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Agricultural Students' Association.

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OURSELVES.

THIS magazine is published in the interests of the members of the Agricultural Students' Association; it is intended to serve as a medium for the accumulation and diffusion of agricultural knowledge.

The magazine will be published monthly during each session of the Agricultural College. It will contain concise reports of the papers read before the Association, and of the discussions held thereon; also contributions by members and others of interest and of use to persons interested directly or indirectly in promoting agricultural inquiry and judicious reforms in the husbandry of the country. It is proposed to set apart a page of the publication for questions and answers.

While the promoters of the magazine will do their best to make it [illegible] special use in the diffusion of [illegible] views and useful information, they wish it to be understood that they look upon the mazagine as a medium for collecting and storing agricultural facts, and venture to hope that, in their endeavour to carry out this object, they will meet with the hearty co-operation of the members of the Association now scattered widely over India, engaged in agricultural pursuits. If these members support the

magazine, in the way it is expected they will do, it cannot fail in being of great use not only to the members of the Association, but to all engaged in agricultural reform in this country.

ENGLISH AGRICULTURAL PROPOSITIONS.

By Sir J. B. Lawes, Bart., LL.D., F.R.S.

1. The soil of Great Britain is not cultivated by those who own it, but by others who pay a money rent.

2. The mode of cropping and the sale of the products of the land are regulated by customs, agreements, or leases.

3. Restrictions are placed upon the crops which may be grown, and those which may be sold, but no restrictions are placed on the sale of the products of animals, or on the sale of the animals themselves.

4. The employment of purchased cattle foods or manures does not form part of the contract between the owner and the occupier of the soil.

5. In special cases where permission is given for the sale of a crop—hay, for instance—which under the contract should be consumed on the land, a stipulation that a certain amount of manure shall be imported for each ton of hay sold, is generally inserted in the contract.

6. The soils of the country generally, when first brought into cultivation, contained larger stores of fertility than they do at the present time.

7. A gradual exhaustion of the soil appears to be the prevailing system under which farming is carried on in this country.

8. The owner of the land may, therefore, be considered to be a dealer in fertility, who for an annual money payment called rent, sells to the tenant the right of removing

a certain amount of this fertility from the soil. The tenant may further make use of another portion for the purpose of building up vegetable products, such as roots, straw, &c., but these must be returned to the soil.

9. The lighter class of soils contain a comparatively small amount of fertility; and in consequence they cannot be cultivated profitably without the import of cattle foods and manures. The necessity of this imported fertility, although admitted, does not form part of the contract.

10. The various rotations which are enforced, and the amount of produce which may be sold, may be supposed to bear some relation to the fertility of the soil and its competency to furnish—from its own resources, and without any sensible decline in the crops—the amount of soil ingredients exported each year.

11. The consumption of imported cattle foods in this country is a removal, in a concentrated form, of the fertility of other soils to our own.

12. Although such imports form valuable additions to fertility, still the agriculture of the country must depend mainly upon the fertility of its own soils.—*Agricultural Gazette.*

PROCEEDINGS OF THE ASSOCIATION.

Saturday March 7, 1885.

The President W. R. Robertson, Esq., *in the Chair.*

The paper read was :—

OUR DRY LAND.

By Mr. C. K. Subba Rao.

It appears from a paper recently read by Mr. Buck, Secretary, Revenue and Agricultural Department of the Government of India, at a Meeting of the Indian section of the Society of Arts, London, that when the Famine report

was written, there were about 300 million acres of cultivated land in British India, of which only about 8 million acres were watered by canals and tanks and 12 million acres by wells. 280 million acres or 93·3 per cent. of the whole area was thus dry land. If the figures really refer to the cultivated, and not merely to the occupied, area, it is manifest that the extent of occupied dry land must be more than 93·3 per cent. of the whole area under occupation, because the greater part of the unirrigated area carries but one crop during the year, whereas a portion of the irrigated area is cropped twice annually. In this Presidency, out of 18¾ million acres of occupied land, excluding South Canara for which figures are not available 14¾ million acres or about 79 per cent. of the occupied area is dry land. In many of the Districts the percentage is much higher. For instance, in Coimbatore, the extent of occupied dry land is about 90 per cent. of the occupied area, Cuddapah 93, Kurnool 95 and Bellary 96. It is only in the Districts of Tanjore, Chingleput, Ganjam, and Malabar that the wet area is larger than the dry area and in Godavery both are nearly equal. While these districts support from 273 to 583 persons per square mile, the drier districts of Bellary, Kurnool, Cuddapah and Coimbatore support only from 90 to 211 persons per square mile. It is thus evident what an important part irrigation plays in the development of the food resources of the country. Government apparently intend to bring more dry land under the influence of irrigation; this is, indeed, highly desirable owing to the uncertainty of rainfall over the greater part of the country. But Government may bring a large area of dry land under irrigation without further investment of capital in irrigation works, if they only take steps to prevent the waste of water which is at present going on. In my 'Vernacular Quotations on Agriculture,' I have adduced the evidence of famous Tamil poets of the

agricultural class to show that water is used in excess in paddy cultivation for the sake of the fertilizing silt. The ryot is helpless, as regards water-supply only, and not as regards manure, this country being so rich in manurial resources. It would be very beneficial to agriculture if the State would make a number of careful experiments in various parts of the Presidency and show whether by the proper use of manure, water cannot be largely saved for the benefit of a large area of dry land. If the State provide fresh irrigation works, these will, of course, be utilized for paddy cultivation, and thus the area of dry land brought under irrigation would not be great. It may not be politic to interfere with the extent of paddy cultivation; but if Government desire to develope the food resources of the dry land to the largest extent and with the least expenditure of money, they must, by all means discourage any further extension of paddy cultivation. The common wheat (Triticum vulgare) of Northern and Central India was grown with tolerable success last year on the 'blowing sands' of the Saidepet Farm. There can be no doubt that common wheat will yield in the better climates of this Presidency at least 14 bushels or 868lbs. per acre on soils of average fertility, and, under fair treatment. The present outturn of paddy under similar conditions, is not more than 1,300lbs. of which only about 860lbs. is rice. Mr. Buck estimates that the area under irrigation at present, may be increased ten-fold over the region of uncertain rainfall. To do this most economically, all attempts at further extension of paddy cultivation must be as far as possible discouraged, and the growth of wheat, maize, or other superior cereal food crops must be encouraged. It is advisable that the land which may hereafter be brought under irrigation should be charged only with water-rate varying in amount according to the nature and water requirements of the crop cultivated,

instead of with the wet-assessment irrespective of the crops cultivated. If the water-rate for paddy be fixed, as it should be, much higher than for wheat, maize or other superior corn crop, there will be a wholesome check on the extension of paddy cultivation. In Spain, for instance, the cultivation of rice is strictly prohibited, at present, beyond certain limits, as Mr. Clements Markham says: This question of restricting the paddy cultivation without prejudice to the development of the food resources of the country is one of vital importance, and I can only suggest it for the serious attention of abler men than myself.

The provision of wells for dry land is even of greater importance than the extension of canal and tank irrigation; for by wells, we can command a supply from the unfailing "underground seas," as Mr. Buck calls the store of subterranean water, at times when the other sources are exhausted. The Madras Land Revenue Report for 1861-62 shows only about 235,534 acres of land irrigated from wells in the whole Presidency, excluding Malabar and South Canara. There has probably been no great increase since then in the well irrigated area except in Coimbatore. In this District there were only 17,134 acres under well-irrigation in 1866. There could not have been then more than about 5,700 wells. Mr. E. B. Thomas, to whom Coimbatore is greatly indebted, so far encouraged the digging of wells by lending money without interest, on the mere security of good land, that in about 5 years, the number of wells multiplied more than ten-fold; for in 1871-72 there were 57,432 wells. This shows how public prosperity can be secured by providing wells for the dry lands.

Though Government may do all that they can, in the way of extending canal, tank, and well-irrigation, the greater part of the occupied land will remain unirrigated. Dry land is at present almost the only food producing area

for the rapidly increasing population. For instance, in 1861-62, the population in this Presidency was 24½ million people and, the extent of occupied dry land was 12¼ million acres. In 1882-83 we find the population to have been 31 million souls and the extent of occupied dry land 16¾ million acres. While there was an increase of 4½ million acres of dry land during the 20 years, the wet area was increased only by about 1 million acres. There is at present no other alternative for the people but to go on extending the dry cultivation as population increases. There are at present about 17¾ million acres of cultivable waste dry land most of which is very poor, and which must necessarily be brought under cultivation within a century or so, if recourse be not had to other means of meeting the demand for food, of the greatly increased population, such as emigration, the improvement of agriculture, and the development of pisciculture, &c. In British India, there are said to be about 100 million acres of cultivable waste dry land.

The last census returns and the cultivation statistics, show that at present about 90 acres of land are cultivated for every 100 persons in this Presidency. Of that area, 20 acres represents the area under paddy, 56 acres under food corn crops, and the rest under miscellaneous crops. 100 persons require about 500 cwts. of grain for consumption; 20 acres of wet land will supply them with about 220 cwts. of grain, and the dry lands scarcely supply the balance, so that in 1882-83, about 3 cwts. of grain was imported in excess of the exports for every 100 persons. It will thus be seen that notwithstanding so large an area under dry cultivation, the people of this Presidency live a "hand to mouth" existence and can have no store of grain to lay by against an adverse season. Irrigation has already been noticed as one of the best means for developi[ng] the food resources of the country. But sin[ce] their greater part of the cultivable area must after highly unirrigated, we must consider the best mea[ns] manner,

the productiveness of the dry land. It was with the express object of ultimately improving the dry system of cultivation that the Saidapet Experimental Farm was established by Government. It is my present purpose to show how far the dry cultivation of the country can be improved by applying the experiences obtained on the Farm. Fortunately, good results having been obtained there, even under the worst conditions of soil and season, there is little room for doubt but that the experiences gained may be applied with great benefit even to such poor soils as are now available for applicants. Before stating what improvements can be effected, I must show how defective the present system of dry cultivation is. How meagre is the net profit per acre in the cultivation of dry land may be seen from the following statement:—

Districts.	Average Assessment per acre.			Net return per acre = twice the assessment.			Gross return per acre = 3½ times the assessment.		
Ganjam ...	1	5	4	2	10	8	4	7	5
Vizagapatam ...	1	1	10	2	3	8	3	11	5
Godavari ...	1	9	3	3	2	6	5	4	2
Kistna ...	1	8	2	3	0	4	5	0	7
Nellore ...	1	2	7	2	5	2	3	13	11
Cuddapah ...	0	13	4	1	10	8	2	12	5
Bellary ...	0	9	11	1	3	6	2	1	1
Kurnool ...	1	0	3	2	0	6	3	6	2
Chingleput ...	1	2	6	2	5	0	3	13	8
N. Arcot ...	1	6	6	2	13	0	4	11	0
S. Arcot ...	1	11	0	3	6	0	5	10	0
Tanjore ...	1	3	10	2	7	8	4	2	1
Trichinopoly ...	0	15	2	1	14	4	3	2	7
Madura ...	1	5	4	2	10	8	4	7	1
Tinnevelly ...	0	12	3	1	8	6	2	8	10
Coimbatore ...	0	14	9	1	13	6	3	1	2
Salem ...	1	2	9	2	5	6	3	15	10
[illegible]abar ...	1	9	9	3	3	6	5	5	10
way or average ...	1	3	0	2	6	0	3	15	6

greater part

Dry land is at p[illegible]

It appears from the Settlement Reports as well as the District Manuals that Rs. 10 is the largest amount of profit which a ryot may expect even under the best circumstances from dry land. It is very surprising that the net return from even the rich black and red soils has been found by numerous experiments to be not more than about Rs. 2. For in Fasli 1290 or the year 1879-80, 144,877 acres were under cotton cultivation in Bellary, and the corresponding assessment was Rs. 140,818 or scarcely 1 Rupee per acre. In the same year 204,777 acres were cultivated with cotton in Coimbatore, and the assessment corresponding to this area was Rs. 207,986. Similarly the assessment on cotton soils was very low in other districts. To show how low is the out-turn from even good dry lands, I may further state that the settlement officer in Kurnool, which District is as noted for its cholum as is Bellary, found as an average result of 7 experiments that the out-turn of cholum from 1st class red loamy soil was 213 measures per acre or about 532lbs. and from red sandy soils 143 measures or about 357lbs. And yet these results, the settlement officer states, relate to the *best* villages in the 1st group. In fact, the highest yield of cholum recorded for Kurnool is 480 measures or about 1,200lbs. per acre. Such an out-turn of superior unirrigated cereals has repeatedly been obtained in ordinary seasons from the far inferior soils of the Saidapet Farm under moderately good cultivation. The average yield of raggy in the Saidapet Taluq in which the Farm is situated, is 266 measures or about 670lbs. per acre which does not compare favourably with the out-turns obtained from the poorer soils of the Farm during the bad seasons of the last two years. While the average net return per acre of dry land in the Presidency is about 2¼ Rupees, the net return from their cultivation of cotton and maize on the Saidapet Farm has usually been about Rs. 30 per acre this highly this manner,

times the net return now obtained by the ryot. What does a net return of Rs. 30 per acre from cotton cultivation on "the blowing sands" of the Saidapet Farm mear? Surely an annual increase to the wealth of this Presidency alone, of at least 40 million Rupees obtainable from the 1,456,423 acres of excellent black and red soils which are now under cotton cultivation. It is very fortunate that the fertile, retentive and hygroscopic black soils as well as red soils should form no inconsiderable portion of the driest regions of the Presidency. There cannot be the least doubt that these soils can be made to yield under skilful cultivation, more than 200lbs. of clean lint per acre, and about 1,000lbs. of maize or other good grain from each acre under cotton cultivation. For the cultivation of cholum on black soils, one good downpour of rain to get the seed in, and a couple of good showers to bring it to maturity, it has been said by Mr. Banbury, of the Revenue Settlement, are quite sufficient. In certain parts of Coimbatore, ryots warp their black soils with red silt obtained by damming the neighbouring jungle stream. A mixture of black and red soils is thus produced, which is called 'Mathavay munn' in Tamil, and is considered better than either the black or the red soil. It is a great pity that the productive capabilities of these excellent dry lands should remain to a great extent dormant. The excellence of the black soils is due to a great extent to the abundance of organic matter in a fine state of division which they contain, and indicates the importance of organic matter for this country. Unfortunately, the prevailing light-coloured dry lands of the Presidency are seriously deficient in organic matter. Mr. Buck way that an American Farmer when introduced to Indian greater [illegible] remarked: "How can these people expect to Dry land is a[illegible]r land, when they not only do not put a

scrap of vegetable matter on it, but actually scrape, pare off, and remove every morsel of vegetable matter that they find on it." The Saidapet Farm has practically taught a very easy and inexpensive method of enriching the light-coloured, or sandy soils with organic matter derived from the carbonic acid of the air through the agency of plants. I mean, of course, green manuring. Of the 16¾ million acres of dry land in this Presidency, only 478,371 acres or scarcely ½ million acres carried a second crop during 1882-83, when the season was very favourable, as the Administration Report for that year will show. What was done with 16¼ million acres of dry land during the year? It must, of course, have been lying waste. These 16¼ million acres could have been made to produce 2 crops of horse gram for green manure or fodder, one before, and the other after the cold weather crop. Even the 478,371 acres could have been made to produce one crop of horse gram previous to the hot weather crop. The weather was very favourable in 1882-83 for growing horse gram during any 3 months between January and May, and again between May and September. In ordinary seasons, the harvesting of the cold weather food corn crops may be arranged to take place early in January. It will then be possible to grow horse gram even in the absence of any rain, provided the land is ploughed on the very day that the crops are reaped. For instance, Field No. 10 of the Farm was treated in this manner in 1882-83, and produced 3 tons of horse gram plants per acre without any rainfall whatever. 3 or 4 ploughings even with the country plough and about 6 measures of seed are all that is required to produce a crop of horse gram for manure. It is the duty of all men who have the welfare of the country at heart, to use their influence towards the general adoption of this highly beneficial practice of green manuring. In this manner,

many million tons of organic matter may be added annually to the soils of this country. As any number of crops can be grown on dry land without extra assessment, I do not see what difficulty the ryot will have in adopting it. Some of the dry lands are so deficient in organic matter as to be unfit for cultivation. Such lands, however, if not far from large towns where there is a good demand for fuel, and from Railways, may with advantage be planted with casuarina. Waste lands are obtainable for this purpose, free of any assessment for the first 20 years, no assessment being charged even if crops be grown between the lines of trees properly planted. The improvement of the soils being the primary object, the sheddings must neither be sold nor allowed to be taken away as at present.

(To be continued.)

HISTORY OF THE CATTLE DISEASE PREVENTION DEPARTMENT.

BY J. MILLS, M.R.C.V.S., ARMY VETERINARY DEPARTMENT, INSPECTOR OF CATTLE DISEASES, MADRAS.

In the year 1865, Government thought it desirable to appoint a veterinary surgeon to investigate an extensive outbreak of cattle disease which occurred in the Nilgiri district, and to inquire into the nature of it on the spot, and also to ascertain a suitable mode of dealing with it. The officer appointed, the late Mr. Thacker, looked upon the malady as Pleuro-pneumonia of the most virulent type; so much so, that, on the average, not more than two per cent. of those attacked recovered; and by which visitation it was said that the large cattle-owners among the Todas and Badaghars were reduced from comparative wealth to absolute poverty. But, subsequently, Mr. Thacker came to the conclusion that his former diagnosis was wrong, and he looked upon this outbreak to be

true Rinderpest, in which opinion, after a service of three years as Inspector of Cattle Diseases, I am inclined to concur, as this malady is of somewhat frequent occurrence there. From this date, and from the good service he rendered to the Civil Government, it was considered absolutely necessary that a veterinary surgeon should be transferred from the Military Department for the purpose of investigating future outbreaks of disease. This arduous duty Mr. Thacker undertook single-handed, and without the slightest assistance whatever, which was, we need hardly add, work for many.

From the records before us, it would seem that Mr. Thacker continued steadily at this duty until the end of 1871, and during that interval he seems to have done an enormous amount of good in every part of the Presidency; so much so, that on his relinquishing the appointment, he, we have heard it stated, was of opinion that the future services of an officer as Inspector of Cattle Diseases were unnecessary, as he said "that the natives of the Presidency had such a firm belief in his mode of prevention, and the drugs he used, that Government could do without one."

Two years later (1873), however, a severe outbreak of Murrain, in the Chingleput district, compelled Government to seek again the aid of a professional man, and Veterinary-Surgeon Pritchard, of His Excellency the Governor's Body-guard, was selected for this purpose. He seems to have worked on somewhat the same lines as his predecessor, but did not evidently place much faith in Thacker's medicines; for he reports, on a subsequent outbreak, that out of 1,460, the total number of cattle in four villages of the Cuddapah district, 260 were attacked, 122 died, and 80 recovered; the remaining 108 were reported to be still sick. In the village in which it first broke out 101

cattle died. This outbreak was said to be Epizootic Aphtha, but from the high mortality, we surmise that it must have been Rinderpest. In 1875 Mr. Western was appointed Inspector of Cattle Diseases, but in 1876 was ordered to revert to the Body-guard from the Revenue Department, under which he had been employed.

From this time up to 1882, nothing was done, with the exception of an occasional employment, when required, of a veterinary surgeon, until the appointment was made a permanent one in the month of August of that year, and from that time I commenced to form the Cattle Disease prevention Department as sanctioned in G. O. No. 1917, 12th December, 1881. When complete it will consist of the following officers :—

Inspector of Cattle Diseases	1
Deputy-Inspector of „	1
Local Cattle Disease Inspectors	22
Total	24

The Department at the present time contains one Inspector, one Deputy-Inspector, and 14 local, and 4 probationary local inspectors. The Deputy-Inspector is an ex-farrier-major of a Madras cavalry regiment, and was appointed on account of his knowledge of the natives and their language. He also acts as assistant to the inspector. His duties are to *continually itinerate*, to superintend the work of the local inspectors, and, when not on tour, to render practical instruction at the hospital.

The local inspectors are specially-selected graduates of the Agricultural College. These men undergo a training there of three years, after which they are appointed as probationers in the Department, and in this capacity have to serve a further term of twelve months, during which time they are under my immediate tuition, or under the surveillance of the Deputy-Inspector. Every month they

have to pass a severe examination, both practical and theoretical, on the subjects which have been taught them.

(*a*) For this examination the total number of marks will be 100, viz., theoretical 50, and practical 50.

(*b*) At the termination of the twelve months' course, a final examination will be held, and those students who fail to qualify will be put back without promotion on the following scale. Those who pass will be promoted as follows :—

60 per cent. and over	Promotion to the grade of Local Cattle Disease Inspector.
50 per cent. & under 60 per cent.	Put back for instruction for one month.
40 per cent. & under 50 per cent.	Put back for instruction for two months.
Under 40 per cent	Put back for instructiou for three months.

(*c*) Unsuccessful students will be told in what subjects they have failed, with the view to their giving special attention to them during the interim they are so put back.

(*d*) Students who have so failed will be examined monthly, and if they do not reach the standard of 60 per cent. within three months, which will be the maximum time allowed to qualify in, their case will be referred to the Director of Agriculture for his consideration as to whether it is desirable to retain such candidates longer.

(To be continued.)

THE EIGHTH ANNIVERSARY OF THE COLLEGE.

The Anniversary was celebrated on the evening of Saturday the 31st January Sir Charles Turner, C.I.E., Chief Justice of Madras presided. There were present His Highness the Maharajah of Vijianagram, G.C.S.I., the Hon'ble C. G. Master, Member of Council, Mr. J. H. Garstin, C.S.I.,

Member of the Board of Revenue, Mr. H. B. Grigg, Director of Public Instruction, Mrs. Grigg, Colonels Bruce and Magrath, Brigade-Surgeon Keess, M.D., Principal of the Madras Medical College, Dr. D. Duncan, M.A., Principal, Presidency College; Mrs. Duncan, Mrs. W. R. Robertson, Mr. G. Duncan, Principal, Government Normal School, Mrs. Duncan, Mr. and Mrs. J. B. Bilderbeck, Mrs. Mills, Dr. McNally, Dr. Dymott, Mr. Adams, M.A., Principal, Patcheappah's School, Mrs. Adams, Mr. W. M. Scharlieb, Mr. D. Grant, Veterinary Surgeon Shaw, the Rev. John Black, Mr. P. Orr, Honorary Surgeon R. Wilkins, F.R.C.S., Mr. B. H. Chester, M.A., Mr. A. Pinto, Mr. V. Ragava Charlu, B.A., and others.

Mr. W. R. Robertson, the Principal, opened the proceedings. After referring to the general objects of the College he said: The College was established in 1876. Between that time and now 83 persons have undergone the full three years' course of training. Of these, 59 have obtained the first-class certificate, and 23 the second class. I have endeavoured to ascertain the present employment and place of residence of these men, and have been able to obtain particulars regarding 74 as follows;—17 are employed as owners, superintendents, or occupiers of estates and farms; 5 as Agricultural lecturers and instructors; 4 as Agricultural inspectors; 8 as Land revenue inspectors; 11 in the Forest department of this Presidency and Native States; 19 as local cattle-disease inspectors and private veterinary practitioners; 5 as Collector's clerks, museum curator, &c.; 4 as general merchants; while one has joined the Royal Agricultural College, Cirencester. These men reside in the following Provinces and States: Bombay Presidency 7, Mysore Province 6, Kattywar State 3, Central Provinces 2, Gondal State 2, Baroda State 2, Bengal 1, Holkar State 1,

Scinde 1, Travancore 1, Outside of India 3, and, in this Presidency our "passed" students are in 15 of the districts pretty evenly distributed. As far as can be judged from the salaries received, the majority of these men are in good positions. There are 9 whose salaries range from 100 to 375 rupees per month, 21 whose salaries range from 50 to 100 rupees per month. The salaries of the remainder vary from 20 to 50 rupees. These latter have, in most instances, but recently left the College, and consequently their remuneration is smaller. It should be remembered that none of our graduates are of more than five years' standing, no College certificates having been granted before 1879. Excepting about half a dozen, the whole of our "passed" students are employed directly or indirectly in connection with agriculture. It cannot reasonably be expected that every student who passes through our course will embark in an agricultural career. The authorities in charge of Agricultural Colleges in Europe and America usually express themselves as satisfied if not more than 50 per cent. of their students engage in occupations other than agricultural, and, I believe, the experience in other professional institutions is similar. It is yet too early to form any very decided opinion of the work being done and the influence exercised by the majority of our "passed" students, but I have had the most conclusive evidence that many of them are doing very creditable work and are exercising a very useful influence in the respective localities in which they reside, and I feel sure that the majority will prove a credit to their College and prove benefactors to their country. It would, of course, be very unreasonable to expect that every student, on the termination of his course here, should at once be qualified to take charge of every kind of agricultural work or undertaking. In most professions there is a probationary period following the College course in which the

student has opportunities for developing his knowledge and gaining practical experience, and what is necessary in Medicine, Engineering, and Forestry is equally necessary in Agriculture. Besides, a successful farmer requires not only a thorough knowledge of the sciences bearing on his profession and of the practical details of his art, but he must have business habits and possess judgment and tact. The latter our training cannot confer on a student who is without them, though we are able to develope these desirable qualifications. I must, however, now pass on to review some of the points of interest connected with the work of the past year. At the beginning of the official year we had 60 students in the College. We have at the present time 101 excluding the probationers (8) of the Cattle-disease department who attend lectures. This is the largest number we have yet had, and judging from the numerous recent applications for admission, our numbers will, I think, continue to increase as far as our insufficient accommodation permits. Our present students consist of:—Europeans, Eurasians, and Native Christians 18, Muhammadans 13 Brahmins 49, Sudras and others 21. Eighteen came from Mysore, Coorg, Travancore, Bombay, Bengal, Rajputana Berar, and Patiala; the remainder belong to this Presidency, every district being now represented in the College. The educational attainments of these students on joining the College may be summarised as follows:—Passed the First in Arts Examination 6, Passed the University Matriculation Examination 58, Passed the Middle School Examination 23, Passed other Examinations 3 and the remaining 8 had passed no special examinations. From inquiries I have instituted I have ascertained that our present students and their families hold together about 6,000 acres of land, which shows an average of about 60 acres per student, but, besides this, the family of one

student are said to possess extensive zemindari rights. It will be seen from these facts that the College is year by year becoming more closely connected with those interested in the land. It is gratifying to note the extent to which the College has been utilized by Native States and Zemindaries, the following of which have either had, or have now, students here:—Mysore, Travancore, Holkar, Patiala, Berar, Kattywar, Dewas, Gondal, Wadwhan, Ulwar, Kolhapur, Vizianagram, Karvetnagar, and Kalahasti. The average marks obtained at the various examinations in the past year were quite as high as in previous years, and the progress and conduct of the students generally have been highly satisfactory. The average percentage of marks obtained for the whole of the College last session was—Agriculture, 66; Veterinary 72; Chemistry 58; Botany 72; Hydrostatics 50; Mensuration 66; Civil Account Code 63; Book-keeping 55; Mechanics 55; Arithmetic 70; and Physiography 50. The students now in the College are divided into three classes—Class I, formed at the beginning of the present session, which contains 37 students, class II formed in October 1883, containing 31 students, of whom, up to the end of the last session 23 had qualified for first-class certificates and 8 for second class; and Class III, which contains 33 students, of whom, up to the end of the last session, 23 had qualified for first-class certificates and 10 for second class. A class formed in 1881 terminated its course at the end of the last session. Of the students in the class, 17 have been declared to be eligible for first-class certificates and 2 for second class.

The Hon'ble Chairman next distributed the certificates after which Veterinary Surgeon Mills, Professor of Veterinary Surgery, delivered an address which will appear in full in the next issue of the Journal.

The Chairman having alluded to the difficulties that presented themselves in addressing an assembly gathered together on such an occasion as the present said :—When, Mr. Robertson, the Principal of the College, asked me to preside at the anniversary of this institution, I at once enquired of Mr. Robertson if he had asked that statesman, the Right Honorable the Governor, who rules over this Presidency, to take the chair, as that gentleman is advanced in the sciences of Europe, and would be better able to handle the subject and pourtray in unmistakeable language the enormous advantages of the science of agriculture than myself. If there are any among the audience who do not at the present moment, share my views as to the importance of scientific education to the agriculturists, I hope before my address is finished, I shall have persuaded them of its value, and I would especially crave the attention of educated native gentlemen who have at heart the interests of their country, and are active in promoting them. To what source in India must we look, if we seek to increase the national wealth ? We must look to the land. You must develope the resources of the land. You may have also a country of which the resources are principally upon the surface, and such a country is India. This empire has so many different climates that it produces a number of plants which are not only necessary for its inhabitants, but have a commercial value in other parts of the world. Husbandry is the occupation of the large bulk of the population, and its labour market is so well stocked that it exports labour. The great antiquity of agriculture in this land has secured for you an inheritance of ready made knowledge, but we must not stand where our grandfathers stood, in these progressive days. Scientific agriculture has been and is recognised both by ancient and modern *savants* as a necessity for a nation of agriculturist. We are now taught that each country should produce that which it can produce best and cheapest, and that the wealth of every country is materially increased by adopting this doctrine ; that it is a waste of capital for a country to pay Rs. 10 for a home-made article when the same article can be supplied to it, of the same quality, by a foreign country for Rs. 5. If India is to be made richer, it is either by increasing the number of these products, or their quality, or by converting raw material into a manufactured article, in which case you will make two profits, the profit of growing or collecting the raw material, and the profit of converting the raw material into the manufactured article. And this double profit you can secure if you avail yourselves of what, wherever it is found, can be made a source of wealth, a supply of cheap labour. Labour can only be cheap where food is cheap. Therefore both the profits I have mentioned eventually come from the land. The source of your food supply, and, therefore, of your cheap labour, is also the source of your raw material. Even when labour is dear, we may find instances of the practical advantages of scientific agriculture. It is idle to say that in India the agriculturist does not require scientific training. He has little occasion to resort to machinery to supply the place of human labour, but he has his own difficulties to contend with. He has to work with a rainfall which is capricious and descends on the land more frequently in violence than in gentle showers. The science of the Engineer is here called into play to regulate the water supply, to store and distribute it to the best advantage, and to provide adequate drainage. The science of the agriculturist is to select in each season crops which may resist in varying degrees extremes of drought or moisture, so that if some fail others may succeed, to replace a crop that has been lost by a speedily growing crop which may in some measure compensate

for the loss of the original crop. Much too may be done to improve our crops by the careful selection of seed and by hybridization. There is no reason why we in Southern India should not improve the staple of our cotton, and enable the Carnatic and Buckingham, the Bellary and Travancore Mills, to supply the Eastern markets with fine, as they are now supplying them with coarse numbers. The enterprize of the manufacturer and the merchant is no doubt required to distribute, or deal with, the produce of the agriculturist. If I might suggest an industry which is likely to prove profitable, I think the experiment might be made of converting the hides we now export into leather, and of sending them to the market in a finished condition, so that the industry of India might secure all the profit, and a profit enhanced by a considerable saving of freight. Amongst other branches of agricultural training, which I hope to see firmly established in this College, there is none more needed than that brought under your notice in the very interesting lecture delivered by the Professor of Veterinary Science. There is no reason why Madras, Bombay and Calcutta should be fed with indifferent mutton. There is no reason why the fleeces of Indian sheep should not be improved by careful selection, as has been proved possible in France and in Australia. You have but to be guided by carefully acquired veterinary knowledge, to produce a very much better article both for the food market and for manufacturing interests. In regard to your cattle, no one can overestimate the amount of suffering inflicted on animals throughout this country by want of veterinary science. And no one can say how much of the indebtedness of the Indian ryot is due to the loss of cattle which might have been prevented, had science been at hand with a remedy. I look to the land to provide for the ever-increasing expenditure of this now progressive country, not by an increase of the burdens

which press on the areas under agriculture, but by the extension of those areas, and by the taxation of wealth which a large expansion of manufactures and commerce will secure to British India. With very legitimate pride in the recognition of the merits of the training provided at this institution, the distinguished Principal has told us that his pupils have found employment readily, and upon very remunerative salaries; and, I trust, that the same measure of success may attend those at present enjoying the benefits of the institution, and those who will succeed them. There is a vast area of country calling for scientific methods of agriculture, and if, as I believe, the instruction here given is of practical value, the wider the pupils of this institution are spread over India, the greater will be the results which the institution will achieve. Students, you have heard from Mr. Mills that you have two courses open to you; you can go away and forget all you have learnt, or be content to learn no more, secure in the employment of an income sufficient for your bodily wants; or you may on the other hand leave this College assisted by its training, to pursue science in its widest range, and you may enable yourselves at some future time not only to look back upon your lives as well spent from a purely personal point of view, but upon lives well spent in the service of your native land by the diffusion among your neighbours of the results of the education which this College imparts.

Mr. H. B. Grigg, the Director of Public Instruction thanked the Chairman for his presence, and for his powerful and earnest advocacy of the cause which the pupils of this institution had at heart. This institution was of comparatively recent origin, for, although it had been in existence for 7 or 8 years it was only within the past five years that it could be said to have been started upon its present sphere of educational action. It was only five years since it was placed in the charge of the Educa-

tional Department, and it was hardly three years since the revised rules were framed connecting it with the revenue administration of the country. Now each Collector could nominate a young native from his district and send him to this College for training in agriculture. In the first year in which that selection was made, some Collectors were unable to take advantage of the liberal arrangements which the Government had made in that matter, and it was also found that some of the young men who were sent to the College possessed but comparatively few educational attainments. But afterwards he found F. As and B. A's among the students, and among those recently sent there was a decided improvement. This Institution was, he thought, one to which the public interest should be more and more directed, for the Education Commission had recommended most strongly that the youth of this country should be encouraged to cultivate different lines of thought, and depart, more or less, from the peculiar literary bent which the education of the country had been following hitherto. Excepting the Civil Engineering and Medical Colleges, there had been no institutions in Madras capable of providing means for carrying that recommendation into effect. Here, in this institution, they had the means, towards attaining the desired result. Some of the principal sciences were already taught which had a direct connection with the development of the agricultural and mineral and material resources of the country; and he could not doubt that if means were placed at his disposal—as he believed they would be—they would be able to provide in this institution for the thorough education of young men in several branches of learning most useful in this country. He trusted that within a short time instruction would be given there, not only in those branches of science connected directly with agriculture, but also in Veterinary science and forestry.

VERNACULAR QUOTATIONS ON AGRICULTURE.

By C. K. SUBBA RAO,

Asst. Professor of Agriculture.

The exaltedness of Agriculture.—Some of the greatest Tamil Poets whose sayings are generally held infallible have extolled agriculture above all other professions. Auviyar (ஔவையார்), Thiruvulluvar (திருவள்ளுவர்) and Kumbur (கம்பர்) are simply enthusiastic in its praise. Auviyar is an incarnation of Saraswathi the goddess of learning, Thiruvulluvar, of Brahma the Creator, and the greatest man in learning is Kumbur (*கல்வியிற்பெரியவன் கம்பன்.*)

Auviyar says in her Athichoody "*பூமிதிருத்தியுண்*" that is, "cultivate the land well and live," meaning, of course, that agriculture is a better means of livelihood than others. It is no longer advisable, however, that agriculture should absorb all attention; it is desirable that more attention be given to manufacturing industries than at present.

In Kóndraivéndan (*கொன்றைவேந்தன்*) she says, "*சோர்த்தேடி சோரைத்தேதி,*" that is, "If you seek happiness, seek the plough." This corresponds to the Tamil proverb "*உழவின்மிருந்த ஊதியம்இல்லை,*" that is, "There is nothing so profitable as agriculture." No doubt, agriculture was once very profitable. In ancient vernacular works we have a very glowing account of the agricultural prosperity of the country. Agriculture in its present condition is not profitable as the following proverb shows: "*உழுதவன் கணக்கைப்பார்த்தால் உழக்கேனும் மிஞ்சாது,*" that is, "If the ploughman balances his accounts, it will be found that he will not have an ollock of grain left." Not only are his cultivation expenses heavy but also many idle people live

at his expense, for instance, the village astrologer, the village poojarie, and others not to mention the supplies he has to make to the lower revenue officials. Auviyar says again in கொன்றைவேந்தன் "தொழுதூண்சுவையி னுழுதூணினிது," that is, "Food earned by husbandry is better tasted than food earned by flattery." Farming is indeed an independent means of livelihood, and those who have plenty of land and capital will do better to engage in farming than to serve under any one. மேழிச்செல்வம் கோழைபடாது, that is "Wealth acquired by husbandry will never diminish." The spirit of this is that agriculture is the most innocent and honest means of livelihood. Ill got wealth, it is supposed, will soon be lost, and the wealth of the agriculturist being, as a general rule, properly acquired, will last. In Nalvali (நல்வழி) Auviyar says

"ஆற்றங்கரையின் மரமுமரசறிய
வீற்றிருந்த வாழ்வும் விழுமன்றே யேற்ற
முழுதுண்டு வாழ்வதற்கொப்பில்லை கண்டீர்
பழுதுண்டு வேறோர் பணிக்கு."

Translation.—"The tree on the river bank and the splendour of the royal life will alike fall. To live by husbandry is proper. All other professions have defects."

On the occasion of king Chola's coronation Auviyar was asked to bless the king as all the poets had done. Thereupon she simply said "வரப்புயர", that is, "May the field banks of thy country rise." Every one wondered whether this could be a blessing, and Auviyar was again and again asked to bless the king. At length, she explained herself as follows :—

"வரப்புயர நீருயரும் நீருயர நெல்லுயரும்
நெல்லுயரக் குடியுயரும் குடியுயரக்
கோலுயரும் கோலுயரக் கோனுயர்வான்."

Translation.—"If the field banks (of wet land) r high, likewise does water rise, likewise does the pa

out-turn, likewise people (in prosperity), likewise revenue, and likewise the king."

Precisely the same views are expressed in a stanza of சிறுபஞ்சமூலம் (Sirupunchamoolum), viz.,

"வார்சான்ற கூந்தல் வரம்புடை வைகலும்
நீர்சான்றுயரவே நெல்லுயரும் சீர்சான்ற
தாவாகுடியுயரத்தாங்கருஞ்சீர்க் கோவுயர்தல்
ஓவாதுரைக்குமுலகு."

Translation.—"O woman of long and beautiful tresses it has always been said that the higher the field banks are, the higher can water be stored within them, the more rapid will be the daily growth of paddy, the more prosperous will the people become, and the more powerful and invincible will the king be."

Indeed the notion of the ryots is that the larger the quantity of water stored within the field bunds, the larger will be the out-turn of paddy. In fact, the quantity of the fertilizing silt deposited on the fields is proportionate to the quantity of water used. The following verse from Kanchipuranam also shows that the ryots use plenty of water in wet cultivation chiefly for the sake of the silt.

"அருள்விளங்கலு முடல்பொருளாதியபந்தர்
தருமவன் புடைக்கொடுத்திடுந்தகைபோற்
பெருகயாத்த நீர்க்கலங்கல் போய்த் தெளிர்தபின் முழுது
மருவுகால் வழிவடிந்துறக்க விழப்பர்கண் மள்ளர்."

Just as a man that finds divine grace gives up all worldly connections, corporal as well as proprietary, to Him that gave them, so the ryots let off the water that is abundantly confined within the bunds, into the drainage channels, after the water is cleared of the silt.

The aggregate quantity of drainage water called கழிவடை தண்ணீர் in Tamil, which finds its way into the rivers from the paddy fields is so great as to cause a

perceptible rise in them at times when there has been no rain to account for the rise. I once observed such a phenomenon in the Noyel river at Coimbatore and was told that it was owing to the கழுவடை நீர் (drainage water.)

Thiruvulluvar says in his Kural,

"உழுதுண்டு வாழ்வாரேவாழ்வார் மற்றெல்லாந்
தொழுதுண்டுபின் செல்பவர்."

that is, "Those alone live properly, who live by husbandry. All others are more or less flatterers and hangers-on."

Kumbur has written 70 verses in praise of agriculture. There is a common saying among the Tamilians, viz., "ஔவானெல்லாம் உழுவான் தலைக்கடையிலே," that is "All scholars are but dependent on the husbandman," which is but a corruption of what Kumbur says in the verse.

"வேதநூன்முதலாகி விளங்குகின்றகலையனைத்தும்
ஔவாவொல்லாரு முழுவார்தந்தலைக்கடைக்கே
கோதைவேன் மன்னவர்தங் குடைவளமுங் கொழுவளமே
ஆதலாலிவர்பெருமை யாருரைக்கவல்லாரே."

