiction that once a hay stack big or little gets well on fire in spite of many rules, regulations, orders, etc., for

precautions against fire and action to be taken, you can say good-bye to the lot, at any rate as fodder, what is not burnt will be ruined by water, so why have all your eggs in one basket? Opinions differ.

A round stack to hold 1,000—1,200 maunds of hay should be 30' in diameter (don't build too fast, be building two or three stacks at once when you can, and go from one to the other) at base, build up gradually to 18'—20' the eaves at which height the diameter should be 36'; from the eaves build still more gradually and spread evenly treading down (dubao) well sloping gradually up to a point which should be 12' high from the eaves. This stack intelligently built, and with a 9"—12" thatch, will always look well and will stand any weather, the quantity varying with the coarseness of the grass, the time taken, and the evenness or otherwise of the laying and trampling down. For those who prefer the rectangular stack any proportion may be taken, that generally used for 2,000—2,500 maunds of hay is 60' × 20' at the base, and sloping outwards on all sides to 70' × 30' at the eaves (the writer recommends a rather less slope than this), the height at this point will be 18'—20,' from here the sides only *not ends* should slope inwards and upwards to the ridge at a height 15' from the eaves. Always select high lying level ground for a stack. A platform is not "usually" necessary but the area may be measured out and bounded by a trench 1½' wide and 6" deep, the earth excavated being thrown into the centre and sloped gently to the edges. Some cinders, ashes or sand may be spread, when available for nothing, over the earth; and exit for rain water must be provided on the lower side of the surrounding ditch. In making a stack never forget the centre, keep it up, fill the centre as quickly as the outsides, otherwise after completion as soon as it starts "settling" your stack will become an eyesore, and what is worse will let in water freely. For the first 8' or so from the bottom build your stack up, plumb on all sides or even incline inwards a trifle, at the 8' let the grass settle

a day or two if you can manage it and trample down particularly well. Continuing from this point don't overlap too suddenly to get your increased area at the eaves, the mere process of stacking of itself has a tendency to make this outward slope without much extraneous assistance ; spread your grass evenly and equitably all the time to get shape and stability and the more trampling the better ; pay your stacker a good wage and make a friend of him. There is a useful implement for saving labour in stacking invented by Mr. J. L. Flowerdew, Grass Farms, Bangalore, which is simple, inexpensive, and worth a trial. A few handfuls of the commonest salt crushed coarsely and scattered amongst the grass at intervals "does" improve the quality of the hay.

[N. B.—As regards the shape of stacks, it is a question of "point of view"—but the Government Order says that stacks are to be built of rectangular shape, chiefly probably for the sake of uniformity and easier measurement.]

Contents of Stacks.—Seeing that within reasonable limits the figures can always be checked if desired or required by authorised persons, the system of recording the contents of stacks "by measurement" seems the best, much the best ; but the measurements must of course be made accurately and intelligently. As the Manager, the man at the wheel, is the person who should know what is in his own stacks so he should measure them himself. Having got so far "the crux of the whole business" rests upon what figure is going to be taken as the density of the stack, this is to a great extent a matter of judgment. Time, experience, observation, and care are the best teachers, but there is no real difficulty to those anxious to learn. The following will help you in making your decision :—(1) Time taken in building stack. (2) Method of stacking whether by labour with ladders or ramps, or mechanical elevators. (3) Fine and dry or damp dull weather. (4) Quality of grass as regards coarseness and length. (5) Within the writer's own experience among various average stacks the density has been found

to vary from 3 lbs. to 10 lbs. per cubic foot; this is a good margin and will show the possibilities—also the need for care and intelligent calculation. A big “surplus” on a stack is equally as culpable or as bad management or whatever term you care to use as a big “loss”; the results are not always the same! Now it seems to me that the Manager being the responsible person for both stock and books, provided that he can produce the quantity of any stack as borne out by his ledgers when required, or hand over to a successor or other authorised person to their entire satisfaction at any time nothing more is required. Surpluses and losses have to be accounted for and adjusted monthly—accounts are audited monthly—ledgers and other books as well as stock are inspected regularly and constantly—if rates are satisfactory or if not explicable, what more is wanted? Let the Manager arrive at his figure as he will (in reason) once he enters it in his book “by the laws of the Audit Department it altereth not” he must abide by it and it is obviously to his benefit and credit to avoid a “disproportionate” surplus or loss for which a satisfactory explanation is not forthcoming.

