This method is certainly the more acceptable of the two mentioned in the bulletin under notice. While the surroundings of the cattle will be preserved in a sanitary condition, excellent and well-rotted manure (for both systems aim at bringing the manure into this state) will be obtained. We are afraid that the first system, if sanctioned, will merely mean a licence to the average native cattle owner to attain to the supreme degree of felicity which will be his if he be permitted to be at rest while filth accumulates around him and his animals.

RAINFALL AT THE SCHOOL OF AGRICULTURE DURING JULY.

1	..	Nil	13	..	Nil	25	.. Nil
2	..	Nil	14	..	Nil	26	.. Nil
3	..	Nil	15	..	·03	27	.. ·27
4	..	Nil	16	..	·16	28	.. ·01
5	..	Nil	17	..	·73	29	.. Nil
6	..	Nil	18	..	·27	30	.. Nil
7	..	Nil	19	..	·11	31	.. Nil
8	..	·04	20	..	·31		
9	..	·15	21	..	·03	Total	.. 2·39
10	..	·24	22	..	·01		
11	..	·01	23	..	·01	Mean	.. ·077
12	..	Nil	24	..	·01		

Greatest amount of rainfall in any 24 hours on the 17th ·73 inches.

Recorded by P. Van De Bona.

THE FIXATION OF NITROGEN.

Dr. Andrew Wilson contributes to the "Science Jottings" column in the *Illustrated London News* an interesting article on the fixation of nitrogen by the vegetable world. Where and how in the plant is this free breakfast table utilized? Where and how is the free nitrogen actually fixed and made useful for the purposes of the plant's life? Professor Marshall Ward tells us that the view that it was the leaves of the plants which absorbed it, and that the living protoplasm of the leaf cells was the agent which effected the operation, will not bear criticism. Then comes a second possibility. The bacteria, it was held, lived naturally on the soil, as many microbes do. They acted the part of underground cooks and caterers, and produced in the soil itself the nitrogenous food elements, who were duly absorbed by the plant's own roots. Even the bacteria in the root swellings, it was contended, might perform this work, which really enriched the soil, of course, and through it gave to the plant its nitrogen. This view of things remains for further elucidation. It may, therefore, be left for the present.

The third possibility maintains that the fixation and utilization of the air-nitrogen could be conceived to result from the action of the plant *per se*, regarded as stimulated to an excessive degree of energy by the bacterial swellings on its roots. Here the matter is viewed as if the bacteria on the roots acted the part of instigators of an action which, but for their encouragement and assistance, the leguminous plant would not be able to undertake. It is clear that the difficulties of the problem increase when this view is considered. Without the bacteria the plants can not avail themselves of the free nitrogen. What, then, is the exact relation of the microbes to the plant's work? Professor Marshall Ward, who inclines to this view of things, reminds us that there is an intimate connection between the root swellings and the roots themselves. These swellings are the seats of great activity. They are really chemical laboratories wherein business is always very brisk; so that it may well be that the living machinery of the plant is really stimulated in a direct degree by the efforts of the microbes on the roots, and that the plant is supplied from the root swellings with materials on which its own living cells can abundantly operate. My remarks that the plant gets its food materials cooked for it in this way, by the microbes, serves to explain the gist of this third view. It may be able to assimilate cooked food when it could not fix that which is raw.

Then comes the fourth and last suggestion. It is that the root swellings are merely so many accumulators of the nitrogen food, and that the plant simply absorbs what its microbe lodgers and boarders have prepared. This opinion regards the microbes as mere parasites, and unless the bacteria are capable of absorbing the free nitrogen from the air itself, as Prof. Marshall Ward observes, it is difficult to account for the gains by the plant on this theory. This, then, is the end of this story of plant feeding. That its real outcome—whenever shall be settled—is of immense importance to agriculture cannot be doubted. Once again we see how the so-called "unpractical" work of science in its laboratory and with its microscope, has bearings of the most intimate kind on commercial prosperity and human interests.—*Sugar Journal.*

TOMATO DISEASES.