(To be continued.)

NOTES.

On the 4th of November 1884, a donkey 3 years old was admitted to Hospital with a compound comminuted fracture of the right metatarsals. From the history of the case, it was learnt that the fracture was caused by the patient being run over by a bullock bandy, some four or five days previously. On examining the limb, it was found very much swollen, the bone protruding through the skin and a most fœtid discharge of pus coming from the opening. It was decided to amputate there and then. Accordingly the patient was chloroformed and the limb

removed about 3 inches from the hock by the circular operation. The flap operation could not be performed owing to the bruised condition of the tissues around the fracture. The vessels were tied and little or no blood was lost. The stump was dressed with carbolic lotion (strength 1 to 40) over which was placed a pad of cotton-wool and lint secured by a bandage. The case did well from the first under dressings containing carbolic acid, with an occasional touch of nitrate of silver to keep down granulations. A firm stump has formed, a cast of which has been taken and an artificial limb is being made for the donkey.

The patient, a female elephant, 3 years old was visited by me on the morning of the 19th November 1884, when the following symptoms were presented. Pulse weak and running down, body thin and emaciated, subacute abdominal pain, constant restlessness, laying on abdomen with legs outstretched and head resting on knees; this position was maintained only for a short time, when the head was swung with a thud on to the ground and she rolled over, with a deep groan. Trunk cold. Fæces passed frequently, which had the appearance of peasoup, scanty, a most disagreeable smell, and voided with pain and straining. On examination the fæces was found to contain a quantity of mucus and blood. There was champing of the jaws.

Before medicine could be administered the patient died.

Post mortem examination one hour after death revealed:—Body emaciated, eyes sunk and skin dry. The intestines, especially the large were inflamed throughout, and here and there patches were to be seen bordering on

ulceration. All the other organs of the body were healthy and weighed.

Heart	7	Pounds...	
Lungs	11	do ...	
Liver	16	do ...	
Spleen	$2\frac{3}{4}$	do ...	Length 1 yard 9 inches.
Kidney left	$2\frac{1}{4}$	do ...	
Do. right	$2\frac{1}{16}$	do ...	

Remarks.—

As is very often the case a mahout had been called in to treat the patient a few days before I was sent for, which only gave me an opportunity of seeing the last phase of the disease. From what I could learn the animal had been suffering from diarrhœa for some time previous to the dysenteric symptoms setting in.

Professor Tyndall, writing in the *Times* says :—Splenic fever, or malignant pustule, is a very loathsome disease, and the sufferings of animals dying from it are obviously very great. An account of the symptoms which precede death would be by no means pleasant reading. Some years ago I visited the laboratory of the Ecole Normale, and was shown there by Pasteur himself the formidable organism with which he was then occupied. It was curious to reflect how a thing so mean could exercise such deadly power over man and brute. Pasteur and his assistants had to be wary in dealing with the organism, for a single one of its invisible spores getting into the blood through a scratch on the hand might prove fatal. In a room adjacent to the laboratory stood a large cage containing guinea pigs and rabbits, some sprightly and munching their food, some drowsy and languid, some in their last agony, and some in the rigour of death. It was subsequent to these experiments that Pasteur operated upon larger animals, subjecting them to the "cruelties" and "tortures" here described. Imagine a certain tender-

hearted Bishop—with whose kindly feelings I have every sympathy— entering the laboratory of Pasteur and seeing him sow this malady among his unprotected victims, what would the Bishop have done under these circumstances ? Were it in his power, would he not have invoked the arm of the law to stay such damning cruelties ? Most assuredly he would, and yet in doing so he would have affixed the brand of cruelty upon himself. In lieu of the few animals saved from the operations of the man of science, he would have handed over tens of thousands of the same animals to the ravages of splenic fever.

Veterinary Professor Strebel, of Fribourg, Switzerland, bears testimony to the success of vaccination as a preventive against charbon * ; in other words, he confirms the Pasteur discovery. Switzerland loses about 2,500 head of cattle annually, from the charbon plague, equal in value to half a million francs. In 1884, M. Strebel states 2,199 vaccinations were effected on young cattle heifers and bullocks. Of the results, 1,499 cases are known, and only two were failures, due to injecting the vaccine when too much bleeding followed incision made in the skin, and the other to the operation having been made on a very sultry day. But these exceptions rather confirmed, than militated, against the preventive discovery. It was found that certain humid pasture lands were very favorable to the production of charbon ; now the cattle vaccinated escaped the disease, while those not so treated were attacked. This year Switzerland will vaccinate 20,000 head of stock. Care ought to be taken, when inoculating, not to allow the instrument making the incision to penetrate the vertebræ of the tail, as such may lead to the loss of some of its joints. Also, avoid operations in hot weather.—*Madras Mail.*

The honor of the discovery of this new local anæsthetic is due to Dr. Kollar, a young medical student, still engaged

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* Anthrax.

they are the food of plants which have green leaves has not yet been proved.

18. The proportion of nitrogen to carbon in the soil is much higher than that which exists in vegetation growing upon the surface. A combustion of carbon and a formation of heat and carbonic acid must take place in the soil, somewhat similar to that which takes place in man and animals, where food undergoes a like change.

19. The ultimate result of these changes in the soil is the complete separation of the carbon from the nitrogen, and the combination of the nitrogen with hydrogen forming ammonia, and with oxygen forming nitric acid.

20. In order to neutralise the nitric acid when formed, chalk or lime must be present in the soil. The process of nitrification is quite independent of the vegetation growing upon the surface; and it takes place equally well upon a bare soil.

21. The benefit desired from summer fallows is chiefly due to nitrification. The soils most suitable for fallowing are rich clays. Peat soils, although full of organic nitrogen, are not suitable for the purpose, owing to the absence of lime; and light soils are equally unsuited owing to the deficiency of organic nitrogen.

The sun and atmosphere.

22. The growth of plants is entirely dependent upon the forces which exist in the sun.

23. The atmosphere furnishes water, carbon, and ammonia.

24. Four-fifths of the atmosphere consists of nitrogen, but there is at present no evidence that plants derive their nitrogen from this source.

25. The amount of carbonic acid in the atmosphere is exceedingly small, not amounting to more than from two

to three parts in 10,000; and not much more than one quarter of the carbonic acid consists of carbon.

26. The large amount of carbon taken from the air by plants, which in some instances amounts to as much as several tons per acre, is provided for by the constant movement of the air, by which fresh portions are constantly brought in contact with their leaves. The rate at which air travels amounts on an average to nearly 300 miles daily according to results obtained at the Greenwich Observatory.

27. The amount of organic nitrogen which is nitrified every year—assuming that the necessary agents are present—depends upon the amount of organic nitrogen in the soil, the temperature, the moisture of the season, and the frequency with which fresh surfaces of soil are exposed to the atmosphere.

28. The amount of nitric acid formed each year is probably a better measure than any other of the fertility of the soil.

29. Nitrates are very soluble in water, and form no insoluble compounds with the soil; consequently they are removed in large amounts by drainage, when there is no living vegetation to take them up.

30. The water passing through a soil, which at all other periods of the year contained nitric acid, has been found to contain none when a crop of wheat was in the full vigour of growth.

31. It is possible, therefore, that all the nitric acid produced every year is either taken up by vegetation or lost.

32. The change of the organic nitrogen of the soil into nitric acid, and the formation of organic nitrogen in the crop from the nitric acid, must be continually going on as long as growth takes place. Temperature and moisture are the most powerful agents affecting the growth of

plants. As no two years are exactly alike in regard to rainfall and heat, so the growth and yield of crops varies more or less every year. There is no evidence to prove that the climate of Great Britain has changed during the last 100 years; if, therefore, the yield of the crops have decreased, the result is more probably due to a decline in the fertility of the soil.

PROCEEDINGS OF THE ASSOCIATION.

Saturday March 7, 1885.

The President W. R. ROBERTSON, ESQ., *in the Chair.*

The paper read was :—

OUR DRY LAND.

BY MR. C. K. SUBBA RAO.

(Continued from page 12.)

Dry land if properly cultivated will prove a great resource of wealth for this country. It is chiefly for certain valuable products of dry cultivation that there is a large demand in the foreign market, and there can be no doubt that the demand will greatly increase if the products are improved in quality. The following table of exports from this Presidency for the year 1882-83 will exhibit the comparative demand for the produce of dry and irrigated lands.

DRY LAND.			IRRIGATED LAND.		
Articles.	Quantity.	Value.	Articles.	Quantity.	Value.
	Cwts.	Rs.		Cwts.	Rs.
Indigo ...	33,944	77,83,057	Rice ...	1,517,458	4,481,697
Cotton ...	6,56,907	16,484,093	Paddy ...	1,62,337	2,02,629
Oil seeds ...	14,70,012	6,498,608	Sugar ...	12,46,954	7,568,940
Grain ...	1,11,313	2,69,118			
Pulse ...	6,37,780	2,08,677	Wheat ...	10,418	32,710
	Gallons.			Pounds.	
Ground nut oil ...	3,72,634	3,21,404	Tobacco ...	70,45,569	13,84,135
Castor oil...	3,73,798	3,19,576	Spices ...	32,383,920	53,69,012
Other oils...	50,582	2,64,223			
Total value ...		32,148,756	Total value ...		19,129,123

It will be seen that the demand in 1882-83 for the produce of unirrigated land was about 67 per cent. higher than the demand for the produce of irrigated land.

Among men who are qualified to give opinions on Indian agriculture, there is no difference of opinion as to the present system of dry cultivation being highly exhaustive. How can it be otherwise when the small manurial resources of the country are for the most part wasted, and to a great extent remain unutilized? In 1882-83, there were in this Presidency excluding South Canara, about 8 million head of cattle, including buffaloes and cows, and nearly 9 million head of sheep and goats. A large number of these stock are not employed in agriculture. Supposing them, however, to be so employed, we find that the strength of livestock per square mile is about 98 head of cattle calculating 8 sheep as equivalent to one head of cattle. In fact, for every 100 acres of occupied land in this country, there are scarcely 50 head of cattle. The 9 million head of sheep and goats cannot manure more than 1 million acres during the year. Supposing half the cattle dung to be used as fuel and the other half stored for manure in loose heaps in an open place, the quantity of manure finally available will not be more than ¼ ton per head, as the results of repeated experiments on the Saidapet Farm have shown. The total quantity of cattle manure available is thus about one million tons which cannot manure more than ¼ million acres. Manure is thus available for about 1¼ million acres annually. The land having to be manured once in 2 years, only about 2½ million acres can be insured against exhaustion. The area of the wet and the garden land together is about 4 million acres, and it is to this land almost exclusively that manure is applied. Exhaustion is, of course, inevitable. It is no wonder then that in good

liquid excreta of their own households. In short, if all the available manurial resources of the country be properly utilized, I have not the least doubt that each acre of dry land can be made to produce as well as each acre of wet land now produces on the average. We have plenty of land and plenty of cheap labour in this country. Of the third requisite of Wealth, *viz.*, capital, we have also a good deal in the shape of the various manurial resources of the country which are at present wasted or unutilized.

Though the dry land is greatly exhausted, the remedy is easy. Sir Arthur Cotton rightly remarked at a public meeting in England: "All India is virgin soil; for the soil has not been cultivated more than 2 or 3 inches deep." Fortunately, that implement to which we must look for the regeneration of our dry land, I mean the English pattern plough, requires scarcely any more outlay than the country plough. In Coimbatore, there are thousands of holdings each above 30 acres in extent. For a holding of 30 acres of dry land, 3 country ploughs, and 3 pairs of cattle at Rs. 50 per pair are required in that District, as the Administration and the Settlement Reports show. If some light plough for general purposes such as the small iron plough at Rs. 14 be adopted, the outlay for a 30 acre holding would be Rs. 28 for 2 such ploughs and Rs. 120 for 2 pairs of cattle and Rs. 10 for a harrow, or Rs. 158 altogether. The outlay required at present is Rs. 150 for 3 pairs of cattle and Rs. 3 for 3 country ploughs or Rs. 153 in all. The labourer's wages and the cost of cattle keep are manifestly much more in the case of the country plough than in the case of the English pattern plough. Poverty is thus no real obstacle in great many cases to the adoption of an efficient system of tillage.

What deep cultivation and a liberal supply of organic manures can do for our dry land is manifest from the

fact that outturns of 400 to 900 lbs. of grain and 1½ to 2 tons of straw per acre were obtained by those means on the Saidapet Farm during the last famine year, while all around was parched and dry. Government have observed in the Farm Report for that year, "This being the chief cultivating season of the District in which the Farm is situated, the methods of cultivation adopted on the latter were subjected to a crucial test. In the case of the crops reported on, the result was highly gratifying, for deep cultivation and high manuring secured a fair outturn and one that with straw and grain at famine prices was distinctly remunerative."

The assessment on the cultivable waste dry land being very light, scarcely 1 Rupee per acre in the majority of cases, the ryots will do well to get such land on application and grow green fodder. Cholum, Cumboo, horsegram, &c., may be grown at any time during the year, if fodder is required. In Nellore, the ryots pay about Rs. 1½ per head of cattle for their grazing while they are unemployed. The waste lands may be expected to produce in ordinary seasons 2, if not 3, fodder crops during the year, yielding 2 or 3 tons per acre each time. Thus a very good supply of good fodder will be secured for the livestock.

Over the greater part of the Presidency, there are two cropping seasons for the dry land. The summer crops, are chiefly cumboo and gingelly. But there are certain varieties of cumboo and gingelly which are cultivated in the cold season also. In the Northern Circars, there appear to be 3 cropping seasons, *viz.*, paira, pedda and punasa for dry land. The south-west monsoon rains on which the summer crops depend being very precarious, the crops very frequently fail and a great part of the dry land remains uncropped. The cold weather crops are sown at the

out-burst of the North-east monsoon towards the beginning of October.

The next statement shows what percentage of the total cultivated area is generally occupied by the several dry crops.

Dry crops.	Percentage of the total area cultivated.
Cholum	16
Cumboo	11
Raggy	6
Varagoo	6
Tenney	4
Shamay	2
Other cereals	2

It is said in the Administration Report for 1882-83 that maize was grown in that year on 70,163 acres, of which 38,863 acres were in Kistna and 26,170 acres in North Arcot. If maize was really grown over such an extensive area, it is highly gratifying; for the nutritive value and the productive capabilities of the crop are naturally much superior to those of the ordinary dry grain crops of this country. But I have known that in many cases the officials return cholum (sorghum vulgare) as 'maize' mistaking this to be the English word for 'cholum.' I have no doubt that maize was indeed grown to some extent in North Arcot and Kistna. My suspicion is confirmed by similar mistakes being noticeable as regards certain other crops.

FARMING AS AN OCCUPATION.

THERE are some things about farming, concerning which, we would all have the same opinion. We should

all agree, for example, that it is a very necessary vocation. There are some occupations whose influence is evil, and society could better get along without them,—occupations in which men are employed to the injury of their fellowmen. There are others again that although beneficial might be dispensed with better than farming, because they are not fundamental. The merchant and the lawyer, the doctor and the minister, the teacher, and even the politician have their use, and must always find a place in all well regulated communities.

Let us then consider briefly. First, some of the things that are required on the part of one who would be likely to engage successfully in farming; and secondly, what return he will be likely to receive for his well-directed industry.

First, then, I observe that in order to obtain the best results in farming, a knowledge of the principles of agriculture is necessary, together with a skilful application of them. This is none the less true because some so-called ignorant men have been very successful as farmers. We have known such men; they could hardly write their signature; but, although they were almost as ignorant of what books contained as the team they drove, they were men remarkably endowed in some other ways. Sharp, shrewd observers in regard to cause and effect, and of such indomitable energy and unwearied industry as to make up in large measure for the disadvantages under which they labored, because of their ignorance of the principles which underlie their occupation.

Why, the man who has nothing but a sneer for what he terms book farming, and who claims that science has nothing to do with farming or farming with science, does not know what he is talking about and to him the

occupation will always be one of drudgery and poorly requited toil. Now, suppose we were to turn over to a race of savages, all our improved cereals, and vegetables, and fruits, and sheep, and cattle; let them have the same soil that we have, would not all the advance that has been made soon disappear; some varieties would die out and others revert to their wild condition. In other words, those fruits of the earth, and domestic animals, which it is the object of agriculture to produce and approximate toward their most perfect forms, can only be improved by men who are themselves in an advanced state of cultivation. The idea that any ignorant dolt can make a successful farmer never had an existence except in the brainless head of such a dolt. That man will attain best results, all other things being equal, who best understands the principles of his occupation, who studies and reduces to practice the most advanced ideas on the subject, so far as his soil and circumstances will permit. Just as the laws that govern and influence navigation must be understood by the mariner, so must the laws that relate to the wants and suceptibilities of the soil be understood by the farmer. As well might the former commit himself and his vessel on the pathless ocean without compass or chart and say, I am going to be practical and feel my way instead of trusting to book-learning, as the farmer in his calling ignore the principles that relate to the fertility of his soil and the improvement of his products. We admit that theory alone is as dead and useless as faith without works. We must have practice. But this is not more true in regard to farming than in regard to other pursuits. What is the practice of law or medicine or mechanics but the application of the principles, as laid down in the books, to the details of the business. The lawyer who is ignorant of books, and who has no well defined principles to apply, is

not the man to whom you would commit your case. The farmer sustains the same relation to his farm that the lawyer does to his cabinet, or we might better say, that the physician does to his patient, regulating his food, directing his exercise, and so restoring his impaired vitality; therefore, a knowledge of the principles of agriculture, and a skilful application of those principles to his individual circumstances, is demanded of him who would be a successful farmer.

Time will not permit me to point out the almost endless variety of instances in which it might be shown that skill in the application of the principles that relate to farming is constantly demanded, and is of the very first importance. There are peculiarities of soil and climate of which he must be a close observer with a view to adapt his fertilizers and methods of tillage to meet their requirements. Each locality has its peculiar relations to market, that might be profitably considered with reference to a rotation of crops, or with reference to special crops. A systematic arrangement and proper division of work will materially affect the results accomplished within a given time. Like the painter, who, on being asked what he mixed his paints with, answered "brains," so the farmer will find as much need of brains in the pursuit of his occupation as any other man. The farmer cannot bury his mistakes out of sight like the doctor; they remain above ground where they are seen and known by all men. Having thus briefly spoken of what agriculture demands of him who engages in it, let us now notice what it has to give him in return:

First, with regard to the money there is in it. As we are sometimes accused of worshiping the almighty dollar, I thought I might as well put this first. "Money answereth all things," says the proverb. That is not quite true, but, after all, we cannot get along without money, and I would

advise you to keep away from any occupation that has not any money, if it were necessary to give any such advice.

If the farmer's occupation does not yield a fair remuneration for the thought, and care, and toil that he bestows upon it, then it is not the calling that I should recommend, nor the one that you would be likely to choose. I think, however, it can be shown that farming properly conducted will yield, as compared with other occupations, a fair return in money, while the risk of loss and failure is incomparably less in this than in most other pursuits. Because some farmers do not make anything is no proof that nothing can be made at farming unless it can be shown that the cause of failure is not in the man but in the occupation. Although as a class farmers are an industrious, frugal people, yet there are to be found idle, shiftless, worthless farmers who neither achieve nor deserve success. Yet even they manage to live along in a kind of a way, and are generally able to indulge in the luxury of tobacco and plenty of time to smoke it, and of keeping two or three dogs to prey upon their neighbour's sheep or pick up their living in some other disreputable way, (*i.e.*, the dogs, I mean, not the men); but to the industrious, intelligent cultivators of the soil, agriculture is not niggardly in the reward she renders for all such well directed industry. In this new country of ours being so rapidly developed, sometimes the return from the investment of capital is out of all proportion as compared with ordinary gains. We are too apt to leave out of consideration the element of hazard and uncertainty connected with such investments, and thinking only of the rapid gain, the mind is apt to become distracted and unsettled and so unfitted for those steady business habits that in ninety-nine cases out of a hundred constitute the foundation of financial success. Farming does not hold out this prospect of rapid gain, neither on

the other hand does it involve the risk of moral and financial ruin which environ and so frequently overwhelm the great schemers and speculators of the day. Wealth that is gained without labor is often squandered without wisdom, while that which is acquired by industry is preserved with care and expended with judgment. I have been through most of the older settled counties of this State and find that a very large proportion of the wealth of these counties is in the hands of the farmers. As a rule, the men employed in mercantile business do not become rich.

It is difficult to show just what the profits of the farmer are on any given piece of labor. We might, as is sometimes done, take a given field and crop, estimate the cost of seed, cultivation, harvesting, and marketing, and compare it with the value of the crop. That, however, is not very satisfactory unless we could have the actual account as kept accurately by the farmer himself. Such an account to the farmer must be of great value, as in a few years he would know, with almost a certainty, what he could raise most profitably, and what it was better for him not to try to raise at all.

On general principles we may assert that the margin of profit in farming will depend, as in other occupations, on the order of talent devoted to it and the capital employed in it. Judging from the practice of the average farmer, we think he has a good deal to learn yet on both of these points. The old adage so frequently quoted as though it were a self-evident truth: "He that by the plow would thrive, himself must either hold or drive," is, in my opinion, a piece of unmitigated nonsense. It is a part of the old absurdity that farming simply means manual labor. A man might drive a team or hold a plow excellently, and yet be destitute of nearly every quality that would constitute a good farmer; just as a man might be an expert in

the manipulations of setting type, and yet be entirely unfit to conduct a newspaper successfully. Ability to perform some manual or mechanical operation is a very convenient thing to have; it is not, however, of much importance in estimating the fitness of a man for the successful conduct of any business enterprise, whether it be a farm, a factory, or a mercantile establishment. More than that, a man who is going to conduct such an enterprise, must be better employed. He cannot afford to spend his time in mere manual operations, that he can hire done for from one to two dollars per day. Your return will be in proportion to what you give, and as you give. Does not your occupation as well as the Bible teach you that what a man soweth *that* shall he also reap? That and not something else. If you have nothing higher to give your farm than mere manual labor, it will yield just about what manual labor is worth in the labor market, and you must be content to live on that, not because your farm has nothing better to give, but because you have nothing better to give your farm. Give it the enthusiasm of one who loves his occupation. Give it the best intellectual service of which you are capable, leading you to the wisest possible adaptation of means to ends, and with liberal hand it will shower upon you the ampler reward of that higher service.

The margin of profit in farming will also be in proportion to the amount of capital judiciously employed. I have known some farmers who, in other respects, had excellent practical ideas, but whose practice in regard to the use of capital did much to prevent a larger success. As soon as they made a little beyond their immediate wants, they would put it out at interest. Well, perhaps you will say a little money out at interest surely is not a very damaging thing. Of course, in itself considered, it is a very good thing, but it be worth while for some people to ask whether

here is not something better. Whether there is not a bank n their own farm in which that money could be made to ield a larger dividend; or better still, whether some of it night not be better employed in improving the minds and nanners of the members of the home circle, fitting them to ningle in society with the intelligent and refined. We see comparatively few farms on which a more liberal outlay of capital, if made judiciously, could fail greatly to increase both the pleasure and the profit of the labor expended upon them.

When we remember that only a very small percentage of the men who turn to mercantile pursuits are successful —some claim not more than four per cent.—the farmer's slow but sure accumulations are not to be despised. The young men who leave the farm for other occupations, and the older men who sell their farms and go into business, expecting speedier and larger gains, frequently find only too late that they have made a fatal mistake.

One of the essential conditions to our best development is a sound body, therefore the most healthful occupation, all other things being equal, is the best. It is generally admitted that the average health of the farming community is better than that of other classes. This is one advantage which the farmer has in the pursuit of manhood over others. It is much easier for one whose circulation is perfect, whose digestion is sound, and whose nerves are steady, to be a man among men, than one who is nervous, thin-blooded, or dyspeptic. Some one has well said, "The profession of agriculture is more favourable to the entire development of the human faculties, to the unfolding and perfecting of this physical, this intellectual, this moral and immortal being, which God has given us, than any other employment. It imparts vigor to the body and to the mind leaving the soul free from feverish excitements, to embitter,

as it were, with its growth the lessons which nature teaches; in fine, it is capable of ministering most successfully of all arts and of all occupations, to wealth, to intelligence, and to virtue." This is becoming more and more true as time goes on, for every improvement in farm implements and methods of operation takes away so much of the drudgery of farming.

Extracted from the Report of Michigan State Board of Agriculture for 1881-82.

ADDRESS DELIVERED BY J. MILLS ESQR. M.R.C.V.S. AT THE COLLEGE ANNIVERSARY MEETING.

SIR CHARLES TURNER, LADIES AND GENTLEMEN,—I assure you, when Mr. Robertson, our esteemed Principal, asked me to deliver the usual annual address, it was with considerable doubt and misgiving that I undertook to do so. This being an Agricultural College, where the subjects taught are many and varied, I was at a loss to select a theme which would prove generally interesting, but naturally I selected something relating to my own profession and department, and will give you an outline of the history of Veterinary Surgery and the progress it has made of late years. It is evident Veterinary medicine came into existence when man began to domesticate the inferior animals. This must have taken place at a remote era, an idea which is borne out by the remains of the horse, the ox, &c., being discovered in ancient "Tumuli," lake-dwellings and caves, intermingled with the bones of primeval man. And again, among all the members of the Aryan race, the names of domestic animals still bear the marks of a common origin at a distant pre-historic period, when, before their separation into Greeks, Celts, Slaves, Hindus and Persians the common ancestry dwelt together and spoke the same language in

Northern India. From the Greeks we learn that Veterinary art was studied and practised in ancient Egypt. It then passed into Greece, where the utmost care was given to the breeds of cattle, resulting in marvellous success. This proves that the Veterinary profession had then made considerable advances. From the Greek authors we find that many works existed on the diseases of domestic animals. Hippocrates and Xenophon were among the most eminent authors of the period, and their works clearly illustrate the importance Veterinary art had attained in those days. The Romans, too, gave Veterinary Medicine careful study. It was to their advancement to do so, from the fact that their large army was constantly requiring Cavalry Remounts, That ever-memorable event, the fall of the Roman Empire has deprived us for ever of the greater portion of ancient literature, including that relating to the lower animals, but what remains, shows us the advancement Veterinary art had then made towards a science. Pliny, in his Natural History written A. D. 50, throws a deal of valuable light on the Veterinary Medicine of his day. Even the great poet Virgil took a deep interest in Veterinary matters and, after completing a course of Medicine and Mathematics, he applied himself to the study of Veterinary Surgery, and, in fact, his ability in this art was the means of bringing him under the notice of Augustus Cæsar, the illustrious Emperor of the Romans, in whose stables he was for a time employed. After the fall of the Roman Empire, Veterinary Medicine, like other Sciences, became no longer cultivated, and degenerated into a mere handicraft, and was only practised by the lower orders of the people in a most empirical fashion. Blacksmiths and Farriers had begun to assert themselves as the only competent men to treat animal diseases. To the former belonged the forging of the shoes, and the nailing of them on to the foot, which we all know is a most delicate operation, and requires a certain amount.

of knowledge of the anatomy of the delicate structures contained in the hoof, their ignorance of which often brought them into serious trouble, for they sometimes inflicted injuries to the foot which they were unable to cure. At this period the actual cautery or hot iron came into general use, and was freely applied in all ailments, being considered the "panacea" of the day. If we but reflect for a moment, it will be seen that this rude form of treatment is still practised, to a terrible extent in India. I use the word "terrible," and I might add "horrible," as the cruelty inflicted in this way is more than we can conceive. We have ample illustrations of this in the yards of fire-marks seen on the bodies of bullocks working on our public roads. About the ninth century a change came over the armies of Greece and Rome. Chivalry was introduced, necessitating the employment of a powerful class of horse called a "Destrier," which now no longer exists. An idea may be formed of the size and power of these animals, when it is considered that they carried a combined weight, in knight and armour, of at least 30 stones. These horses were not selected so much for speed as for rapid evolution: so that the lance and battle axe of his rider could be wielded in a small space. They were subjected to a prolonged and severe training, which renderd them liable to many injuries and diseases; but as they cost a great deal of money and could only be procured in Spain and Italy, it was natural that the greatest care was bestowed upon them necessitating some knowledge of Surgery and Medicine. A most cruel practice was adopted in those days of cropping the ears close to the head and digging the tail out at the croup, the object of which was to allow the coat of mail, which the animal carried when fighting, to fit closely to the body. Now, the Riding-master or Marechal came to the front. It was his duty to buy, train, and treat the Destriers. Therefore, he was compelled to study the nature and constitution of the horse, and was

looked upon as one possessing the highest degree of Veterinary skill known at the time. The office of Riding-master was then considered of no mean importance, so much so, that it was usually held by one of the highest of Military Nobles. It is important, too, to remember that the French word Marechal, which denotes the highest Military officer in France, originally meant a Veterinary Surgeon, and is used to this day as the name for a Farrier. When gunpowder came into general use, Chivalry ceased to be practised in warfare. This brought about the downfall of the old Marechals and their profession. A profession which kings and nobles had loved to teach fell into the hands of a class of ignorant men, who called themselves Riding-masters, but who virtually were no such thing. After this the profession of a Veterinary Surgeon was fast passing again into a mere trade; when the subject received attention in Italy. In the year 1618, Cario Runni wrote an excellent work, with beautiful illustrations. Then France followed and published several works of standard value, one of which was translated into Scotch by Sir William Hope. These efforts seem to have stimulated others to make endeavours to lift the Veterinary art from the obscurity into which it had fallen, and to promote it in the form of a Science. Many Medical men of eminence wrote on the subject and did a great deal to raise the dignity of the profession Among them may be mentioned the names of Gibson Bracken, La Fosse and Osmer. Yet their modes of treatment and application of remedies were in many instance cruel and puerile. As time went on and human medicin and surgery improved, Veterinary Science benefited in lik manner. In the beginning of the last century Veterinar Colleges were in existence in Italy. Next comes Franc where in 1761 a College was founded at Lyons, after whic the now well-known school of Alfort was founded, in 176 In 179? a College at London was founded, and, since th

time, Colleges have been formed in every European capital and the progress towards advancement has been making rapid strides ever since, and more especially of late years. It has now attained a position which it never reached even in the most brilliant days of Greece and Rome. It is no longer a mere art, it has become a Science, and a Science of vast range and vast importance, and has come into line with human Medicine and Surgery. Neither of these two Sciences can hereafter stand apart, the Veterinarian has much to learn from the medical man, and the medical man from the Veterinarian; indeed, the time is not far distant when, for all the higher purposes, the two provinces of Medical Science must coalesce. In India, the Government have instituted schools at Lahore, Poona and at Saidapet. The two former are purely Veterinary schools. Unfortunately, here, at Saidapet we have no distinct Veterinary class. When I say no distinct Veterinary class, I mean although men are allowed to enter the school as paying students, and to attend the Veterinary classes, beyond being granted class certificates, they receive no further recognition of their labors. And while such is the case, we cannot expect men to come forward and take up this branch of Science. I trust, however, that at an early date we will be able to grant Veterinary students some suitable recognition, which will give them a certain status in the professional world, and the public some guarantee as to their ability. Now let us glance briefly at the advantages of a knowledge of Veterinary Science to an agriculturist. To begin with—What could the Indian farmer do without his cattle? They plough his land, raise his water for irrigation purposes, produce manure to fertilize the soil, cart his grain and straw to the market, and serve him in many other ways too numerous to mention. In short, the Indian agriculturist is entirely dependent upon his cattle for his daily bread. If the ryot's cattle die from disease, or if they

depreciate from want of food he is not the only loser. The revenue also must suffer. Rice, the staple food of the people of not only India but of the various parts of the globe to which it is exported, becomes a dear commodity, and thus we have all the attendant miseries of scarcity and high prices. Therefore the careful preservation of the cattle of this Presidency is of no mean importance. It is its main wealth, and should be scrupulously regarded as such. It will probably be not uninteresting to you to know the enormous loss which takes place annually in this Presidency from the ravages of animal plagues. Since the formation of the Cattle Disease Inspection Department, statistics have been collected, and the loss in live-stock from the 1st of September 1882 to the 31st of December 1884, a space of two years and four months, has been seventy thousand and sixty-six, showing a money value of one million, five hundred and ninety-one thousand, six hundred and eighty rupees, or one hundred and twenty-seven thousand, three hundred and thirty-four pounds sterling, which is a very serious matter. These figures must be taken to represent only a fraction of the actual loss this Presidency sustained during the period referred to; for I have known, and have reasons to believe, that owing to the indifference on the part of the village officers and of cattle owners, a large number of deaths among live-stock are never reported. But I am happy to be able to state that during the last official year the death-rate was 17 per cent. less than in the previous one. The Department as at present constituted cannot be expected to do very much, considering the vast area of the Presidency, 150,000 sq. miles, with a strength in live-stock of seventeen millions, eighteen hundred and forty-five-thousand, five-hundred and seventy-six. This does not include Zemindary and Inam lands. Yet, its formation is a great and grand step in the right direction, and the

public more especially the agricultural classes, owe a deep debt of gratitude to Government for maintaining such a Department constantly at their service and at all times ready and willing to promote their welfare. I cannot conclude my address to-day without saying a few words to those young men who have just received certificates of proficiency. This ought to be one of the proudest days of your life. You have obtained that which you have been struggling for, for the last three years. No doubt it has cost you a deal of mental labor, not to mention anxiety. But the thoughts of the past must be allowed to fade from your minds when you consider that you now possess a patent which will enable you to earn your daily bread and give you a status in the world of learning. The lectures you have heard on Veterinary Surgery in this College cannot fail to be of the utmost service to you, for you must remember that a sound acquaintance with the principles on which the growth and maintenance of the bodies of animals depend is a desideratum in the acquirements of those whose future profession will be the cultivation of the soil. Of course it will be readily granted that all scientific knowledge, if of a sound character, is worthy of attainment for its own sake; and what is generally true of all Sciences is particularly so of that one on which I had the honor to lecture to you. It must always have a special place in the education of the Agriculturist. You will find, and have no doubt found already that it fosters a taste for direct contact with stock and for the careful observation of their various peculiarities pointing out the necessity not only of a general acquaintance with domestic animals but of such an attention as only to be acquired by handling them, watching the movements, comparing one with another, and in becoming thoroughly acquainted with them. And let me impress upon you that, if you do not study the peculiarities of an animal in health, you will find it a most difficult matter to correctly diagnose disease. You have enjoyed advantages which many of your predecessors did not, you have had opportunities of putting the theory you heard in the class-room into practice, at the Veterinary Hospital and the dissecting shed. Bear in mind that in the prosecution of your calling, practice is the grand secret of success, and do not forget what I told you in the first part of my address regarding Virgil. Work on, so that your ability may attract notice and tend to your advancement. Learn your profession that you may be able to live by it, that you may be able to deal with the eternal varieties of nature. Cultivate the habit of reading, not merely as a duty, but that it may become a source of enjoyment, and as a guard against the disastrous results of idleness. Not that I would advise you, for one moment, to devote your whole time to reading, as such a course would, in all probability, injure your health. Rest your mind at certain periods of the day and take plenty of exercise; for unless you sustain your bodily health your mind will soon give way, and of all the afflictions which can befall one in search of knowledge, the approach of mental incompetence is without a doubt the most lamentable. You stand now on a vantage ground which the scientists and thinkers of the past in your country never possessed and some return is due by you to the future; that return can only be made by strenuous exertions on your part to add still more to the stores of learning that will fall to those who will come after you. There is yet one sentiment which must always be uppermost in your minds throughout your career, and that is to practise humanity to the lower animals. Be kind to all living creatures yourselves, and endeavour to teach others to be the same. With these words I leave you. (Cheers).

up in the following verse of Sirupunchamoolum:

'கள்புனத் தன்மைபடக்கி காரு காகோர்போக்கிப்
புன்புலத்தைச்செய்பெருப்போக்கியபின் இன்புலத்த
பன்கலப்பைப்பெண்ணிலை பாய்பமிப்பாளுழவோன்
நன்கலப்பை நூலோர் நவார்.'

Translation.—Those who study the science of the simple plough say that he is a husbandman who having stacked hay on his land, daily tills the raw ground with fresh (unworn) ploughs, and thereby converts it into good soil, and after manuring the land, uses the ameliorating plough again.

So, ryots are advised to provide plenty of fodder for their cattle, to use ploughs which are in an efficient state, to manure the land well, and then to plough it in, so that it may not be exposed to the sun.

In the following verse, an advice is conveyed to the ryots to be on amicable terms with their labourers:

பொச்சாப்புக்கேடு பொருட்செருக்குத்தான்கேடு
முற்றுமைகேடு முரண்கேடு தெற்ற
தொழிலாளர்தம் மொடுமாறுபடுவோன்றம்
உழவர்க்குக் கேடென்றனை

Translation.—Forgetfulness, vanity of riches, defective learning, and malice are all alike injurious to one's self, and if a husbandman lives at plain variance with his labourer, be it said that it will ever be injurious to himself.

The following verse is from Vinotharasamunjiri.

எருவிரண்டேருதா வின்றித்திண்டித்தாய்
கிராருகேசேர்க்க நிலையுமைதாய் வராருகே
சென்றவாவெளிதாய்ச் செய்வாருஞ்சேரக்கேட்டின்
என்று முழுவேவினிது.

[redacted]
l situated at a convenient [redacted]
l willing and obedient labourers, then agriculture will er be a delightful occupation.

Thiruvalluvar says—

இலமென்றசை யிருப்பாரைக்காணி
னிலமென்னு நல்லாணகும்.

Translation.—"The goddess of earth laughs ridiculingly at those who keep idle and yet complain of poverty."

There is indeed no excuse for pauperism so long as productive land is available. The able bodied beggars of this country will surely do well to emigrate to where productive land awaits the application of labour.

தொடிப்புழுதிகஃசாவுணக்கிற் பிடித்தெருவும்
வேண்டாது சாலப்படும்.

Translation.—If a soil be so cultivated as to reduce 1 pollum of earth to one-fourth pollum and then ærated, the crop on it will thrive even without a handful of manure.

By the statment that one pollum of earth is to be reduced to one-fourth pollum, Thiruvulluvar evidently means that a *bulk* or *volume* of earth which weighed 1 pollum before, should now weigh only one-fourth so much. For soils are expanded by cultivation, and since density varies inversely as volume, cultivation necessarily lowers the specific gravity of soils.

Thiruvulluvar's assertion that on a well tilled soil a crop will thrive even without manure harmonizes with the fact that tillage is tantamount to manuring the ground by the atmospheric agency which not only supplies ammonia and nitric acid, but also renders inert plant-food active. In fact the total quantity of nitrogen obtainable for a well-

duced by highly fed animals in England.

எரினூன்றுலெருவிடுதல் கட்டபின்
நீரினு னன்றதன்காப்பு.

Translation.—Maunring is more beneficial than ploughing and care after weeding is better then watering.

So Thiruvulluvar attaches less importance to irrigation than to ploughing, manuring, hoeing and weeding. By 'care' is meant care in harvesting the crop at the proper time, preservation from theft, &c. By the statement that manuring is more beneficial than ploughing Thiruvulluvar means that when land has been both ploughed and manured, manuring will contribute a greater share of benefit than ploughing.

செல்லான் வளவனிருப்பினிலம்புலக்
கில்லாளினூடிவிடும்.

Translation.—If the owner of a land does not visit it daily, it will like a wife that is treated with cold reserve, become unyielding.

The purport of this verse is that a man who does not himself look after his land properly cannot very well enjoy it.

The following proverbs are current among the T speaking ryots.

அகலஉழுவதைவிட ஆழஉழு.

Translation.—Plough deep rather than wide.

Some ryots understand by this statement that tillage or intensive tillage is better than extensive till Surely it is advisable to cultivate the land as deep possible, even if on account of the depth of tillage ryot cannot cultivate so much as he would other able to do. For instance it is better to cultivate h ding 7 inches deep rather than cultivate the whole only inches deep. Others would refer the word 'wide' to the rrow itself. At any rate, there can be no question that e depth of furrow is more to be desired than the width.

உழவினும்பசை எருவினும்தீராது.

Translation.—No amount of manure can make up for defective tillage.

For the oxygen of the air serves purposes in a soil h no manures can as satisfactorily fulfil.

அதிர அடித்தால் உதிரவினையும்.

Translation.—If the land be well tilled, the crop will be a bumper one.

மேலுக்கு உழுவார் கூழுக்கு அழுவார்.

Translation—.Those who plough late will suffer for want of food.