Measurements for Circular Stacks :—

(The square of the average girth in feet multiplied by $\cdot 07958$) \times (the height from the ground to the eaves in feet) $+$ (the square of the girth at eaves in feet multiplied by $\cdot 07958$) \times (one quarter the height from the eaves to peak).

Measurements for Rectangular Stacks :—

(The area of the base *plus* the area at eaves *plus* the area halfway between base and eaves) $\times 4$: (divide this total by 6, and multiply the remainder by the height from ground to eaves); $+$ (the mean area between eaves and ridge, multiplied by $\frac{1}{2}$ the height from eaves to ridge).

These measurements though not strictly exact in mathematics are correct in practice, and allow sufficiently for ordinary wastage in tops and bottoms. To find the contents

of a stack the sum of these measurements must be multiplied by the density per cubic foot in lbs., the total being in lbs.

There are other methods of measurement but the foregoing will be found as simple as any with accuracy, so I will only deal with one more which is useful when speed is desirable :—

(Mean length of base and eaves \times mean width of base and eaves) \times Height from ground to eaves ; + (Mean length of eaves and ridge \times width at eaves) \times Half-height from eaves to ridge ; the sum of these by the Density.

Never measure your stack until it has stood *at least* 14 days, and a month for choice.

It is not always possible, or allowable, to delay stack measurements even 14 days, but obviously the sooner the stack is measured after building, the sooner and greater the variation in both measurements and density ; consequently the longer you can reasonably defer your first measurements the more reliable they are (*i.e.*, the less the variation on re-measurement). Government require stacks to be re-measured every 3 months. On the other hand you have to measure before you thatch, also there is the possibility of losing the stack by fire before you have a record of its contents.

Thatching.—There is not much to be said, and whether to thatch stacks at all unless they are to stand over the monsoon is an open question ; the writer thinks it is best done, but if you do it make “a good job” of it. The stack must be measured before it is thatched, and if there is no particular hurry another week or ten days settling down is as well. Local custom is the best guide for a thatch, get a professional thatcher and pay him fair for fair work, the thatches must not be any less than 6” thick for ordinary and 12” to stand over a monsoon ; in many places side and end thatches will be necessary. The Lahore system of thatching is very economical and efficient.

CHAPTER XV.

Baling and Bales.—There are more ways than one of bundling or pressing grass, bhoosa, etc., from the primitive of digging a rectangular hole in the ground of somewhat less dimensions than the required size of the bale, filling it with grass over lengths of rope and treading it down; from this progressing by various makes of hand-presses good and bad, up to steam and hydraulic presses up to the Lyon Press for grass or bhoosa which is about the latest, and perhaps the best. The writer will always retain a great regard for the old “Dederick Perpetual Press” a good old patient long suffering machine; with less woodwork about it it would want a lot of beating; the Howard Press is generally satisfactory also. The Dederick is a minimum of trouble, convenient to repair, always patchable and workable with any old engine that will run at all. When run under good conditions it will almost consistently turn out a bale $24" \times 17" \times 14"$ weighing 80 lbs. and 250—300 bales a day or more as a new machine with a sympathetic engine, and intelligent working staff. Usually, however, we find the out-turn per day is more like 150—200 bales; variations are easily accounted for by working conditions of both engine and press, experience and ability of the supervisor and engine driver, experience and handiness of the working coolies, quality of grass and if loose or in pulas, cleanliness of boiler and all working parts. The secret of a “good bale” is its density. The bales from a Dederick Press made properly as above are 25 lbs. per cubic foot, which figure leaves nothing to be desired. Now obviously by reducing your density to say 18 lbs. per cubic foot you will be able to get a faster out-turn, *i.e.*, more bales per diem all things being equal—you will also be nursing your machine by saving strain, you will be able to work with a less steam pressure, and fewer revolutions per minute. To turn out 30 bales an

Relation of Out-turn
to number of hours
of “working-day.

hour is "good" work, and the number of hours considered as a working day (which must be variable) are also factors controlling the output. Ordinarily speaking 20-25 bales an hour of 18 lbs. density and $6\frac{1}{2}$ c.ft. per bale (not the Dederick which is smaller) is a decent show and no one can grumble.