Growers of tomatoes, especially in the low-country, must often have experienced much difficulty in raising the plants owing to disease affecting them; and to most growers the attack known as "drooping disease" must be the most familiar. It is particularly disheartening to see healthy plants all of a sudden begin to show signs of withering—often only in certain regions at first—and finally dying out altogether. This and other diseases of the tomato-plant have been the subject of enquiry in the pages of the *Journal of Horticulture*, and the information elicited through the agency of that excellent periodical is of a most useful character, and will we are sure be welcomed by our readers. As regards "drooping disease," which is so familiar, we first give the opinions of two correspondents who write as follows on the subject:—

"Your readers may, some of them, be glad to know that a prompt earthing-up round the stem of a drooping plant will usually save it. I use light soil and a few loose bricks or boards. Plants treated thus promptly will often equal in crop the best in a house. For black spot in the fruit I find the best thing is to sprinkle sulphur on very hot lime whilst slaking in a bucket, then walk up and down the house, shaking the bucket violently, and the sulphur and fresh lime will fly all over the house. This makes the fruit a little dusty, but that is better than losing it. Cladosporium also does not seem to make headway where the lime and sulphur bucket is used. I attribute a comparative freedom from both clubbing and drooping in my Tomatoes to the use of chemical

instead of animal manures, also to the use of burnt ashes and mortar rubble, with gritty stuff of all sorts in the soil, to a large extent. My soil is greensand, but goes very closely together when rammed, which I find is necessary for Tomatoes. The ashes keep the soil sweet.—F. WILLIAMS.

"I take it Mr. F. Williams (page 9) is alluding to the *Phytophthora infestans* when he speaks of the drooping disease in Tomatoes; at least I do not know any other disease which makes the plants droop. I have not experienced the good result mentioned by your correspondent by top-dressing or earthing up the plants, though I have tried it this season. It seems to me almost impossible to outgrow it, for the moment we see a plant drooping brown patches of the fungi can be seen on the stem, showing quite clearly the tissue is destroyed and incapable of taking up or rather passing along further supplies of food. In all probability the earthing up as described by your correspondent would answer, provided the diseased parts were near the roots or low on the stem.

"At the present time I have only had ten attacked in a house containing about 400 plants, so I cannot complain of its ravages. I have grown many plants in pots, so that I can always fill a blank space, and my method of procedure is briefly this: when a plant is noticed drooping it is pulled up at once and promptly put in the fire, then one of the large plants in pots is used to fill up the vacancy. By this method no space is lost, and as the plants are large they do not make any noticeable difference in the house. I trust entirely to chemical manures for feeding purposes, because I find animal manure added to the loam causes the plants to grow grossly, whereas by planting out in firm loam a sturdy growth follows, and a good set results from such treatment. Immediately the first truss of bloom sets the feeding commences.

"I am under the impression that this particular fungoid pest can be almost avoided by careful and constant attention in ventilating and watering. While a light buoyant atmosphere is maintained very little trouble will be given; but allow the air to become charged with moisture and the ventilators closed for a few hours in the early morning, and the disease will readily appear. I have no doubt spraying with a Bordeaux mixture will prove very helpful where the plants are grown in single rows, so that the work may be done thoroughly, but I question its utility where the plants are grown thickly, as in market culture.—JAS. B. RIDING."

Lastly, we have the opinion of the management of the *Journal of Horticulture*, given under the heading of answers to correspondents:—