Advantage must be taken of the earliest showers so that the land may be sown with as little delay as possible, during the cultivation season. If a day of favourable weather be lost, it is possible that we may have to wait for a very long time for such weather, if at all we have it again during the season.

Milk

ஒரு வேலி ஒன்றுக்கு சாணைமாடும் இரண்டு ஆளும் வேண்டும்.

Cultivation.—For every Veli (5 cawnies=6·6 acres) of Trans es of oxen and 2 labourers are required.

d, 2 yok overb refers to wet land. Several agricultural This p uch as Dr. Buchanan, the renowned tourist of orters other parts of Southern India, and Mr. Clogsore an uty Director of Revenue Settlement, Coimbaun, De agreed that for every 3 acres of wet land, a e, hav and a pair of cattle are required. Mr. Krishnaugh Moodelliar of Sheally finds one improved country , costing about Rs. 5, and, of course, 1 pair of cattle

and 1 labourer to be sufficient for about 13 acres of l
land.

நிலத்தில் எழுந்த பூண்டு நிலத்தில்மடியவேண்டும்.

Translation.—Plants growing on a spot must eventu
ly decay there alone.

Whatever is taken from the soil must eventually
restored to it.

அசையோபயிர் அடம்போ குடித்தனம்.

Translation.—People must live close, but plants m
be wide apart.

In other words, thick sowing is bad.

ஐதுநெல் அடர்ந்தது சுற்றம்.

Translation.—Distance between paddy plants and
closeness in relationship are desirable.

வேலி ஒன்றுக்குப் பன்னிரண்டுகலம் விதைப்பாடு.

Translation.—Twelve Kalams (1 kalam = 24 Madra
measures) of seed are reqnired for 1 Veli (6·6 acres)
land.

The seed referred to is probably paddy.

The quantity of paddy sown per acre, according to t
proverb, is about 44 Madras measures or abou
In transplanting paddy, the ryots use a m
quantity than in broad cast sowing. On the Sai
very good outturns of paddy equalling those
and Coimbatore have repeatedly been obtaine
tity sown per acre being about one-fourth of t
mentioned quantity.

(To be Continued.)

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MILK.

In the current number of the Bath and West of England Society's *Journal* there is a full report of the lecture delivered on the above subject by Dr. J. Voelcker in the Parkes Museum of Hygiene last year. In view of the great interest that is being taken in all matters relating to the dairy, it may be of value to present a short *resumé* of the paper to our readers.

Milk is a very complex liquid, yielded by the mammary glands of all animals belonging to the order mammalia. The composition varies greatly, and depends on a number of circumstances. Under the microscope it has been to be a clear liquid full of little globules ; those globules prove to be pure butter-fat surrounded by a skin of casein. They are of different sizes, not only in the same sample of milk, but also in samples procured from different breeds. They are very large, for instance in the case of the Jerseys. Butter being a fatty substance, is lighter than water, and, therefore, will float in it, and so these particles rise to the top in milk and constitute cream ; the larger ones rising quickest, the smaller ones perhaps not

at all. In the process of churning the "skins" of th
globules burst and allow the contents to unite and fo
masses of butter. It is necessary to say, however, t
authorities are not at all agreed as to their being
actual skin or envelope of casein; this latter substance
the cheese forming ingredient—is present in solution, an
some say that there is a more condensed portion round th
particles of fat, but not as a definite coating. These
globules float in a solution in water of the following
bodies:—Casein (as above), albumen, milk-sugar and
mineral matters.

The casein when precipitated by the action of rennet or by the milk turning sour, forms curd, which will ripen into cheese: the butter particles being entangled therein and enriching it. Why casein is precipitated by these agents is a matter yet to be explained. The whey which separates in this process contains nearly all the albumen and milk sugar, and some of the salts. Casein will not coagulate by boiling, but albumen will, on removal of the casein. Milk-sugar or "lactose" remains in whey after removal of albumen, and, if the liquid is evaporated down crystals of this substance will be deposited. It has very much less sweetening power than ordinary cane sugar. In the natural souring of milk this substance is converted into lactic acid by the action of a ferment known as the *Bacterium lactis*, and those substances are natural precipitation of the curd, obtained in followed by the matters left after a quantity of three-fourth of salts are the solid to dryness and the residue ig been evaporated of phosphates of lime and ey consist chiefly d.) of potassium and sodium. ia, and chlorides dairy farmers have found it replace these that other phosphatic manures t ary to use bones and their soil. ep up the fertility of

The composition of perfectly pure milk varies greatly, but the following may be taken as a sample; it is the average of eight analyses by the late Dr. Voelcker:—

Water	86·84
Albuminoids	3·95
Fats	3·80
Sugar	4·60
Ash	0·81
	100·00

This gives 13¼ per cent. of solids, but Dr. J. Voelcker states that we may take the minimum of good milk as 8½ per cent. of solids, not fat, and 3 per cent. of fat, or 11½ together, and water 88½ per cent.

The lecturer gives a list of some twelve British breeds of cattle which are suitable for dairy purposes, but it may be questioned in case of some of these if they are adapted for the production of milk on a paying scale—as milk or its products. He gives the palm to the Shorthorn as a dairy and meat producing animal.

The effect of different kinds of food on the quality and quantity of the produce is shortly commented on. Cows feeding out-of-doors in summer were found to have a very low percentage of fat—only 1·79 per cent. while when these same animals were put in-doors in autumn and given an allowance of meal, &c., the fat rose to 3·76 per cent. The milk during the day time, also, was found to be poorer than that secreted during the night, owing to the feeding. Particular foods, if taken in too large quantity, influence the flavour of the products, as, for instance, in the case of turnips. The evidence with regard to ensilage is as yet contradictory.

The milk first drawn from the udder is poorer than that taken last. The cream has begun to rise even in the

organ, and the glands tend to re-absorb the watery portion when filled up, thus making the residue richer in solids.

There are several instruments used in the analysis or testing of milk, the simplest of which is the lactometer, which will show to a certain extent the amount of water—if any—which has been added. The others require more or less knowledge of chemical manipulation.

Dr. J. Voelcker finishes by pointing out that the principal matter to be attended to in working with milk is perfect cleanliness. A good supply of pure cold water is an absolute necessity. The milk will require to be cooled, the vessels to be washed, and the animals water to drink, and in all and any of these an impure supply will spoil the produce and the animals, not to speak of the dissemination of infectious diseases.

There is nothing very new or very fresh in the lecture, but a perusal of the original cannot fail to be interesting and useful to all connected with the dairy interest.—*English Agricultural Gazette.*

PROCEEDINGS OF THE ASSOCIATION.

Saturday, April 25th, 1885.

The Vice-President Mr. G. Krishna Prabhu, B.A., *in the Chair.*

The paper read was:—

The Cultivation of the Ground-nut,

By Mr. K. Krishnamachariar of Anantapur.

History.

Ground-nut as an oil yielding plant seems to have been long known in India, though its original home is universally believed to be South America, from whence it was transported to Britain in 1712. When and by whom was this plant introduced into this country is not exactly known. It is extensively cultivated in South India and in some parts of

Bengal and Upper India. The first recorded export of Ground-nut oil from this Presidency was in 1848 and 49. Since then, it has become gradually an article of great commercial importance, so much so, as to interfere with the French trade in olive oil.

Uses of the plant.

It is cultivated for the sake of the oil which the seeds yield on expression. The oil is used for pharmaceutical purposes, also for lamps, and for lubricating machinery. It is used in the manufacture of soap and in the preparation of sweetmeats. The cake is a very valuable food for live stock and an excellent manure when applied to the soil. The husk, though hard and woody, forms a good manure when well decomposed. The plant also ranks as a valuable fodder herb as it furnishes much nutritious haulm for forage.

How the seed pod produced.

Arachis hypogéa is particularly remarkable from the manner in which the fruit is produced. The young fruit, instead of being placed at the bottom of the calyx, as in other kinds of pulse, is formed at the bottom and in the inside of a long slender tube which looks like a flower-stalk. At the same time, the stalk of the fruit lengthens, until the point strikes the earth into which the now half-grown fruit is speedily forced and where it finally ripens. When mature, it is a pale yellow wrinkled oblong pod often contracted in the middle. The plant possesses a long tap root which extends deep into the earth, drawing thence the nutriment which is beyond the reach of many of our cultivated crops. The plant is an annual, as it passes through all the phases of its existence in one year and it is a lime-feeder.

Area under ground-nut

In this Presidency the total area under ground-nut cultivation is 73,568 acres of which in South Arcot 48,220, Tanjore 8,649,

Chingelput 7,876, Trichinopoly 5,796, Salem 1,288, North Arcot 1,249, Coimbatore 470 and Godavery 20 acres are cultivated.

Selection of land.

A light loose calcareous soil is best fitted for its growth. It thrives well on sandy soils containing a fair amount of phosphates of lime, potash and magnesia. The outturn of nut and the percentage of kernels and oil are great when the plants are grown on light loose reddish loams. Very stiff clays and soils containing much saline matters are not well adapted for its growth. The crop has a very strong aversion for stagnant water, therefore it will not grow on land which is always wet or on which water is likely to stagnate.

Mode of cultivation.

About the month of June or even earlier if there be a shower of rain, the land is freely ploughed twice or thrice and all the weeds are extirpated. Until the time of sowing the seed, the soil is every now and then stirred so as to expose every particle of it to the beneficial action of the atmosphere.

Manuring.

When the land is ploughed and a perfect state of tilth is obtained it is liberally manured by penning flocks of sheep at an average of 400 to 500 head per acre or by the application of 20 to 30 cart loads of well decomposed farm-yard manure.

The first method is decidedly a better one; for both dung and urine may be utilized; but they are not secured, for most of the volatile ingredients contained in them are lost by exposure to sun and wind, leaving for the use of plants only a very small quantity of valuable mineral matters.

Selection of seed.

As a rule in preserving ground-nut for seed much care is taken. Heavy and good looking pods are selected and dried in the sun

for about 4 or 5 days. Sometimes the pods are exposed to the action of dew in the night, next morning they are dried in the sun as usual. This is done, they say, in order to protect the seeds from being attacked by insects. The pods are then put in pots with some ashes and a thin layer of straw at the top, and the pots are then closed with cow-dung.

Preparation of seed for sowing.

A day previous to sowing, the pods are decorticated by hand. It must be remembered that if the pods are shelled or husked either by being trodden or by being beaten with a stick, as is generally done for expressing the oil, the embryo between the cotyledons is loosened or otherwise injured and consequently the percentage of vital seed is remarkably diminished. Seeds, as a rule, germinate better when sown within 2 days after being decorticated. And if kept mixed with husk in an open basket they are fit to be sown 4 days after separation. Blanched seeds or seeds whose thin brownish colored covering is removed, never germinate.

Seed necessary per acre.

About 30 to 40 Madras measures of seed are necessary for sowing an acre. Under favourable circumstances and careful management a less quantity may be sufficient.

When sown.

In July, or if there be no rain in that month, after the first shower in August, the field is ploughed twice in the morning, and in the afterpart of the day the seed is generally sown.

Thick and thin sowing.

On poor soils the seed must be sown thickly. On rich soils they must be sown thinly. More seed is required if the crop is sown late in the season.

The mode of sowing the ground-nut may seem to be very peculiar. A man with a pair of bullocks and a plough goes on opening staight furrows; and 3 men, or 4 men, with sacks of seed around their waist follow the plough and drop the seeds 5 to 6 inches apart. When the ploughman opens the second furrow, the soil raised by the plough partly covers the seeds in the first furrow; thus the soil from each subsequent furrow covers the seeds in the previous one. After the whole field is thus sown a heavy levelling plank is dragged over it for the double purpose of consolidating the loose earth and of covering wholly the seed sown. The field is then squared into beds of 6'×6' so as to facilitate the subsequent irrigation in case the periodical rains disappoint. Undecorticated pods are rarely sown. In this case more moisture and longer time are required for the seeds in the hard woody shells to germinate. Another difficulty is as there may be more than one seed in a pod it must be broken before it is dropped into the furrow. Transplanting is not practised here.

How sown.

If too much moisture be present in the soil when the seed is sown, a hard incrustation will be formed by evaporation which effectually prevents the young plants from shooting upwards. Another evil effect of over-supply of moisture is the rotting of the seeds under ground. If too little of it be present in the soil the seeds would not germinate for want of sufficient moisture. Sound common sense and good practical experience are necessary to guard against such faults.

Sound practical experience necessary.

During the day time for about 3 or 4 days, after the seed is sown, crows begin to pick them up from within the soil. To prevent this a long post is fixed in

Ravages by crows and Jackals. How prevented.

the centre of the field. To the other end of it is suspended a dead crow or at least its wing and feathers. Jackals do more harm during the night, they may be prevented by watching the fields till the seeds begin to germinate.

The time which the seeds take to germinate depends upon the nature of the soil and the condition of the weather. On the 4th day after sowing some plants may be seen coming through. By the end of a week the whole field will be covered with the young plants. If for want of moisture the young shoots strive in vain to come through, you may safely irrigate the field. The next day the young plants will all shoot upwards.

Time which the seed takes to germinate.

When the plants are about 3 or 4 weeks old, they attain to a height of 4 to 6 inches. The field is then hand-hoed for the first time and the plants if overcrowded are thinned out.

After cultivation.

As the ground-nut pods are borne under ground, a good outturn will depend on the lateral branching of the plants over the soil; but if the plants are too near each other they will grow straight up with but few side branches. Moreover when the plants are overcrowded they will prevent the free circulation of air between them and consequently the plants will suffer from *rot* a disease in which the lower branches begin to decompose.

Too many plants objectionable.

When the plants begin to flower and the small tubules which are to be the future seed pods, elongate, growing downwards to penetrate the soil the crop is handhoed a second time.

Second hoeing.

As a rule for about a month from the date of sowing no watering is necessary; after that period unless the monsoon rains help

Irrigation.

the cultivator, the ground-nut fields require to be watered once a week during dry weather and fortnightly if the season be fair.

Too much water injurious.

Excess of rain or water turns the plants pale and weak, the fields when frequently flooded yield slender and weak nuts (pops) which are often empty containing no seeds in them.

Signs of maturity.

In about 6 to 7 months the growth of plants ceases and they begin to wither. Dig up some pods and if they are hard, break readily with brittleness and the kernels inside have a reddish brown covering, it is certain that the crop is sufficiently matured. Withhold watering and allow the plants to dry.

Harvesting the crop.

A portion of the field is moistened in the evening, and the plants are pulled off next morning. The soil is loosened with a small pick and the pods are collected.

Stacking the hay.

The vines of the ground-nut plants are dried and stacked. This hay is considered to increase the secretion of milk in cows.

High wages paid in kind.

Wages to coolies who pick the pods is always paid in kind. It varies with the quantity of pods to be found in the field. If there be plenty, one part out of every six which a cooly collects forms his share; but if the yield be poor the fruit of his labor is equally divided between him and the cultivator.

Labor difficulty.

The chief difficulty which the cultivator has to encounter in the cultivation of ground-nut is in securing a sufficient gang of coolies at the time of harvest notwithstanding the high wages he is prepared to pay.

Less expensive mode.

In some places where water flows to the field by gravitation the following less expensive mode of collecting the nuts is adopted. The plants are first removed and the nuts underground are allowed to dry thoroughly. The field is then moistened and ploughed. Water is then let in till it is 6 inches to a foot in depth. The soil is then well stirred until all clods are well disintegrated. The pods being lighter than water are easily collected.

Harvesting time is attended with uncertainty.

Before harvesting, the pods are dried underground. A gentle shower of rain will make all pods sprout before a sufficient number of coolies can be gathered.

Present system of cultivation considered exhaustive.

The ground-nut crop as generally cultivated in this country is considered to be a very exhausting one notwithstanding the accumulation of partly decomposed vegetable matter to a uniform depth of one to one and half inches over the whole field. Whatever may be the decrease in other constituents of the soil one thing is ascertained beyond all doubt (*viz.*) that the land is positively better stored with organic matter at the end of the period than it was before the crop was grown, while the general experience has proved in a more conclusive manner that the field subsequently planted with ragi without the least application of manure gives better results than when the crop is grown on other lands, (not previously sown with ground-nut.)

Prices fluctuate.

Generally the nuts are sold by the cultivator at so much per cart load which is equal to nearly 11 Madras colums or 1000lb. If there were no foreign demand the prices will be as low as Rs 25 per cart load, and they rapidly rise to Rs 40 if there be any.

The approximate cost of cultivating an acre of land with ground-nut :—

	Rs.	A.	P.
Ploughing 6 times at 12 annas each time.	4	8	0
Manuring with 24 cart loads of manure ...	6	0	0
Seed, about 35 measures	3	8	0
Sowing	1	4	0
Hand-hoeing twice...	2	4	0
Well irrigation, 4 times	6	0	0
Rent	4	0	0
Wages to coolies paid in kind (half a cart load)	17	8	0
Total expenditure... ...	45	0	0
Net outturn of nuts per acre about 3 cart loads at 35 Rupees	105	0	0
Two tons of straw	10	0	0
Total ...	115	0	0
Net profit to the cultivator	70	0	0

Manufacture of the oil.

Husking the nuts. The nuts are thoroughly dried and beaten with sticks, the seeds are separated from the husk by winnowing.

Labour required. The services of 2 men and 1 woman are required for 6 hours to husk a cartload. The outturn of kernels is nearly 4 colums or about 360lb. The wages paid to them is nearly annas 10.

Expressing the oil. The kernels are pressed in a mill for the sake of the oil they contain.

The oil mill. The native oil mill consists of a wooden or granite mortar with a pestle. Generally 2 oxen are yoked to a projecting spar or geering. About 30 to 40 Madras measures of seed are thrown into the mortar and about a measure of water is added in the beginning. As the mill goes on grinding, a man is engaged in throwing in the seed which may have got displaced. In about 4 to 5 hours the oil fills the mortar while the fibrous cake lines it.

The grinding is then stopped; the pestle removed and the oil is taken out and strained while the cake is scraped out and dried.

Outturn of oil and cake. One hundred measures or about 300 lbs. of kernels yield about 25 to 30 measures of oil and 35 to 40 visses or 110 to 125 lbs. of cake; more oil may be obtained when the seed is pressed in an improved oil mill. By heat and pressure the quantity may be increased to nearly half the weight of the nuts.

Imperfect separation of oil. It is a curious fact and illustrative of the imperfect manner in which the oil is separated from the seeds that in France the cake obtained from this country is once more subjected to pressure and from 10 to 12 per cent. of oil is easily procured.

Not a serious loss if cake be given to cattle. When the oil cake is meant for feeding the stock such loss is of little consequence. But when the cake is directly applied as manure it is a serious loss, inasmuch as the oil contained in the cake is of little or no use in adding plant food to the soil.

Properties of oil. It is a fixed edible straw colored oil, much esteemed for domestic purposes as it does not become rancid so quickly as other oils. Its specific gravity is 0·916. In brilliancy it is far superior. In an experiment made in France as to the relative

combustion of ground-nut oil and olive oil in a lamp having a wick of one-eighth of an inch in diameter, it was found that an ounce of ground-nut oil burned 9 hours and 25 minutes while olive oil under similar circumstances burned only 8 hours. It has an additional advantage of giving no smoke. In this country it is used for adulterating gingelly oil and in Europe the clarified oil is passed off for olive oil.

The cake.

The value of the cake as a feeding stuff has been clearly shown both by experiments and scientific reasoning.

It is often complained by cattle owners that its use is often attended with hard-breathing in their cattle. No doubt there is some truth in what they say; but if a dessert spoonful of salt be given with the cake the evil effects will be prevented. Experiment has proved that draught cattle will keep in better condition when solely fed on this cake than when fed exclusively on horse gram. As a food for horses this cake may safely be recommended. In the beginning the plan to be adopted is to deduct one-half the usual allowance of gram and substitute for it an equal weight of cake. In this way a saving of 25 per cent. could be effected in the cost of food of every horse now fed on gram while the condition of the animal also would be improved. The analysis of this valuable article will be useful.

	Per cent.
Moisture	11
Oil	10
Allumunods	30
Sugar starch, &c.	36
*Ash	3-5

the high percentage of introgenous matters explains why the cake is so valuable. It may be observed here that the high percentage of nitrogenous compounds in the cake causes a great increase in the value of manure by animals fed on it; for it is proved by the best authority on the subject Mr. J. B. Lawes of Rothamstead that the loss of nitrogen in the consumption of cake is about one-tenth of that which it contains, the rest passing off in the manure.

*Contains phosphates and phosphoric acid.

The export of this article as kernels is an agricultural loss.

Enormous quantities of ground-nut kernels are exported yearly from this Presidency. As an instance I may here state that the quantity of seeds booked at one small Railway Station, Nagari in the Karvetnagur Zemindari, during the year 1884 was about 90,000 maunds of 82-2/7 lbs. each or 3,806 tons. It represents a very serious loss of rich manural matter to the motherland from which the nuts were obtained.

DISCUSSION.

Mr. T. Guroosawmi Naidu of South Arcot rose and said thus:—

In South Arcot where the crop is extensively cultivated, the crop thrives well on sandy loams containing a small percentage of organic matter. The crop is also cultivated on clayey soils; cattle dung and village ashes are generally used as manures. The ground is well tilled and manured. The seeds are sown between the middle of August and September in the furrows made by the plough 6 inches apart. The furrows are 3 to 4 inches deep and 5 inches wide; after depositing the seed the furrows are covered with soil. After a shower of rain the seeds are sown or if there be no rain the field is irrigated after sowing. In about 10 days all the seeds germinate, the field being watered once in every 3 days. When the crop is a month old it is hand-hoed. The crop is harvested in the

middle of January or in February. The outturn per acre under ordinary circumstances is 80 colums of nuts per acre, which when husked give 30 colums of clean seed; a colum being equal to 30 Madras measures. This represents a money value of Rs. 60. Deducting the cost of cultivation, &c., 35 to 40 rupees is the profit per acre. Under favourable conditions and better management the yield may be Rs. 100 per acre. The ground-nut is a creeping plant, it produces creeping stems and covers the ground like a pasture. The nuts are underground and by digging they are taken out. The seeds supply an oil called ground-nut oil useful for illuminating purposes and in cooking. The smoke formed by burning the oil is said to make the eyes dim. The oil is used largely to adulterate gingely oil; the fraud is difficult to detect except when present in large quantities. The cake is given to animals as food. The nitrogen gives nourishment to the animal and the oil fattens it. It is said to increase the quantity of milk. The stems and leaves form an excellent fodder even when dry, cattle like them very much. The husk is used for fuel. Every year thousands of tons of ground-nut are exported from India. Thus the country not only loses the oil but also much manural matter. The crop is fallowed by ragi or cumboo as summer crops. Many of the ryots of the Cuddalore Talook complain that they do not now get as much produce as was obtained some years ago. This is mainly due to the repeated cultivation of the crop on the same land. Where the crop is first introduced it yields a good outturn. Although the crop is an exhaustive one under the present management it may be made to be a restorative one under improved cultivation whereby all the refuse must be returned to the soil.

Mr. Washiker of Kolhapore next made the following remarks :—

The crop is useful to the farmer as it affords food to him, to his cattle and to his soil. It is difficult to extract all the oil by the rude country mills as in the case of sugar-cane mill. This is clearly shown by the fact that the Europeans who buy the cake, extract out of it by improved mills so much oil as to afford them a fair profit.

Mr. Surbhai of Bombay then said that he could not understand the statement of the lecturer that the field is some times puddled to collect the pods.

Mr. Rungachariar then observed: In North Arcot the land selected is usually a sandy soil. The average seed sown is 25 to 30 Madras measures. Except in a few cases where the crop is irrigated, it chiefly depends on rain. Before harvest the crop is allowed to be grazed down by cattle, water is then let in and the field is ploughed several times, more water is then let in and by means of pads the soil is well stirred, the nuts then float these are then swept, as it were, by means of a light plank to one corner of the plot. The nuts are then easily collected and dried.

Mr. C. K. Subba Row then said :—

Ground-nut is often called, in bazzars, in Tamil, 'Manilla-Kottay.' That it is not indigenous to the country is, therefore, clear. In the Dutch Guinna there is a plant known by the native name Gobbe which like ground-nut matures its pod under ground. Ground-nut is a product of much commercial importance. In 1848 and 49 about 37,000 gallons of ground-nut oil were shipped from this Presidency. About 300,000 gallons are now exported annually. Pure ground-nut oil does not become rancid so soon as other oils, and gives off very little smoke in burning. The nut is used as a substitute for chocolate. Its oil is used as a substitute for olive oil and in the preparation of salads in France and America. It is considered one of the

most bilious things known in this Presidency. Ground-nut cake is very nutritious stock food; but the ryots are of opinion that bullocks fed on its cake are unfitted for hard work. They suppose that the cake causes what is called in Tamil ஏப்பம் *i.e.*, hard breathing; but no such effects are observable in the Farm cattle which are fed on the cake. The cost of maintaining the horses may be materially reduced if a portion of the daily allowance of gram be replaced by the cake; and the eggs of the fowls fed on the cake are known to improve in flavour. In no other seed is there such a large portion of the starch mixed with the oil. The ash of the seed consists of salts wholly soluble in water, being phosphates of the alkalies with traces of alkaline chlorides. About 12 per cent. of the husk is ash which consists chiefly of common salt and phosphates of lime and magnesia. Ground-nut requires a porous soil rich in lime; and if the soil is poor in it, the crop rushes to stem and leaf and produces what are known as pops in America. Many practical American farmers have recommended that the immediate cultivation for ground-nut be shallow, for the crop will bury its pods deep into a deeply tilled soil whereby the harvesting of the crop is rendered difficult. But deep cultivation is very desirable for the ground-nut crop which makes so large demands on the soil. To make both ends meet, the soil must be cultivated deep a long time before sowing the crop, allowed to settle and cultivated about 4 inches deep. If necessary, the ground may be consolidated by rolling. For sowing the seed, make beds 2 to 3 feet wide and about 2 or 3 inches high with furrows 1 to 1½ feet between; sow two rows of seed on each bed 12 to 18 inches apart, 2 seeds being deposited at intervals of 1 ft. in the rows. Frost aids the American farmer to a great extent in harvesting the crop; for the harvest begins after the first frost when

the soil is crumbled. The haulms are dug up with digging forks and are then pulled off; 2 days after harvest, the haulms are stacked for about 2 weeks on a platform made of small poles in such a manner that there may be a free supply of air among the plants. The seeds give from 44 to 45 per cent. of oil if pressed in an efficient press. If the seeds be heated before being pressed, a larger quantity of oil is expressed; but the oil is then inferior. I may inform Mr. H. K. Wasker that there are already several screw presses in Madras where ground-nut oil is expressed. It is the oil which is chiefly required for the foreign market. If oil only be exported, we shall only be exporting, as it were, carbon, oxygen and hydrogen and save cattle food and manure for the country, and reduce also the charges on account of freight, while the commercial prosperity of the country will be maintained. No crop so well pays the ryot as ground-nut in dry cultivation. In the Botanical Garden, under moderately good cultivation nearly 22 lbs. of ground-nut was obtained last season from a small plot, the yield being nearly half a ton per acre, although the seed was sown very late, and was exposed in its early stage of growth, to the unprecedented heavy showers of October, November and December.

M. Rama Row of Mysore.—Lime is indispensable to the proper growth of ground-nut. In soils poor in lime, the produce will be simply 'pops,' that is to say, hulls without kernels. It is plain, then, that lime is an indispensable ingredient for the perfect development of the nuts. Ground-nut cake is a very nourishing food for cattle. Mr. Subba Row said that it produces hard-breathing when given to cattle. This is quite true, as I have seen it myself. The best mode of averting this difficulty is to give a proper quantity of salt daily with the cake. The lecturer said that 30 to 40 measures of seed are sown per acre: but I cannot quite concur with him, because I have

never seen more than 8 to 10 measures sown per acre. It has been already pointed out by some speakers that it is very largely exported to France, and in corroboration of this, I have to observe that within one week in April 6,500 bags of ground-nut were exported to France from Pondicherry. Unless the oil manufacture is carried on in the country there is no chance of farmers fully realizing its profits.

The chairman said he had no doubt the Meeting appreciated the trouble taken and the care exercised by Mr. Krishnama Chariar in writing the interesting paper and invited the Members to give their opinions on the points treated of.

VERNACULAR QUOTATIONS ON AGRICULTURE.

By Mr. C. K. SUBBA RAU,

(Continued)

சிறை விதைத்தவன் சிறை அறுப்பான்.

Translation.—'He who sows sparingly will have a meagre crop.'

It is always better to sow too much rather than too little seed. If the crop is found to be dense, it may be thinned, and the surplus plants may be sold, used as fodder or otherwise disposed of.

அவரைக்கும் பருத்தியும் அடர விதைப்பரோ?

Translation.—Cotton and castor seeds must not be sown thick.

In order to economize the ground under these crops they must be sown in lines at least 4 feet apart, the interspaces being occupied by tall growing crops such as cholum.

ஆடியை நோக்கிப்போடு.

Translation.—Provide seed-corn and sow it in July.

A wise farmer will provide himself with good seed a considerable time before the cultivation season begins. If seed be procured in a hurry just when it is wanted, there may not be time enough to test it properly, and if bad old seed thus happens to be sown, it will not germinate and the season may be either far advanced by the time the land can be re-sown, or may be lost.

இரைத்தவன் எள்ளுவிளைக்கவேண்டும் கொழுத்தவன் கொள்ளுவிளைக்கவேண்டும்.

Translation.—'The poor must sow gingelly and the rich horsegram.'

Horsegram is supposed to have a tendency to rush to stem and leaf, and such tendency is the least in gingelly. A poor man cannot afford to bear the risk attending the horsegram cultivation. Whether this interpretation of the ryots is correct is open to doubt.

கதிர்கனிந்தும் களைபிடுங்கு.

Translation.—You must hoe and weed the land, though it be at the risk of shedding corn from the ear-heads.

எள்ளுக்கு ஏழுழவு கொள்ளுக்கு ஒருழவு.

Translation.—Gingelly requires 7 ploughings whereas one ploughing is enough for horsegram.

This shows that horsegram is hardy and grows fairly even under indifferent cultivation.

உழக்குளிர் அடித்தால் நாற்று பிடுங்கப்படாதா.

Translation.—If it is too cold to plough, why not put out the seedlings?

A farmer must as far as possible provide himself and his cattle with work adapted to the different kinds of weather experienced. If the soil is saturated with moisture and the weather cold, it is advantageous to transplant seedlings.

மெல்ல மெல்லப்பாயும் தண்ணீர் கல்குழியப்பாயும்.

Translation.—Water which flows slowly will soak even into the hard stones.

Water which flows rapidly will moisten only the surface of the ground.

எமன் ஒருவனைக்கொல்வான் ஏற்றம் மூவரைக்கொல்லும்.

Translation.—Yama (the Hindu Pluto) can kill but one man at a time; but the picottah will kill three at once.

Most picottahs are worked by 3 men, two men walking to and fro on the lever beam, and the other raising and lowering the bucket pole. These men often fall and are severely injured.

ஏரி உடைபடுதற்குமுன்னமே அணைபோடவேண்டும்.

Translation.—Construct a ring bund in time to prevent the tank from being breached.

முடப்புல் முக்கல நீரைத்தடுக்கும்.

Translation.—A handful of straw is capable of withstanding 3 kalams (about 27 gallons) of water.

When a tank bund is in imminent danger of being breached, the ryots prevent the catastrophe by putting heaps of paddy straw, brushwood, &c., on the inside of the bund where it is weakest, and treading them in with clay. The elastic straw withstands the hydrostatic pressure very well.

இறைத்த கிணறு ஊறும் இறையாத கிணறு நாறும்.

Translation.—A well whose water is largely lifted up will be kept always fresh and wholesome by the springs. Otherwise it will stink.

தொட்டனைத்தூறு மணற்கேணி.

Translation.—If water be tapped in a sandy stratum, the deeper you bore it, the deeper will be the water in the well.

பசு நெடுவாலும் எருது குறுவாலும் ஆகாது.

Translation.—A cow with a very long tail and a bullock with a short tail are bad.

மாடுமுக்கி வரவீடு கஷ்டவரும்,

Translation.—If the cattle come home hungry, there will be no prosperity for the family.

Cattle are indeed sent long distances for grazing. They only find a few tussocks of short coarse grass and return home hungry, undergoing much waste of tissue in the journeys to and fro.

கொன்றப்பாவம் தின்றப்போகும்.

Translation.—The sin arising from the killing of animals is absolved in consuming them.

"It is allowable to kill animals which may thereby become of use to us."—*Chambers' Moral Class-book.*

வைக்கோல் தின்கிற மாட்டுக்குப் பால் கொஞ்சமதுரம் அதிகம்.

Translation.—A cow which is fed with paddy straw will give but a small quantity of milk which will, however, be very sweet.

The ryots understand that cholum straw promotes the secretion of milk and that inferior straw such as paddy straw, wheat straw and varagoo straw, decreases the secretion.

The following two slokas (couplets) are from Parasara Smrithi.

క్షుధితంతృషితంశ్రాంతంబలీవర్దం నయోజయేత్ । హీనాంగంవ్యాధి
తం క్లీబంవృషం విప్రోనవాహయేత్ ॥

Translation.—A Brahmin must not employ for draught (of tillage implements) cattle which are hungry, thirsty, easily fatigued, deformed, diseased or impotent.

By 'impotence' is here meant natural impotence and want of spirit and vigour, and not the artificial impotence caused by castration.

క్షీరాంగాంశ్చబలవత్పుష్టాన్ సన్నదాన్ కుంజరాభాన్ వాహయేద్దివసా
ర్ధం పశ్చాత్స్నానం సమాచరేత్॥

Translation.—After having driven for half a day, cattle which are muscular, healthy, well-barrelled, smart and bellowing, and endowed with good masculine power, the Brahmin must bathe.

மாரிவளம்பொய்க்கி னூர்க்கின்னாவாக்கின்னா
மூரியெருத்தி னுழவு—திரிகடுகம்.

Translation.—Failure of rain is bad for the country and so also is the tillage performed by old and weak cattle. Thirikadugum.

The following slokas are from Dharmaprakasika.

వాచొద్వాంశ్య కేనైవ శాఖయా వానపత్రయయా। నదండేన నయష్ట్యా
వానపాకేన నదాయయా॥

Trahslation.—The ploughman must endeavour to drive his cattle, if possible, solely by his voice. If this will not do, he may use a green twig with leaves on it. He must on no account use stout sticks or whips for driving.

Unfortunately, the cultivators of the wet lands are so cruel as to tip their whips with a sharp nail or needle and prick the hind-quarters of the animals, especially, the buffaloes, until they cause circular sores which may be commonly observed in Coimbatore in the ploughing season.

అష్టగవం ధర్మహలం షడ్గవం జీవితార్థినాం। చతుర్గవం నృశంసానాం
ద్విగవం బ్రహ్మఘాతినాం॥

Translation.—A charitable man will yoke 8 oxen to a plough; an ordinary ploughman 6; a homicide 4; and a Brahminicide 2.

It is, therefore, considered a very grave sin to yoke only one pair of oxen to a plough. The spirit of the sloka is that we must not overstrain our cattle.

The sloka admits of another interpretation, viz.: "A charitable man will *keep* 8 oxen for each plough, &c.

The following proverbs indicate the importance of the trees in a country.

அடைமழைவிட்டும் செடிமழைவிடவில்லை.

Translation.—The trees continue to drip water long after the rain has ceased.

If there be no trees at the sources and catchment basins of rivers, the water of the heavy rains will for the most part only accumulate on the surface and rush to the sea. But if there be forests in such situations, the vast mass of foliage will catch the showers and drip the water slowly to the ground, enabling the soil to absorb the water thoroughly.

எட்டிமரமானாலும் வைத்த மரத்தைவெட்டாதே.

Translation.—You ought not to cut a tree which you have once planted, though it be an Etty tree (Strychnos nuxvomica.)

The poison-nut tree is considered by the ryots quite worthless. Even if a forest be composed of only such trees, the denudation, it is understood is productive of evil.

Fences. வேலிபயிரை மேய்ந்தால் விளைவது எப்படி.

Translation.—If the hedge grows at the expense of the crop, how is it possible to have a good crop?

This is one of the reasons urged by the ryots for not having hedges round their fields. They suppose also that the wind blowing from corkapully, and certain other fences is injurious to the crops. The roots of corkapally, it has been found, spread within a radius of 15 feet even when the

plants are about 4 years old and, of course, tend to exhaust the soil. This is, however, not a very serious evil. This may be overcome by manuring the headlands. Mulberry and certain other fences are considered unobjectionable.

வேலியைத்தக் காப்பாற்றாத கன்றும் ஆலையைத்த ஆட்டாத வாணியனும் சரியல்ல.

Translation.—Plants which have no protecting fences and a sugar planter who possesses no mill cannot thrive.

The following couplet about Salt lands is from Hithopadesa.

"మరుస్థలియథావృష్టిః క్షుధార్తే
భోజనం తథా । దరిద్రేదీయతేదానం
సఫలం పాండునందన॥

Translation.—O son of Pandu, alms benefit the poor to the same extent that food benefits the hungry, and rain benefits the salt lands.

In the dry weather, the salts in a salt land accumulate at its surface and form an efflorescence. When there is rain, the salts are washed down into the soil. The surface soil containing then no excess of salts, the plants will be healthy.

Weather proverbs.—*எறும்புமுட்டைகொண்டு திட்டையேறின் மழைபெய்தது.*

Translation.—If the ants crawl up a mound with their eggs, rainfall at hand is certain.

It is wonderful that this proverb should closely agree with what Virgil says in the following lines, (translated) in describing the signs of approaching rain :—

"The careful ant her secret cell forsakes
And drags her eggs along the narrow tract."

காலை செம்மானம் கடுமாரி
அந்தி செம்மானம் அழுதாலும் மாரியில்லை.

Translation.—Red sky in the morning betokens speedy rainfall. Red sky in the evening indicates that there will be no rain soon, though you cry for it.

This is closely analogous to the following English proverb :—

"Evening red and morning gray
Will set the traveller on his way
But evening gray and morning red
Will bring down rain upon his head."

பனிக்கண்திறந்தால் மழைக்கண்திறக்கும்,

Translation.—If there be dew, there will be no rain.

பனிபெய்தால் மழையில்லை பழம் இருந்தால் பூ இல்லை

Translation.—If there be dew, there will be no rain, and a tree which bears fruit will have few flowers.

These two proverbs agree with the following English proverbs :—

(1) "If nights three dewless there be,
"Twill rain, you are sure to see."

(2) Fog in the morning indicates a fair day.

அந்தி ஈசல் பூத்தால் அடைமழைக்கு லட்சணம்.

Translation.—If white ants take wing in the evening, it indicates excessive rain.

This is similar to the English saying "Ants are very busy; gnats bite; crickets are lively, spiders come out of their nests; and flies gather in houses just before rain.

அகல வட்டம் பகல் மழை.

Translation.—A large halo round the sun indicates a rainy day.

Dr. Hiram A. Cutting says in the Vermont Agricultural Report for 1883-84, "During the last twenty years

at Lunenburgh, I have observed three hundred and thirty six solar halos and one hundred and forty-one lunar halos. Of the solar halos, rain or snow fell in twenty-four hours, or less, in two hundred and seven cases; in thirty-six hours or between twenty-four and thirty-six hours, in sixty-six cases; between thirty-six and seventy-two hours in twenty-four cases; leaving twenty-nine cases of failure or twenty-nine cases where rain did not fall until the next depression. Of lunar halos, eighty-seven were followed by storm within twenty-four hours; twenty-nine in less than thirty-six hours, nine in less than seventy-two hours, leaving sixteen cases where there was no storm until the next depression."

அந்த செம்மானம் அடைமழைக்கு லட்சணம்.

If this means "Red sky in the evening indicates a heavy shower at hand," it would be directly contradictory to a Tamil proverb quoted elsewhere. It probably means "If red clouds be gathered in the part of the horizon where the sun is setting, there will be rain." In this case the proverb would harmonize with the English saying:

"When clouds are gathered toward the sun at setting with a rosy hue, they fortell rain."

அந்திமழை அழுதாலும் விடாது.

Translation.—Rain which commences in the evening will not cease, though you cry for its cessation.

This means, of course, that evening rain is generally of long duration.

In England, too, the time at which rain commences is supposed to indicate its duration, as the following proverbs show:—

"If it rains before seven
It will clear before eleven."

"If rain begins at early morning light,
'Twill end ere day at noon is bright."

மின்னல்கொல்லாம் பின்னல்கு மழை.