Don't try to get more out of your press and engine than they can honestly do, a little less will pay you, or you will have constant breakdowns ; have a full day off,

Engines and Presses are manufactured to perform specified work.

work once a fortnight and thoroughly clean boiler, etc., well oil all working parts, do any little repairs, tighten up bolts, nuts, screws, etc., everyone will benefit by the change. When fixing up engine and press be sure the driving wheels on engine and press are in perfectly true alignment or the driving belt will be always off. Never bale grass, hay, straw, bhoosa (except cotton) which is wet or even damp ;

Don't bale wet or even damp hay.

in seasons when there is dew about when you start the day's work take the grass from underneath and spread out the top lot in the sun, if you bale damp the bales when opened will be at least mouldy in the middle if not quite spoiled. This has perhaps done more baled hay than anything else. Don't bale bad stuff (unless specially ordered or for a special purpose), it doesn't pay you or anyone else in the long run. Some folk think it rather smart, and a clever way of getting rid of inferior old or bad stock—well it isn't.

The average cost of working a baling plant "inclusive" is Rs. 7-8 per diem, local conditions of labour and cost of fuel will make a variation but a minimum of Rs. 7 and a maximum of Rs. 9 per diem should always cover it, a day being reckoned as an approximate 8 hours. The boiler (variable) will consume 8-10 maunds of coal and rather more than double that quantity of wood per diem. A bale should cost in the making "inclusive" one and a half annas, possibly a trifle less, not often, probably a little more, it should never exceed two and a quarter annas.

Cost per bale must be variable.

Some useful information on this subject will be found in Notes on Pressing and Presses by Lieutenant A. E. Crawford.

CHAPTER XVI.

Farm Animals—Feed and Keep.—The extent of the farm, nature of the work, amount of carting, not forgetting distances, must be the determinators of the number and kind of farm-animals required. For economy's sake as few as possible but for humanity's sake sufficient to avoid a suspicion of overwork, get good animals of their kind, no crocks no weeds, they may be cheap ; but no manner of use and they eat as much as better animals. Treat your animals well and they

Treat animals well. will treat you well ; if you have a wrong 'un get rid of it, don't leave them entirely to the tender mercies of syce, bullock-driver or other native staff. Broadly speaking, the native's respect and regard for an animal is equal to the momentary value of that animal to him personally, no more ; he treats it accordingly—so let, at least, occasional personal attention to the care and comfort of your animals be part of your work. For mowing machines and reapers you must have the big Hissar type of bullock, and when working two pairs must go with each machine and be changed every half hour or so and they should have a slight increase in their ration of concentrated food at this time as the work is very exacting (suggest a seer of kali). For hay rakes, when available mules are far away the best animal, if not available get ekka ponies, and on a decent ration they will do you well besides getting you your money back or more after the harvest, if you want to sell ; fit their harness well and comfortably, avoid sore backs, chafed loins, etc., water and food regularly and they'll work for ever. For ploughs and cart work I prefer the stiff short well-set-up little bullock, not leggy, not too small, and lots of bone, and the best of feet.

For all animals at all work well fitting harness and saddlery and line gear are "essential"; eye fringes for the hot weather and cold too for choice: jhools for the cold weather; shoeing all round for every animal once a month; cost of shoes for a horse Rs. 2 a set or Re. 1-8 for cold shoeing, for a mule Re. 1-8, for bullocks As. 5 to As. 6 a set. Feeding is a matter of opinion, but any little variation from time to time is valuable to all animals, market rates must of course be a consideration; the usual ration for a horse is 20 lbs. dry fodder or its equivalent and 10 lbs. concentrated food of which at least 2 lbs. should always be bran, salt 1 oz.; for mules and ponies 6 or 7 lbs. is ample and again 2 lbs. should be bran, with 15 lbs. of dry fodder or its equivalent; for bullocks 20 lbs. bhoosa or 25 lbs. other dry fodder or its equivalent green and 6 lbs. concentrated food variable according to time of year, salt $\frac{1}{8}$ oz.; in case of extra hard work it will be necessary to give bullocks 8 lbs. of concentrated food and the extra two pounds should be a change from the regular ration if possible.