"In a thorough examination of your plant we found no pronounced disease. The roots were quite clean and healthy, free from nodules, excrescences, and root-knots. On the root-stem and at the part where the radicle or tap root had assumed the fibrous formation we found "canker," which had destroyed the bark, quite encircling the part affected and causing the destruction of the cambial layers, also the underlying woody tissue. In this there were some mycelial threads, possibly those of the Potato disease fungus (*Phytopthora infestans*), but that is not by any means certain, as there were no outgrowths, "fruits" or reproductive bodies, and could not produce the canker. This yielded, in an alcoholic solution, a vast number of minute bodies or spores, which belong to the Myxomycetes or family of slime fungi. There was, however, no "slime," nor any abnormal swelling of the tissue or cells, or any ferment, such as usually accompanies attacks of Schizomycetas (bacteria). This condition may have been due to the disease being only in the initiatory stage, and could only be determined by examination of a plant which had succumbed or was succumbing to it in acute form. The stem of the plant above ground showed no signs of disease, and the fruits were quite clean and normal. The leaves were in some parts affected with "browning"—that is, they were dark brown or blackened, "drooping," and the tissue destroyed. This part had a clammy "feel," such as indicates the presence of Plasmodiophora, or slime fungus, but we were unable to detect anything beyond the disruption of the tissues or cells, which were not abnormally large, and the adjacent cells merely showed traces of discolouration. The examination leads to the deduction that the "drooping" is occasioned by "browning," and is caused by a fungus similar to that producing "browning" in Vines (see pages 519). If not the same it is an allied species of Plasmodiophora, which for the sake of distinction may be called *P. lycopersici*, though it also attacks Potatoes and causes the leaflets to wither and the tubers to be comparatively small, but perfectly free from disease. The fungus is unquestionably introduced with the soil or manure, as it has a great liking for decaying organic matter, and, though mainly a saprophyte, has been found in living tissues, the contents of which it speedily appropriates. Your soil seems of a vegetable or rather warpy nature; it certainly is alluvial, and needs lime. This is the best antidote to Plasmodiophora, therefore we advise your giving the plants a dressing of quicklime, fresh slaked, but cool, not using less nor much more than a peck per rod, and washing it in at once moderately. In future seasons we advise mixing one-tenth part of quicklime with the soil about a month or six weeks before using it for the plants. Cut away all the "drooping" leaves and parts of the plants and burn them. This should be done early, and be followed up as required. Under that routine the plants will generally grow out of the disease, or it will not prejudice the perfecting of the crop, though it will reduce the number and size of the fruit."

As regards the disease which seems to confine itself to the fruits, we have the following opinion given under the authority of the journal:—

"The fruits sent are infested with the destructive parasite Cladosporium lycopersici. This fungus causes the decay of the fruit. It begins with a minute black spot, which surrounds the small decaying style. The black spot gradually increases in size by new circles of growth, one beyond another in the style of fairy rings. The fungus growth at the same time flattens the apex of the fruit, till at last the whole substance is blackened and entirely destroyed by the Cladosporium. The fungus spreads from the leaves, also from one fruit to another, till at last leaves, stems, and fruits are all alike decayed. The brown spores of this Cladosporium are often produced in such enormous numbers upon both sides of the foliage that they fly

from the leaves in millions. Most of the Tomato fungi are in their earlier stages quite superficial, so that if remedies are applied in good time recovery seems to be possible. All such fruits as you have sent should be gathered and buried.

"If the plants become badly infested remove the worst leaves as well as the fruits attacked and burn them, then spray the plants thoroughly with Bordeaux mixture, using a weak one, say 2 oz. of sulphate of copper dissolved in half a gallon of water in a vessel by itself, slacking 2 oz. of quicklime in another vessel, and forming into a thin whitewash; pour this into the vessel containing the sulphate of copper solution slowly through a hair sieve, then add enough water to make 3½ gallons; stir well, and apply to every part of the Tomato plants, coating them evenly with the thinnest possible film of the Bordeaux mixture, also every part of the house. It will not injure the green fruit for use, and that near ripening may be cut, as it is not desirable to use it over fruit approaching ripeness. The lime must be quite fresh and the sulphate pure. It may be necessary to repeat the spraying in about a week or ten days. Ventilate freely, and top-dress with dissolved bones three parts nitrate of potash two parts; mix, and use 4 oz. per square yard over a little fresh loam."

On the subject of "clubbing" caused by the attack of eel-worm, the *Journal of Horticulture* recommends the use of phenyle. The following directions as regards the use of phenyle for "club" in cucumbers will be a guide to those who wish to try the remedy in connection with tomatoes:—