Translation.—The more frequent the lightning is, the more will it rain subsequently.

ஆடிக்கரு அழிந்தால் மழை குறைந்துபோம்.

Translation.—If the weather in July be not cloudy, there will be scanty rainfall.

ஐப்பசிமாதம் அழுகைத்தால் கார்த்திகைமாதம் களமழை.

Translation.—The showers in October are gentle, and they are very heavy in November.

ஐப்பசிமாதத்து வெயிலில் அன்று உரித்தகோல் அன்றைக்கே காயும்.

Translation.—The solar heat in October is so great that on the very day that the skin of an animal is flayed, it may be dried.

கார்த்திகைக்குமேல் மழையு மில்லை கன்னுக்குப்பின்கொ டையுமில்லை.

Translation.—After November, there is seldom any rain; after Karna (really the eldest of the Pandus), there has been none so munificent.

தை சருப்புல்லுமில்லை மாசிசணமரமுமில்லை.

Translation.—There is no grass which does not thrive well about the month of January; nor is there any tree which does not put forth fresh shoots about the month of February.

தையும் மாசியும் வையத்தறக்கு.

Translation.—Sleep in a thatched house in January and February.

The weather in these months is very cold. Thatch being a bad conductor of heat, serves to keep the inside of the house warm.

பங்குனி மாதம் மழைபெய்தால் பத்த எட்டுச்சேதம்.

Translation.—Rain in March will cause serious loss.

The harvesting, cleaning, and drying of corn are carried on up to the end of March. Fair weather is, therefore, desirable in March as well as in February.

பெருமழை விழுந்தால் குளிராது.

Translation.—Heavy rains are not attended with cold.

The early showers of the monsoons are generally warm and will do no harm to the agricultural labourers who may advantageously be then employed in planting trees, transplanting pady, &c.

பொங்குஞ்சாலம் புளியுக்கும் மங்குஞ்சாலம் மாயுக்கும்

Translation.—A season when the tamarind trees blossom very well is generally a good agricultural season, and a season when the mango trees blossom profusely is a bad season for the agriculturist.

வடகாற்று அடிக்கவந்தது மழையே.

Translation.—If the wind veers to the north, it will surely rain.

வடக்கே கறுத்தால் மழைவரும்.

Translation.—If black clouds be seen in the north, there will be rain soon.

This probably refers to the setting in of the north-east monsoon, and corresponds to the Telugu proverb "ఉత్తరమున నల్లదనమైన," that is, "If you see black clouds in the north take your seed basket, that is, prepare to sow the land."

விடாதமழை பெய்தால் படாதபாடு படவேண்டும்.

Translation.—Incessant rain is higly injurious.

விட்டுவிட்டுப் பெய்கிற மழையினும் விடாமற்பெய்கிறசாரலே நல்லது.

Translation.—A continuous light rainfall is far preferable to interrupted heavy showers.

Sudden and heavy showers which last but a few minutes each time are of little use, because the moisture, instead of soaking into the soil, will very soon flow off or evaporate.

வேனலுக்குக் கனமழைவரும் வேந்தனுக்குக் களனும்சேரும்

Translation.—The sun is often very hot just before it rains. Many claim relationship with the king.

Miscellaneous proverbs.—ஆலையில்லா ஊருக்கு இலுப்பைப்பூ சர்க்கரை.

Translation.—In a place where there is no sugar-cane mill, that is, where sugar-cane is not cultivated the flowers of Bassia longifolia themselves are sugar.

Bassia flowers are rich in saccharine matter.

ஆலும் வேலும் பல்லுக்கு உறுதி.

Translation.—A banyan or babool tooth-pick binds the gums of the teeth well.

The barks of the two trees are used in dental surgery by the native physicians.

இருக்கவேண்டுமென்றால் இரும்பைத்தின்.

Translation.—If you want to live in good health, consume iron.

Various medicinal preparations known has லவங்காதம், கரும்பிரும்பாதி லேதியம் &c., used by the native physicians contain iron. They are, no doubt, good tonics.

சர்சுவர்க்கு எதிராயுள்ளிச்சி

Translation.—Toddy derived from Phœnix sylvestris is most cooling to the body, of all beverages.

உப்புமிஞ்சினால் தண்ணீர் தண்ணீர்மிஞ்சினால் உப்பு.

Translation.—Exsess of salt consumed, calls for water, and excess of water requires salt for its correction.

உப்பைத்தாட்டுக்கொள்ளும் உரலிழுங்கலாம்.

Translation.—With salt as a condiment, we shall be able to swallow a mortar itself.

This refers to the fact that salt promotes the appetite very well. If we want to get our live stock into good condition, we must give them salt.

மென்றுதின்னும் மலையும் தின்னலாம்.

Translation.—We can digest a mountain itself, if we only masticate it fine enough.

Food is rendered more digestible by thorough mastication.

வாயுண்டிருக்கும் வாலில்லை.

Translation.—If food be masticated fine enough, it will never cause disease.

If food is swallowed without sufficient mastication and insalivation, it causes diseases. For instance, cattle that bolt green cholum straw suffer from Tympanitis.

ஒருகுடம் பாலுக்கு ஒருதுளிபோதும்.

Translation.—A drop of butter-milk is enough to turn a potful of milk.

ஒரு சாடியிலே இரண்டு வகையும் ஒன்று வெள்ளை ஒன்று மஞ்சள்.

Translation.—There is a pot which contains two kinds of oil, one white and the other yellow.

This riddle refers to the contents of an egg, the wings of the bird being formed of the yolk and the body out of the albumen.

குளிர்ப்பச்சைப்புழு பின்னே.

Translation.—A certain kind of green larva is the offspring of the wasp.

This is an observation of the metamorphosis of insects.

(To be Continued.)

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SOUTH INDIAN AGRICULTURE.

BY MR. C. K. SUBBA RAO.

Introductory.—In the beginning of the present century Dr. Francis Buchanan was appointed by the then Governor-General, to report upon the dominions which had been recently conquered from Tippu Sultan. He was instructed that "the first great and essential object of his attention should be the agriculture of the country." He accordingly made a tour through nearly the whole of Southern India.

It is thought that extracts from his reports cannot but be interesting to the readers of this Journal and prove useful as a means of testing whether our agricultural practice has in any way changed. About the general condition of agriculture he states: "On con-"sidering the state of agriculture many capital defects "will be perceived. Ameliorating succession of crops "is utterly unknown; scarcely any attention is paid "to the improvement of the breed of labouring cattle, "and still less to providing them with sufficient nourish-

"ment* * * * * * * I am afraid that the reader, in perusing "the foregoing accounts, will have formed an opinion of the "native agriculture more favourable than it deserves. I "have been obliged to use the English words ploughings, "weedings, and hoeings, to express operations somewhat "similar, that are performed by the natives; and the "frequent repetitions of these, mentioned in the accounts "taken from the cultivators, might induce the reader to "imagine that the ground was well wrought, and kept "remarkably clean. Quite the reverse, however, is the truth. "Owing to the extreme imperfection of their implements, "and want of strength in their cattle, a field, after six or "eight ploughings, has numerous small bushes remaining as "upright as before the labour commenced; while the "plough has not penetrated above 3 inches deep, and has "turned over no part of the soil. The plough, it must be "observed, has neither coulter, nor mould-board, to divide, "and to turn over, the soil; and the handle gives the "ploughman very little power to command its direction."

Rotation of crops.—As regards rotation of crops, Dr. Buchanan says that in Coimbatore "tobacco preceded by "kavir (raggy) and followed by sholum (Sorghum vulgare) "is by far the most important rotation," and again regarding Malabar he says, "In such part of the high land as is "manured sufficiently to enable it to produce annually a "crop of grain, a rotation has been introduced. 1st year "shamay (Panicum miliare), 2nd year Ulundu (Phaseolus "radiatus), 3rd year, either of the Pyros (grams). Another "rotation is alternate crops of Sesamum and Shamay"; and further, regarding rotation for wet land, he says, "So far "as I have observed in Mysore, ground once brought into "cultivation for rice is universally considered as having "arrived at the highest possible degree of improvement; "and all attempts to render it more productive by a "succession of crops, or by fallow, would be looked upon

"as proofs of insanity. When there is a supply of water, "Ryots think that the best plan of cultivation is to sow "one crop of rice, immediately after another has been reaped." Dr. Buchanan remarked that ryots know that some crops exhaust the ground more than others, and that the remedy was, giving a greater quantity of manure to the crop that followed the exhausting one; thus they often continued for years to cultivate the same field with the same description of crop.

The following extracts from the Reports of Collectors taken from the Report on the Saidapet Farm for 1877-78 will show that the practices of the ryots as regards 'Rotation of crops' are the same as at the time of Dr. Buchanan's tour. Mr. D. F. Carmichael, reporting on the Vizagapatam District, remarked: "With the exception of sugarcane "which is never grown on the same land for two years "running, the practise of rotation of crops is unknown in "this District."

Mr. J. R. Cockerell, with regard to the Cuddappah District, said:—"As regards rotation of crops, there is no "established system among the cultivating classes."

From Bellary, Mr. A. Hathaway reported:—"For "rice or paddy * * * * * no system of rotation is known. "The early crop is followed by the second, year after year. "On sugarcane land, however, crops of rice and sugarcane "are raised in rotation, or alternately every second year."

Regarding unirrigated land, he added:—"The only "approximation to a system of rotation is as follows:—

"First year—Cotton and Koraloo (Panicum Italicum) "sown together, one row of cotton to two or three of "koraloo; or sometimes the former alone, or white cholum, "and sometimes mixed with Bengal gram in the proportion "of five rows of the former to one of the latter.

"Second year.—White cholum alone or mixed with "Bengal gram.

"Third.—White cholum and wheat.

"As a general rule, cotton is sown only once in three "years on the same land, as it is alleged that this crop "greatly exhausts the productive qualities of the soil, and "engenders much heat whereby the land is disqualified "from producing in succession any good crop."

Again, in referring to an inferior class of soils, he remarked:

"There is no rotation system acknowledged."

Mr. J. Fraser, reporting from the Godavari district, said, "After the early sown dry crops are reaped, horse-"gram is generally cultivated, as a second crop. * * * * "With indigo no other crops are grown in rotation. * * * * "Black gram or green gram and cucumber seed are sown "together with cholum seed. * * * No other crops are "grown in rotation on the ground on which red cotton is "cultivated."

Mr. J. F. Price, Head Assistant Collector, North Arcot, remarked:—

"There is no rotation of crops in this division. The "same process goes on from year to year, and so long as "there is rain, the ryot cultivates the crop which pays him "best, and for which his land is best suited."

In South Arcot, Mr. Banbury reported:—

"As regards nunjah, (wet land) in certain localities, "raggy is first raised and then sumba paddy is sown, this "thus goes on from year to year."

Mr. G. L. Morris, Collector of Tanjore said:—

"The system of cultivating crops by rotation is not "known as regards wet cultivation, the same crop being

"always cultivated on the same lands. In the case of dry "lands, ragi and varagu are the only crops, which, as a "general rule, are cultivated with other crops."

Mr. Macdowell from Trichinopoly reported with reference to unirrigated land:—

"In valuable lands, any one of the higher descrip-"tions, *viz.*, ragi, cholum, and cumbu are grown first, and, "varagu afterwards, or *vice versâ*. Pulses of different kinds "are sown together with the higher description of dry "cultivation."

Mr. Arbuthnot, reporting from Salem, said:—

"Rotation of crops exists in this District. In wet and "in dry garden lands, various sorts of paddy are sown in "rotation * * * * * When the water is insufficient (for two "paddy crops) dry grain, *viz.*, cholum, cumboo, yelloo "(gingelly) or raggy are sown as the first crop, and paddy "as the second crop. In dry lands also there is rotation. "In lands on which cholum, cumbu, and other dry crops "have been cultivated, black-gram, horsegram, green-gram, "Bengal gram, and other quick growing crops, which "require only a small quantity of rain, are cultivated in "rotation, either before or after the principal crops."

The Collector of South Canara, Mr. W. M. Cadell, said:—

"The rotation of crops, as a rule, may be said to be unknown."

Mr. Ballard, Collector of Malabar reported:—

"Nor is any rotation practised with the dry crops."

Mr. John Kelsall says in the Bellary Manual:—

"The principle of not straining the resources of the soil too far is fully understood, and a crop requiring little nourishment always succeeds an exhausting one. Thus raggy is usually sown after sugarcane, cotton, and indigo.

* * * * In the red soils horsegram is sown in the 1st year, sajja (Penicillaria spicata) or jonna (Sorghum vulgare) in the second, oil-seeds, &c., in the third, and in the fourth the land is usually left fallow or relinquished.

(To be Continued.)

FUEL.

By Mr. A. Ramalingier, M.A.

Fuel may be divided into five classes. The first comprehends the fluid inflammable bodies; the second, peat or turf; the third, charcoal of wood; the fourth, pit coal charred; and the fifth, wood or pit coal, in a crude state, and capable of yielding a copious bright flame. The fluid inflammables are considered as distinct from the solid, on this account that they are capable of burning upon a wick, and become in this way the most manageable sources of heat; though, on account of high price they are never employed for producing it in great quantities, and are only used when a gentle degree, or a small quantity of heat, is sufficient. The species which belong to this class are alcohol and the different fixed oils. The first of these, alcohol, when pure and free from water, is as convenient and manageable a fuel for producing moderate or gentle heat as can be desired. Its flame, as every one can easily find out, is perfectly clean, and free from any kind of soot; it can only be made to burn slower or faster, and to produce less or more heat, by changing the size or number of the wicks upon which it burns; for, as long as these are fed with spirit, in a proper manner, they continue to yield flame of precisely the same strength. The cotton or other materials, of which the wick is composed, is not scorched or consumed in the least, because the spirit with which it is constantly soaked is incapable of becoming hotter than 79°C., which

is considerably below the heat of boiling water. It is only the vapour that arises from it which is hotter, and this, too, only in its outer parts (the oxidising flame) that are most remote from the wick, and when only complete combustion is going on, in consequence of communication and contact with the air. At the same time as alcohol is totally volatile, it does not leave any fixed matter, which, by being accumulated on the wick, might render it foul, and fill up its pores. The wick, therefore, continues to absorb the spirit, as freely after sometime, as it did at the first. These are the qualities of alcohol as a fuel. But it is to be borne in mind that these qualities belong only to a spirit that is pure. If it be wick and contain water, the water does not evaporate so fast from the wick as the more spirituous part of the mixture; and the wick becomes, after sometime, so much soaked with water, that it does not absorb spirit properly. The flame consequently becomes weaker, or is altogether extinguished from the excess of water. When alcohol is used as a fuel it ought to be made as strong, or free from water, as possible.

Oil, although fluid like alcohol, and capable of burning in a similar manner, is not so convenient in many respects. It is disposed to emit soot; and this, attaching itself to the bottom of the vessel exposed to it, and increasing in thickness, forms, gradually, a soft and spongy medium, through which heat is not so freely and quickly conducted. It is true we can prevent this to a certain extent by using very small wicks, and increasing the number, if necessary, to produce the heat required. Or we may employ one of those lamps, in which a current of air is allowed to rise through the middle of the flame, or to pass over its surface with such velocity as to produce a more complete combustion than ordinary. But our position will be awkward in another way; for the oils commonly used, being capable

of assuming a heat greatly above that of boiling water, scorch and burn the wick, and change its texture, so that it does not take in the oil so fast as before. Some attempts have been made in remedying this inconvenience, by making the wick of asbestos, but still, as the oil does not totally evaporate, but leaves a small quantity of fixed carbonaceous matter, this, constantly accumulating, clogs the wick to such a degree, that the oil cannot ascend, the flame becomes weaker, and in some cases, is totally extinguished. But there is a difference among the different oils in this respect, some being more totally votatile than others. Experience will show that even the best are troublesome in this way, and the only remedy is, to change the wicks often, though we can hardly do this and be sure of keeping always an equal flame.

The second kind of fuel mentioned, peat, is so spongy, that, compared with more solid fuels, it is unfit to be employed for producing very strong heats. It is too bulky for this; we cannot put into a furnace, at a time, a quantity that corresponds with the rapid consumption that must necessarily go on when the heat is violent. There is, no doubt, a great deal of difference in the qualities of the different kinds of this fuel, but this is the general character of it. However, when we desire to produce and keep up, by means of cheap fuel, an extremely mild and gentle heat, we can hardly use anything better than peat. But it is better to have it previously charred or burnt to black coal. The advantages gained by charring are considerable. When it is prepared for use in that manner, it can be made to burn more slowly and gently without any bad odour.

The next fuel in order is the charcoal of wood. This, [illegible] is prepared by piling up pieces of wood into a [illegible] heap, with several flues formed through the

pile and the whole is so constructed as to kindle throughout in a very short time. It would burst out into a blaze and be quickly converted into ashes were it not covered all over with clay, having openings only at the flues. These are carefully watched, and whenever the white watery smoke is observed to be succeeded by light blue and transparent smoke, the holes are immediately stopped; this being the indication of all the watery vapour being gone, and the burning of the true coaly matter commencing. Thus by raising a strong red heat through the mass, all the volatile organic matters are driven off, and nothing now remains but tolerably pure charcoal. The holes being all stopped in succession, as the change of the smoke is observed, the fire goes out for want of free air. The pile is now allowed to cool and this requires many days; for, charcoal being a bad conductor of heat, the pile long remains red hot in the centre, and, if opened in this state, would instantly burn with tremendous rage. Small quantities may be procured at any time by burning wood in close vessels. This kind of fuel is very much used in our country by the smiths and Chemists as it possesses many good properties. It kindles quickly, emits little or no watery vapour while burning, and when consumed, leaves very little ashes, which are very light. They are, therefore, easily blown away, so that the fresh surface of charcoal, when exposed to the current of air, burns freely. This sort of fuel is also capable of producing as intense a heat as can be obtained by any; but in violent heats it is quickly consumed, and needs to be frequently supplied.

Coke has, in many respects, the same properties as charcoal of wood; as kindling readily in furnaces, and not emitting watery smoke. This sort of charcoal is even superior to the other in some properties. It is a much stronger fuel containing the combustible matter in a more

condensed state. It is, therefore, consumed more slowly and particularly valuable when employed for producing intense melting heats. The only inconveniences that attend it are, that, it leaves more ashes than other fuels which are, liable to collect in such quantity or to obstruct the free passage of air through the fire; and further, that when the heat is very intense, these ashes are disposed to melt or vitrify into a tenacious substance, which clogs the grate, the sides of the furnace, and the vessels. This last inconvenience is only troublesome however, when the heat required is very intense. In ordinary heat, the ashes do not melt, and though they are more copious and heavy than those of charcoal of wood, they seldom choke up the fire unless the bars of the grate be too close together. This fuel is, therefore, preferable, in ordinary cases. The heat produced by equal quantities, by weight, of pit coal, wood charcoal, and wood itself, is nearly in the proportion of 5, 4 and 3. The reason why both kinds of charcoal are preferred, on most occasions in our chemical operations in the Laboratory, to the crude wood, or natural coal, from which they are prepared, is that the crude fuels are deprived by charring, of a considerable quantity of watery vapour, and other volatile parts of wood and coal. These volatile parts often obstruct and spoil the chemical operations. In chemical operations, therefore, it is much more convenient to use charred fuel, than the same fuel in its natural state.

It is very necessary to take precautions against the dangerous nature of the products of burning charcoal as it burns without visible smoke. The air arising from it appears to the eye as fair and as clear as common air. Hence charcoal is much used, by those persons who are studious of neatness and cleanliness in their apartments. But this very circumstance should make us more watchful against its effects upon our health. Burning charcoal yields an invisible gas called carbonic acid, which, when breathed, produces sickness.

QUESTIONS IN AGRICULTURE.

By Professor John Scott.

1.—Soils.

1. Explain the origin and formation of soils?

2. Name the chief elements of plant growth found in all fertile soils?

3. In what respects do soil and sub-soil differ?

4. Explain the following terms:—

Weathering, Denudation, Alluvium, Drift, Nitrification?

5. Give a brief statement of the physical properties of soils?

6. What are the physical properties of (*a*) clay soils, (*b*) chalk soils, (*c*) sandy soils, (*d*) peat soils?

7. How is fertility of soil influenced by (1) mechanical texture, (2) climate and local conditions?

8. What practically determines fertility of soil?

9. Distinguish (1) between a *barren* soil and a soil *exhausted* and (2) between *natural* and *acquired* fertility?

10. How are soils classified?

11. What soils and conditions of soils possess the power of capillary attraction in the highest degree; and what is its importance as regards drainage, the retention of moisture, and the supply of that moisture to the growing plants?

12. State some of the principal causes of infertility in soils?

13. Is there a ready test for ascertaining the presence of injurious constituents in soils?

14. Give instructions for a rough mechanical analysis of a soil?

15. What is meant by exhaustion of soil, and what causes it?

16. Mention (*a*) the surface distribution, and (*b*) the agricultural characters of (1) Silurian, (2) old and new Red Sandstone, and (3) Greensand soils.

Answers.

1.—Soils.

1. The mineral and organic matters forming the crust of the earth are the origin of all soils. The inorganic or mineral portion of the soil is derived from the crumbling down of the solid rocks by the natural process of weathering or disintegration, which is favoured by warmth, and the presence of moisture and organic matter. All rocks, however, are not acted upon with the same ease; but the hardest of them are surely though slowly crumbling into dust under the mighty but invisible agency of the carbonic acid and oxygen of the air. The union of decaying vegetable matter in the soil with the oxygen of the air also helps to promote the decomposition of rocks,—as do frosts, rain, wind, and other kindred forces. These disintegrating agents are further aided by the root-growth of plants, by the burrowing of worms and other earth-dwelling creatures, and in no small degree by the acids generated by organic decay. The organic portion of the soil is derived from the remains of plants and of animals and insects of various kinds. In some cases the soils are purely organic in their origin. These are both plant and animal formations—the former comprising vegetable mould and peat mosses, the latter, beds of chalk and limestone, &c.

2. The inorganic or mineral constituents found in all fertile soils are silica, alumina, calcic carbonate, potash, soda, magnesia, phosphoric acid, sulphuric acid, chlorine, and oxide of iron. The first three—sand, clay, lime—represent perhaps 90 per cent. or more of the substance of most soils. The others vary from a mere trace to at most 2 per cent. The organic matter is formed of C. H. O., and a series of organic acids—humic, ulmic, geic. Sandy soils are generally deficient in this ingredient. Cold clays are also poor in organic matter. In fertile loams it is more abundant; and in peaty soils it is usually in excess. Altogether the organic matter in soil varies from 1 to upwards of 90 per cent.

3. In a majority of cases the *soil* is merely rotted *sub-soil*, and differs from the latter chiefly in the greater amount of organic matter it contains, and in being less compact, and darker in colour.

4. "Weathering" is the term used to denote the natural disintegration or breaking up of rocks as explained in answer to the first question. "Denudation" is the washing or carrying away of soils from the place of their original formation by rainfall or surface water. "Alluvium" is soil deposit which has been transported from higher to lower levels by the agencies of rivers or tides. "Drift" formations, which is attributed to glacial action. "Nitrification" is the oxidation of nitrogenous bodies in soils—humus and ammonia—and their conversion into nitric acid.

5. The physical properties of soils which may be supposed to exert a greater or less influence on fertility have been well stated by Schubler as follows:—

(1) The weight of the soil, its specific gravity as well as the absolute weight of a given bulk in a dry and moist state.

(2) Its power of containing water, according to its weight and bulk.

(3) The firmness and consistence of a soil in its dry and in its moist state.

(4) Its different capability of becoming dry on exposure to the air.

(5) Its diminution in bulk on drying.

(6) Its absorption of humidity from the atmosphere.

(7) Its absorption of oxygen from the atmosphere.

(8) Its power of retaining heat.

(9) Its capability of becoming more or less warm by the sun's rays.

(10) Its capability of developing heat on being moistened.

(11) Its electric polarity and capability of conducting electricity.

6. A clay soil differs from all others by being tough, wet, and cold. In wet winter weather it sticks to the plough, like mortar, and in dry summer weather it is hard and cloddy, and the surface covered with chinks or cracks. A sandy soil is subject to defects of an opposite description. A chalky or calcareous soil contains a great deal of carbonate of lime, and when wet, is of a soapy nature, but is marked by the freedom with which it admits of natural drainage, and warm and productive, though white in colour. A peaty soil is light and spongy in texture, dark in colour, and very absorbent and retentive of both heat and moisture.

7. Mechanical texture influences fertility of soil in a great degree, for the conditions of air, moisture, and warmth, which are essential to the development of the changes which occur in the process of germination, have

little or nothing to do with the chemical qualities of the soil, but are all dependent upon its mechanical relations. This influence is not confined to the first stage of vegetation. Climate also exercises a great influence on fertility, and disregard of local conditions sometimes leads to very erroneous estimates of the value of soils which may be similar in composition and texture.

8. Fertility of soil is practically determined by the *minimum* of any one essential ingredient and not by the maximum of the others, but intrinsic value depends on the depth of the soil, its mechanical texture, situation, altitude, and surroundings, quite as much as on its chemical composition.

9. The difference between an *exhausted* and a *barren* soil is this; the former will recover its fertility or be renovated by nature in the course of time if, meanwhile, nothing more is carried away from it; whereas a barren soil, will continue barren, if the operating causes remain as before. A soil which has once been fertile can never be completely exhausted by the cultivator, and the deeper the soil the more superficial will have been its partial exhaustion. The distinction between *natural* and *acquired* fertility is that the former is a permanent quality and the latter is not. An examination of the soil and sub-soil is the only reliable test. The appearance of the crops on arable land is often very misleading, and even in the case of grass land the herbage is not altogether a criterion of the quality of the soil; if the herbage is poor it may be the result of years of bad management; while on the other hand, a splendid pasture may owe more to good farming than to the natural fertility of the soil.

10. Soils are usually arranged in four classes—clay, sandy, calcareous, and organic soils—according to the dominant ingredient. A soil consisting of nearly equal parts

of sand and clay is termed a loam, if two parts sand and one part clay a *sandy loam*; and if two parts clay and one part sand, a *clay loam*. A soil consisting of nearly equal parts of clay and lime is termed a *marl*; if two of clay to one of lime, it is a *clay marl*; and if two of lime to one of clay, it is a *calcareous marl*.

11. The soils which have their particles in the finest state of sub-division possess the power of capillary attraction in the greatest degree. Its importance to plant growth in dry seasons and on dry soils can scarcely be over-estimated. It will be referred to again in connection with land drainage.

12. As regards the principal causes of infertility in soils the following are the conclusions arrived at under this head by the late Dr. Voeleker as set forth in his paper on the subject in the *Journal* of the Royal Agricultural Society :—Soils appear to be barren or more or less unproductive,

(*a*) When they contain something inimical to vegetation.

(*b*) When they are deficient in one or more important constituents which enter into the organisation of the living plant.

(*c*) When they contain too large a preponderance even of a valuable ingredient, such as organic matter, sand, lime, and even clay.

(*d*) When there is but a thin layer of soil resting on the bare rock.

(*e.*) When the land is thin and rests on an impervious and very thick clay sub-soil, or on sub-soils containing something injurious to vegetation.

(*f.*) When they are badly drained.

(*g.*) When they are affected by a bad climate.

The soil constituents which are injurious to vegetation briefly are—

(*a*) Superabundance of organic (humic) acids.

(*b.*) Sulphate of iron (green vitriol) even when present in the soil in small quantities.

(*c.*) Sulphide of iron (iron pyrites), and especially finely-divided black sulphide of iron which in the smallest proportion, is most pernicious to plants.

(*d*) Abundance of protoxide of iron, and absence of peroxide, indicating a bad physical condition of the land.

(*e*) Chloride of sodium (common salt) in proportions of 1-10th per cent. and upwards.

(*f*) Nitrates, and all soluble saline matter, in quantities exceeding small fractions of 1 per cent. of the whole mass of soil.

13. The presence of injurious constituents in soils can be readily ascertained by bringing a strip of litmus-paper in contact with wet soil. If the blue colour of the test paper turns rapidly red, the soil is certain to contain something injurious to plant life. All good and fertile soils either have no effect upon red or blue litmus-paper, or show a slight alkaline reaction; that is to say, in a wet condition they restore the blue colour to reddened litmus-paper.

14. Put a given quantity of soil into a large glass jar of water then shake well, and allow to stand. The ingredients settle in the following order, and their proportions can then be estimated :—

(1) Sand or gravel;

(2) clay;

(3) organic matter.

15. A soil is said to be exhausted for a particular crop when it will no longer grow that crop, or practically speaking, will no longer grow enough of the crop to afford the cultivator a profit. This can only be brought about by a continued course of cropping without manuring. But when a soil will no longer grow a certain crop, it may still have all the elements requisite for the growth of some other crop.

16. The silurian soils are for the most part high-lying, cold, and poor. Where limestone predominates the soil is better, but, as a whole, they are deficient in lime. Even where the soil is naturally good on this formation the climate and position are generally unfavourable for the cultivation of wheat and the higher vegetables. Finger-and-toe in turnips and louping-ill in sheep are very prevalent diseases on these soils. The old red-sandstone furnishes some of our best soils, but these, too, are generally deficient in lime. The old red-sandstone formation may be called the home of the Hereford breed of cattle, and of the old Ryland breed of sheep. The new red sandstone soils are light and moderately fertile. The green sands are light soils of great adaptability and productiveness. Want of space prevents a full reply to this and some of the other questions, but discussion is invited.—

Scottish Agricultural Gazette.

ANNUAL REPORT OF THE AGRICULTURAL STUDENTS' ASSOCIATION.

The Report is for the year 1885-86. The Association was established on the 30th March 1883.

At the beginning of the year there were 99 members on the rolls of the Association, 5 Honorary and 94 ordinary members. During the year 6 persons were enrolled, as Honorary members, and 18 as ordinary members. The number on the rolls, is now 121.

The Association held nine meetings during the winter session, when papers on the following subjects were read and discussed:—

1. "Agricultural Experiments," by M.R.Ry. Krishnasawmy Iyengar of Cuddalore.

2. "Oil seeds of South India," by Mr. S. Ramasawmy Iyer of Somaithangi, North Arcot.

3. "Cocoanut Cultivation," by Mr. P. Rangacharriar of Poondy, North Arcot.

4. "Foot and Mouth Disease," by Mr. B. Subramaniya Iyer of Kumbakonum.

5. "Improvement of our Live Stock," by Mr. P. N. Subramaniya Iyer of Madura.

6. "Practical Agriculture," by Colonel Olcott, Adyar.

7. "Soils" by Mr. V. R. Venkatakrishnama Naidu of Trichinopoly.

8. "Poppy Cultivation" by Mr. Naowroji, M. Bomanji of Bhadgaon.

Attendance at these meetings was usually confined to students and others connected with the College, but when Col. Olcott addressed the Association on "Practical Agriculture," the lecture was public and the lecture theatre was crowded. The meetings are held not only that members may hear the papers read, and exchange their views freely on the points raised, and as the members come from widely

scattered parts of India, much interesting matter referring to agricultural practice is elicited.

The Journal of the Association was commenced at the beginning of the year; Seven numbers have been published and all contain useful information. The Journal has a good circulation among persons interested in the improvement of agriculture. It has been favorably received and promises to meet fully the objects for which it was established. It is to be regretted that more satisfactory arrangements cannot be made for greater promptness in issuing the monthly numbers. The fault rests entirely with the printers.

It is also to be regretted that subscriptions are not paid to the Treasurer with greater promptness. The arrears due at the close of the year amounted to Rs. 312-11-6, far too great a sum for the welfare of so young an Association. The Committee hope that members will support them better in the future, not only by paying their subscription when due, but by getting more subscribers. The Journal costs the Association about Rs. 500 per annum, an amount which could easily be recovered if all the graduates and students of the College were subscribers. The income and expenditure of the year are shown below:—

	RS.	A.	P.
Cash on hand on the 1st April 1885 ...	79	15	3
Collections during the year 1885-86 ...	274	0	3
Total ...	353	15	6

	RS.	A.	P.
Expenses during the year 1885-86 ...	304	14	0
Cash on hand on 31st March 1886... ...	49	1	6
Total ...	353	15	6

Assets.

	RS.	A.	P.
Cash on hand ...	49	1	6
Arrears due to the Association ...	312	11	6
Total ...	361	13	0

Liabilities.

	RS.	A.	P.
Amount due	150	0	0
Balance Account for balance	211	13	0
Total ...	361	13	0

COLLEGE ATHLETIC CLUB REPORT.

The report is for the winter session, 1885-86. At the opening of the session the Club consisted of 5 Honorary and 26 ordinary members. During the session 15 joined as ordinary members thus making the number of members 46.

Receipts.

Balance at the end of the last session	67	9	6
Subscription collected from Honorary and ordinary members during the session	61	0	0
Arrears and subscriptions collected	5	4	0
Entrance fees collected from new members ...	8	0	0
Donations and Fine	10	8	0
Interest on the money deposited in the Savings Bank	2	2	0
Total ...	154	7	6

Expenditure.

	RS.	A.	P.
Amount spent during the session, in purchasing materials for the use of the Club, cost of repair of boat, &c.	63	6	0
Balance...	91	1	6

The Committee are of opinion that a further supply of Badminton bats and Tennis balls should be purchased. The Committee regret the delay that has occurred in getting the boat repaired, due to causes partly not under their control; but the work is now in progress and the Committee hope that it will soon be finished. In the early part of the session Badmintion was the all-absorbing game. Subsequently Lawn tennis was engaged in more frequently. Committee meetings were held frequently during the session and three general meetings were held. Cricket was played only occasionally.

SCARLET FEVER FROM THE COW.

Mr. A. W. Blyth has presented a report to the Marylebone Vestry from which we take the following extracts:—"On December 14th I received a communication from Dr. Hickman to the effect that there were several cases of scarlet-fever in Dorest Square. I found that the only connecting link between the various households was a common milk supply. I had on December 9th, caused to be removed to hospital a lad suffering from scarlet fever, one of the milk-carriers at the dairy from whence the sick family obtained their milk. The first impression was that this lad had in some way contaminated the milk, but this supposition was speedily excluded, for a number of the cases had occurred several days before the lad was taken ill, and the whole evidence clearly showed that the lad was infected by the milk, and not the milk by the lad. The dairy, which may be conveniently called 'Dairy A' derived its supply from two sources, chiefly, 63 barn gallons from a large farm in the parish of Hendon. The Hendon farm is one of the model type, with excellent drainage and water supply. The milk produce of the farm was distributed to three retailers, A, B, and C. 'Dairy A' took 63 barn gallons daily, B (St. John's Wood) 20 barn gallons, and C (Hamstead,) 67 barn gallons daily. All three had the milk from different sheds. I ascertained from a personal examination of the milkmen that there was not, nor had there been, any scarlet-fever, sore throat, or other infectious malady on the farm. Nevertheless, I was far from satisfied, and still less satisfied when by a mere chance I heard a rumour of a family deriving milk direct from the farm suffering from scarlet-fever. I obtained with a little trouble the particulars, which were as follows: Five cases of scarlet-fever had occurred almost simultaneously, on or about December 3, in a household at Hamstead, no scarlet-fever being at that time in the immediate neighbourhood. The cause of the attack was to the sufferers a mystery. They had their milk supply direct from the Hendon farm. Dr. Power afterwards elicited the important fact that this milk was derived from the same shed which supplied 'Dairy A.' I felt it my duty to make a strong representation to the proprietor of 'Dairy A.' requesting him in the public interest, and his own, to at once cease retailing the Hendon milk. He did so, and a very instructive event followed. The very milk that would have been delivered in Marylebone was in part thrown away, and in part given to poor people in the neighbourhood of the Hendon farm. Within a few days eight of the families partaking of this milk were struck down with scarlet-fever. On the same day on which the milk was stopped I had all the cans disinfected. They were taken to the stone-yard in carts, packed in the hot air chamber, submitted for many hours to a temperature of 250 degs., and finally washed with hot-water and soda, under the careful superintendence of Mr. Phillips. Too much stress can scarcely be laid on the fact that after stopping the supply from Hendon and disinfecting the cans there was no fresh infection of the dairy. The customers of this Local Government Board seeing the importance of the epidemic, especially as the facts seemed likely to throw light on the genesis of scarlet-fever, at once deputed Dr. Power to investigate the matter, and he directed his attention to the state of the cows in the different sheds. I will only say now that certain of the cows are 'suspect,' and that one, the appearance of which was least satisfactory, has been brought and conveyed to the Brown Institution, and Dr. Klein is making experiments with the milk and other secretions. This report is necessarily

incomplete, for the full history will not be known until Dr. Power publishes his report and gives the details relative to cases in the parishes of Hendon and Hamstead infected either directly or indirectly from the Farm, together with the results of the examination of the cows and Dr. Klein's experiment. I believe that we are on the eve of some very important discovery as to the origin of scarlet fever."

ECONOMY IN GOOD IMPLEMENTS.

Farmers are obliged to use every effort to economise in their outlays while prices of all kinds of farm products remain so low, but it is important that they study and practise in the right direction. It is unfortunate for most persons that they have to economise so closely, for, as a rule, the economy of those who do it on compulsion is a wasteful rather than a saving character. The poor man necessarily works at great disadvantages. In cultivating a crop he has to use an old style implement that does not do half work, in either quality or quantity, and he labors long and hard to do things by hand, when he might accomplish ten times as much if he could take advantage of the best farm implements. Not being able to do things on a large scale, what he produces costs relatively more than it should.

The prosperous farmer always has good tools and takes good care of them. He gets the best when he buys and always has his repairing done before the implement is needed. Ploughs, wagons, and machinery are always ready to hitch to and to do the work required of them. The farmer with limited means thinks this is all very well for his rich neighbour to practise, but that he can't afford it. He concludes that he is compelled to go on in the old way because he has not the money to do better, probably knowing all the while that such a departure would pay

good interest on the necessary investment, and if he does not know it, a small amount of figuring will soon convince him of the fact that he is practising false economy. If it pays well-to-do farmers to keep nothing but the very best implements, it necessarily follows that the poorer a farmer is, the less able he is to afford the opposite course. By following it up he has nothing but hard work, high taxes, interest, and almost starvation in store for him in future. We would not advocate the indiscriminate purchase of all new farm implements and machinery that could be used upon the farm. It is quite probable that it would be inadvisable to buy implements which are only used a few days in the year, or when there is not sufficient work on the farm to warrant the outlay. But for such things as wagons, ploughs, harrows, and cultivators, the best are much the cheapest, and nobody can economically afford to be without them if he expects to farm it profitably.

The man who grows only a few acres of wheat annually does not need a self-binder harvester much more than he does a threshing machine, but can't grow a good corn corp profitably unless he spends a few dollars for the right kind of a cultivator. It is impossible to grow a good crop on a few acres by cultivating the same with an old-fashioned diamond for jumping shovel plow, but one man would make a poor show in keeping down the weeds if turned into a thirty acre field with either of these tools and no one to help him.

If a farmer will take care not to purchase what he cannot use or has little need for, he will soon learn that it is poor economy for him to buy anything but the best, and if he takes care of his implements as he should, the interest on their cost will be his greatest expense and he must be a poor farmer indeed who cannot afford this.

Farmers Home Journal.

WEEDS.

Habit of growth.

This is a matter of great importance, inasmuch as the best method of treatment depends so largely upon it. As regards their manner of growth, weeds may be classified as follows :—

1. *Upright weeds.*—Those which grow straight from the ground; usually fibrous-rooted.

2. *Creeping weeds.*—Those that send out runners above ground, which take root at different points.

3. *Running weeds.*—Those which increase by spreading underground stems.

4. *Prostrate weeds.*—Those which have weak stems, or trailing herbage, and cover a considerable space.

5. *Climbing weeds.*—Those which cling to or twine around other plants.

6. *Tap-rooted weeds.*—Those which form thick, fleshy roots, that grow straight downward.

Many weedy plants are of small size, with comparatively straight stems. Such weeds take up but little room individually, but are often very numerous, and may be very injurious to crops, especially during the early stages of growth. By a little neglect just at the critical time, root crops are frequently smothered and completely overpowered by weeds of this class. If the crop is not completely ruined, it often costs more than it is worth to remove these intruders. Taken in time these weeds may be readily killed. Neglect is fatal. The best time to destroy them is before they come up. In most cases this can be easily and cheaply accomplished by the use of the smoothing harrow or garden rake. Under no circumstances should weeds of this class be allowed to grow to seed.