**Harness and Gear
must fit.**

Regular shoeing.

Food.

CHAPTER XVII.

Some Ailments of Animals.—In cases of severe illness or serious wounds, if at all handy and available, call in a salutri or native veterinary surgeon. Cases of infectious natures must at once be reported to the local authorities (G. O. C.—S. V. O.—S. M. O.). At other times you will be able to deal with minor troubles and 'sickness yourself, assisted by your bullock jemadar if he is any use, or a villager of repute as a cow-doctor. Always bear in mind that prevention is better than cure, good supervision, regular methods, fair treatment will reduce your sick list to a minimum.

Tumours and Abscesses.—Lance and remove pus, dress with carbolic oil or wax ointment. (Wax-vaseline-sulphate of copper.)

Ringworm.—Infectious, dress three times daily with a mixture of turpentine and sulphate of copper.

Lice.—Wash frequently with dilute phenyl (25—1).

Fractured Horn.—Bandage securely but loosely and apply *nim* oil freely and frequently.

Sprained Fetlock.—Bandage fairly tightly, put on *kulthi* poultice, after which apply cold water constantly for some days.

Sprained Hip.—Shoot in 99 cases out of 100.

Eye Troubles.—Foment, dress with solution of sub-acetate of lead, protect from light. If discernible of course abstract any foreign matter such as a thorn, etc.

Colic.—Strong purgative, douche if necessary, and keep the animal moving about until relieved.

Diarrhœa.—Chalk 1oz., catechu 1oz., opium 4 drms., and gum 1oz.; give twice daily. A stimulant will be necessary sometimes.

Dysentery.—As for diarrhœa, but “give no water” for drink, give skim milk and parched barley meal.

Indigestion.—Purgative, change of diet, extra salt, and look for enlarged conical papillæ; a little stimulant occasionally if falling away.

Poisoning.—Emetic, strong purgative (1½—2 seers ghi is generally the best).

Enlarged Conical Papillæ.—Rub well with salt by hand twice or three times a week, it is sometimes necessary to cut. Hand-rubbing the mouths of horses and horned cattle especially with powdered salt occasionally apart from any actual necessity is an excellent tonic, and they like it.

Foot and Mouth Disease.—(Mocha) very infectious, segregate and isolate, verify and notify the authorities. For treatment see various veterinary works, puddle feet in lime, earth, and tar, soft food, disinfect continually and very thoroughly when rid of the disease, stimulants, wash

eyes and mouth and nostrils with dilute alum water : burn or bury in quicklime any casualties.

Rinderpest.—(Bosonto) more virulent and deadly than foot and mouth : notify at once : see veterinary handbook, or call in veterinary officer. When in your district it is well to have all your horned cattle inoculated at once, you may lose one or two by this ; but—.

Swollen Hump and Sores.—When due to heavy draught work “ don’t ” stop the animal’s work entirely or the swelling may remain a permanent disfigurement, put on “ light duty ” and massage thoroughly every evening with *kharwa-ki-tel*. For sores on hump and neck stop work entirely, look to fitting of yokes if necessary, put on sheepskin or numdah pads. If justifiable fine the bullock driver and the jemadar if he has neglected to report, and choke off your Indian Overseer. Dress the sores with carbolic oil, look out for worms, if any soak some tow in diluted phenyl and put in the cavity, protect from sun and flies but don’t exclude air, diet ; when the sores are dry rub over with sulphate copper, start work easily. Once more remember “ prevention is better than cure ” and if you are caught act quickly and thoroughly.

There is a small Handbook on Treatment of Cattle-Diseases, issued to most farms in India by the Quarter-master-General in India Department, which will be found very useful. I think it is a Government Press Publication.

CHAPTER XVIII.

Machinery, Implements, and their Care.—The quantity and nature of the machinery will vary with the size and work of the farm.

Boilers.—One or more, when not in use, keep covered and clean, bright, and working parts smeared with burnt oil. Never empty a boiler while under pressure or while any fire

remains in the grate. Boilers must be cleaned constantly when in work, remove all incrustations, accumulations of dirt at least twice a month, after scraping swill out and brush with water. To fire properly spread the fuel evenly over the fire bars, you will get more "effective" heat with a lesser consumption of fuel. Keep a regular water supply at a constant level. Ashes and soot from tubes, smoke box, and ash pans should be removed daily to ensure the greatest efficiency. Keep your boiler in regular repair, and a new coat of paint occasionally.