"Soluble phenyle ($C_6 H_5$) is a cure, provided the plants are not too far gone, for when "clubbing" has set in so as to affect the foliage nothing will cure, though by earthing up the plants and getting new roots from the stem they may be continued in bearing some time. Phenyle is a preparation of coal tar, and to be of use must be soluble (Little's Soluble Phenyle can be had of all druggists). It should be used with soft or rain water, quarter pint to four gallons of water, mixed well, and a gallon applied to each square yard of bed. You mention the length of the border (100 feet), but do not state its width, yet ask how much of the liquid to use? The mixture may be applied at intervals of about fifteen days, and it will not injure (like carbolic acid) but invigorate the plants, as it is a nitrogenous manure. You can, however, use carbolic acid, one part to twenty of rain water, and employ a gallon of the solution per square yard, but it will act prejudically upon the plants for a time. If you would like to still further experiment, procure some gas liquor from gasworks, and use half pint to a gallon of water, applying that to a square yard of bed. The cysts of the eel-worm may resist this, but when they emerge as eel-worms they will soon seek "pastures new" or wriggle themselves out of existence. The quantity named is for very strong gas liquor, but it is as well to be safe, otherwise it may be used at a strength of one part to eight of water—viz., one pint to a gallon. It is a sure preventive if applied in time."

Corbonate of copper has also been most successfully used in the case of tomatoe disease caused by fungus. The Journal draws to the experience of one of its correspondent who entirely succeeded in banishing the fungus and gathering a very profitable crop of tomatoes through the use of carbonate of copper solution. He says:—

"Having read in the *Journal of Horticulture* of the value of carbonate of copper solution, I determined to give it a trial, and therefore applied to the wholesale drug stores, but was told by them that they kept the copper sulphate but not the copper carbonate. I also saw in the Journal a method by which the sulphate may be converted into carbonate. I proceeded to put it into practice as follows:—I purchased 4 lbs. of sulphate of copper and 4 lbs. of ordinary washing soda. I placed the sulphate in a wooden vessel and added thereto 9 gallons of hot water, stirring this vigorously until the sulphate was all dissolved. I then placed the soda in another vessel and dissolved it with a similar quantity of hot water. After allowing the two solutions to stand a sufficient time for the water to become cold I poured the soda solution into the vessel containing the copper, stirring well to thoroughly mix the two solutions, the effect of this being to cause the sulphur to part from the copper, the former floating as a thick yellow scum on the surface of the water, whilst the latter settled to the bottom, having the appearance of a thickish brown mud. The vessel was then covered with boards and left to stand quietly for twenty-four hours to give time for completing the partition and settling, after which the water with the floating yellow scum was most carefully poured off, leaving the sediment undisturbed. This was then collected in a pail and placed near the fire until the water was all evaporated, leaving it a dry, hard cake of a brownish orange colour, this being the carbonate of copper required, and which was stored away for use as required. This carbonate of copper is insoluble in water, but soluble in liquid ammonia. In using it I dissolved 2 oz. of the carbonate in one pint of liquid ammonia, and mixed this in 20 gallons of water, keeping it well stirred to prevent any settling and applying it as a fine spray with the syringe, using a jet thereon instead of a rose end, and breaking the jet into fine spray with the forefinger of the left hand. During the time necessarily taken up in obtaining and preparing these materials the disease had spread itself so rapidly that there was not a leaf upon the plants unattacked, the disease ceased to spread after the first spraying, and I continued throughout the remainder of the season to spray at intervals of ten or twelve days, thus protecting the young foliage as formed. I was soon able to clear away every leaf showing disease, and late in the autumn I had the house again well furnished with healthy clean foliage, and also, which was of more value, a good second crop of fruit, which continued ripening satisfactorily until considerably after Christmas. I have thus given as clearly as I can the methods I followed with the results, and the deductions I have myself drawn from them are that by commencing the sprayings with this ammoniacal solution of carbonate of copper early in July, before the disease has shown itself upon the foliage, I can practically bid defiance thereto, as I have proved most surely that its spores cannot germinate on foliage thus protected. The Bordeaux mixture, consisting of a solution of sulphate of copper and lime, is too

astringent, and is found injurious to the young tender foliage, but the carbonate of copper solution seems to have no injurious effects whatever."

FODDER CROPS AND CATTLE KEEPING IN CEYLON. II.