Perhaps the most troublesome plants of all, certainly the most difficult to eradicate, are those already alluded to, which belong to the class of "Running weeds." In dealing with these we must look below the surface, and if possible remove the underground stem. If this cannot be done, it is well to remember that the life and growth of plants is largely dependent upon the development of the leaf. If no leaf-bearing stems are allowed to appear above ground the plant will ultimately perish.

The best way to master top-rooted plants is to cut them off as far below the crown as possible. If cut off at the crown they will often send up a multitude of short stems, and produce more seed than the original stem would have done.

Duration of Growth.

Like other plants, weeds may be divided into annuals, biennials and perennials. The natural history of each species should be known, for upon this are based many important remedial measures. As a rule, annual weeds are largely confined to cultivated areas. They should be closely watched, and never allowed to interfere with the growth of crops. By neglect we suffer the double injury of lessening the yield of the crop in which they appear, and providing a supply of seeds so that the pests will be continued, thus causing future trouble.

Biennial weeds, for the most part, produce no seed the first year, but seed is often produced quite early in the second season. On this account they should be destroyed during the first year of their existence. Most of the worst biennial weeds have fleshy or tap-roots. In exterminating these plants just as much of this root should be cut off as possible.

Perennial weeds are those the tops of which die down at the approach of cold weather, the roots remaining alive, and from them new shoots are sent up year after year. Many perennial weeds produce their flowers and seeds much earlier in the spring than annuals. On this account they should be most carefully watched. They are apt to be most troublesome in pastures and meadows, and are often very abundant along roadsides and fences. They should always be cut before they blossom, or at least before any seed is matured.

Hints for destroying weeds.

The complete destruction of weeds is no easy matter, yet within certain limits it is not only possible, but practicable. For nearly all cultivated grounds constant and continued clean culture is the best remedy. Clean culture has been practised at the station for the past three years, and grows easier each season. The best way to secure clean culture is to never allow weeds to breathe.

In pastures, meadows, and all uncultivated areas weeds should never be allowed to blossom.

Besides using every known precaution to prevent our land from becoming seeded, and adopting the methods already indicated for killing weeds, we should summon the law to our aid. Wise enactments, founded upon substantial information and judiciously framed, would, if enforced, aid us materially in our warfare against these intruders. Make it an offence punishable with fine and imprisonment for any one to sell impure seed, or allow any weeds to go to seed on his property. This would tend to check at once the spread of weeds, and when people become better informed, and public sentiment thoroughly aroused, it would cease altogether.

London Agricultural Gazette.

RECENT ADVANCES IN SANITARY SCIENCE.

"Hygiene," in the words of the late Professor Parkes, "is the art of preserving health, that is, of obtaining the most perfect action of body and mind during as long a period as is consistent with the laws of life. In other words, it aims at rendering growth more perfect, decay less rapid, life more vigorous, death more remote." The art of preserving health is correlative with the science of prevention of disease, since perfect health means the absence of disease and of tendencies to disease. Hygiene is thus the art of preserving health and the science of preventing disease; and in taking into account recent advances in sanitary science, we must consider recent acquisitions in our knowledge of the origin, causes, and spread of disease, more especially of those diseases known as "preventable," as well as the methods of improving the natural conditions or social relations surrounding us, which are instrumental in preserving health and counteracting disease.

The etiological relations of all diseases are a subject of interest to the sanitarian, but those which have received the most attention of recent years, and in which the most striking advances of knowledge have either already been made, or are imminent in the near future, are perhaps Asiatic cholera, typhoid or enteric fever, diphtheria, and phthisis or tubercular disease of the lungs. The mode of origin and spread of Asiatic cholera has attracted great popular attention, both on account of its possible introduction into this country from infected districts of the Continent and from the alleged discovery by Koch of a *Spirillum or comma-bacillus* asserted to be the specific cause of this terrible disease. The report of the Government

Commission consisting of Drs. Klein and Heneage Gibbes, who visited India in 1884 with the object of undertaking researches into the etiology of Asiatic cholera, has lately appeared, and in this Report the conclusions arrived at by Koch from his own researches are very directly traversed. This Report, too, has received a very cordial support from a Committee consisting of many eminent physicians and physiologists, which was convened by the Secretary of State for India for the purpose of taking it into consideration. It must be apparent, however, to any one who makes an impartial study of the literature of the subject, that, if Koch's organism has not yet been proved to be the actual cause of the disease, it has been proved to differ from all other organisms asserted to be identical with it, from the fact that its growth in various nutrient media is characteristic, and serves to distinguish it from all other organisms. As far as our knowledge at present extends, difference in manner of growth in nutrient media affords as just a basis for distinction between micro-organisms as difference in microscopical appearance or other morphological characteristics. Koch's comma-Bacillus is, therefore, diagnostic of the disease, and this fact has now placed in the hands of medical men the power of at once recognising a true case of Asiatic cholera, the isolation of the organism from others in the choleraic discharges and its cultivation in suitable media being alone needed. The results of Koch's researches, whether fully accepted or not, have not affected, nor are they likely to affect, the measures on which reliance alone can be placed for the prevention of out-breaks and spread of the disease. In the words of the Committee before alluded to, "Sanitary measures in their true sense, and sanitary measures alone, are the only trustworthy means to prevent out-breaks of the disease, and to restrain its spread and mitigate its severity when it is prevalent.

Experience in Europe and in the East has shown that sanitary cordons and quarantine restrictions (under whatsoever form) are not only useless as means for arresting the progress of cholera, but positively injurious."

The view that typhoid fever cannot arise *de novo*, but is always propagated by a specific contagion from a previous case of the disease, is steadily gaining ground, as the number of epidemics where the disease has been definitely traced to specifically polluted air or water increases. In many other cases, although the specific pollution has not been definitely proved, the probabilities in favour of such a view have been very great. No micro-organisms has yet been found which can lay claim to be regarded as the specific contagion of the disease, but we are in possession of so many facts concerning the mode of origin and spread of this disease, that any discovery of that nature would probably not greatly affect the measures now taken for its prevention.

(To be Continued.)

THE

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PROCEEDINGS OF THE ASSOCIATION, JUNE 1886.

THE PRESIDENT W. R. ROBERTSON, ESQ., M.R.A.C., in the chair.

The paper read was :—

Gingelly Cultivation.

BY MR. P. RUNGACHARRIAR of North Arcot.

Gingelly is the name of the plant known to Botanists by the name of Sesamum Indicum, N. O. Tiliaceœ. The plant is said to be indigenous to India and is cultivated all over this peninsula, also in China, Egypt, West Indies, and South America. It is an annual shrub growing to a height of from 3 to 4 feet and throwing out a number of bushy lateral branches. According to the Administration Report of 1883-84, the crop occupies about 500,000 acres in this Presidency, that is, a little less than half the whole area occupied by oil seed crops. The seed is largely exported to France, Egypt, Mauritius, United States, Ceylon and the Straits Settlements. The value of gingelly seed exported to France in 1883-84 was about 31 lacs of rupees. The crop is grown in almost all the Districts of the Presidency, the Godavari District producing a fifth of the total area.

Varieties.

There are three varieties of this crop, the white seeded, the red or yellow seeded and the black seeded, the last being the most generally cultivated. The white variety is largely grown in Bengal and the red variety to a small extent in Northern India. In this Presidency the black variety is the most extensively cultivated; the white variety is grown in very few localities. There is also a wild variety of this grown in some of the Telugu Districts.

Soil.

The crop is grown either as a dry crop or as a wet one, but generally as a dry crop. It may be grown in sandy loams or sandy soils with a moderate proportion of organic matter. It may also be grown in red sands but unless there is rain at proper intervals or unless the land is irrigated, the crop will fail. It is also considered that the crop will grow well even on sandy soils provided the land is well-manured and irrigated during the growth of the crop. In some parts of North Arcot it is grown on wet land immediately after the removal of the sugar-cane crop, but in this case the land is not irrigated.

Tillage.

The soil must be thoroughly tilled to a depth of from 4 to 6 inches but the best results are obtained by ploughing the land to a depth of 9 inches. But the depth to which land is ploughed in South India depends upon the means and condition of the ryot; for instance, a well-to-do ryot can afford to plough the land to a greater depth than a poor ryot. The land is generally ploughed immediataly after the first shower of rain, so that the crop may be sown after the second or third fall. Grasses and weeds are then removed and the land is levelled by means of a levelling board or plank.

Manuring.

Generally land is not manured in South India but in some cases sheep manure or farm-yard manure is applied. The manure of 500 sheep folded on an acre of land for about 3 days is considered a liberal manuring. This occurs about 15 or 30 days before the crop is sown and the manure is allowed to remain on the land till it is ploughed for sowing. Ordinarily about 10 cart-loads of manure are applied and this is dispensed with if the ryot has to manure other important crops such as sugar-cane, paddy, garden crops, &c. It is asserted by ryots that green manure should not be applied to this crop.

Sowing.

Gingelly is either sown as a separate crop or with Cajanus Indicus (dholl) or other crop, the object in the latter case being that the ryot may be sure of getting a harvest from one, if the other fails. But a ryot who has a large area of dry land will prefer to sow it as a separate crop. There is no crop which is so liable to damage during harvesting as gingelly. It is, therefore, very important that the sowing season should be so arranged that the crop may be gathered during the dry weather. The crop is generally sown broadcast after rain when the soil is sufficiently moist but not when it is too wet, as in the latter case most of the seeds will not germinate. The crop is sown at the end of May, or better still, in the beginning of June. The seed must be mixed with sand and scattered broadcast by the hand, care being taken that the seed is sown neither too thick nor too thin. The quantity of seed required for sowing an acre of land depends on the nature of the soil and the quality of the seed, but generally 6 Madras measures of seed are considered sufficient for an acre.

Cultivation.

The seed will germinate in about 4 or 5 days after sowing and when the plants are about half foot high or about 30 days after sowing, the land may be weeded. The crop will grow very well if there is rain at intervals of every 10 or 15 days, but in the absence of rain it must be irrigated. At the end of the second month or the beginning of the third month, the crop will begin to flower and in about 15 days after that, it will begin to bear. About 20 days afterwards it is fit for harvesting.

Injuries.

If there is no rain after the crop has been sown, the plants will fade and die; if there is excessive rainfall, the roots decay, the plants become white and gradually die. Sometimes the plants do not flower at all.

Gathering.

The time for gathering the crop is just when the seeds begin to turn brown. The plants are cut with reaping knives and tied into bundles 2 feet in circumference. About 60 such bundles are the average produce of an acre. The bundles are stacked for 4 or 5 days in the open air and covered with straw or sugar-cane refuse. The process by which the seed is removed from the capsules is this :—A piece of land is well cleaned by removing the grass and paring off the surface. It is then well smeared with cowdung and afterwards dried and swept by brooms. The bundles are brought to this place untied, spread evenly and exposed to the sun, when, in the evening of the 1st day, about one-eighth of the capsules burst. The plants are heaped in the evening on the same land and covered during the night with palmyra or cocoa-nut leaves. The next day the drying process is continued and in the evening about three-fourth of the capsules burst. The process is again continued on the third day, when almost the whole of the

remaining capsules burst and shed their seeds. Intelligent and economical farmers will repeat this process even on the fourth day, so as to ensure the thorough separation of the seed. The plants are sometimes beaten by sticks after the last drying. The heap is well stirred after the last drying and the plants are carefully removed so that no seed may be left. The seed remaining at the bottom of the heaps is then sifted and winnowed by hand by winnowing fans (முறம்). The average produce of an acre is about 200 Madras measures of seed and about 2 cart-loads of waste plant. This plant refuse is used as fuel for domestic purposes or for kilns. The ryots say that this refuse should not be applied to the land on which it was grown, or the succeeding crops will be unproductive.

Gingelly Seed.

The black seeded variety yields a larger percentage of oil than the white seeded one. The seeds are known in commerce by various names, namely, gingelly seed, Til seed, and sesamum oil seed. Good seed yields as much as 40 per cent. of oil and is sold in the bazaar at 3 annas a Madras measure. The varieties of gingelly seed possess the same properties, and in commerce are met with, both intermixed and pure. This seed is largely exported to England, France and other European countries.

Extraction of the oil.

The method adopted in extracting the gingelly oil consists in throwing the fresh seed without any cleansing process into the common mill consisting of a sort of pestle and mortar, and expressing the oil in the usual way. The oil thus becomes mixed with a large portion of the colouring matter of the epidermis of the seed and is neither so pleasant to the eye nor so agreeable to the taste, as that obtained from seed repeatedly washed in cold water, or boiled for a short time, so as to remove the whole of the

reddish brown coloring matter. The seed, thus prepared is dried in the sun and the oil expressed. This process yields from 40 to 46 per cent. of a very pale straw colored sweet smelling oil. It is said that the addition of Jaggery facilitates the extraction of the oil. About 16 Madras measures (a Madras measure = 100 cubic inches) of seed give about 7 visses or 22lb. of oil and about 6 visses or 19lb. of oil cake. The oil expressed in the ordinary way becomes rancid in about one month but the oil obtained from the washed seed keeps a long time without becoming rancid.

Uses of the oil.

Gingelly oil is a well known oil and is used by all classes of the community. This oil is consumed to a greater extent than any other by the natives of India and is second only to cocoanut oil in its importance as an article of commerce. The great variation of color observed in this oil is attributed to the mode of preparation. In India the oil is used in cookery, for anointing the body, for making soap, and for purposes of illumination. In England, it is used for the manufacture of soap, and for table lamps, for which it is better suited than cocoanut oil, owing to the lower temperature at which it congeals. The price of this oil varies from 3 to 6 Rs. per maund of 25lbs. in this Presidency, and in England it is sold at about 47£ a ton. It is sufficiently free from smell to admit of being made the medium for extracting the perfume of the jasmine and the rose. Gingelly oil is used to adulterate oil of almonds.

The oil cake.

The oil cake obtained by pressing the gingelly seed is, of course, valuable for feeding purposes but not so valuable as ground-nut cake. It may also be used as manure, but under ordinary circumstances no man of ordinary sense will use it as manure if he has live stock, because it

is more economical to give it to cattle and use their excrements as manure, as in this case the oil of the cake is assimilated by the animals, which would serve no useful purpose in the soil. In fact, the direct application of gingelly cake to the soil as manure is unwise, for the oil arrests the decomposition of the manure.

Gingelly cake becomes mouldy if kept too long and is then only fit for use as manure and must not be given to cattle. It is useful for feeding, only when fresh, and there is an impression that it is superior to ground-nut cake in its feeding value. People say that this cake increases the quantity of milk to a greater extent in buffaloes than in cows, about a viss being an ordinary daily ration for a buffalo. The cake is also eaten by the poor people mixed with certain vegetables but especially with the plants of the genus Amaranthus (greens). It is sold at 9 to 12 pies per viss of 3¼lb. The following is the average composition of an ordinary sample of gingelly cake.

Moisture	12·56
Oil	5·38
Albuminoids	32·81
Organic matter and cellulose ...	41·39
Sand	7·86
	100·00

Discussion.

The President remarked that 500 sheep folded on the land for 3 nights only would not give enough manure for an acre. With reference to the lecturer's remark that the poverty of the ryot and the smallness of his holding do not allow of efficient tillage, he said that a ryot under such circumstances should by his personal labour till his land well, and that Belgium in which the holdings are very small is one of the best tilled countries in Europe.

He said that he saw no reason why the application of the refuse straw of the Gingelly crop to the land should prove injurious to the next crop, and suggested that the injury noticed might be really due to other causes. He thought June somewhat too late for sowing Gingelly, as the crop, when maturing, would be spoiled by the rains.

Mr. Dharmaranga Raju of Tinnevelly said, that he was not aware that the ryots consider the refuse of the gingelly crop injurious if applied to the soil, but he has heard it said that paddy husk is so. Sometime back he advised some ryots to apply paddy husk to the soil. The crop to which it was applied happened to be attacked by insects, and this was attributed to the paddy husk having been applied. Paddy husk ashes, however, are considered innocuous.

Mr. C. K. Subba Rao said that the notion that the remains of the gingelly crop are injurious if applied to the soil is probably not a general one, and may be confined to the District to which the lecturer belongs. He knew for a fact that the ashes of the sugar-cane crop are considered injurious to the soil. Probably the silica which is so abundant in sugar-cane might in combination with the alkalies, fuse and thus lock up the plant-food as it were. But he could not understand why gingelly straw should not be applied to the soil. It is a pity that the restoration to the soil, of the remains of these two highly exhaustive crops, should be considered injurious. Dr. Buchanan makes frequent reference in his Report on Mysore, to gingelly straw being used for purposes of manure. More than any other crop, gingelly is apt to be spoiled by rain falling when it is maturing. This is the case both in this Presidency and Northern India.

Mr. Chakravarthy Iyengar of Mysore observed:—that in Mysore gingelly is sown in September or October, and that the plants flower in December. The harvesting takes place in February. It is generally sown after sugar-cane or paddy. The straw is used either as fuel or is thrown into the manure pit.

Mr. Vencata Rama Iyer of Madura said that in Madura and Trichinopoly gingelly is grown in wet land after the paddy crop is harvested Gingelly is sown about the beginning of February. It is harvested about the end of June It is the general practice in Madura to burn the straw. If the ryots see that gingelly is attacked by disease they generally put it in a pit and cover it with earth and after it is well decomposed use it as manure.

Mr. T. C. Krishna Kurup of Malabar said.—Gingelly is largely cultivated in most of the Taluqs of Malabar. Only two varieties are common there, yielding white and black seeds. The oil extracted from white seeds is preferred for human consumption. The seeds give by expression 40 to 42 per cent. of a pale straw coloured oil, which on the Malabar Coast is largely used for anointing the body, illuminating lamps and in the preparation of medicinal oils. The seeds are, sometimes, parched and used as food and also employed in confectionary. They are considered a stimulating remedy and applied externally for boils and rheumatic pains. The leaves are an effectual remedy for bowel complaints. Gingelly is cultivated generally on the sides of hills. Usually no manure is applied. The straw is usually burnt and used as manure. The oil cake is given to milch cows.

SOUTH INDIAN AGRICULTURE, PAST AND PRESENT

By Mr. C. K. Subba Rao.

(Continued from page 38.)

Fallow.

Dr. Buchanan makes frequent mention of fallowing as practised in various parts of Southern India. But it is

clear that the practice to which he refers is simply leaving the land uncropped without any tillage. He says, "They "are sensible of the advantage of fallow; but very rich "people only have recourse to what is considered as a very "expensive mode of improvement, as they must pay rent for "the field, whether they plough it or not." The Parumba or high lands of Malabar, Dr. Buchanan says, were cultivated once in two years only, and required a year's fallow, to recover their strength; but land situated near villages, where it receives manure, or is much frequented by men and cattle, gave a crop every year. At the present day, the area under fallow, that is, simply left uncultivated, is very large, indeed, and indicates the serious extent to which the exhaustion of dry land goes on. Mr. Cox writes in the North Arcot Manual;—"In the Southern "Taluqs, the customary neglect of dry lands is to some "extent remedied by the habit of resigning them after one "season, allowing them to lie fallow for a year or two, and "then taking them up again. There is usually an under- "standing among the villagers that none shall interfere with "this arrangement by applying for the relinquished fields "except the ryot who has relinquished them, and if a "stranger should make a bid, the preferential right of a "resident villager meets the difficulty. * * * * * * * * "Fallowing of wet land is never practised where water is "available, but dry land of low quality is not unfrequently "allowed to lie waste for a year or so." Regarding the so-called fallowing system, Mr. Kelsall writes in the Bellary Manual;—"Irrigated lands are never allowed to "lie fallow, unless the supply of water is insufficient, and "even then 'a dry crop' is generally raised. Nor is it "found necessary to leave the best kinds of black cotton "soil to lie fallow, though rest is afforded to the soil by "altering the crops raised. * * * * * But a fallow time is "necessary for the poorer red and mixed soils, and the ryots

"will take up land, cultivate, and exhaust it in two or three "years, and then throw it up altogether for five or six."

Manuring.

A perusal of Dr. Buchanan's Report will show that the ryots generally had not stock enough to manure their land. He, describes certain interesting methods of manure management in South Canara, which the ryot of the present day will do well to adopt. For instance, the Doctor says, "The leaves of every kind of "tree and bush except such as are prickly, are used for "manure. The cattle are kept in the house all night, and "their dung is collected for the same use. It is kept in "pits, and every day's collection is covered with leaves; the "whole dunghill thus forming alternate strata of dung and "leaves which soon rot." A better method of manure management was observed by Dr. Buchanan in a place in South Canara, called Haiga, and is described as follows:— "At night, the cattle in every part of Haiga are kept in the "house, where they are daily well littered with fresh "materials. The litter and dung are carefully reserved, as "a manure for rice land, and the manure that is made from "each kind of litter is kept in a separate dung-hill. In "the two months preceding, and in that following, the "winter solstice, the litter is dry grass, and the manure "formed with it is called Cardada gobra. Dry leaves of "every kind of tree except those that are prickly, and those "of the Govay or Anacardium occidentale are used as "litter in the three following months, and form a manure "which is called Draghena gobra. During the six remain- "ing months mostly of wet weather, the fresh leaves of "trees are used for litter, and make a dung called Hudi "gobra, which is esteemed the best. The ashes of the house "are kept in a separate pit, and are applied to different pur- "poses. The cakes made of cow-dung are little used as fuel "in this part of the country, but to increase the quantity of

" manure, the women and boys follow the cattle while at " pasture, and pick up the dung." The following is the description of a somewhat similar method of manure management in Concan: " In the rainy season, the cattle are kept " in the house, and to increase the quantity of manure, are " littered with fresh leaves. In the dry season, they are shut " up at night in pens, which are placed on the *Surd* lands, " and are shifted once in four days. Every morning some " dry soil is mixed with the foregoing night's dung, and the " whole is made smooth that the cattle may lie down. The " manure collected in the rainy season is given to the soil of " first and second quality, which are always sown with rice " after the dry seed cultivation." The following extract " refers to the manuring practice, as observed by Dr. " Buchanan in Nagara, which closely approximates to the " Loose-box system of manure management. " The cattle " are kept all the year in the house. In the rainy season " they are littered with green leaves. Fresh litter is every " day added, but the stable is cleaned only once a week. " This dung is collected in a pit, and called Sopina gobra, or " leaf manure. During the two months preceding, and the " two following, the winter solstice, the cattle are littered " with hill grass, and cleaned once in four days. This dung " also is collected in a separate pit, and is called Hindu or " Soday gobra. In the hot and dry season the cattle are " littered with dry leaves, and cleaned once in four days; " the dung is generally spread upon the hollow roads lead- " ing into the villages, where it is trodden upon by man and " beast, and is thereby much improved, but it renders the " villages quite loathsome. This is called Daraghina gobra. " The grass dung is never used for rice land; but all the " three are indiscriminately used for gardens." The advantage of making the dung compact consists in arresting excessive fermentation whereby the quantity of manure will be considerably diminished.

The fact that the ryot applies whatever manure he has to garden or wet land in preference to dry land which depends for manure chiefly on the casual folding of sheep, was observed by Dr. Buchanan, and is noticed in the following extract: " The village cattle during " the whole year are kept in the house, but are not " littered. Their dung is collected in pits and mixed with " the ashes and other soil of the family. This manure is " reserved for rice land. The dry field gets nothing except " the dung of the sheep, which at any season are herded on " it at night. A flock of 500 in two nights are supposed to " manure fully a plough of land." With reference to the system of manure collection in the neighbourhood of Coimbatore, Dr. Buchanan says, " Leaves are not in use " here as a manure. The cattle are never littered but the " straw which they do not eat, the rice straw that rots, " with that of Hessaru, (Phasealus mungo), Ellu (Sesamum " Indicum) and the like, are collected together in one " pit with the dung, ashes, and other soil of the house. A " great defect in this manner of procuring manure is the not " using the Hessaru straw and leaves for litter. Sheep and " goats are at nights gathered on the arable lands, but are " not confined by folds, which seems also an error."

The following quotations from reports written in 1865 show the manuring system at the present day and it seems that the supply of litter which Dr. Buchanan speaks of with reference to certain parts of the Presidency is a thing of the past. The Collector of Ganjam wrote:—

" Lands are usually manured with animal refuse, " village sweepings, and the soft deposits of tank beds, &c. " Flocks of sheep and cows are also penned over the fields. " Refuse from the Gingelly oil-mills, commonly called oil- " cakes, is used to enrich lands planted with cane. It is

" essential to a good crop. Manuring paddy land with " branches and leaves of trees is not usual in this District."

The Collector of Vizagapatam wrote :—

"The manures are of chiefly cow-dung, wood ashes, " refuse of indigo vats and oil-mills, but the most effectual " manures are the droppings of sheep and goats which are " secured by penning the flocks at night on the land requir- " ing to be manured."

Mr. J. W. B. Dykes, Collector of Nellore, stated :—

"In the haphazard cultivation of the red soils, as " might be imagined, manure is unknown. The whole of " the manure that can be scraped together is there put in " the gardens."

The Collector of Cuddapah wrote :—

" Every ryot keeps a heap of farmyard manure near " his house, and he pollards all the trees in his holding for " the leaves and branches. The *leaf manure* he uses for " wet land, laying it down in considerable quantities after " the land is ploughed. The leaves are quite fresh and " recently cut. They ferment and decay in the soil. The " ryots even buy leaves for manure. They are generally " leaves of neem and trees other than fruit bearing trees. " The ryots also use extensively the refuse of the indigo " vats for manure. * * * * * The *farm-yard* manure " is applied to dry soils and to garden lands. It is, as I " have said, stored carefully and bratties for fuel are not " so exclusively used in this as in other districts."

The Collector of Bellary wrote :—

"It is to be regretted that the universal practice of using " cow-dung for sweeping the floors of Hindu houses, and " for fuel, prevents the use of a very fertilizing ingredient. " The cultivating population are unacquainted with chemi-

" cal or mineral manures, although in some parts of the " district, where there are mountain streams, as for instance " at Kona Uppalapad, they have not failed to appreciate the " benefit derived from the drainage of hills which, in the " instance specified, are composed to a great extent of " limestone."

"The productive power of wet land for paddy and " sugar-cane is maintained by manuring them at the rate of " 15 to 25 bandy loads per acre, with the contents of dung- " hills in which are amassed house-sweepings, cow-dung, " ashes, and other refuse, by ploughing into the ground " leaves and branches of different kinds of trees, as also of " Anumulu," a kind of bean (Dolichos lablab), which is " purposely grown in the land intended for paddy ; and after " the former is reaped, the stump, creepers, and the remains, " are forced in by a plough, and then moistened to fertilize " the soil, and lastly, flocks of sheep are folded at night on " the land for four or five nights."

The Sub-Collector of Bellary remarked :—

"The practices of manuring and penning a flock on " black cotton soil are not everywhere followed, but in some " villages land is manured and sheep penned on them. * * " * * A flock of sheep is penned on the ground, and it is " then inundated for five or six days, then ploughed length- " ways and crossways. After a lapse of eight days again " ploughed, and then manured by the leaves of Cassia auri- " culata, wild indigo, Indian beech, and other trees being " thrown in at the rate of 50 bundles per acre, again " ploughed, and manure consisting of cow-dung, house- " sweepings, &c., is thrown up."

Mr. Minchin, Collector of Kurnool reported :—

" Paddy lands are manured with animal refuse ; but " more generally with branches and leaves of trees. Garden

" lands are invariably cultivated most highly, the sweepings " of the villages and cattle manure being used. Flocks of " sheep are also penned over the fields for the purpose of " manuring them. The richer dry fields, when situated " near the village, are treated in the same manner as garden " lands. * * * * * * In the dry cultivation of those taluks, " manure is never used, as all the available supply is " required for the more remunerative irrigated lands."

The Collector of North Arcot said :—

"Manure is used more or less liberally in proportion to the circumstances of the ryot. It is most diligently collected, and stored throughout the year, and consists of all the cow-dung not used for fuel and domestic purposes, of wood-ashes, house-sweepings, with straw and large quantities of leaves admixed. * * * * * There is another method of manuring very commonly combined with that just described. A flock of sheep and goats is penned in the field during the night, and paid for at the rate of 2 annas to 2½ annas per 100, with rations to the shepherds. A flock from 300 to 500 sheep will thus manure a cawnie of land in three or four nights. I may mention here that in some parts the alluvial deposits in the beds of tanks are made use of as manure, especially in light upland soils. Unlike the Chinese, our ryots have no idea of utilizing sewage, and, in fact, express great disgust at the proposition.

The Acting Head Assistant Collector of North Arcot reported :—

" Sewage is never employed, and indeed the ryots " appear to have no idea of the value of either this manure, " nor yet of bones or decomposed animal matter. A dead " beast is either left outside the village for the vultures, or " eaten, if edible, by the village Pariahs, and the bones are

" left where the animal died, no one appearing to have the " least idea of the use to which they might so profitably be " put."

The Collector of Trichinopoly wrote :

" In wet lands under river irrigation, manure is but " seldom used, as the alluvial deposit left by the Cauvery " water is considered to be sufficiently fertilizing. In the " case of lands situated remote from channels, and of those " watered from the surplus drainage of other fields, and " other localities, fifty bundles of leaves, valued at eight " annas, and penning flocks of sheep at an average cost of " 8 annas per acre, are the means adopted to manure the soil. " A portion of the indigo crop raised is not reaped, but " ploughed up with the earth and trodden in. A cawnie " of land is considered to be well manured, if 1,000 sheep are " penned on it for five or six nights consecutively."

(To be Continued.)

" *TOBACCO LAND IN NORTH CAROLINA.*"

In the Campaigne, or Eastern division of the State named, the principal features in the soil adapted to the growth of yellow tobacco are an open, sandy texture, light gray color, with a gray or yellow sub-soil, sandy, permeable, and well drained, with a tree growth of pine or oaks, chiefly post oaks and white-oaks. In only three countries of this division has the experiment of growing yellow tobacco been tried, *viz.*, Wayne, Lenoir, and Lampson. It is believed, from these sporadic trials, that its culture may be extended over the entire cotton belt of the two States where suitable soils prevail. From these soils, which belong to the class known as transported, or drift soils, most of the clay and iron oxide have been washed out, leaving the sandy and gravelly material behind. A much

larger proportion of this territory is adapted to the production of the crop than any of the other articles, and the product ripens fully a month earlier than in the more elevated regions. In this respect only does climate exert an influence on the product.

The industry took its rise in what is known as the Midland district, a district generally hilly, the streams having cut down through the strain from 50 to 200 feet below the summits of the intervening ridges. The soils suitable for producing yellow tobacco, are irregularly distributed, even in the most highly favored countries, forming but a small part of the whole area. "So controlling," says Prof. Kerr, "is the constitution of the soil, that a part of the same farm, or even of the same field, may produce the finest brands known in the market and another part be wholly incapable of making anything better than the commonest article. The quality of the tobacco is determined absolutely in the field before cutting, and no manipulation in the handling or curing will make a fancy, bright tobacco out of a plant of inferior texture and color of leaf, although the best grades may be spoiled in curing." The bright tobacco patches, as a general rule, are found on the ridges and branches between the watercourses. Whenever their ridges have a gray, or yellowish, or cream colored sub-soil, and covered with a gray, sandy or gravelly soil the bright tobacco may be grown. Upon old fields, long exhausted, and having a scanty growth of chinquepin, old field pines, and running briers, this tobacco will grow in its highest perfection, provided always, that the soil and sub-soil are of the character and color indicated above. No soil of a reddish hue, containing a large percentage of oxide of iron will under any circumstances produce a high grade of yellow tobacco. All the characteristics of the best tobacco soils are those which denote sterility.

They are utterly worthless for the production of wheat, corn, oats, or grass; are low in alumina, humus, and the oxide of iron, and contain from 90 to 96 per cent. of insoluble silica. They are indeed a bed of fine, yellowish sand of open texture, well drained and warm.

Farmer and Mechanic.

—North Corolina Farmer.

ENSILAGE A SUCCESS.

THE English Agricultural Department has rendered a real service to agriculture by the Ensilage Enquiry which it has conducted. It sent a series of queries to all who have been experimenting with ensilage, and the result is a bulky volume of 300 odd pages giving a vast amount of exceedingly useful and interesting—we might almost say encouraging—information upon the general subject of "silos and ensilage in Great Britain." The returns relate the experience with no fewer than 1,183 silos—963 in England, 59 in Wales, and 161 in Scotland—and amongst the points fully reported upon are the size, situation, construction, and cost of silo; the crops ensiled when cut, and whether chaffed or unchaffed; the weighting, cost of making silage as compared to making hay; opening of silo and appearance and condition of the silage; results of feeding stock upon silage, especially dairy cows—noting the effect produced upon quality and quantity of milk; the daily quantity of silage and of other food given to stock; the effect of silage on the health of stock; and the making of silage without a silo.

What is the verdict from all this mass of evidence? Emphatically in favour of ensilage. The system, of course, has come short of the great things that were claimed for it by enthusiasts. This was certain to be the case, for

enthusiasts invariably over-estimate the importance and worth of their hobbies. But in spite of all the shaking of heads and the sceptical suggestions that "more light" was desirable, the silo has already fully established its claim to rank as a useful, if not indeed as an essential, adjunct to farm buildings in the United Kingdom. The system has been put on its trial in nearly all conceivable forms and circumstances, and the results when summarised are decidedly in its favour. "Of the importance of ensilage as an auxiliary to other food for animals, whether for dairy, store, or young stock, among cattle as well as other kinds of stock, there can now be scarcely any doubt." Such in effect is the conclusion drawn by the Agricultural Department from the evidence collected—such is "the sum of the aggregate of the results of the replies" received from over 300 agriculturists who have put the system upon its trial in various parts of the country. And this conclusion by no means over-states the case. A careful perusal of the "evidence" will show the "verdict" to be well within the mark.

A carefully drawn summary presents briefly the substance of the detailed accounts which make up the main part of the volume. The silos which, as we have seen, numbered in 1884, 1,183, varied in capacity from 96 to 55,440 cubic feet, the average being 2,801 cubic feet. Some are drained and others are not. Stone, brick, concrete, slate, wood, and earth, have been used in forming the walls of silos, and they are built entirely above, partly below, and entirely beneath the surface. The cost has varied greatly—"from being merely nominal to sums exceeding £400" and, in very many instances, structures previously existing have been converted into suitable silos.

The crops preferred for ensiling would appear to be meadow-grass, clover, trifolium, and aftermath, but "oats

green barley and wheat, maize, buck-wheat, sainfoin, rye, and other artificial grasses, vetches, lucerne, hopbine, marigold and turnip-tops, peas and beans, with mowings of rough grass from plantations and orchards, hedge-sides and ditches, together with nettles, sedges and rushes, have all been more or less successfully made into ensilage, and in that palatable form have been taken eagerly by stock." Some have chaffed and others have not chaffed the material before putting it into the silo. "Economy of space is gained by chaffing, but its extra cost appears to be sometimes considerable." As to weighting, opinions generally are in "favour of a simple system of lever pressure, as economising labour in moving dead weight, and as affording opportunity of regulating the pressure."

An important consideration is the question of cost. So far as present experience goes, "opinions lean to the belief, confirmed by actual test in a few of the reports, that the cost of making ensilage is less than that of making hay, more especially when wet weather prevails." In almost every case where the system has had anything like a fair trial, the material has been well-preserved, barring a small quantity at the top and sides—estimated by some at ten per cent. of the whole.

Silage has been found to be an excellant food for nearly all kinds of stock. "Almost unanimous testimony is afforded" as to its good effects upon the health of stock. Silage has been fed extensively to dairy cows, as a rule, along with other materials, but in a few cases alone, and the weight of the evidence is decidedly favourable to ensilage. The recorded opinion of 294, who have tested silage in its effects in regard to milk and butter, are classified as follows:—No change in milk 22, in butter 1; improved in quantity and quality, milk 65, butter 18; decreased quantity and deteriorated quality, milk 1, butter

none; increased quantity, milk 93, butter 13; decreased quantity, milk 5, butter 2; improved quality, milk 34, butter 26; deteriorated quality, milk 5, butter 3; improved quality and decreased quantity, milk 4, butter none; increased quality and deteriorated quality, milk 5, butter none; favourable results—whether in quantity or quality not stated—milk 30, butter 15; unfavourable, milk none, butter 1.

On the whole, therefore, the more we know of ensilage the better we like it. "It is an invaluable system in rainy seasons, and *six seasons in ten* in England are rainy when hay is down." In a single sentence Mr. Learmouth thus puts the case forcibly and truthfully.

Live Stock Journal.

AMERICAN AGRICULTURAL STATIONS.

The following table will indicate the States that have regular stations in active operation :—

Location.	Organized How.	When.	Annual support by State, &c.	Amount of land used.	Cost of outfit.
Maine : Orono.	State College	1885	$5,000 per annum.	Enough.	$5,000
Mass : Amherst.	State College	1882	$5,000	20 acres.	$3,000
Conn : New Haven.	Independent Station.	1877	$8,000 and fees.	5 acres.	$30,000
New York : Geneva.	Independent Station.	1882	$20,000	125 acres.	$30,000
New Jersey : N. Brunswick.	State College	1880	$11,000	Ample.	$16,000 and buildings.
Ohis : Columbus.	Ind. Station at College.	1882	$5,000	23 acres.	$15,000 and buildings.
N. Carolina : Raleigh.	Independent Station.	1877	License tax $8,000	None.	$10,000
Alabama : Auburn.	Ind. Station at College.	1883	License tax $7,500	226 acres.	$8,000
Wisconsin : Madison.	State College	1888	$8,000	125 acres.	$8,000
Houghton Fa'm New York.	Mountain-ville Pr. enterprise.	1877	Private $6,000	10 acres.	$5,000 and Farm buildings, &c.

"Besides these regular stations, agricultural experiments are conducted at a number of the State Agricultural Colleges and Universities, by an especial assignment of College funds, and managed by the College Professors. Work of this character, constantly in progress, and costing from $700 to $8,000 per annum, has been reported by the following named gentlemen, in charge for some years past: Dr. G. C. Caldwell, Cornell University; Dr. John R. Page, University of Virginia; Professor W. H. Jordon, State College, Penn; Professor John M. McBryde, Columbia College, S. C.; J. W. Gleason, East Tennessee University, at Hooseville; Professor J. W. Sanburn, Columbia, Mo; Professor E. M. Shelton, Kansas College; Professor H. C. White University of Ga; and Professor E. W. Hilgard, University of California. There are others similarly engaged, from whom I have no reports. But it may be said that they are doing faithful work in the interest of the farmer, and for the advancement of agriculture.

In the opinion of the writer, nothing would conduce more to the improvement of agriculture in Virginia than a properly conducted experimental farm in every agricultural district of the State, as a part of the State Department of Agriculture, and under the supervision of the State Commissioner. Such farms would not only afford instruction to a large majority of farmers it is impossible to reach otherwise, but would furnish the means of procuring seeds and plants best suited to the climate and soil of each district, an object itself of incalculable importance in the development of a system of mixed farming with a variety of crops, the only hope of our prosperity in the future.

PROGRESSIVE FARMING.

THERE has been real progress made in agriculture, and there are many machine helps in the field, in the barn and in the house, that our fathers and mothers did not enjoy. But the young farmer who has inherited a bank account should not undertake to be too progressive. He should begin with a small farm, the acres of which bear some proper relation to his experience and actual knowlege. Let him buy a few acres, build a small house, secure a little stock and such implements as he must have, and begin in a small way. Let him raise his own seed, plant his own nursery, increase his herds and cattle by natural generation and not by purchase, except an occasional male animal of good blood. Let his own skill and industry supply his own wants as far as possible. As he adds acres to his farm, and rooms to his house, and length and breadth to his barn, and numbers to his cattle, horses, and herds, and comforts to his home, and weight to his character and purse, he will feel a just pride in the thought that all this is the result of his own skill and industry. He will learn how to keep and improve what he gets, and to add more and still more to his possessions. He will feel that he is himself a living power, capable of producing the means of comfort and wealth.

Such a young man may not figure in mutual admiration cliques as progressive, but he will be counted as a growing man. And a growing man is a man always in the favor of his fellows. When a man is going up, everybody is glad to lend him a helping hand. All who know him volunteer to do him service. But when he is going down, all step forward to kick him along. Every one accelerates his downward course. It is always best, therefore, to start at the bottom of the hill and work steadily up. Better be small in raising a little than great and falling a little. The true course for every young man in every business, is to begin at the alphabet of his business and rise as fast as he can safely and honorably.

AN ASTONISHING DAIRY TEST.