Engines—Of all kinds should be always kept thoroughly clean, tightened up, and constantly and systematically oiled (there is no need for any waste of oil and no benefit derived from over oiling). Keep working parts bright and free from grit. For cylinders and bearings a good "mineral" oil is the best. Every engine or machine turned out is made to run at a "certain pace," never exceed that pace.

Elevators, Grain Crushers, Chaffing Machines, Cake Crushers.—Try and keep up with the times, you may not always find it too easy, coolie labour nowadays is very expensive in most parts so mechanical substitutes are in the end cheaper and certainly quicker. Make a good case showing a *definite* saving and you will have a chance of getting what you want; but having obtained your desired machine see that you prove your case, get your money's worth, and nurse your machine. The best each of its kind will pay in the end, though there is no advantage in getting a machine bigger than you have work for or bigger than your "power" capacity.

Mowing Machines, Reapers, Hay Rakes, and Ploughs.—Get the best of their kind to suit your work, lightness being the great consideration. Horses are rarely available for drawing these machines in India, and they are very heavy for a pair of bullocks which is aggravated by the slow pace of the bullocks. Some makes are more suitable than others and you must have "strength with the lightness";

a lot of little modifications, minor alterations, etc., can be made at home after you get your machines which will help to ease the burden, but you must keep them in perfect repair and well oiled. Bamlett's Reaper-Thirsk, Yorkshire, England, is an excellent machine for Indian work.

For storing "all" your machinery, boilers, and implements, however small, have a *covered godown*. This with fair care and attention will repay you as also a covered engine shed and shafting: while orderly and systematic storage, a place for everything and everything in its place, will make your dead stock return and godown register an unmixed blessing and also facilitate the day's work.

CHAPTER XIX.

As on most Military Grass Farms buildings are already existent, more or less, to enter into any detail herein would be superfluous. If you have the opportunity of doing any building, do it with an eye to the future, possible extension and development. Build for use not ornament, always bearing in mind that the better your Buildings—Offices. establishment, animals, and machinery are housed the better and more smoothly will your show run. The farm offices should be quite conveniently near the manager's house but "*not*" a part of it and the two places as central as possible for easy communication with the farm yard, post office, treasury, and railway station.

CHAPTER XX.

Out-door Establishments.—In addition to the manager, who should be everywhere and see everything at varying hours, except on the smaller farms an Indian overseer is also necessary as an immediate assistant to the manager,

he should spend the least possible amount of time in office. Beyond these a certain number of munshis, time-keepers, weighmen or what you will, who are energetic, smart, used to an outdoor life as honest as you can get, and able to write a little English and certainly English figures ; a Bullock Jemadar (where there are not many bullocks the senior driver will do) strong and useful with a knowledge of cattle and their ordinary ailments he will to a certain extent be responsible for the bullock drivers and their doings, the bullocks and their condition, the farm carts and their condition, the bullock line gear, lines and their repair and cleanliness, preparation of feed ; bullock drivers, men with some knowledge of and a liking for bullocks if obtainable, not old men, if you have quarters for them their homes should not be nearer to the farm lines than a full 10 miles, if there are no quarters (most unsatisfactory) their homes must be nearer of course. For bullock drivers a sliding scale of pay is a good institution ; engine driver and fireman one man can do both jobs on a small farm, but don't economise at the expense of your plant, etc. ; carpenter, blacksmith ; a store-keeper and cattle yard munshi combined on good pay he will be *directly* responsible to the manager (or his temporary deputy) for *all* stores, their safe keeping and preservation, and all issues of grain and fodder to farm animals, the bullock drivers and cattle rosters, and the shoeing roll.