The sources of the present scanty supply of fodder have already been mentioned. It is evident that if anything is to be done towards profitable cattle rearing in the Island, the supply of foodder should be looked to as of the greatest importance. In the vicinity of towns, especially in and about Colombo, a large quantity of grass is grown. This supplies the demand in the town. The cultivators of grass fields make a fair profit, which undoubtedly acts as an inducement for the extension of grass cultivation. Still, it is rarely that a person grows fodder for the sole purpose of feeding his own animals. The immediate profits are more aimed at than the results to be expected from a more systematic method of farming. The Ceylon cultivator is not the city man but the villager; and it is only in the villages that we could expect farming to be carried on; but the curious thing is that however large a number of cattle a villager keeps he never sees the necessity of growing fodder for their use. If, then, he is prohibited from allowing his animals, as he at present does, to find a "living" for themselves, he will be forced either to grow some food for his animals or to reduce the number of animals he keeps.

Among the grasses that would thrive well under cultivation, special mention could be made of two species, the Guinea grass and the Mauritius or water grass. *Guinea grass*, Panicum Maxicum thrives well wherever it is grown. It is a native of Africa and grows well in all tropical countries. Under cultivation it often attains to a height of from 6 to 8 feet, but ordinarily the grass grows to an average height of 4 feet. This grass does not do well at all in moist or marshy land; it requires a free soil of good average fertility. The common method of planting Guinea grass is by laying out the shoots. Each plant gives out such a large number of stems that within a year a single stem, becomes a bush of from twenty to forty stalks. The land should be well tilled and the grass stems planted in ridges two to three feet apart; the lesser distance adopted where the soil is not very rich. The richer the soil the better do the plants grow, and hence the ridges may be set a little wider apart. The selected stems are to be taken with the roots on their tops cut off and the roots pared before planting, which is done slightly slanting-wise. It need hardly be noted that the grass does better at a season when there is a fair amount of moisture present in the soil. A new Guinea grass plantation should be opened just before the rains. Manuring and weeding are essential for obtaining a successful plantation. Guinea grass is often grown from seeds. When it is necessary to grow the crop from seed, it is thinly sown in nursery beds, well prepared and levelled down. The nurseries require watering and careful attention till the plants are from nine to twelve inches high, at which time they are fit to be transplanted in a field. Guinea grasss should be cut and used before the stems grow tough, always before flowering. The mowing should be done quite close to the ground, and after each cutting a dressing of manure is almost essential. A Guinea grass field gives a crop every six weeks, (sometimes oftener), except during very dry weather. Eight crops a year could be easily obtained in this country. A report of the Babugath Breeding Farm in the North-Western Provinces of India gives the the cost of planting Guinea grass in an acre of land with *hired labour* as follows:—

	R.	a.	p.
Ploughing	5	0	0
Harrowing, collecting and burning weeds	2	8	0
Clod crushing	0	14	0
Manuring (carts, coolies, &c.)	10	0	0
Ridging	2	8	0
Planting	1	0	0
Total cost of planting ..	21	14	0

and the cost of keeping up Guinea grass on one acre of land with hired labour per year is given as

	R.	as.	p.
Irrigation	36	0	0
Weeding	16	8	0
Manure, cart, and cooly hire	52	8	0
Ploughing and ridging ..	6	0	0
Total..	111	0	0

Now of these expenses it may be observed that the item under irrigation will not be incurred in Ceylon unless it be during a very unfavourable season, &c., the other expenses, with the exception of manure, are on hired labour. Here hired labour will not be necessary for any village who goes in for grass cultivation, but all the same the amount as set above would undoubtedly serve us to measure in a way the labour required for cultivating the crop. If the grass is grown for one's own stock, manure would be easily available. Coming to receipts, it is estimated that an acre of land would produce fifteen tons per cutting or hundred and twenty tons for the eight cuttings, which would mean that, taking everything into consideration, a ton of grass would cost a little less than a rupee.

Guinea grass is easily converted into hay, and this hay is considered to be an excellent feeding stuff.

W. A. D. S.

21st August, 1894.

(*To be continued.*)

RAINFALL.

The *Rural Californian* in considering the possibility of helping or assisting nature to furnish man with water in the shape of moisture from the clouds, draws attention to the fact that the "great American desert" mentioned by Geography books within the memory of the present has passed away, and enquires into the causes and conditions which have arisen to bring about this change. The change, it is replied, has been brought about by the advent of rail-roads, settlements, cultivation of the soil, planting of trees, and last but not least by irrigation.