MR. Valancey E. Fuller, writing in the *Rural New York*, says:—

In the "advanced reports" issued by Professor William Brown of the Ontario experimental farm, some most valuable and interesting comparative tests are set out between a cow of each of the breeds claiming special attention as dairy animals namely, Jerseys, Ayrshires, and Holsteins. The Jersey was three years old, weighed 830 lbs. and had calved in February. The Ayrshire was four years old, weighed 1,150 lbs. had calved in January and the Holstein was three years old, weighed 900lbs. and had also calved in January.

The first series of tests was for the months of February, March, and April, or 89 days, with the following results for that period:—

	Pounds. Milk.	Pounds. Cream.	Pounds. Butter.	Pounds. Curd.
Jersey ...	1,602	296·7	127·6	224·3
Ayrshire ...	1,780	228·0	85·5	240·8
Holstein ...	1,958	237·7	73·1	205·6

The next is a summer test with the same animals in May and June, and applying the tests to aggregate quantities for the 61 days, the outcome is as follows:—

	Pounds. Milk.	Pounds. Cream.	Pounds. Butter.	Pounds. Curd.
Jersey ...	1,342	190·5	116·2	232·1
Ayrshire ...	915	134·5	66·3	143·6
Holstein ...	1,231	112·7	34·9	157·5

Taking the three cows for the whole 151 days, the length of the tests, the following are the results:—

	Pounds. Milk	Pounds. Cream.	Pounds. Butter.	Pounds. Curd.
Jersey	2,944	487·2	243·8	456·4
Ayrshire	2,695	362·5	151·8	383·9
Holstein	3,239	350·4	108·0	363·1

In other words the Jersey weighing 833lb and three years old, gave 249lb more milk than the Ayrshire four years old, weighing 1,150 lbs. and 285lbs. less than the Holstein—900lbs. and three years old; but the Jersey gave 248lbs. of butter for the 150 days, to 151½lbs. from the Ayrshire, and 108 from the Holstein—nearly 100lbs. more than the Ayrshire and more than double the amount given by the Holstein. When we turn to the ground especially claimed by the Ayrshire and Holstein, here, too, the Jersey leads by a large majority, for she gave 456 lbs. of curd to 383 from the Ayrshire and 363 from the Holstein. Of butter and curd together the Jersey gave 699 lbs. the Ayrshire 534 lbs. and the Holstein 471lbs.—verily a great difference in favour of the Jersey, especially when it is borne in mind that one of the greatest characteristics of the Jersey is to hold most persistently to her milk. It seems, therefore, that there is little doubt as to which is the best all-around cow, if those figures can be relied upon. And why not?

The Agricultural Gazette.

THIRD ANNUAL REPORT OF THE NEW YORK AGRICULTURAL EXPERIMENT STATION, FOR THE YEAR 1884.

This Experiment Station was established by an Act of Legislature passed in 1880, and amended in 1881. The management is entrusted to a Board of Trustees, who appoint a director, horticulturist, botanist, chemist, stenographer, farmer, and assistants. Such an organisation must be considered as a step in advance beyond anything, yet done in this country, being a direct action on the part of the Government to promote the exact knowledge of agriculture. This is the main point we desire to bring before the readers of Nature. Among the many voices raised on behalf of technical instruction of artisans and others engaged in industrial pursuits or of musicians and artists, few are to be heard in favor of the promotion of exact agricultural knowledge. The Americans are wiser, and are establishing what they call "experiment stations" in various parts of their wide territory. A few of the objects of investigation at present occupying the attention of the staff of the New York station may be enumerated as follows:—(1) Fertilizer analysis; (2) sample orchards containing single trees of each known variety; (3) soil temperatures at various depths; (4) digestibility of various foods; (5) germination of commercial seeds; (6) a study of maize; (7) root distribution by root washings; (8) milk; (9) diseases of plants. These sections furnish material for 418 pages abounding in tables of results of great practical value. The pains taken in thoroughly working out the conditions of milk-production in the case of two cows, "Meg," and "Gem," are evidence of great activity and zeal. The weight of the cows was taken daily from September 17 to November 12. The weight of food consumed, the accurate analysis of the food, the daily weight of solid and liquid excrements, the daily yield of milk, the daily analysis of the milk, all this carefully and punctually recorded, and fixed in tables, is a work of great importance, not only as nearing directly upon dairying, but having likewise a physiological value. Such constant daily observations are not only essential, if the experiment is to be of any practical value, but must be beyond the efforts of practical farmers, who really ought not to under-

take such investigations. But the value to the community at large when such experiments are conducted quietly and regularly by persons specially set apart and paid to carry them out cannot be overrated. They must not be attempted by ordinary dairymen in ordinary stalls, and with ordinary business appliances, but can only be carried out by trained hands in specially constructed stalls and with special arrangements, all of which must be carried out at a *loss*, which loss is the reason for an endowment. It is hard to say whether the perusal of such a report as now lies before us impresses most with admiration for American activity or regret for supineness.

Nature.

ANALYSIS OF RAGI.

The following analysis of ragi is by Dr. McNally :—

	Per cent.		Per cent.	
Water ...	... 10·81	Cellulose ...	... 7·00	100·00
Albuminoids	... 7·66	Oil ...	... 0·49	
Starch ...	... 71·62	Ash ...	... 2·42	

The ash is very rich in phosphoric acid (P_2O_5), which constitutes 0·62 per cent. of the grain.

RECENT ADVANCES IN SANITARY SCIENCE.

(Continued from page 63.)

The etiology of diphtheria has lately received very careful study, but so far without the attainment of any results capable of exact formulation. It is not a disease invariably dependent on insanitary conditions, and such as typhoid fever is, but that such conditions favour its spread and severity is more than probable. The far greater comparative frequency of diphtheria in rural districts than in

large towns in this country is well known, and has been attributed to the presence in the air of the latter of the products of coal combustion. This view appears the more probable seeing that continental cities, where wood, and not coal. is chefly used as fuel, enjoy no such comparative immunity from the disease. Excessive moisture in the air of a house, whether arising from defective construction of the walls or roof, or from a water-logged soil are conditions very often associated with diphtheria. The fact also that the disease is most prevalent in the damper seasons of the year, when vegetable matter is undergoing decay and fungus life is most active, favours the theory that the specific contagion of this disease is a mould or fungus, which flourishes most strongly in a damp and smokeless air. It is a remarkable fact that diphtheria is sometimes associated with scarlet fever in one epidemic, the two diseases appearing to be interchangeable ; but this is a subject that requires further elucidation. The contagion of diphtheria is extremely persistent and long-lived ; clinging with great pertinacity to infected articles so that every article which is likely to have become contaminated requires very thorough disinfection, preferably by heat. There can be no doubt that school attendance is often a chief factor in the propagation of the disease amongst children.

Koch's discovery of the *bacullus tuberculosis*, a micro-organism and proved to be the specific contagium of tubercular disease in men and animals, has placed tubercular phthisis in the category of contagious diseases. A peculiar disposition or tendency, whether hereditary or acquired, is no doubt granted to enable the germ to take up its habit in the human lung, but the fact that this idiosyncracy can seldom be definitely recognised renders great caution necessary both on the part of members of a

family in their association with a consumptive relation, and of hospital authorities in admitting into a general ward cases of tubercular disease, or of massing together into one institution patients in every stage of the disease. The Bacillus is constantly present in the sputum and probably in the breath of phthisical patients, and this points to the necessity of free ventilation of living and sleeping apartments, and disinfection of soiled articles of clothing and furniture. The external conditions which, of all others, cause a pre-disposition to consumption are, a damp sub-soil, causing excess of moisture in the air, and the constant breathing of an atmosphere vitiated by human respiration. It has been asserted that tubercle can be propagated from animals to man by the consumption of diseased meat, or, in the case of the cow, from the milk of a tuberculous animal. Further proof is required before we can accept such an hypothesis, but there is nothing improbable in such a mode of conveyance of the disease, especially in the case of children with a tubercular pre-disposition.

Besides the diseases which we now know to have been propagated through the agency of milk—enteric fever, scarlet fever, diphtheria, &c., in which the introduction of the morbid matter is accidental the milk serving only as a means for its conveyance and perhaps for its growth, there is a complaint fairly definite in character, which has been attributed to the consumption of the milk of cows suffering from foot-and-mouth disease. Here the morbid quality is inherent to the milk as taken from the cow, and is not due to an accidental introduction. The symptoms described in the epidemics recorded are fever, vesicular eruptions on the lips and in the throat and mouth, and enlargement of the glands of the neck. During the prevalence of foot-and-mouth disease, all milk taken by a household should be boiled before consumption. In view of

the many dangers which threaten us through the agency of milk, it would perhaps be advisable, especially where children are the chief consumers, that this precaution should be always adopted; at least until the sanitary authorities in towns have the power of inspecting and controlling the farms and dairies in the country from which the chief part of the milk-supply is derived.

The possibility of the transmission of the contagion of small-pox for considerable distances, not exceeding one mile, through the air, has been warmly supported. There are many facts in favour of such a view, and its great probability will be seen from the following considerations. The contagion is almost undoubtedly a micro-organism of the class Bacteria, but as it has not yet been isolated and indentified, we are unaware if it is capable of spore-formation or not. The spores of Bacteria can resist external agencies—heat, cold, drying, and antiseptics, to a much greater extent than the fully formed organisms, and it is probable that those diseases in which the contagion remains dormant for long periods are transmitted through spores capable of existing for long periods outside the body. But in small-pox it is not necessary to rely upon spore-formation to support theories of aerial transmission. The contagion as given off from the body of the patient is inclosed in minute epithetial scales and dry pus accumulations. Here, protected from the air and from external destructive agencies, it may be wafted as a minute dust through the air, to descend at considerable distances. That the radius of infection from a small-pox hospital as a centre does not exceed a mile may be due to the great dilution of the contagion as it is diffused through greater distances than a mile from its centre of origin, the hospital. The observations of Dr. Miquel, at the observatory of Montsouris near Paris, have shown the number and variety

of solid particles which are carried in the air, and the immense distances which some of them, as pollen and spores, may be presumed to have travelled. An educated public opinion will soon, if it does not already, regard small-pox hospital as possible centres of infection, and will insist on their removal outside inhabited areas.

The compulsory notification of infectious diseases to sanitary authorities, either by the householder in whose house the case occurs, or by the medical attendant, or by both, has been adopted in numerous provincial towns during the last five years. This measure has done much to furnish the authorities with early information of the occurrence of infectious disease which would not otherwise have been obtained, and such information has doubtless enabled the sanitary officials to stamp out many an epidemic in the bud, which might otherwise have reached large dimensions. The more universal adoption of a measure of compulsory notification in our large towns is urgently needed.

Nature.

(*To be continued.*)

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PEPPER CULTIVATION IN MALABAR.

BY MR. VENGAIL K. RAMAN NAYANAR OF MALABAR.

THE pepper vine grows plentifully about every valley among the hills delighting in a moist rich soil. It is indigenous to the forests of Travancore and Malabar. We see the climbers hanging in festoons, spreading between the branches. It is to the pepper vine that the dense, primeval forests of North Malabar are chiefly indebted for their picturesque beauty and wild tangling luxuriance.

So valuable an article of commerce is pepper considered, that the Maplahs, the commercial class of Malabar, call it the "Black Pearl."

Although a product of many countries such as Sumatra, Bali, Malacca, Penang, Siam, Singapore and some of the islands of the Indian Archipelago, the pepper produced in Malabar, more especially that which comes from the Taluqus of Cherakal and Kottayam is commonly acknowledged to be the best.

The cultivation of pepper is more extensively carried on in North Malabar than in South Malabar. The cultivation is very simple. The choice of a site for planting pepper is a consideration of the first importance. Level ground lying along the banks of rivers and rivulets is to be preferred both on account of the vegetable mould commonly found in such situations, as well as on account of the facilities for water-carriage which such situations generally afford. But the land should never be so low as to be liable to inundation. Declivities, unless very gentle, are to be avoided, for the simple reason that the soil loosened by cultivation is apt to be washed away by heavy rain.

The soil most esteemed for pepper is red soil containing small stones. Above all the vine loves a moist climate. The vines are chiefly planted on the hill sides but thrive well enough in the low country in the moist climate of Malabar.

Pepper is propagated by cuttings or suckers, and is planted before the commencement of the rains in June. They are usually planted near trees which have rough bark. The creepers are trained on a great variety of trees, but the one in most common use is the Muricca or the *Erythrina Indica*. *Erythrina Indica* can be easily propagated by cuttings and is a fairly rapid grower and further it has the advantage of having a rough and prickly bark. It would grow equally well on other trees which have rough barks, such as the mango, jack, &c., but these grow very slowly.

The manner of forming a plantation of pepper upon the Muricca is as follows: The land must be cleared of all scrub jungle and then fenced with a mud wall and levelled into terraces. Between July and November, dig the ground deep with a hoe and plant plantain shoots

4 or 5 feet apart. Then just immediately after two or three showers of the heavy monsoon, plant branches of Muricca. These branches should be from 6 to 8 feet long; straight branches having a golden colour at the bottom should be preferred. Pepper does not thrive well when planted too close. An acre of land will in round number have 1,200 plants and as the vines require but little care, the cost of cultivating and maturing the crop per acre does not exceed Rs. 500 or 600; and as the annual yield when the plants come into full bearing is worth upwards of 1,000 Rs. the investment certainly is a very profitable one. Between the middle of May and the middle of June, the vines are planted, which may be done in two ways. Some people take 5 or 6 cuttings, each a cubit in length and put them in a basket with their upper end slanting towards the tree. The basket is then filled with fine mould and buried in the ground at the foot of the tree and after a lapse of three or four months the earth round the basket is dug and dry leaves and cow-dung are then put round the vines as manure. Some people plant the cuttings round the tree without any basket. It is said that the basket prevents many accidents to which young roots are liable, so that, of those plants which have this protection, much fewer die than those which have it not. The former process is, of course, more expensive. Whichever manner of planting the shoots may be adopted, there is not much difference in the after treatment. During the dry season for one or two years after planting, the vines must be watered; in favourable soils once in three days, in dry soils every other day. But in large plantations, on hill-sides especially, it is indeed very difficult to water the plants. In such cases the authorities adopt a peculiar system which somewhat corresponds to mulching. They carefully cover the tender vines with small bushy branches and thus protect the young shoots from the scorching sun. About the end of

October and the beginning of November the plants must be manured, if possible, and carefully tied up to the tree until they are 10 or 12 feet high, after which they are able to support themselves. In the 4th year the plantains which in the meantime have served to afford shade to the growing vines, are all dug up and not less than twice a year the whole plantation must be hoed and dry leaves put as a sort of manure round the roots of the vines. During the growth of the plants, it is necessary to remove all suckers, and the vines should be pruned, thinned and kept clear of weeds. The branches of Erythrina must also be pruned during the months of March and April and the soil must be well stirred and loosened just after the commencement of the monsoon. If pruning is neglected, the crop will not be good. The cultivators do not generally use any special manure for the plant, but at the beginning of the monsoon, some leaves, ashes, and dung are spread on the ground near the roots of the vine. If the suckers or shoots are good and healthy, 4 to 6 will be quite sufficient for a tree. These suckers are generally cut about the middle of June. The shoots which are a cubit long cost 3 to 6 rupees a thousand and the branches of Erythrina have, of late, become very dear. They cost about Rs. 60 to 80 a thousand.

The pepper vine begins to bear at 4 or 5 years of age, and in three more years it is in full bearing, and continues to yield a full crop for 30 or 35 years when the Muricca dies and must be replaced by a fresh branch and new vines. Under the best mode of cultivation and with the most congenial soil the vines become unhealthy and are never profitable when they are old. The period during which a plantation will remain in full bearing, depends, of course, on a variety of circumstances, but with the most careful treatment consistent with profit, the vines will not do much good after they are 30 or 40 years old.

The pepper vine is capable of growing to a height of 30 or 35 feet, but for the sake of convenience and for the facility of collecting the berry it is usually kept down.

The young amenta begins to form about the time of the *feast* called 'Tiruvathira Nattuvela' (திருவாதிர நற்றுவேலை) which is accompanied by a happy concurrence of certain stars, the exact period of which none but astrologers can pretend to tell. Last year it happened on the 19th June and they say that next time it will happen on the 21st June and will last as usual for a fortnight. The success of the crop greatly depends upon the heavy rain during these two weeks. The beginning of the rainy season is usually the flowering time for the pepper vine.

When the fruit is intended for black pepper, it is not allowed to ripen fully but is collected as soon as the berries become hard and firm, which happens between the middle of January and that of February. If they are collected too early they will spoil, and so, much experience is required to know the exact time.

The men who collect the pepper go up the bamboo ladders and with their fingers twist off the amenta and on very rare occasions strip off the berries. They collect the fruit in a bag or basket and having placed it on the ground, rub it with their feet to separate the berries from the amenta. The bad berries having been thrown away, the good ones are spread on mats or on a piece of ground made smooth, so that one berry does not lie upon another. For three days they are thus spread out in the sun, but every night are gathered and taken into the house. Drying on mats is by far the best method. 15 Malabar seers of pepper dried on mats will weigh a tulam or maund while 16 Malabar seers of pepper dried on the ground will weigh no more. A man can daily

gather and cure from 14 to 18 Madras measures according as the crop is less or more plentiful. A man will, therefore, on an average collect half a tulam a day and the drying and rubbing out of the berries is frequently performed by children and with their assistance a tulam may be collected. A prudent man who does not receive advance for his pepper sells it at from 10 to 12 rupees a tulam, or from 200 to 240 rupees a candy. It may not be quite irrelevant here to notice that the price of pepper has of late been nearly doubled. Twenty years ago the price per candy was never more than 120 or 130 Rs. This year some of the great planters of Malabar have sold many candies of pepper at 270 rupees per candy!!

Each vine yields on an average 4 or 5 lbs. of pepper per annum up to 30 or 35 years, after which it begins to decline. The small round berry grows somewhat loosely to the number of 20 or 30 on a common pendulous fruit stalk. The fruits are at first green, then become red, and if allowed to ripen, yellow, but as I have said before they are gathered before they are quite mature and by drying in that state turn blackish-grey.

White pepper is the same fruit freed from its outer skin, the ripe berries being macerated in water for the purpose. In the latter state they are smaller, of greyish white colour and have a less aromatic or pungent taste. If white pepper is wanted, the berries are allowed to become quite ripe. The vines in this case are very apt to die and in our part of Malabar white pepper is little produced. Besides being propagated by shoots or suckers, pepper can also be raised from seed and experienced men prefer this mode of propagation because, they say, the vine so raised bears well for 40 or 45 years; on the other hand though the cuttings yield well only for 25 or 30 years, the crops they give after their maturity are decidedly greater and the berries are both of large size and of superior quality. Moreover vines raised from seed take a much longer time to bear. It is for this reason, therefore, that in Malabar the propagation is effected by cuttings.

Pepper is one of the most wholesome and useful of spices and the Malayalees esteem it so much that we can scarcely find a single garden without, at the least, 20 or 25 trees having thin foliage and straight stems such as teak, jack-trees, &c., which are intended as supporters for this valuable plant.

SOUTH INDIAN AGRICULTURE, PAST AND PRESENT

(*Continued from page* 81.)

Live fences.—Of the want of live fences in this country, Dr. Buchanan says: "Were it not that the "slovenly cultivation in use here, leaves a few straggling "bushes in the midst of the fields, the whole would be "entirely bare and devoid of vegetation. These lands "appear, however, to be perfectly fitted for the English "manner of cultivation; and in order to preserve some "moisture in the ground, they ought to be enclosed with "hedges, and planted with hedge-rows. The *Euphor-* "*bium tirucalli* common in the country, makes a beautiful "fence; and I think it probable that the Mahagony and "Chestnut would be found to answer in hedge-rows, as "they are both natives of hilly countries and warm "climtes." The following is a parallel observation made by W. R. Robertson Esq., M.R. A.C., in 1875: "The "appearance of the country might be greatly improved if "our ryots could be induced to plant live fences around "their fields; such fences would be of use in many ways,

"they would protect crops from damage by trespassing "cattle, they would moderate the force of the wind, and "lessen the losses that are somtimes experienced about "harvest time from the effects of storms; they would render "the herding of cattle and sheep unnecessary, and be of use "in many other ways, but their chief use would be to afford "fuel for domestic purposes, the cattle dung now used by "the ryot as fuel being set free for use in a legitimate way."

"There are many kinds of shrubs admirably adapted "for forming fences, each suited to the various conditions "met with in different parts of the Presidency. One of the "most generally useful is the corkapilly (*Inga dulcis*) which "resembles the English hedge-thorn very much in general "appearance, and which has been grown on a consider- "able scale on the Sydapett Farms. A hedge of this "shrub can be raised at a very moderate expenditure "of labour; it is only necessary to dig a trench about 1½ feet "deep, and 12 inches wide, along the line of the proposed "fence, and to fill this trench with a mixture of good "surface soil and any manure that is available; when this "is done, the seed is to be sown, say, in three parallel lines "at equal distances in the trench. If the seed is put down "with the first showers of the monsoon, it will be unneces- "sary to use water; if, however, sowing is done in the dry "season, which perhaps the ryot will find the most con- "venient time in the year, he having then no urgent field "work to engage his attention, it will be necessary to apply "water regularly until the seedlings are at the least one "foot in height; but good treatment is not lost on a hedge "of this kind; a fence that is properly started is always the "least costly to maintain in good order. After the second "year, the hedge may be cut regularly once a year, and "will yield a large quantity of excellent fuel. When estab- "lished, a mile of such a fence under fairly good treatment

"in a climate similar to that of Madras will yield annually "from 30 to 40 cart-loads of cuttings, most of which would "be well suited for use in the house of the ryot. The "cutting should be done only after the monsoon has passed "over, thus securing the fences, when at their full height, to "protect growing crops from the ill effects of the high "winds that prevail during the monsoon."

Inefficient cleaning of the land.—The following remarks of Dr. Buchanan show that land is seldom cleaned properly: "The raggy is now coming up, and makes a wretched "appearance; for in every field, there is more grass than "corn. Notwithstanding the many ploughings, the fields "are full of grass roots, which are indeed of great length, "very tenacious of life, sprouting at every joint, and are, "of course, difficult to remove; but a good harrow would "effect much. The farmers of this country are abundantly "industrious; but their want of skill is conspicuous in every "operation."

That dry land is, as a general rule, not properly weeded, is testified to in the Madras Administration Manual, page 286, where it is said, "during the growth of the crop, but little is done in after-cultivation or hoeings."

Fodder crops and Pasture.—The following reference to cholum (*Sorghum vulgare,*) cultivated as a fodder crop near Seringapatam is interesting: "Near Seringapatam "where the demand for fodder is great and where the Jola "(*Sorghum vulgare,*) is commonly cultivated with a view "to furnishing that article, the two kinds (the white and "the red) are often sown promiscuously. * * * * * If "Jola be intended merely for fodder, the seed is sown very "thin; but then should it by chance succeed, and be allowed "to ripen, the produce will be very great. * * * * If it

"be intended for fodder, the Jola is sown about the middle "of Chaitra or the 9th of April, and cut down in Ashadha "or from the 23rd of June till the 23rd of July." The following extracts will show that pasture was as wretched at the time of Dr. Buchanan's tour as it is now. "The "pastures are such waste lands as are not more than 2 "miles distant from the village, and are in general poor; "the tufts of grass are but thinly scattered, and the bare "soil occupies the greater space."

Regarding Malabar, he says, "this seems to be a "country well fitted by nature for rearing cattle; but no "place, in fact, rears worse or fewer. The hills over a great "part of Malabar are clear of wood or bushes, and in the "rainy season, produce a thick coat of grass, which, as it "ripens towards the beginning of the fair season, and is "then about a cubit high, is fit for making hay. By the "natives, this is entirely neglected. Some of the grasses "are indeed very coarse; but Mr. Wye has made good hay "from one of the species, which I take to be Dr. Roxburgh's "Ischamum geminatum. It grows very commonly, and "with a little pains, might be made universal. At "present, there being the greatest abundance of grass, the "cattle of Malabar are in better condition than any that I "have seen in India; but as that will soon wither up from "the drought, I am told that for three months before the "commencement of the rainy season, their condition will be "deplorable."

Regarding South Canara he says: "They, therefore, "consider the greater part of the country as totally useless, "except for pasture or hay, and very little of it produces "the proper grass. One kind of grass only that is produced "in Tuluva (South Canara) is eatable; and when I pro- "posed to the natives to destroy the bad kinds, and sow the

"seed of the good, they were filled with astonishment at "what they considered as the extravagance of the project. "Where the hills are not too steep for the plough, I am "persuaded that this might be done to great advantage, and "the quantity of livestock and manure quadrupled. The "hay at present is very bad and sapless; for the grass in "its natural state withers from maturity, before the rainy "season is over, and before that period, the hay could not "be preserved. This, however, might be easily remedied "by cutting the grass while young, and allowing a second "crop to come up, so as to be in juice at the commence- "ment of the fair weather. This project the natives con- "sider as equally extravagant with the former; nor can it "be expected that in their circumstances they should "attempt any innovation of the kind, until convinced by an "experiment made before their eyes that it would succeed." The following extract from the Madras Administration Manual shows the treatment of pasture land at the present day: "Grass is allowed to grow spontaneously in all "parts of the village area where it will not interfere with "other crops. Special grass crops raised from seed, or "developed by irrigation and manuring, are as yet unknown "in this Presidency, the remuneration not proving sufficient. "Ryots will frequently leave permanently uncultivated "the least productive portions of their holdings for the "sake of giving a better pasture to the livestock required "for farm labour than is to be got in the porumboke "(unassessed) land. Or they will leave the land tempo- "rarily fallow in the same way, with a view to combining "pasture with passive renovation of the soil. With "the exception, however, of certain cases, yearly diminish- "ing, where a light assessment is placed on arable land "reserved for pasture, the ryots have to do this at their "own expense, paying full assessment for the lands thus "employed. The principle of deriving remuneration from

"grass and fodder crops in the form of farm manure will "doubtless be more acted upon as capital increases."

Dr. Buchanan refers to some fair pasture land in the Pollachy Taluq, Coimbatore District, which is in existence now. He says: "I have already mentioned that besides the bad stony land which is common, the farmers here keep in fallow for pasture one-third of their whole land. They pay full rent for the latter, but nothing for the use of the commons. For pasture they are never necessitated to send their cattle to the hills."

It is interesting to compare the foregoing with the following extract from the Report on the Coimbatore District, by W. R. Robertson, Esq., M.R. A.C.: "An "exceedingly small proportion of the occupied area is under "grass. I saw some fair pasture near Othikalmundapum "in the Coimbatore Taluq, and also a few patches of mid- "dling pasture in the Pollachy and Kongiem Taluqs, but, "elesewhere in the District, excepting on the slopes of the "Annamalays and the Nilghiris, on the banks of the larger "rivers, and on the margins of irrigated land, I saw nothing "that could be called "grass land." Over the greater "part of the country, there is not, in each 1,000 acres of "occupied land, more than one acre under pasturage."

The following extracts refer to the cultivation, nearly a century ago, of maize which is a crop of great merits: "In Silagutta, maize is cultivated between the rows of "turmeric. It can hardly be called an article of food, as "the natives have a prejudice against it, conceiving that it "produces gripos. The straw is given to the gardener's "cow, but is not reckoned wholesome food, which is pro- "bably a great error."

Referring to the maize crops at a place called Doda Balapura, the Doctor says: "The maize thrives better

"than at Silagutta, growing seven or eight feet high, and "producing four or five heads. The gardeners, however, "remove all except one, and allege that the plant is not able "to bring more to perfection. The same prejudice against "the grain prevails here as elsewhere, in this country. "When I asked if they ever made it into flour, my question "was considered as a joke, or perhaps as an absurdity, at "which the people could not help laughing."

Late castration, a cause of degeneration among cattle.—"This breed (Madhugiri) seems to owe its "degeneracy to a want of proper bulls. As each person in "the village keeps only two or three cows for supplying his "own family with milk, it is not an object with any one to "keep a proper bull; and as the males are not emasculated "until three years old, and are not kept separate from the "cows, these are impregnated without any attention to "improvement, or even to prevent degeneracy. Wealthy "farmers, however, who are anxious to improve their stock, "send some cows to be kept in the folds of the large kind "and to breed from good bulls. The cows sprung from "these always remain at the fold, and in the third genera- "tion lose all marks of the parent's degeneracy."

INTRODUCTION OF IMPROVED MACHINES, IMPLEMENTS AND TOOLS, INTO INDIA.

It is necessary to bear in mind that the Indian ryot can obtain the services of *eight field-labourers* for the same sum that an English farmer pays for *one labourer*; and, that even allowing that one English field-labourer can do the work of four field-coolies, our labour is still *fifty per cent. less costly than English field-labour.*

2. As manual-labour becomes more costly in this country, so will the use of labour-saving machines become

more general. In the northern counties of England, southern counties of Scotland, and over the northern States of America, field-labourers are paid from three shillings to five shillings per day, and, as a consequence, in these districts, all sorts of labour-saving machines and implements are in regular use. Whereas in the southern counties of England, northern counties of Scotland, and over nearly the whole of Ireland, where field-labourers can be obtained at from one shilling to one shilling and six pence per day, few of our modern machines and implements are known. In these districts, more especially in the south of Ireland, there are hundreds of Farmers who still use the flail in threshing; and the wind for separating the chaff from the grain.

3. In very few districts in this Presidency, have the ryots had any opportunity of determining for themselves, the practical value of European Agricultural machines. They must not only see them actually working, but should be able at all times to ascertain from observation *the nature of the results obtained.* It is only when employed in regular Farm-work, that the qualities of a machine or implement can be determined. Trials made under extraordinary circumstances are misleading. I can imagine no better opportunity for judging of the suitability of a machine or implement for one's requirement, than when in regular use in the hands of properly-trained men, on a well-managed Farm. To test a machine under circumstances, it will never be called upon to meet; or under the management of people who neither understand its construction nor its uses, is certainly the most effectual way of preventing its introduction.

4. I have no hopes of seeing large and costly machines introduced through the agency of Co-operative

Societies amongst the ryots; such arrangements have not generally been successful at home. Many agricultural operations are dependent on the weather, and it would usually happen that all the members of such an association would require the implement or machine at *one time.* Besides, the expense of transporting such a machine as the Threshing-machine from place to place, would be very costly in this country, as trained cattle and labourer would have to accompany it.

5. We have as yet no Threshing-machine that will effectually thresh all kinds of Indian crops. Even if these difficulties were overcome, it is very doubtful whether labourers using well-constructed flails would not more cheaply and effectually thresh out the grain. I am personally acquainted with several districts in Ireland where the flail successfully competes with the travelling Threshing-machine. If we can do our threshing with manual labour as satisfactorily as would be done by the Threshing-machine, why should we sink one or two thousand Rupees of our capital in purchasing one? I believe that a modification of the Threshing-machine, something similar to that in use in Scotland about thirty years ago, which could be made by any village carpenter at a comparatively trifling cost, might be introduced into some districts with advantage; it would familiarize the ryots to the new process of threshing and prepare the way for more complete machines, should an increase in the value of manual-labour render this necessary. So also the old winnowing machine. Blower might be introduced here, its construction is very simple, and it would not cost one-third of the sum asked for the modern Winnowing-machines. Indeed it appears to me that the machines used in England and Scotland thirty or forty years ago, are better adapted for

introduction into India, than those of the present day; at that time we had in England no extensive Agricultural Implement Manufacturers scattered over the country, we had to trust to the village carpenter and smith for the manufacture and repair of our implements and machines. Though the machines then manufactured were rough and rude, in comparison with our modern machines, they were nevertheless simple in construction, strong, cheaply made, and readily repaired. Wood and wrought iron were then chiefly used, and iron castings seldom employed. The large use of iron castings in the construction of English-machines, has prevented their more general use in this country. When an accident occurs to a casting, *the machine is frequently thrown aside as useless*; even if the cost of obtaining a new casting from the probably distant foundery, does not exceed the value of the machine, still such delay, trouble, and inconvenience is experienced, that few care to submit themselves to the annoyance a second time. From information which frequently comes to me in connection with my official duties, I believe there is a very large amount of English agricultural machinery in this country, which have been thrown aside as useless, for the reason I have already given.

6. I do not think that it is altogether from a lack of enterprise amongst Ryots that English-machines have not become more common near our large towns, where the ryots more frequently see them. I fear that to no inconsiderable extent the unpopularity of our machines amongst the native cultivators, is due to the many lamentable failures, and their ghosts in the shape of broken machines, which are frequently met at the auction rooms in our large towns.

7. I believe much good may be done by introducing amongst the ryots good specimens of our smaller implements and tools, such as grubbers, drill-cultivators, rollers, harrows, chaff-cutters, barrows, shovels, picks, mattocks, axes, hedge knives, sheep shears, sickles, rakes, manure forks, pitch forks, etc., etc., all these are now in regular use at the Government Farm at Madras, in the hands of ordinary field-coolies. A great many of these tools were made on the Farm by ordinary carpenters and smiths, it is in this direction that I hope we may achieve success; at the same time, I cannot help expressing the opinion, that, as a rule, *we greatly under-value native implements and tools*; there is a charming simplicity about them, a simplicity almost approaching to that shown by nature in her works. Take for example, the Picottah, Mamotie, the Plough, and the Drill, they are frequently made of very inferior materials, and are carelessly put together; still, taking into consideration their small cost, and their suitability to the present circumstances of the ryot, I feel sure we have nothing that will successfully compete with them. However, as we expect that the ryot will, partly from choice, and partly from necessity, ultimately adopt a better system of culture, a demand for maize, cotton, oil-seed, etc., for export, rendering dry land cultivation more profitable—so we believe will a demand for better tools and implements be generated. In the meantime, it appears advisable to adhere as closely as we can to models of native tools which have been found most useful in this country. By gradually adapting these tools to the necessities of an improving agriculture, we may hope, ultimately to introduce many valuable European appliances, which are now, not only not appreciated, but are actually considered hurtful.

Analysis of Ceylon Soil.

Samples selected by the Planters' Association and representing estates upon which Coffee, Tea, Chinchona and Cacoa have respectively been planted.

The following analytical results represent the soils in the air-dried condition :—

Name of Estate.	Coffee.		Tea.				Tea and Cinchona.	Cinchona.	Cacoa.	
District.	Ragalla. Udapussellawa.	Dambatenne. Haputale.	Rookwood No. 1. Hewaheta.	Rookwood No. 2. Hewaheta.	Rookwood No. 3. Hewaheta.	Dunedin. Kelani Valley.	Dryburgh. Matale.	Liddesdale. Udapussellawa.	Pallekelle. Dumbara.	Warriapolla. Matale.
Waterlostat 212° F.	4·022	3·765	2·555	1·549	3·091	1·938	4·244	3·338	1·218	2·781
*Organic matter and combined water	24·337	14·345	11·799	9·005	15·893	12·838	18·002	16·134	4·818	9·183
Oxides of iron and some Manganese	8·247	9·444	11·679	60·151	4·611	9·841	9·131	4·638	6·857	13·111
Alumina	11·949	9·467	11·769	7·933	5·546	10·803	10·894	9·030	5·477	9·911
Lime	·385	·434	·339	·213	·149	·302	·449	·743	·450	·287
Magnesia	·057	·394	·381	·087	·141	·216	·484	·271	·645	·554
Potash	·137	·210	·170	·119	·107	·081	·246	·176	·353	·304
Soda	·045	·122	·165	·058	·050	·006	·104	·024	·010	·228
Phosphoric Acid	·122	·160	·161	·025	·184	·083	·131	·175	·064	·118
Sulphuric do.	·013	·043	·027	·068	·063	·001	·014	·041	·020	·056
Carbonic do.	·191	·273	·242	·584	·164	·120	·391	·531	·201	·451
Chlorine	·005	·090	·004	·007	·006	·003	·005	·005	·009	·004
†Insoluble Silicates and Quartz.	49·880	61·253	60·709	74·337	69·995	63·768	55·905	64·894	79·878	63·012
	100·000	100·000	100·000	100·000	100·000	100·000	100·000	100·000	100·000	100·000
*Containing Nitrogen ...	·521	·411	·228	·114	·429	·117	·496	·501	·114	·199
†Containing Quartz	8·940	10·720	15·740	25·000	30·780	11·020	7·890	8·660	14·680	12·280

(Signed) JOHN HUGHES, F. C. S.,
Fellow of the Institute of Chemistry,
Member of the Society of the Analysts.

A. PHILIP, ESQ., Kandy, Dear Sir,—Mr. Shand as the representative of your Association called upon me this week to express his thanks for the analyses of the ten soils which I had sent him, and copies of which were forwarded you by last week's mails.

Mr. Shand is having these analyses printed in large type, so that when hung up in the Ceylon Court next week, they can be readily seen and read by visitors. He further informed me that he thought a few general remarks, by way of interpreting the analytical results, would be acceptable, and I have, therefore, much pleasure in contributing the following :—

Of course it will be understood that these remarks are made entirely upon the analyses themselves, and without reference to the respective elevations, rainfall, exposure (more or less) to wind and wash, the general physical character of the land, whether steep or flat, together with its situation, aspect and other matters which are naturally of great importance and demand careful consideration when reporting on the relative fertility of different soils.

1. For general convenience of future reference, as well as in order to arrive at the respective retentive properties of the ten soils, similar weighed quantities of each soil in an equally pure state of division were exposed for a fortnight to the air in a room, when the temperature varied from 60° F. to 75° F. The proportion of water still retained after being thus air-dried was then carefully determined by drying in the usual way at 212° F. and the whole of the different analytical results were accordingly calculated for the soils in this air-dried condition. By glancing, therefore, along the line of figures arranged under the heading of water it will be noticed that there are great variations: thus Dryburgh 4·244 stands highest; next

comes Ragalla with 4·032 ; then Dambatenne 3·765 ; and so on down to Pallekele which has only 1·218.

2. Next as regards the proportions of organic matter and water of combination it will be noticed that there are great variations also under this heading, sometimes, as in the case of Ragalla, Dambatenne, Rookwood No. 3, Dryburgh, and Liddesdale; the high results are largely caused by the presence of an unusual amount of nitrogenous organic matter, as will be seen on referring to the column marked "nitrogen," which is an important element in the composition of such valuable fertilizing matter.

3. The variations of the oxide of iron and alumina in each soil are not very great, but there are notable instances, Rookwood No. 1, containing the most and Pallekelle the least. Generally high proportions of iron and alumina are associated with a more or less stiffness of soil.

4. The lime varies a good deal, Liddesdale having as much as ·743 while No. 8 Rookwood has only ·149, and as ·100 per cent. is usually taken to represent one ton per acre of soil to the depth of six inches, it will be understood that these differences although only appearing in decimals really come to a question of tons when considered per acre: In soils originally formed from granitic rocks like those of Ceylon, the relative amounts of lime found in each generally may be considered as indicative of its degree of fertility, and, therefore, its careful estimation is a matter of considerable importance in an analysis.

5. Passing over the items under magnesia which do not call for any remarks, as this constituent is not usually supposed to have any great effect upon the soil, we come to the proportions of potash which are very high in both the cacoa soils, also in Dryburgh, and Dambatenne, and fairly high in most of the others, Dunedin in the Kelani Valley being the lowest ·081, but Rookwood No. 2 and 3 are only very slightly higher.

6. The proportions of soda, sulphuric acid, carbonic acid vary, but do not call for any special remark.

7. Chlorine is also somewhat various, but in Dambatenne the proportion is far above the average, though what the reason for such being the case is, I cannot, of course, say unless it be *exposure* to the monsoon. *

8. Phosphoric acid stands very well in many of the soils: thus Rookwood No. 3 has the most ·184, though curiously enough No. 2 next to it has the least of any, neither soil having been manured. From information furnished by Mr. Armstrong in reference to these two samples, it would appear that No. 2 represents a field of tea 10½ years old in virgin forest land, elevation about 5,300 ft., even lay of land; also that No. 3 represents a field of tea 10½ years old, *steep* lay of land, facing N. E. never manured, elevation about 5,300 feet.† With this information it seems remarkable that there should be so great a difference in the phosphoric acid which moreover is also followed up in the proportion of nitrogen, both being in favour of the steep land which is specially loaded with quartz. I am inclined to think, therefore, that sample No. 3 may have been taken from some rich hollow in which a rather large proportion of vegetable debris had been previously washed down the steep face. †

* There can be very little doubt that the origin of the exceptional amount of chlorine on Dambatenne estate is to be traced to the not remote salt formations at Hambantota.—*Ed.*

† Perhaps from the sheltered hollow which Mr. Armstrong described in one of his valuable papers, as giving an exceptionally large yield of tea.—*Ed. C. O.*

9. Nitrogen stands very high in many of the samples and must be regarded as indicative of considerable latent fertility, which only requires time and a dressing of limes * to render available as plant food. How far nitrogenous organic matter is or is not in an available form cannot be absolutely determined by chemical analysis, but the fact that a soil is rich in nitrogen, at least, is certainly satisfactory, for it tells us that the element which is so important in all fertilizers is present and that it needs only proper cultivation to make it practically useful. A glance at the analyses will show which soils contain the most and those who know the situation of the several estates will be able to judge how far this richness in nitrogen is due to elevation, rainfall, even lay of land, and freedom from the exhausting influences of wind and wash.