Grass cutters, hay makers, and all other temporary labour will be obtained as required, at rates to be approved by the manager and changeable only by him, though munshis of plots and sections under the orders of the Indian overseer from villages in the nearest vicinity to their plots, the munshis will *not* pay their labour. In conclusion, be patient "East is East and West is West," etc., if your farm establishment is well supervised and paid a fair living wage for work done, one good worker for a full day at six annas is worth more than two at three annas spending most of their time at the well and with their pipe ; a man at six annas does not

usually want to lose his job, if he does another soon takes it ; the man at three annas is perfectly indifferent and will just as soon go as stay, to work ; treated with justice and firmness with a minimum of abuse and a " regular " pay day all will go well and you will know where you are and what is being done. Low wages, indifferent supervision, irregular payments, want of interest, neglect, injustice or abuse and you will never know where you are or what is going on, neither will the farm prosper.

CHAPTER XXI.

ALTHOUGH managers must keep a constant eye on the out-door work, near and far, it is nevertheless most essential that he should be fully acquainted with *all* his office work, and be thoroughly conversant with the system of accounts in vogue : therefore he must spend several hours a day in office. The larger the farm usually the greater the number of hours ; the ability to arrange his hours of work so that " everything " is attended to and nothing neglected is the criterion of good management. The great thing in the office is to keep up to date ; to get into arrears is fatal, and lost ground most difficult to recover. In India with its surfeit of gazetted and other holidays, exclusive of the Sundays and absences on private leave of clerks on

General Remarks.

Clerks and Holidays.

various pleas, it is no easy matter in a busy office to hold your own ; but by having an antedated list of Reports and Returns in his own office a manager can usually get these off up to time. The regular recurring weekly and monthly returns and accounts should not be left over entirely until the month is over ; in several cases it is possible to *start* them early in the month to which they refer and work them up gradually—this will save a rush and scramble at the end, and innumerable errors in consequence. Babus must understand clearly that when Government allowed all these

holidays, it was certainly never intended to be at the expense of the work ; if the holidays are to be granted the work must be up to date, and it is for the head clerk and office staff to arrange things amongst themselves to this end, by punctuality, steady work in office hours, an occasional hour overtime

Correspondence, files, etc., not to be taken away. if necessary, and so on. But on "no account" must records, files or any books be taken home from office under this

plea or any other. If your clerks are irregular, unpunctual, unsteady, or slovenly, give the offender warning at once, and only twice ; at the third offence the delinquents must go. Be strong about this, there are lots more clerks, your work won't stop because one man has to go, however indispensable he may appear — chase him. The head clerk must look after the others, under the manager's direction ; it is not enough for the head clerk to be a "good" man himself,

Head Clerk to run Office — or go. do his own particular share of the work well and let the rest look after itself.

He must "run" his office, and run it well, and be responsible to the manager for whatever is put in front of him. Second and third clerks should not put up papers, etc., for signature without the initial of the head clerk, and as a rule, and as far as may be, all things for signature should be brought up once daily only. This saves time, constant running about and getting up and down, and tends to system of working. If your head clerk cannot run his office well and smoothly, and won't learn to do so pretty quickly, change him : there are millions of babus in India. Have your office

A well conducted office no trouble. clean, tidy, with a methodical system, punctual and regular hours for clerks, a minimum of noise and talking, and keep out visitors and others except on business with yourself ; be just, clear and concise, but don't let the head clerk or his subordinates forget that you are manager and boss and know every detail of the work, and so are quite independent of their services if need be ; a well conducted office will save you lots of worry.

CHAPTER XXII.

IN conclusion the student is referred to the “ Rules with specimen books and forms relative to the new system of accounts for grass farms ” published in book form (Army Dept.) No. 9723—6 (Q. M. G.-9) dated 4th July 1913. On joining a class for training this publication will no doubt be obtainable on loan from the Director of Grass Farms, by its careful and intelligent perusal with some little practice during the course of training a very fair idea and foundation for the future use of the system will be obtained. Some official modifications and amendments will probably be issued from time to time.

System of Accounts.

Other useful works of reference and for more “ detailed ” study of Scientific Grass Farming and its attendant subjects are :—

Reference works.

Duthie’s Fodder Grasses of Northern India.

Coldstream’s Grasses of the Southern Punjab.

Morland’s Agriculture of the United Provinces.

Dictionary of Economic Products.

Church’s Food Grains of India.

McConnel’s Agricultural Note Book,

Etc., Etc.

There is a large field for knowledge in agriculture, and there is always something to be learnt :
In conclusion. “ give every man thine ear,” and when you don’t know don’t be ashamed to ask.

THE END.

CALCUTTA .
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