It is noticeable, however, that both the soils upon which cinchona flourishes, are particularly rich in nitrogen: thus Liddesdale has ·501, Dryburgh ·496, and while Ragalla at present included under coffee has even more than these, namely ·521 and Dambatenne follows closely after with ·411 which is far above the average of most coffee soils previously reported on by myself.

10. The proportion of quartz furnishes the last heading and varies from 7·89 in Dryburgh to 30·78 in Rookwood No. 3, the latter a soil that has already been specially alluded to when speaking of the high proportions of phosphoric acid. Generally a soil which contains much quartz is light and porous in character with low retentive properties and a general poverty in the important elements of

* There is a general feeling that the application of lime is adverse to the flushing of tea; but we suspect that a moderate dressing of lime, would be as beneficial to tea land, especially if clayey and stiff, as to soils growing any other substance. The application of a dusting of caustic lime would seem to be especially indicated when moss grows on the tea bushes.—*Ed.*

fertility: thus Rookwood No. 2 is a fairly good illustration as we notice that the potash, phosphoric acid and nitrogen are all comparatively low and are associated with 25 per cent. of quartz and 1·549 only of water. On the other hand No. 1 the next with 15·74 of quartz has nearly twice as much nitrogen as No. 2 and is proportionally richer in the other important elements, such as potash, phosphoric acid and lime. In fact, I have every reason to suppose that No. 1 is generally a much superior soil to No. 2* Again the Kelani valley soil furnishes another instance in which with 11·02 of quartz the important elements above alluded to are also low, with the exception, however, of the lime ·302 which is fully high for the average Ceylon soil. At the same time we see two instances (Ragalla and Dambatenne) where the quartz is nearly as high as the last, and yet the nitrogen, lime. &c., are certainly very far above the average.† The proportions of quartz must, therefore, only be considered in *conjunction* with the other items when forming a general opinion of a soil.

11. Taking then all these analyses, as a whole, I certainly must consider them as very favourable, and they indicate in many instances a wonderfully fertile soil which under favourable climatic influences should be capable of producing highly satisfactory crop returns. The analyses representing, as they do, the soils on estates whose names already stand high in local reputation must be useful as a future means of comparison and as every care has been taken to render the results accurate I hope they may in this way be of practical use as well as of immediate interest.

* Unless the sample was taken from an exceptionally rich portion of the estate?—Ed.

† Such being the case the question naturally arises whether the samples may not have been taken from spots containing unexhausted manure?—Ed.

In conclusion I have only to add that if any information is required respecting the particular manure for the respective crops on these soils, I shall be happy to express my professional opinion as I have already been requested to do in one case.—Believe me, &c.,

(Sd.) JOHN HUGHES, F.C.S.,
Member of the Society of Public Analysts.

Tropical Agriculturist.

THE PRODUCTIVE RESOURCES OF WET LAND IN COIMBATORE,—NOT THOROUGHLY UTILIZED.

By Mr. C. K. Subba Rao.

During a short stay at Coimbatore in the last summer vacation, I saw a very luxuriant crop of cholum in flower, under the bund of the Valangoolum tank, near what is called "the second sluice." It occupied about 3 acres. The plants were about 8 feet high, with robust stems and large blades, and it had been grown without any irrigation. The crop was about 2½ months old, the seed having been sown early in May, and I estimated it at not less than 8 tons of fodder per acre. The crop was very conspicuous on the vast expanse of bare wet land which stretched out from the bund, redeemed but by a few patches of sugarcane and betel leaf grown under wells. The ryot, named Veerun, to whom the crop belonged, said that it was a catch crop and he had intended to cut it for fodder if the rain either proved insufficient or occurred while the crop was ripening. I wondered why the other ryots near had not followed his example. He told me, that the growth of cholum was thought to diminish the produce of the next paddy crop. No

doubt, under the present system of agriculture, the production of a crop means more or less exhaustion of the land. But a fodder crop of cholum is a restorative crop, provided the dung and the urine of the stock which consume it are properly utilized as manure. The successful growth of cholum by Veerun, without any irrigation, during the hot weather of this year, shows to what extent the productive resources of some wet land at Coimbatore remain unutilized. A fodder crop, indeed a grain crop, could be easily produced in addition to paddy on each acre of "single crop" wet land in an ordinary year. Now, there are thousands of acres of "single crop" wet land in Coimbatore, which might be made to produce fodder or green manure, besides the usual crop of paddy.

THE AVERAGE COMPOSITION OF MILK.

The following table, showing the average composition of milk, has been compiled by the North British Agriculturist and is based on the reports of the leading authorities of the world :—

Authority.	Solids.	Fat.	Not fat.	Ash.
Average proposed by M. Bondet, and adopted at Paris, 1857	13·00	4·00	9·00	·70
Average of a number of Farms near Paris.				
Five districts (Adam)	13·10	4·10	9·00	·70
Report of the (1885) Paris Municipal Laboratory—average of all authorities quoted	13·30	4·00	9·30	·70
Babcock-Milk Inspector, Boston, 1885.				
Eight samples as delivered by milkmen.	13·30	3·50	9·80	·70
Wurtz (leading French Authority) average of large number of analyses ...	13·50	4·00	0·50	·60
J. Carter Bell—average of 181 cows ...	13·60	3·70	9·90	·76
New York Dairy Commissioner's Report, 1885—average of 296 cows ...	13·73	4·21	9·52	·71
New Jersey State Board of Health—average of 85 dairies	13·80	4·22	9·58	·65
Davenport—average of 18 native cows.	13·82	3·84	9·98	·64
Poggiale—average of 10 analyses ...	14·00	4·30	9·70	·70
Average of a large number of analyses by Bourchardat	13·30	4·10	9·20	·70
Davenport—Milk Inspector of Boston, 1884—average of 31 cows (grade Ayrshire)	13·32	3·70	9·62	...
Cameron—average of 100 cows of the Russel Farm, England	13·40	4·40	9·00	·70
Cameron—average of 42 cows of the Agricultural Institute, Dublin	13·40	4·00	9·40	·70
Davenport—average of three dairies of 56 cows	13·45	3·79	9·66	·66
Sharples' Report of American Academy of Sciences—average of 19 cows ...	14·49	4·83	9·66	·66
Average of the above 16 authorities ...	13·53	3·91	9·62	·68

SUGAR-CANE CULTIVATION.

To M.R.Ry. C. Kristnasawmy Mudaliyar Avargal, Shiyali.

Sir,

My reply to yours of the third has hitherto been deferred for want of the necessary leisure. The varieties of cane to which you refer I understand to be as follows :—1. Pachanadan, called here Ratali, by the country people, and known as the Ribbon cane on the plantations of the Mauritius and the West Indies. 2. Vellarasi, called here the Mauritius-cane, as having been introduced from the Mauritius. Probably identical with the green Salangone of Trinidad. Not now cultivated here by itself, and occurring only in small quantities among the cultivation of No. 1. Further we have :—3. A red cane, growing as No. 2 among No. 1. 4. The Nanalcane, or true Chinese cane, cultivated largely in the neighbourhood of Kullakurchi. The analyses of the juice of these canes are calculated on the 100 total dissolved solids present in the juice.

	No. 1.		No. 2.	
	a	*b*	*a*	*b*
Sugar	87·60	78·80	87·0	90·6
Glucose	7·28	15·40	11·5	4·9
Ash	1·58	1·96	1·2	1·9
Unknown	3·54	3·84	0·3	2·6
	100·00	100·00	100·00	100·00
Original juice contained p.ct. solids—	18·25	17·5	17·7	20·4

	No. 3.		No. 4.	
	a	*b*	*a*	*b*
Sugar...	72·8	74·50	62·20	76·62
Glucose...	21·4	17·38	33·60	16·91
Ash...	2·2	2·32	2·14	2·28
Unknown...	4·4	5·80	2·06	4·19
	100·00	100·00	100·00	100·00
Original juice contained p.ct. solids—	16·8.	14·9.	20·4.	18·27

Where *a* and *b* are, the analyses were made on different samples of juice, such that mean figures would about illustrate an average quality of juice.

Supposing we obtained 130 gallons of juice from the ton of cane, in the cases of 1, 2, and 3 which are soft canes, and of about the same milling quality, and 110 gallons from No. 4, which is very hard and difficult to mill, I should calculate the weight of common country jaggery to be obtained from 1 ton of the canes, as average.

No. 1.	No. 2.	No. 3.	No. 4.
275 lbs,	293 lbs.	240 lbs.	230 lbs.

while if we go further, and desire to know what these jaggeries are worth in white dry sugar and treacle, which is alone the true basis of the value of the cane, I should calculate

1 ton cane yielding common country jaggery ...	No. 1. 275	No. 2. 293	No. 3. 240	No. 4. 230.
Containing white sugar ...	160,	231,	124,	97.
Treacle ...	115 = 275,	62 = 293,	116 = 240,	133 = 230.

and accepting the value of the white sugar as ten times that of the treacle, and valuing the latter at one pie a pound (in its unmanufactured condition in the cane) we have for purposes of comparison.

1 ton cane value for white sugar	No. 1. Rs. 8·5	No. 2. 12·0	No. 3. 6·0	No. 4. 5·0.
Treacle ...	„ 0·9	0·5	0·9	0·11.
Total ...	8·14	12·5	6·9	5·11

Or supposing weight of cane raised per cawnie, and expenses of cultivation are the same, we see at once that there is nearly 50 per cent. more value in No. 2 than in No. 1 (exclusive of considerations for the manufacturer still further increasing this value) and that No. 3 and No. 4 are not to be thought of. As regards weight of cane raised per cawnie, I have reason to believe No. 2 would have the advantage as being a straight-growing and stout cane, but I have no certain knowledge on the subject. As regards expenses of cultivation, I think these may be accepted as the same for all discriptions of cane, excluding such items as jackal damage, which will depend entirely on locality, and cost of guarding against which, must be determined entirely by local circumstances.—*Madras Mail.*

ARTIFICIAL HUMAN MILK.

The rearing of infants who cannot be supplied with their natural food is notoriously difficult and uncertain, owing chiefly to the great difference in the chemical composition of human milk and cow's milk. The latter much richer in casein and poorer in milk-sugar than the former, whilst ass's milk, which is sometimes used for feeding infants, is too poor in casein and butter, although the proportion of sugar is nearly the same as in human milk. The relations of three kinds of milk to each other are clearly seen from the following analytical numbers, which express the percentage amounts of the different constituents:—

	Woman.	Ass.	Cow.
Casein	2·7	1·7	4·2
Butter	3·5	1·3	3·8
Milk-sugar	5·0	4·5	3·8
Salts	·2	·5	·7

These numbers show that by the removal of one-third of the casein from the cow's milk, and the addition of about one-third more milk sugar, a liquid is obtained which closely approaches human milk in composition, the percentage amounts of the four chief constituents being as follows:—

Casein	2·8
Butter	3·8
Milk-sugar	3·0
Salts	·7

I was led to the preparation of this milk by the serious illness of one my children, who was fed for the first three months of his life upon the various popular substitutes for human milk. During the greater part of his time he suffered from diarrhœa and was at length reduced to such an extreme degree of emaciation as to leave but faint hope of his living more than a few days. He was then fed exclusively upon this artificial human milk until he was twelve months old. His condition began immediately to improve, and at the end of the year he would probably have gained a prize at a Baby Show.

The following is the mode of preparing the milk:—

Allow one-third of a pint of new milk to stand for about twelve hours, remove the cream, and add it to two-thirds of a pint of new milk, as fresh from the cow as possible. Into the one-third of a pint of blue-milk left, after the abstraction of the cream, put a piece of rennet about one-third inch square. Let the vessel in warm water until the milk is fully curdled, an operation requiring from five to fifteen minutes, according to the activity of the rennet, which should be removed as soon as the curdling commences, and put into an egg-cup, for use on subsequent occasions, as it may be employed daily for a month or two. Break up the curd repeatedly, and carefully separate the whole of the whey, which should then be rapidly heated to boiling in a small tin pan placed over a spirit or gas lamp. During the heating a further quantity of casein; technically called "fleetings," separates, and must be removed by straining through muslin. Now dissolve 110 grains of powdered milk-sugar in the hot whey, and mix it with the two-thirds of a pint of new milk to which the cream from the other third of a pint was added, as already described.

The artificial milk should be used within twelve hours of its preparation; and it is almost needless to add that all the vessels employed in its manufacture and administration should be kept scrupulously clean.

MICROSCOPIC ORGANISMS IN AIR AND WATER.

This Report is part of the "Annuaire de l' observatoire de Montsouris" for the year 1885, and is worthy of careful study at the present time, when bacteriology is recognised as a special and important department of science. These investigations have been carried on at Montsouris since the year 1875, and through them Dr. Miquel has been enabled to throw much light on the meteorogical aspect of the subject—an aspect that has received but little attention from investigators, as compared with the pathological. Every one will acknowledge that in entering upon a new field in scientific investigation it is extremely important that the line of research should proceed upon as broad a basis as possible, and that the work of experimentation and observation should not be confined to one aspect of the new study, however important it may be. Fallacies are sure to arise when any department of science is too narrowly specialised, from want of that more general knowledge which would prevent the adoption of erroneous views. This is especially liable to be the case in bacteriology, in which the objects of study are so minute and yet so widely distributed in nature. Dr. Miquel's researches important as they are in themselves are doubly welcome at the present time, as tending to popularise a field in which workers are urgently needed, as well as contributing largely to our knowledge. The example of Paris—the only city in which systematic investigations of the sort are now undertaken—should

stimulate other towns which possess properly equipped meteorological laboratories, to conduct observations on the bacterial organisms contained in air, rain, and soil. The results obtained at Montsouris could then be confirmed or confuted by the results obtained at other laboratories under widely different climatic and meteorological conditions, and the enunciation of general laws and principles would in time become possible. We shall endeavour to place before our readers in this article some of the more important results and deductions made from them by Dr. Miquel, from the observations at Montsouris; but it should be distinctly recognised that any conclusions arrived at by Dr. Miquel are applicable only to Paris and its neighbourhood, and cannot at present be accepted as true for other places where the climatic conditions are different.

Tables are given in the Report, showing for each week of the years 1883-84 (*a*) the average number of bacterial micro-organisms present in a cubic metre of air; (*b*) the average barometrical pressure; (*c*) the average temperature of the air; (*d*) the average state of humidity of the air (per centage of saturation); (*e*) the amount of rain-fall; (*f*) the electrical state of the air; (*g*) the direction and average velocity of the wind; (*h*) the average amount of ozone present in the air. From the observations recorded in these tables, Dr. Miquel has arrived at the following conclusions:—(1) An increase in the number of bacterial organisms contained in a cubic metre of air generally takes place when the barometrical pressure is high: this rule is not absolute, but the exceptions are rare. (2) Temperature does not cause such sudden increments; very often, it is true, a large increase in the number of microbes present in the air takes place in summer, but is important to note that a sustained high temperature causes a manifest

lessening in their number. The thermometer is capable of explaining certain seasonal variations, but not the weekly variations. (3) The maximum number of bacterial organisms present in the air corresponds almost always with a low hygrometric condition of the atmosphere; this is explained by the fact that the degree of humidity is always very high during rain, and when the superficial layers of the soil are soaked in water, periods during which the air is always very poor in bacteria. (4) It would appear *à priori* that the number of bacteria should increase with the strength of the wind, but observation negatives this assumption. A maximum number of microbes is found frequently during periods of calm—when the velocity of the wind is N. E., and the greatest number of minima when the wind is S. W. (6) When the amount of ozone in the air is large, the number of microbes present is small. The north winds blow over from Paris and contain but little ozone. They are rich in microbes. The presence of ozone in the air appears to have the power of destroying bacterial organisms, and, on the contrary, absence of ozone and humidity of the air—unless rain is falling—allow of an increase taking place in their number.

(*To be Continued.*)

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ARECA-NUT CULTIVATION.

MR. C. S. THIMMAPPAIYER OF SALEM.

As regards the description, importance, and uses of areca-nut, I cannot claim originality for this paper. But the information as to the different varieties of the areca-nut palm, the method of its cultivation, and preparation of the article for the market, is derived from my own observation in my native village in Atur Taluq, Salem District, and the five neighbouring villages where there are nearly 340 acres of the areca-nut palm, my own village containing the largest number of trees. I hope that the figures which I have given are approximately correct.

Varieties.—Many varieties of areca-nut are known in the market, the difference being only in the ways of preparation, time of gathering the produce, the manner of slicing the nuts, and the degree of astringency possessed by each.

The Betelnut palm (Areca catechu) is generally admitted to be the most graceful and elegant of the Eastern palms, of a remarkably erect growth, attaining a

height of from 30 to 60 feet with a tuft of feathery leaves at the extreme top. It is extensively cultivated in many parts of Malabar, Northern India, Nepal, also in the South-west coast of Ceylon, Siam, Cochin China, Penang and Sumatra.

The nut is conical, but varies, in some having an elevated apex and small base, in others a large base and a very slightly elevated apex. The seed of this palm germinates in 3 months. The plant is said to come into bearing 5 years after sowing, and continues bearing for 25 years. But as far as I have heard and observed, it begins to bear only after the 7th or 8th year, yielding its full produce after the 10th year and continues productive for more than 70 years. I have seen plantations nearly 100 years old in which though nearly half the number of trees have been either cut down or blown down by wind, yet the remainder continue yielding a money return as good as any grain crop can give. The plant flowers from January to June and the produce is gathered from July to November. The structure of the wood is that of the palms generally. It is hard and peculiarly streaked and might be used for sheds, &c. In Travancore and other places it is employed for spear-handles and bows for which it is well suited, being very elastic. The spathe which stretches over the blossoms of this tree called Pakkumattai is a fibrous white shining substance which is made into vessels for holding arrack, water, &c., as cups, dishes and small umbrellas, and also used as a substitute for plates by the higher classes. It is so fine that it can be written on with ink. The arecanut fibre is worthy of notice on account of its capability of being turned to many useful purposes, especially as it has a soft and cotton-like feel and is capable of being spun into twine. Moreover immense quantities of

the husk are now thrown away, and should this fibre be found capable of being made into paper, or turned to other useful purposes of which no doubt is entertained, it may be collected in large quantities and at a very little cost. It is now generally used as fuel for the potter's kiln at no other cost than that of carrying it from places where it is thrown out.

This palm yields the Betel nut of commerce which, mixed with lime and betel leaf in all the countries of South-East Asia, is in frequent use as a masticatory. It is so much liked by the nations who use it that it is not considered as an article of luxury but as an important article to allay the cravings of appetite. Its use is considered by them very wholesome and to stimulate the nervous system. Among Hindu families it is so essential an article of requirement that besides its daily use, no ceremony, whether religious, festive, or bridal, will be considered complete, unless and until the betel leaf and nuts are distributed among those present on the occasions.

A strong decoction of the nut is used in dyeing. The charcoal of the nut powdered and mixed with salt makes an excellent tooth powder. Young nuts are prescribed in decoction in dyspepsia, and costiveness. Ripe nuts are prescribed as a vermifuge for dogs. The nut is astringent and used as a masticatory and as a medicine. The juice of Areca palm leaves mixed with common salt is said to be an excellent remedy for mange and other skin diseases among animals.

The nuts form a very considerable article of commerce with the Eastern Islands and China and are also one of the staple products of Travancore and other places. Unfortunately I have not been able to procure any reliable statistics of its home consumption, exports, or imports.

There are various ways of preparing the nut:

(1) The fruits are gathered while half-ripe; the husk is removed; the kernel, a round fleshy thing, is cut and boiled in water. In the first boiling, when properly done, the water becomes red, thick and starch-like; and this is afterwards evaporated to the consistence of catechu. The boiled nuts being now removed, sliced, and dried, the catechu-like substance is rubbed on them and dried again in the sun, when they acquire a shining black color ready for use. Whole nuts without being sliced are also prepared in the same form for use amongst the higher classes.

(2) Ripe nuts as well as young nuts in a raw state are used by all classes of people generally; and ripe nuts preserved in water in the husk are also used.

(3) But the method adopted in my locality is a somewhat different one. The nuts are gathered half ripe, and decorticated. The kernels are then cut into 2 or 3 slices each and heated in a pot with about a fourth of its volume of water mixed with betel leaf, and lime made into a paste to give the water a red color for the first time; only so much heat is applied as is required to boil the water in the pot. As soon as a red froth appears over the sliced kernels, the pot is removed from the fire and the water strained into another pot. This same water is used for coloring and boiling any quantity of nuts, a little water being added whenever it becomes pasty. The nuts are then dried in the sun when they usually acquire a red color and are then ready for use. Of all the varieties sold in the bazaars this sort is most astringent.

The quality of the nuts does not at all depend upon their size, but upon their natural appearance when cut. If

the white or medullary portion which intersects the red or astringent part itself be red, the nut is considered of good quality. But when the medullary portion is in larger quantity, the nut is considered more mature, does not possess so much astringency and is, therefore, not so much esteemed.

Cultivation.

Hill tracts and moist climates offer great facilities for the cultivation of this palm. The soil generally selected is a loamy soil rich in vegetable deposit and possessing natural facilities for perfect drainage. The best parts of paddy fields capable of producing regularly two paddy crops a year are preferred for this plantation, the situation being such that a deposit of silt may be obtained from some current when in flood. No dry land will be planted with this palm unless the land has at least once been cultivated wet and a paddy crop raised; and this, it seems, is simply because the land must be perfectly level for purposes of irrigation. The trees must be watered at least once a week during dry weather and the land be cleared of such weeds as notch grass, &c.

Arecanut is always planted together with Betel vine and Agathi. The land is simply ridged and the arecanut seeds are sown in regular lines with the Agathi plants at distances either 6 feet by 6 feet or 6 feet by 8 feet, when the Agathi plants attain a height of nearly 5 feet. The heavy cost of cultivation, the difficulty of procuring sufficient labour in time, the absence of any money return for a long period of nearly 10 years, and the great difficulty experienced in irrigating the plantation especially in dry weather, render the planting of arecanut on a large scale impossible except to rich ryots. An acre of this plantation for the first four years especially, requires the constant

employment of nearly eight men, and as this is very costly, the following is adopted by those well-to-do farmers who intend starting areca-nut plantations. The cost of preparing the land, fencing, manuring, agathi seeds, betel creepers and, in fact, the whole cost up to the time of planting the seed nuts and betel creepers both inclusive, is borne by the owner of the land and it is then leased out, there being generally 4 or 6 lessees for an acre on the strict condition that they should maintain the Betel leaf cultivation and with it the areca plants for 4 years at their own cost, that they should pay half the assessment of the land besides supplying the owner with enough of betel leaves for the requirements of his family. Thus the cultivation is kept up for 4 years in the same way as Mr. Ramasawmy Iyah has described it in the Journal. But I am sure that in my place, or at least when Chavika betel is cultivated with arecanut, the money return is not even one-third so much as what Mr. Ramasawmy Iyah has estimated, though the cost of keeping it up may be nearly his estimate.

After these four years most of the Agathi trees are removed and the land is then dug to a depth of not less than 6 inches and 10 to 15 cart-loads of farm-yard manure is applied per acre. Till the trees come into full bearing, every year the plantation must be dug twice; but manure may be applied once a year. Silt is not deposited on the land till the plants begin to bear. Such young plantations especially in dry weather require two waterings in a week, till they are fairly established, when watering once a week is considered sufficient. To prevent too much exposure to the sun's heat, dried leaves of the palm and plantains are tied round the stems of young plants. Great precaution is taken not to allow cattle to graze in young plantations.

An areca nut plantation when fairly established requires no other outlay and labour than for digging

once a year and for watering which is easily done as the land selected is generally the best paddy fields on which water flows by gravitation. The plantation at the end of 10 years becomes so remunerative that it may be considered as good as capital laid out in Government securities.

In situations which will get a deposit of silt from a flooded river during the rains, scarcely any manure is applied; and so much care is taken, indeed, for getting a supply of silt that even if the flood should come during night and even if it be then raining heavily, the owners will, as soon as they hear the noise of the flood, rush to their plantations and let the muddy water to their fields by means of channels of which there are many. But plantations in situations which cannot be so silted are often manured with farm-yard manure, the shells of castor seed, Indigo refuse, and the silt found in the beds of tanks. Besides, in such plantations the sheddings of trees are not allowed to be removed while in the former they are removed and used as fuel. But generally the former which get a deposit of silt to the depth of an inch every year are always more productive and green looking than the latter.

To prevent the level of the land from being raised so high as to make it unfit for irrigation, the accumulated silt is once in four or five years dug out and removed, of which generally a bund is formed round the margins of the land: or the dug up earth serves for earthing the lines of the arecanut trees themselves. I know of no artificial manures that are applied to areca plantations. Arecanut, has not I believe been analysed. The chewing of arecanut in excess (without betel leaf and chunam) is said to give rise to jaundice? but how far this is true I cannot say. The mere chemical composition of a medicine or dietary does not always explain its physiological action. The public will, however, be under a great

obligation to any one who undertakes the analysis of arecanut, not only for ascertaining its properties but also for determining the artificial manures which may advantageously be applied to so valuable a palm.

Gathering of the Produce.

It may be thought that the gathering of the produce from trees which may have attained a height of more than 30 feet and which bear their bunches of fruit only at the extreme top must be a tedious and difficult work. But in practice it is so easy that five men commencing their work at 11 o'clock in the morning are able to gather the produce of an acre and carry it to the houses of the owners by 3 or 4 in the evening or in nearly 5 or 6 hours. Their remuneration is a sixteenth part of the produce gathered, which includes also their wages for slicing the nuts when decorticated, as well as for carrying the produce from the plantations to the houses of the owners. The mode of gathering the produce may be interesting to those who have not seen it. These men divide equally among themselves the rows of the trees. Then each provides himself with only a sort of loop made of some fibrous substance (especially of the areca spathe) just long enough to admit of his feet to clasp the tree. He puts his feet into this thong, stands close to the first tree of the rows of his division, stretches himself at full length, clasps the stem with his hands and draws his feet up as close as possible to his arms. Again he slides up his hand and repeats the process until he ascends to the summit of the tree. But when the trees are more than 50 feet high and, therefore, very liable to bend by his weight he holds for his support the next tree by his side and thus gets to the top. As soon as he reaches the top, he plucks out one or two fruits from a bunch, peels it by means of his teeth to see if the bunch is fit for being

plucked. If satisfied he pulls the bunch off by the peduncle which very easily separates from the tree and throws that down which is picked up and stored by one or two boys engaged for the purpose. Then he bends the tree on which he has climbed and gives it a backward and forward motion until he reaches the next tree by his side, which he first clasps by his hands and then draws his feet to the same from the other. Thus without the necessity of climbing each and every tree he leaps from one to the other and searches each and every tree in the plantation of which there are not less than 900 per acre, to see if there are bunches fit for being plucked, and comes down. Then they separate the fruits from the peduncles by beating them on the stem of a tree. The fruits are then measured and carried home. At the time of gathering the produce especially, the plantations should be cleared of weeds so that no fruit separating from the peduncle as it falls down from the height may be lost.

As soon as the fruit is brought home, girls aged from 4 to 10 years, as well as women, are sent for to decorticate the nuts which they do by means of a sharp knife fixed on a board. So efficient and quick is their work that in an hour each one is able to peel 7 Madras measures of the fruit which yield nearly 3 Madras measures of decorticated nuts. They are paid at the rate of a pie or a pie-and-half for every measure of decorticated nuts. These decorticated nuts are then sliced by those who gather the produce for which, as I have already said, they are not paid separately. The slicing is done by means of a cracker which consists of a broad sharp knife which fits a groove in an iron rod of its own length. A hand-ful of the nuts is taken and one by one the nuts are sliced. The sliced nuts are then boiled, as I have already said, and carefully dried in the

sun on bamboo mats. But there is one great difficulty in curing the nuts (*viz.*) if light and heat be wanting; the nuts become black in color which then lowers their commercial value. This generally occurs during the time of the North-east monsoon when the sky is either always cloudy or when it continually rains. No other process of drying is adopted. The produce is gathered at least 6 times a year at intervals of 22 days.

The areca palms unlike other palms are infested by a kind of red ant which crowds by thousands on each tree and often injures the flower heads besides stinging the produce gatherers. No remedy has yet been found to get rid of these troublesome little creatures. High winds accompanied by heavy rains are injurious to areca plantations. Squirrels and rats do also much mischief. As I have already said there are nearly 340 acres of this plantation around my native village, the raw produce of which is all brought to a single village where only the produce is turned into the commercial areca nut. And I have ascertained from experienced men that this area produced yearly 11,800 maunds of commercial nut valued at Rs. 6 per maund on the average, equal to Rs. 70,800 on the whole; or giving a gross income of 35 maunds of nuts worth Rs. 210 per acre. The dried nut is about 40 per cent. of the raw decorticated nut in volume.

Income.

	RS.	A.	P.
Gross income	210	0	0
Cost of gathering and slicing one-sixteenth of the produce	13	0	0
Cost of decorticating	9	13	0
(A maund weight of commercial nuts is equivalent to 11 Madras measures of the nuts and this reduced to decorticated raw nuts will be 27½ M. measures × 35 nearly 963 M. measure per acre of raw nuts—at 1½ pies per measure)	22	13	0
Assessment of land	14	0	0
Interest on outlay at 10 per cent	120	0	0
(This outlay I have calculated on Mr. Ramaswamy Iyah's estimate for the 1st year and have added to the same the loss of produce, assessment, together with their interest as well as cost of digging, &c., for the first 10 years.)			
Watching and yearly digging	20	0	0
Total expense nearly ...	177	0	0
The net profit per year	210—177=33		

Thus you see that besides getting a comparatively high rate of interest on the capital laid out, the owners get a profit of Rs. 33 per acre which is really very satisfactory.

Renewal of old plantations.

When the plantation becomes more than 50 years old, the land is then well dug and weeded and fresh arecanut seeds or seedlings are planted in the same line with those of the old trees at equal distances between two old trees. In order to afford shade to these young plants, plantains or Agathi plants are again planted throughout the plantation. Great care is taken not to allow cattle to graze in the plantation and to prevert weeds growing till the young plants attain a height of at least 5 feet. Manure will have often to be applied to the land especially at this time as it is required to supply food not only to the old but also to the young plants, and the plantain, and Agathi plants.

AGRICULTURE IN ERODE.

By Mr. E. B. Krishna Rao.

Garden Cumboo: Penicillaria spicata—*Arsi cumboo* is the variety grown under well irrigation. After the soil has been ploughed about 3 times and manured, the seed is sown broad cast, about April or May. The crop is not generally watered till 8 or 9 inches high, which will be in 15 or 20 days; 4 or 5 days after watering, the crop is hoed, and it is not generally hoed again during its growth; 5 or 6 days after hoeing, the crop is watered again. The frequency of the subsequent watering depends on the character of the soil and the weather. It is a 3 months' crop, being harvested in July. The spikes are first cut, leaving the stalks or stems on the ground. Next day the spikes are thrashed by being trodden over by bullocks; then winnowed. The grain is used for food, by all the poorer classes. The straw is used neither for thatching purposes nor as fodder for cattle. This could be used as litter for cattle; but the ryots are not aware of this advantage. The highest yield of grain per acre is only 3 or 3½ Pothies or bullock loads.

The cost per acre is as follows:—

	Rs.	A.	P.
Ploughings 4 at ½ rupee per ploughing... ...	2	0	0
Seeds and sowing	0	6	0
Waterings 10, at rupee 1, per watering ...	10	0	0
Hoeing and weeding (10 persons)	1	4	0
Cost of cutting the ears and for pulling the stalks	1	8	0
Thrashing and winnowing, &c.	1	8	0
The value of the manure applied to the soil ...	4	0	0
Total cost...	20	10	0

The quantity of seed sown on one acre of land is about 3 bullahs or 6 Madras measures. Coolies are paid in kind.

Cholum (Sorghum vulgare). The different kinds of Cholum cultivated are:—White Cholum, Yellow Cholum and Red Cholum. Of the White Cholum there are 3 varieties namely:—

(1) Peria Vellai (big white cholum) (2) Sinna Vellai (small white cholum) and (3) Yennai Vellai.

Cholum is grown both for grain and fodder. It is a four months' crop. Large and small varieties of white cholum are sown in November and harvested at the end of February. The other varieties, namely the red and yellow cholum are sown in Sithirai (April) and harvested at the end of Audi. (July) Sinna Vellai (small white cholum) is also grown in Sithirai and harvested in Audi. The same operations with regard to manure, ploughing, sowing and formation of plots, &c., that are adopted for cumboo are carried out regarding cholum. But cholum requires deeper ploughings and a less number of waterings than cumboo. Generally the land for cholum is ploughed 6 or 8 times, whereas it is ploughed only 4 times for cumboo. As above stated, cholum is sown broadcast. When the crop has grown about a foot high, it is watered. If it appears that the crop has become stunted in its growth for want of water, it is watered sooner. Three or four days after the watering, the land is hoed and allowed to remain without being watered for nearly a week. Then it is watered again. The hoeing operation is performed only once for the crop during the whole period of its growth. If the soil is clayey and sufficiently manured, 6 or 8 waterings during the whole period of its growth are quite sufficient to bring the crop to

maturity. Then the grain is quite ripe, the stalks are cut down 3 or 4 inches from the ground and tied into small bundles which are again tied into larger bundles, and they are allowed to dry on the field for a few days. Then the ear-heads are cut from the stalks and then thrashed and winnowed. The cholum straw is then tied into small bundles and stored or heaped in such a way that rain water may flow off on the sides without entering into the straw which is thus preserved without being spoiled for use for cattle. On black cotton soil or clay soil, cholum thrives well and the yield is greater than on any other soil; and moreover a clay soil requires a less number of waterings. Cholum straw is considered to be the best fodder for cattle, especially for milch cows. The *highest* yield per acre:—grain 4 pothies or bullock loads worth about Rs. 36; and straw worth Rs. 4. The total value is about Rs. 40.

The cost per acre is as follows:—

	Rs.	A.	P.
Ploughings 8	4	0	0
Seed and sowing	0	6	0
Hoeing and weeding	1	4	0
Waterings 8	8	0	0
To cut the stalks first and then to separate the ears	2	8	0
Thrashing and winnowing	1	8	0
Manure applied	4	0	0
Total cost ...	21	10	0

Therefore the net income is about Rs. 18 per acre when the yield is the highest.

Ragi called also kelvaragoo or (Eleusine corocana). It yields a valuable food grain. The crop is a costly

one. The different kinds of ragi grown on garden lands are:—Yelavithu Ragi, Karumuthu Ragi or Karunsuruttai; White or Vellai Ragi, and Thalaivirichan Ragi.

Ragi is sown in the nurseries either at the end of Avani (June) or at the beginning of Audi (July) and transplanted at the end of Audi (July) or at the beginning of Avani (August). It is a four months' crop. Generally the seedlings are transplanted when they are about a month old. If they are transplanted when they are about 22 or 25 days old, they thrive better. Selection of seed-bed: Land is generally selected near the well from which it is watered. There sheep are folded; if the manure thus obtained is considered to be insufficient, and if the sheep are not reared and folded on the land, then cow-dung, the soil collected near the hedges of gardens and mud-walls, ashes, &c., are used as manure. The soil is dug up about 6 inches deep, freed from stones and well mixed with manure. Then it is formed into small square plots; over which compost formed of decayed vegatable matter, refuse straw, &c., are burnt; and upon this burnt soil seed is sown first; then it is well mixed with the soil and spread over by the hand and thus thinly covered over with the earth. Immediately afterwards, the seed-beds are watered. For the first 3 days they are watered daily, and they are then watered on alternate days until the seedlings are removed and transplanted. Generally the land is manured with ashes, farm-yard manure, &c., and is ploughed 6 times. The produce of the land depends upon (1) deep ploughing; (2) thorough pulverisation of the soil; (3) upon the quantity and quality of the manure applied and especially upon the liberality of the water-supply. After the land has been ploughed and freed from stones and weeds, it is ridged up or formed into small plots 5 or 6 ft. square. These plots are then watered and planted

with the seedlings. The land is watered for the second time after the lapse of 3 days. The third watering takes place 15 days after the second watering. Three or four days after the third watering the land is hoed; then it is watered for the fourth time, 4 or 5 days after hoeing. On the average the land is watered 10 times a month during the 3rd and 4th months until the crop is cut down. Generally the land is hoed only once; and if it appears that the crop is overgrown or foul with weeds, a second hoeing is given. The ear-heads are cut when they are fully ripe. They are heaped together and well covered over with straw for 2 or 3 days and then thoroughly dried in the sun for 2 or 3 days and afterwards thrashed, being trodden over by bullocks and then winnowed. The best yield per acre is 4 pothies or bullock loads of grain worth about Rs. 32 or 35 and the straw worth about Rs. 2 or 3. Thus the total yield would be Rs. 35 or 40.

The cost per acre is as follows :—

	RS.	A.	P.
Ploughings 6	3	0	0
Plotting or Ridging	0	8	0
Transplanting	1	8	0
Waterings about 20 or 25	10	0	0
Reaping the ears	1	8	0
Do. the stalks	1	0	0
Thrashing and winnowing...	1	8	0
The value of the seedlings	2	0	0
Do. of manure applied	4	0	0
Total cost ...	25	0	0

Chillies.—Milagai (capsicum annum.) The different varieties of Chillies are (1) Peroo (big or large) Chillies (capsicum grossum) called also kathari (Brinjal) Chillies; (2) Vellari (cucumber Chillies); (3) seeni (small) Chillies and (4) Aúkasa (looking towards the sky) Chillies.

The seedlings are raised in the nurseries and then transplanted. The land is treated just in the same way as for ragi. Ash-manure is considered to be the best. Brackish water is also considered to be the best adapted probably containing salts of potash, &c., which are largely required by plants of the natural order Solanaceæ. The land is well ploughed and weeded; and then formed into plots. These are then watered just before transplanting; and the seedlings are planted about 1½ or 2 feet apart. The land is watered for the 2nd time the next day. The seeds are sown in beds in Auni (June) or Audi, (July), generally at the beginning of Audi (July); and the seedlings are transplanted in the beginning of Avani (August). The young seedlings when about 25 or 30 days old, are removed from the nurseries and transplanted. They begin to flower in Purattasi (September) and the fruits are gathered at the end of Arpasi (October) or at the beginning of Karthigai (November); afterwards gathering takes place once in every 15 days until Punguni, (March) when the plants are removed from the ground. This crop requires a greater number of hoeings and waterings than the before mentioned. The best yield per acre is 15 pothies or bullock loads worth about Rs. 80 or 90.

The cost per acre is as follows :—

	RS.	A.	P.
Ploughings 4	2	0	0
Formation of plots	0	8	0
Transplanting	1	0	0
Hoeings 4	4	0	0
Waterings	50	0	0
Gathering and preparation for market ...	10	8	0
The value of manure	6	0	0
Total cost ...	74	0	0

No other crop is raised generally on the land during that year as this crop remains on the ground for about 8 months; and sometimes for 10 months.

Turmeric.—Munjul (curcuma longa). First the land is heavily manured. If there be rain in Sithirai or Vyasi the land is ploughed many times. If there be no rain, the land is watered and then ploughed. Generally the land is ploughed 6 times and then ridged up. The seed rhizome is planted on the sides of ridges and on the ridges 1½ feet apart, generally in Aani (June). A person with a mamooty takes up a little earth, and in the hollows thus formed, the seed rhizome is put by another person and then covered with the earth taken out. The land thus planted is watered on the same day or a day or two afterwards. It is watered for the 2nd time 3 or 4 days afterwards. Then it is regularly watered on every 3rd or 4th day. On the average it will be watered 10 times in the course of a month. This rate of watering is continued until the end of Margali (December). From the beginning of Thai, (January) the rate is reduced to 4 times a month until the turmeric is removed from the land. It is a 10 months' crop. The rhizome is dug out from the land at the end of Mausi (February). This depends upon the character of the soil and the growth of weeds. Generally the land is hoed 4 or 5 times and weeded once. The weeding and hoeing operations are to be performed by the end of Arpasi. (October). From Karthigai (November) the land is simply watered. Generally turmeric is a mixed crop, being grown along with some vegetables such as Bandikai (Hibiscus esculentis); Kothavarangai (Cyamopsis psoroloides); Brinjal or Egg plant (solanum melongena); Agathi (Agati grandiflora); and also along with castor plant (Ricinus communis); Maize (Zea mays); Tapioca (Jatropha manihot);

onions (allium cepa) and Pooloomungi (Hibiscus cannabinus). These are grown as catch crops. Maize plants are removed from the ground soon after the cobs are collected. Hibiscus cannabinus is grown around the turmeric crop. It is sown in a single line so as to enclose the turmeric crop. The vegetable yielding plants are pulled in the month of Arpasi (October) Agathi and castor plants alone are left along with the turmeric crop that they may give shade to the crop and thus prevent the evaporation of moisture from the soil. At the end of Mausi (February) and rarely at the beginning of Punguni, (March) the rhizomes are dug out from the soil and then sized. Each sort is boiled separately. In large earthen pots the rhizome is boiled, being mixed with a sufficient quantity of cow-dung water; it is thus boiled until the bubbles become inaudible. Then they are well dried in the sun. In the garden here where turmeric is raised, onion (allium cepa) is planted on the sides of ridges. This is done when the turmeric is watered for the 1st or 2nd time. It is a 3 months' crop. No special care is taken of this crop. At the end of the 3rd month it is removed from the ground. The Agathi and castor plants are cut down and removed from the ground in the month of Punguni (March). The produce will be 15 suttais or 150 maunds.

The cost per acre is as follows:—

	Rs.	A.	P.
Manure	10	0	0
Ploughings 6	3	0	0
Ridging, sowing and repairing the ridges	3	0	0
Hoeings 5	12	8	0
Weeding	1	8	0
Waterings 50	40	0	0

	RS.	A.	P.
Digging out the rhizomes ...	6	0	0
Sizing	2	0	0
Fuel & preparation for market, &c.	12	0	0
The value of the seed rhizome ...	25	0	0
Total cost ...	115	0	0

This crop thrives well under channel (Kalingarayan channel) irrigation. Turmeric is said to require a somewhat sandy soil (sandy loam) with a fair proportion of silt or organic matter. Turmeric is grown both on wet and garden lands; that grown on garden land is considered superior to that grown on wet land.

Sweet Potato.—Saccharai Vulli Kilangoo. There are two varieties of sweet potato, *viz.*, the white and red varieties. The white variety is largely cultivated. The land selected for nurseries is well manured, ploughed and made into small plots which are planted with the cuttings from creepers; thus the creepers are produced for transplanting. When about a month old, they are removed from the nursery beds and made into cuttings each a foot long. These cuttings are transplanted on the sides of the ridges formed after the land has been ploughed 6 times. No manure is applied to this land as this crop is raised generally on a soil which is left in a well manured condition after Raggy. It is a four months' crop. The cuttings are planted at the end of Arpasi (October) or beginning of November. The cuttings which are generally planted immediately after watering, strike root easily in the soil. The tubers are dug out from the soil at the end of Mausi (February) or a the beginning of Punguni (March). The crop is only once weeded and never hoed during the whole period of its growth. The value of

the tubers obtained from an acre of land would be nearly Rs. 60.

The cost per acre is as follows:—

	RS.	A.	P.
Ploughings 6	3	0	0
Ridging	1	0	0
The value of the creeper	3	0	0
For cutting...	1	0	0
For transplanting	1	8	0
Watering	25	0	0
Weeding	1	8	0
Digging out the tubers	6	0	0
Total cost ...	42	0	0

Black-gram.—Ooloonthu (Phaseolus mungo Roxburghii). This is sown in gardens in Sithirai (April) and harvested in Audi (July). This gram is also grown on dry land; in that case it is sown in Purattasi (September) and harvested in Thai (January). When grown on garden land, black-gram is watered twice during the whole period of its growth. The first watering takes place just when the crop begins to flower. The second watering takes place 25 or 30 days after the 1st watering. After the pods have thoroughly matured and a little dried, the plants are pulled out by the roots from the soil and kept in heaps for 2 or 3 days and then well dried in the sun, then thrashed and afterwards winnowed. The quantity of seed required for sowing an acre is 4 Madras measures. The yield would be 1½ selagai or about 100 Madras measures which is considered to be the highest yield or produce.

Gingelly (Sesamum orientale). Tamil-yelloo. This is grown on dry, garden and wet land. The soil best fitted for

this crop when required to be grown on wet land is sandy loam. The variety known as kar-yelloo is sown in Punguni (March) or Sithirai (April) and harvested in Audi (July). The seed required to sow 1 acre is 1 Madras measure. The seed gingelly is first mixed with 2 measures of sand and then sown broadcast. When the plants cease to flower and the capsules attain full maturity and turn yellowish, the plants are pulled out from the ground and heaped together and well covered over and thus kept for 3 or 4 days; after the lapse of these 3 or 4 days, the plants are taken out from the heap and shaken at their root end, the plants being held topsy turvy, the seed is separated from the capsules. Then it is winnowed. The yield is only 1 Pothi or bullock load per acre. The variety of Gingelly which is sown with cumboo in Auni (June) or Audi (July) on dry land is called Thuthi yelloo.

Pooloomunji. (Hibiscus cannabinus). In the gardens here it is thickly grown in a single line around the turmeric crop. It grows to a height of about 7 or 8 feet. The leaves are used by the poorer classes as greens. When the plants are in flower, they are pulled out from the ground and tied into small bundles which are kept moist for 3 or 4 days. Then these bundles are steeped in water. Heavy stones are placed on these bundles so as to keep them immersed until they are taken out for washing. They are steeped about a week, then taken out from the water and washed by beating them over the water. Afterwards the fibres are separated from them and are well washed and dried.

Tobacco, sugar-cane, plantain, and also Betel-leaf are not cultivated generally in gardens here.

Dry land crops.—The preparation of the soil for dry land cultivation is simply ploughing. No manure is used except that obtained by folding sheep on the land. Rarely other manures as cowdung, ashes, village sweepings, &c.,

are applied to dry land adjoining the villages. But with regard to dry land situated far away from the villages no manure is applied.

Cholum or Great millet (sorghum vulgare.) The red variety is chiefly cultivated on dry land here. The land is ploughed generally thrice, sown with cholum broadcast and then ploughed again to cover the seeds sown.

Field cholum is sown in October, about 10 Madras measures being the quantity required for an acre. The crop is interploughed during the first month, *i.e.*, when about 2 or 2½ ft. high. Weeding if necessary, is the only other attention that is paid to the growing crop. It is harvested in Mausi. The highest yield is 1½ Pothi or bullock load per acre. The straw is not considered as valuable as that obtained from garden land. As before said the straw obtained from 1 acre of garden land is worth Rs 4; whereas that obtained from the dry land is worth only Rs 2.

The cost per acre is as follows:—

	RS.	A.	P.
Plouglings 4	2	0	0
Seed with cost and sowing	0	6	0
Weeding	0	8	0
Interploughing (Bullock Hoeing)	0	8	0
Harvesting	2	10	0
Manure	2	0	0
Total cost ...	8	0	0
The value of the produce obtained in the form of grain 1½ Potthies worth	13	0	0
Do. straw. Do.	2	0	0
Total ...	15	0	0

Therefore the net-income is about Rs. 7 per acre.

Cumboo or spiked millet (Penicillaria spicata); cotton (Gossypium herbaceum) castor plant (Ricinus communis); Gingelly (sesamum orientale) and all the pulses generally, *viz.*, Horse gram (Dolichos uniflorus) Green-gram (Phaseolus mungo) Nari Payar (Red-gram) Caramani or Thuttaipayar (Dolichos sinensis) Mochai kottai or Avarai (Lablab vulgare). Dholl or pigeon pea (Cajanus Indicus) Black-gram (Phaseolus mungo, Roxburghii). All these crops except black gram form a mixed crop. Among these crops, cotton forms a special crop. Generally the land is manured by sheep and cattle folded in pens. The land is ploughed as often as there is rain (kar rain) in Sithirai or Vyasi. Either in Auni or Audi the above mentioned crop are sown:—First cotton is sown broadcast; then the seed of cumboo. Nari payar, caramani and gingelly are mixed together and sown broad cast. Afterwards the land is ploughed once more to cover the seeds thus sown. In the furrows formed in the last ploughing, castor oil seed, dholl, and avarai are sown in lines or rows 5 or 6 yards apart and are covered over with soil. Within the 1st month of their growth, the land is interploughed. The harvest of cumboo takes place either at the end of Purattasi (September) or at the beginning of Arpasi (October.) Only the ears of cumboo are cut off from the stalks which being left on the ground are entirely removed from the field with the pulse crops in Thai (January).

The gathering of the pods of pulse crops, *viz.*, green-gram, Naripayar, and carramani is commenced at the end of Arpasi (October) and is continued until the end of Thai (January). The pods of other pulse crops, *viz.*, Dholl and avarai; and the capsules of castor oil plants and gingelly are gathered in Thai (January).

In Punguni (March) the land is cleared of all crops except cotton and castor crops. The cotton crop lasts for 4 years and the castor for 2 years since the time of sowing. If the soil is rich, then the castor crop is allowed to remain on the ground for 2 years, if not, for 1 year which is generally the case. Early in the 2nd year just before the commencement of interculture, the castor-plants are cut 6 inches from the ground. This interculture takes place only where there is rain in Punguni (March or April) or Sithirai. Between the beginning of Punguni (March) or Sithirai (April) and the end of Arpasi, (October) the land with cotton and castor crops is interploughed 4 times; in the 3rd and 4th years only twice. As above said if there be rain in Sithirai (April) or Viyasi, (May) the cotton bolls are for the first time gathered in Audi (July) and the 2nd and 3rd gatherings take place in the months of Purattasi (September) and Thai (January) respectively of the 2nd year of its growth. So also for the 3rd and the 4th year. If there be no rain in Sithirai (April) or Viyasi, (May) cotton is gathered only twice, *viz.*, once in the month of Purattasi (September) and again in Thai (January). After the last gathering which is done in Thai (January) of the 4th year, the cotton plants are removed in March.

Now let me say something about the stubble of castor plants left on the ground with the cotton crop of the 2nd year:—

As has already been stated, if there be rain in Sithirai (April) or Viyasi, (May) the first gathering of the capsules of the castor crop in the 2nd year of its growth takes place in Audi, (July) and the next gathering commences in Thai (January) and is continued until Punguni, (March) when, all the castor oil plants are entirely removed from the ground. If the soil on which cotton is grown is such that horse-gram may be grown on it, then it is sown in

Purattasi (Septemper) on that land (if cotton be in its second year's growth). It (horse-gram) is harvested in Thai (January). Then the cotton crop is left alone for the 3rd and the 4th year. The highest yield of cotton is only 3 suttais equivalent to about 188 lbs. cotton-in-seed per acre or 30 maunds of seed-cotton; or 750 lbs. for 4 years and the yield of cumboo is only 1 Pothi, per acre per annum.

Horse-gram is also grown separately on dry land:—Generally the land for the cultivation of horse-gram is not manured, it is ploughed thrice, sown with horse-gram broadcast, which is covered in the 4th ploughing. When it is required to be sown on the land on which cotton is grown, the land is ploughed once, then sown with it (horse-gram) and then reploughed.

MICROSCOPIC ORGANISMS IN AIR AND WATER.

(Continued from page 129.)

From observations at Montsouris, extending over a period of five years—1880-84—the average number of bacterial organisms in a cubic metre of air is stated to be in winter 260, in spring 495, in summer 650, in autumn 380; the mean annual number being 445. In February the air is poorest in bacteria [the average of these five years is 165]. Towards the middle of summer the maxima present themselves [July 700] Observations have also been conducted for a period of four years—1881-84—on the state of the air, as regards bacteria, in the centre of Paris. These observations were made on the air of the Rue de Rivoli, and afford a marked contrast in the number of micro-organisms to the far purer air of Montsouris, a suburb of Paris, and where, it is important to remember,

the observatory is situated in the centre of a park. The average of these four years' observations shows that the air of the Rue de Rivoli contains 3,480 bacteria per cubic metre. The seasonal fluctuations are nearly the same as at Montsouris, the minimum being in February (1,700) and the maximum in July (5,010). The average number of bacteria present in a cubic metre of air, for the year 1881, was 6,295, whilst the average number for 1884 was only 1,830. This enormous decrease—which is observed in the intervening years to a slighter extent is attributed by Dr. Miquel to the better drainage and scavenging of the city, and to the better cleansing of the gutters and watering of the streets in dry dusty weather, in 1884 than in 1881. The death-rate from zymotic diseases—in which are included typhoid fever, small-pox, measles, scarlatina, whooping-cough, diphtheria, dysentry, erysipelas, puerperal fevers, such choleraic diarrhœa of infants—has also fallen very considerably—27 per cent. if increase of population is taken into account during this period. The death-rate of phthisis or consumptive disease has, however, increased during the same period, although those of acute bronchitis and pneumonia have increased. Acute pneumonia is now considered by many to be propagated by infection from specific organisms occasionally present in the air. The curves for the year 1883-84, representing the average weekly number of bacteria present in a cubic metre of the air of the Rue de Rivoli, it, and the weekly deaths from zymotic disease undergo a large increase, owing to excessive mortality from infantile diarrhœa. The variations in the number of bacteria from week to week will be seen to be very much larger and more sudden than the variations in the zymotic death-rate. Very little can be deduced from comparisons extending over one year only, and although we are far from asserting that there can be no mutual relation between the number of micro-organisms

present in the air, and the greater or less prevalence of epidemic disease among the community who breathe such air, still it is unsafe to found any arguments on such obviously indequate data. It is only just to Dr. Miquel to say here that he recognises these difficulties, and is rightly cautious in drawing any conclusions except such as are found upon an extended series of observations. At the commencement of June 1884 Dr. Miquel, who was then in London, made some observations on the number of bacteria contained in the air of Ryder Street, St. James's. A cubic metre of this air was found to contain only 240 organisms, but this low result was probably due to the wet weather which prevailed on four out of the five days on which the experiments were conducted—the air being remarkably free from dust. In Paris at the same time the air of the Rue de Rivoli contained 360 organisms per cubic metre. Dr. Miquel would not, however, be surprised to find that the air of London was habitually fairly pure and free from organisms, owing to the proximity to the sea, and the fact that the houses of London being generally of no great height unlike Paris—the streets are continually being swept by currents of air. The air of sleeping apartments is very impure as regards the number of contained micro-organisms. One such room in Paris was found to contain on the average in the winter and spring of 1882, 73,540 bacteria per cubic metre, and the air of the Hospital de la Pitié has been observed to contain 79,000 bacteria per cubic metre. In contra-distinction to these large numbers the air over the Atlantic Ocean (Moreau and Miquel) has been found to contain from 0 to 6 bacteria per cubic metre, and the air of the higher mountains an average of only 1 bacterium per cubic metre. (Frendenreich.)

A considerable part of the Report is taken up with an account of researches conducted by M. Moreau into the

number of organisms present in the sea-air. These investigations—undertaken under circumstances of considerable difficulty on boardship, and conducted on an elaborate scale—are much of interest as bearing on the treatment of phthisis by high mountain altitudes or by sea-voyages—in both cases the special object desired being to place the patient in an atmosphere free from all impurities. We will quote a few of M. Moreau's conclusions on this subject:—(1) Air taken on the coast, where the wind is blowing off the sea from a direction in which land is at a great distance, is in a state of almost perfect purity. (2) In the neighbourhood of continents, winds blowing from the land always bring an impure atmosphere; at 100 kilometres from the coast this impurity has disappeared. (3) During moderate weather the sea does not yield to the air any of its contained bacteria; during rough and stormy weather sea-air is charged with a minute quantity of bacteria. (4) The air of ships' cabins is also charged with a number of microbes incomparably greater than that of the open air at sea, but the purity of the air of these cabins increases rapidly during the first days of the voyage; later on, an equilibrium appears to be established, depending on the amount of purification of the air of ventilation and the number of occupants. (5) The air of ships' cabins is relatively very poor in bacteria; these probably are hundred times less in number than the air of an occupied room in Paris.

Observations have been made at Montsouris on the hourly variations in the number of bacteria contained in a cubic metre of air. These observations go to show that, contrary to the generally held opinion, the air is less pure—*i.e.*, contains larger numbers of bacteria during the morning and evening than at midday. In Fig. 2 are shown curves corresponding to proportional figures which illus-

trate this phenomenon, as ascertained by forty experiments. A is the bacterial curve, T is the curve representing the temperature, and V is the velocity of the wind. The lowest point of the bacterial curve is between noon and 1 P.M., two hours before the maximum temperature is reached. From 8 o'clock in the evening until mid-night the number of microbes generally remains high, but decreases rapidly from mid-night to 3 A.M., two or three hours before the lowest temperature is reached, and rises rapidly from 4 A.M.,—when the ground and vegetation are covered with dew—until 6 A.M., when the maximum is reached. These night observations, however, are too few in number to be depended upon to give a very correct average. Rain, as has been remarked, rapidly purifies the air. But when the rain first commences to fall, the number of bacteria increases. This Dr. Miquel explains by supposing that many of the first drops of rain evaporate, the atmosphere not being saturated with vapour and deliver up the bacteria. These floating in it are carried down to the ground in the drops of rain, and by this means the air is purified. Investigation of the organisms contained in rain show that the rain which first falls in a shower and that which falls after a period of dry weather contain far larger numbers of bacteria than that which falls at any other times. Under such circumstances 200,000 microbes per litre is not an unusual quantity. The rain which falls during the warm months of the year in summer and autumn—contains more microbes than that which falls in winter and spring. During the year 1883-84 the lowest monthly average was 1,000 per litre in November, and the highest 6,980 per litre in September. As the rain derives its organisms from the air which it purifies in its descent, we should expect the seasonal variations in the number of contained organisms in air and rain to

correspond closely—as in fact they do. It is important to note that the organisms exist in the rain to a larger extent in the form of germs than in the adult state. Of 100 bacteri-form organisms found in rain, on an average 60 are micrococci, 25 bacilli, and 15 true bacteria. But the numbers here given are subject to great variation in different falls of rain: the bacilli may be more numerous than the micrococci the true bacteria being almost always few in number. Dr. Miquel calculates that during a year at Montsouris 4,000,000 of bacteria are carried down in the rain to each square metre of surface. This number, though not probably representing like the real figure, demonstrates that rain is a powerful agent in diffusing ærial bacteria and fungi. We have yet much to learn as to the part these organisms undoubtedly play when diffused into the soil, in altering or re-arranging its component parts or constituents so as to render it more fit for sustaining vegetable life and growth.

The methods and apparatus employed by Dr. Miquel in his researches are very fully explained, and contrasted with other methods—especially those employed by Dr. Koch and other German observers—in terms that are not exactly those which a strict regard for international courtsey would dictate. It is somewhat of a reproach to bacteriologists that their leading authorities in all countries appear unable to keep clear of controversies which are conducted with an acrimony and animus more instructive than seemly. International jealousy would appear to lie at the root of much of this evil and is plainly discernible in the writings of some of the ablest masters of the science. *Nature.*

M. PASTEUR'S EXPERIMENTS.

Sir John Thorold, Chairman of the Veterinary Committee, stated, at the Council Meeting of the Royal Agri-

cultural Society, that Professor Robertson had presented his report upon his visit to M. Pasteur, as follows :—

Report of visit to the laboratories of M. Pasteur at Paris.

In compliance with the desire of the Council of the Royal Agricultural Society, and in accordance with arrangements made, I, in company with another teacher of the Royal Veterinary College, visited the experimental and manufacturing laboratories of M. Pasteur, with the object of acquiring such practical knowledge of the method there adopted for the preparation of vaccines attenuated viruses—of certain specific diseases affecting the animals of the farm, and the modes of employing these, as would enable us to prepare and use them in this country.

Furnished with letters of introduction, we arrived in Paris on June 20th and on the following morning we called on M. Pasteur, who received us in a courteous and kindly manner, introducing us to the Directors of his laboratories, Drs. Chamberland and Roux, under whose direction we were placed during our sojourn which, in my own case, extended to ten days, my colleague, Mr. Penberthy remaining a week longer.

It may be well here to note that the two specific diseases of stock which so far have received the largest amount of experimental investigation under the direction of M. Pasteur, and for which protective vaccines have been found, are 1 "Anthrax," *i.e.*, splenic fever of cattle and sheep; 2 "Rouget du pore," a disease of swine, said to be identical with "swine fever" of Great Britain. The disease known in this country as "quarter ill," or Blackleg symptomatic anthrax" has not received a like consideration from M. Pasteur. It has, however, at the hands of M. M. Arloing, Cornevin, and Thomas, of the Lyons Veterinary school, been experimentally investigated, and for its prevention it is stated a protective vaccine has been discovered.

(To be continued.)

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GINGER CULTIVATION IN MALABAR.

By Mr. C. Krishna Menon of Malabar.

In Malabar, ginger is cultivated in the Taluq of Shernaud, situated to the south of Calicut. The Taluk is intersected by low ranges of hills, in which runs a system of rocks which have not yet been classified by geologists, but which certainly does not belong to the gneissic series, as the soil derived from them is highly appreciated by the people for agricultural purposes. The slopes of these hills have, by the untiring energy of Moplas, by whom the Taluq is for the most part inhabited, been laid out into a set of terraces for the cultivation of ginger, dry paddy, gingelly and other crops.

Selection of land.—A clay loam of a blackish red color, free from gravel, is selected for the purpose of cultivating ginger, great care being at the same time taken, to see that the site selected has a thorough drainage.

Preparation of land.—About the beginning of May, the land is ploughed 10 or 12 times, thoroughly weeded

and levelled; and by the middle of that month, after a shower or two, beds 9 feet long and 4 feet broad are formed, and in these beds small holes are dug one foot apart, which are filled with manure—*viz.*, cow-dung thoroughly dried and powdered, and ashes, mixed in the proportion of 5 of the former to one of the latter. The roots hitherto buried underground, are dug out, and cut into pieces 2 inches long, care being taken not to injure the nodes. These are then buried in the holes in a slanting position with the nodes uppermost, and the whole of the beds are then covered with a thick layer of leaves. The leaves of *Nuxvomica* (Tamil, Yetti maram) are highly preferred; but in their absence, the leaves of *Vitexnegundo* (Tamil, Nochi), *Marinda umbellata* (Malayalum, kambipala) are used. The spreading of the leaves is so essential, indeed, in the cultivation of ginger that the cultivator lays out more money for purchasing them, than on any other account. The leaves serve as manure, they also contribute to protect the crop from being water-logged which will otherwise be occasioned by heavy down pours during the months of June and July. The leaves, while decomposing, impart the necessary warmth to the crop, thus stimulating its growth. When the plants appear 4 inches above ground, a fresh supply of leaves is spread over. Great discretion is at this stage necessary on the part of the cultivator in rejecting bad leaves; for such leaves have often been found to contain worms which attack the crop, and the cultivator has no remedy against them. The leaves should be such as will decompose soon. After the leaves have been spread, drains are cut so as to let off the surplus water, which would otherwise cause the roots to rot. Rain is absolutely necessary for the growth of ginger, more especially, when the leaves are well expanded. In fact, the successful growth of ginger entirely depends upon the rains for the next two months.

After the leaves have decomposed thoroughly, a fresh supply should be spread. The drains should be opened as before, and the soil should be thrown on the sides to prevent manure from being washed off. The fourth and last spreading is done when the crop is four months old. About two months after this, yellow specks appear on the leaves which extend to the midrib and stem within a month. The crop is then fit to be harvested.

The crop is liable to a particular disease just after the 3rd month of its growth. In some cases the disease is caused by bad leaves spread over the crop, in others, the parasite has its origin in the soil itself, especially when the cultivation is poor. In either case, the immediate cause is the failure of the S. W. monsoon. A heavy pour of rain often arrests the disease by washing the disease germs off the plants.

The cost of cultivation is as follows :—

	Rs.	A.	P.
Ploughing 12 times	20	0	0
Manure	60	0	0
Cost of the seed rhizomes (2½ candies) and planting	100	0	0
Cost of green leaves	100	0	0
Sundry charges for weeding, &c. ...	40	0	0
Rent	30	0	0
Total...	310	0	0

Ginger yields from 5 to 15 fold—calculating the yield at 8 fold, the out-turn per acre would be 20 candies, which at the rate of Rs. 25 per candy gives an income of Rs. 500. There is thus a profit of Rs. 200 per acre. The investment is, therefore, a very profitable one. At present,

most of the cultivators are holders of very small areas, having no capital to start with, and the real profit goes to the money-lender who often lends money at the exhorbitant rate of 24 to 36 per cent.

On looking over the items of expenditure, one is almost astonished to find that so much money is expended in buying leaves, and one is likely to conclude that there is some mistake in the calculation. But, if there is any error, the error is only in underrating the charges. For, it is often said by cultivators that more money is required for green leaves than for any other item of expenditure, even the cost of the seed rhizomes included. The demand for green leaves has, within the last ten years, increased to such an extent that, the people of Shernaud tempted by the silver offered at a time when money is scarce and food supply limited, strip their trees quite bare. An ordinary bundle weighing from 60 to 70lb costs as much as 4 annas. I believe that such heavy expenditure could be for the most part avoided, if horse-gram (Dolichos uniflorus) or Mochekottay (*Lablab vulgare*) be grown for green manure. The ryots are fully alive as to the extent to which exhaustion of the soil goes on, and to remedy the evil they have adopted a system of rotation. Just after the ginger crop is removed, they plough the land, and about the beginning of June sow hill-rice or "modun," which usually yields a rich harvest about the middle of September. Gingelly is then put in, which is harvested about January. Till June, the land is left fallow, and in June shamay (Panicum miliare) is sown which is cut about September. For the next eight months nothing is done on the land, not even ploughing, as the cutivators believe that any operation in the field will lessen the yield of ginger which is to follow shamai. During this long period of 8 months' bare fallow, horse-gram, or any other leguminous crop may be profitably grown for the pur-

of green manuring. And I have every reason to hope that the large amount of green manure thus added to the soil will answer, to a great degree, the purpose of green leaves that would otherwise be required for the successful growth of ginger. The plan is at least worth trying, which, if successful, would, not only increase the margin for profit, but also increase the fuel supply of the Taluq which, is at present in a very critical state owing to the fact that trees are stripped of leaves to a serious extent. The present mode of cultivation could not be carried on for any considerable period of time, the alarm has already been given that the extent of jungles and plantation in the Taluq of Shernaud would very soon be diminished—nay, it has already diminished a great deal. Extensive jungles that once covered the hill sides, within the memory of even the younger generation of Shernaud, have disappeared, and the country is now occupied by mere skeletons of trees, redeemed here and there, but by a few patches of cocoanut plantation.

In the items of expenditure, I have omitted the cost of digging out the ginger, the reason being, that the cultivator sells off his crop to the middle-man, when the crop has matured. The after-process of digging out roots, skinning and drying, is all done by the middle-man. The skin is removed by knives made of bamboos. Ginger is then thoroughly washed, dressed with white ashes and spread on rocks to be dried. Rain at this stage injures the article by imparting to it a black color. In that case, the value of ginger is much diminished. Ten candies of green ginger yields 4 candies of dried ginger which is sold at Calicut, at from 80 to 100 Rupees a candy. In the merchant's godowns, ginger is subjected to the final process of curing. Ginger is spread on bamboo mats over perforated wooden shelves, in an air tight compartment.

Chloride of lime and sulphur are fumigated below, and ginger is bleached in about two or three days. Ginger is then fit to be exported.

ON THE ECONOMIC ASPECT OF PEPPER CULTIVATION IN MALABAR.

By Mr. C. Krishna Menon of Malabar.

Mr. Raman Nayanar's article on "Pepper Cultivation," apart from its practical merit, is highly interesting when viewed in its economic aspect. It is encouraging to find that, the price of pepper has, within the last decade, been almost doubled, and that the demand for it is still on the increase. A casual observer is, therefore, forced to conclude that the forecast of pepper cultivation in Malabar is highly promising. But, any one who is conversant with Malabar agriculture is puzzled at the outset when he compares the present export trade of pepper in Malabar, with that of former years. The trade-returns show a startling decrease in the export of pepper, simultaneous with the increase in price. The Custom House returns for the town of Tellicherry, for the year 1801, as shown in the Appendix to Vol. II of Dr. Buchanan's Travels in Malabar," show that the price of pepper per candy was Rs. 100. The price at present is Rs. 230. There was, then, a direct tax on pepper imposed by Tippu Sultan of Mysore. There was no security of person or property. The Nayars and the Moplas of Malabar, the bulk of the agricultural population, were up in arms. The agriculture of the country was, consequently, in a neglected state. And yet, the quantity of pepper exported by sea in those troubled times were greater than at present. The problem as to the future of the pepper trade, therefore, cannot be solved by reducing it

to the ordinary question of supply and demand. The demand has increased, whereas the supply has diminished. There must be a disturbing influence. What the disturbing influence is, and what remedies are to be applied to give the trade the required stimulus, are the questions that should engage the attention of all well-wishers of Malabar agriculture. Three causes are apparently visible, namely, a decrease in the available capital of the cultivator, insecurity of tenure, and a decrease in the production consequent upon the natural exhaustion of the soil. I would take the last first, as it can be more easily explained than the other two about which conflicting opinions exist. It cannot be denied that a piece of land which was once under pepper will fail to produce the same out-turn as it did before, when planted a second time, even though the period under fallow may be a long one. It is also true that the second crop is more liable to disease than the first. But the question of the exhaustion of the soil loses its force when we consider for a moment the vast extent of uncultivated land fit to be brought under pepper, especially in North Malabar and some parts of South Malabar. I may be charged with advocating a principle which is opposed to the recognised principle in agriculture, that an *intensive* and not an *extensive* system should be followed. But, I believe that in the cultivation of pepper it would be safer to break up a fresh soil fit for it, when available, than to work in the old rut. The extent of land under pepper cultivation in Malabar is limited to a degree of surprise and anxiety. The last Administration Report of the Madras Presidency, shows that there are, in Malabar, only 7,000 acres under pepper cultivation. Taking into consideration the extent to which pepper is cultivated in topes and gardens, which may not have been brought to account, owing to the fact that they all had been already classed under a separate heading, we may

assume that there are in Malabar about 10,000 acres under pepper. Is it not incredible that Malabar with her vast Hill systems, enclosing many fertile valleys watered by perenniel streams should have for her only 10,000 acres under pepper? There are immense tracts to be brought under pepper. But, why they are not brought under cultivation is the question. A solution of this problem will be as well a solution of the problem as to the decrease in the export trade of pepper. And so, we may leave out of consideration the third cause, *i.e.*, the exhaustion of the soil. We have now to deal only with the first and the second causes. The question of capital involves the question of labour, for, without it there is no capital. There has been, of late, an increase in the cost of labour, simultaneous with the increase in the cost of all commodities; and in Malabar the increase was more felt owing to the stimulus given to coffee enterprise in the Wynaad. But the increase in the price of pepper acts as a set-off against the increase in the cost of labour. Therefore, the cost of labour would not seriously interfere with the extension of pepper cultivation. Then comes the question of capital. It has been assumed in certain quarters that there has been a decrease in the available capital of the country, consequent upon various causes, such as the litigious habits of the people, the joint family system in which the spirit of enterprise and individual exertion is at a dead lock. I do not fail to notice the force of this argument which has some merit of its own, but, I presume, that other things being equal, the litigious habits or the joint family system would not seriously interfere with the full flow of capital necessary for an enterprise which has everything to gain and nothing to lose. I should, therefore, go to the second cause for a full solution of the problem. It was a favorite saying with Arthur Young that "the magic of property converts sand into gold." The

saying is true for all ages. Nothing conduces more to the happiness and prosperity of a community than the entertainment of the belief amongst the members of that community that they are secure in the enjoyment of the fruits of their own labor. Insecurity of tenure means uncertainty of the enjoyment of the fruits of one's labor, holding that tenure. In Malabar the cultivation is chiefly carried on by peasants already bordering on a state of "insolvent cottierism." There are to be found, here and there, gentlemen farmers possessing large plantations of pepper, but the bulk of the pepper exported is produced by the sweat of the peasant's brow. The expression "already bordering on a state of insolvent cottierism" requires explanation as it is likely to be understood that the "insolvency" is due to causes other than what I have pointed out. It need not be observed that the cultivator starts with a limited capital; such being the case, it is improbable that he should at once open a plantation which involves the outlay of a good capital at the beginning, not to speak of the uneasiness and anxiety of mind in waiting for a rich harvest until the plantation is in full maturity. The cultivator has, therefore, adopted a certain plan, I should rather say that circumstances have forced him to adopt it. He tries to start with a capital which he hopes to raise by growing catch crops on sites that are generally selected for cultivating pepper. The land is cleared of jungle about April, and burnt. Hill-rice, cotton, and dholl are sown. The hill-rice is a very uncertain crop; but the rich harvest rarely obtained even when the season is favorable attracts him all the more to renew his attempts if once disappointed. The cultivator does not hold the land under any fixed tenure. The landlord fixes his share when the crop is mature, and it does not at all matter to him whether the rent trenches upon the margin for profit. The rent is what may be termed "specu-

lative rent." The money-lender, or the person that has lent the seed and other necessaries, follows suit, and what remains, after settling the accounts with the landlord and the money-lender, (and in most cases, not even the cost of labour remains), is the capital of the cultivator! His first attempt to open a plantation is a failure. He is not discouraged. He goes to the next land-lord, takes up land, proceeds with his work as before. Here too, the chances are, that he finds himself in no better condition. But, if the landlord turns out to be a humane and intelligent being, possessing a liberal hand to advance money, at a reasonable rate of interest, a thriving plantation may be seen on the hills. It may be asked how it was that Malabar was able to export more pepper in former times. The answer is simple. From time immemorial, the villagers inhabiting the borders of hills, had a communal right to the hills bordering their villages. There was the same landlord; but his right extended only to what is called "Purushabohgam", "the right of protection". A nominal rent was paid to the landlord as he was the protector of the village. It was also his interest to be always on good terms with his people, as he often stood in need of their help when attacked by others. But the conditions have, of late, been materially changed, and consequently the tie has become loosened. The British administration brought with it the security of person and property. The High Court of Judicature, probably, influenced by the tenure in England, succeeded in converting the *nominal* right of the landlord into a rigid *proprietory*, one with its power of eviction. Animated with fresh vigour and flushed with new rights, the landlord carried on a system of pillage that ruined the entire peasantry. This is now the state of Malabar. The present system of cultivation is objectionable not only on political grounds, but on physical grounds. Vast tracts of forest are annually

burnt down without any effort on the part of the people to conserve fresh forests. I have all along spoken about the poverty of the cultivator, and how could I be consistent if I deny that want of capital is the cause of the decrease in the cultivation of pepper. I say, that capital would flow in if the cultivator holds the land on better tenure. The money-lender would not be induced to raise the rate of interest as at present. For, it is an admitted fact that, to a bad debtor money is always lent at a very high rate, to compensate the risk attending such transactions. And the cultivator, at present, is a bad debtor.

(To be continued.)

RECENT ADVANCES IN SANITARY SCIENCE

(Continued from page 96.)

We cannot doubt that the air of a public sewer is sometimes the means of disseminating disease, and any method which practically excludes such a source of danger from our houses is one to be encouraged. As knowledge extends the simplest form of apparatus is found to be the best; many of the more complicated kinds of traps and contrivances for excluding sewer air are now discarded by builders and architects for those simpler forms which are equally effective.

In the matter of water-supply, the belief is steadily gaining ground that a water once polluted by sewage cannot be regarded as safe for drinking purposes. Safe it may be so long as filtration on the large scale is efficiently performed, but any failure to thoroughly filtrate and aerate the water in times of epidemic visitation might be attended with disastrous consequences, even supposing that filtration through sand and gravel is destructive of disease organisms or their spores. The introduction of

constant supply of water into towns, in the sense that cisterns and receptacles for storing water are no longer necessary, has been of great benefit—especially in the poorer parts of towns, where water stored on the premises is usually highly contaminated.

Of the scientific witnesses who were examined before the Royal Commission on Metropolitan Sewage Discharge, nearly all were in favour of the principle of separation of the rainfall from the sewage. "The rain to the river, the sewage to the soil." In view of the ultimate disposal of the sewage, the advantages of the "separate method" are very great, and would now probably lead to its adoption in any new scheme of sewerage for a town where the circumstances are favourable. From the public health point of view, it is also desirable to have impermeable pipe or brick sewers of small size, so that contamination of the soil by leakage into it of the contents of sewers may be avoided. In any such scheme of sewerage it must not be forgotten that not only are channels on the surfaces of the streets and roads required to convey away surface water, but previous drains laid in the sub-soil are absolutely necessary in the health interests of the town to keep the sub-soil water at a permanently low level. For the disposal of the sewage, the value of a regular daily flow, and the elimination of the necessity in times of heavy rain of dealing with an enormous and uncontrollable volume of dilute sewage, must be obvious. The surface waters of towns are certainly not clean, but where the streets are efficiently scavenged they are free from taint of human excretal refuse, and fit for admission into the rivers which nature intended as drainage channels of the surrounding high lands.

The extreme importance of thoroughly ventilating sewers, is now very generally understood. Pipe-sewers

require as much ventilation as brick-sewers, although the absence of deposit on the smooth internal surfaces of the pipes, and their consequent freedom from smell due to decomposition of deposited organic detritus, originally led to the belief that ventilating openings were not required in pipe systems of sewerage. It was not until Dr. Buchanan showed in the case of Croydon that the absence of proper ventilation in the pipe-sewers of that town was in all probability instrumental in aiding the spread of enteric fever that the opinion of engineers on this matter underwent a change. Displacement of air in pipe-sewers of small diameter is greatly more sudden than in brick-sewers of larger diameter, and it is plain, says Dr. Buchanan, that "means of such ventilation are wanted more numerously in proportion as the displacements of air may be local and sudden." Opening into sewers from the street level are still regarded as the best practicable means for the admission of fresh air, and the exit of sewer air. Charcoal trays, Archimedean screws, and other contrivances for purifying the issuing air, or hastening its exit, are now generally abandoned as useless and inconvenient. The purification and utilisation of the sewage of towns is a subject of much importance both in its public health and commercial aspects. The idea, so long entertained, that town sewage could by various methods be made to yield a manure which would give rise by its sale to an enormous profit is now exploded. The highest degree of purification, we now know, can only be attained on land naturally suitable from its porosity and other properties, and artificially prepared by extensive under-drainage. The agents which purify sewage in its passage through soil, by converting the nitrogenised organic matters into inorganic salts—nitrites and nitrates of the alkaline and earthy bases, and ammonia—have been discovered to be Bacterial micro-organisms, resident chiefly in the

superficial 18 inches of soil, and far more abundant in some soils than in others. Sewage farming has been ascertained to be profitable, under suitable conditions. The sewage must flow from the town to the farm by gravitation—the cost of pumping will neutralise profits from the sale of farm produce; a part of the farm must be laid out as a filter bed, so that the sewage, when not required on the cultivated land or when so dilute from the presence of storm waters as to be inapplicable, may be purified on a wall very porous area by the process of intermittent downward filtration. Very few growing crops are benefited by the application of sewage, except the various kinds of grasses, and of these such enormous quantities can be produced that, unless converted into "silage," or utilised on the farm in the production of stock and dairy produce, they may be expected to result in a loss, from the absence of any demand for such large quantities at all periods of the year.

In this country, the sewage farm at Birmingham is probably the best example of what has been done to solve a most difficult problem by the application of sewage to land. Here, the sewage is first freed from its suspended matters by a process of precipitation, a proceeding necessary not only to prevent warping of the land with offensive solid matters, but also to withdraw the metalic salts and acids incidental to the sewage of a manufacturing town, which would be injurious to vegetation. Even this magnificent example of dealing satisfactorily with the most difficult Municipal problem of modern times is eclipsed by the city of Berlin on the Continent. The sewage farms at Berlin have successfully dealt with the sewage of 887,500 people—nearly twice the population of Birmingham whilst London is still allowing to run to waste an enormous amount of valuable material, at the same time polluting a

river—the highway of its commerce—to an extent never previously dreamt of.

Processes of precipitating sewage by chemicals are now known to exert only a partially purifying influence. The best process yet discovered can do little more than free the sewage from its suspended matters, allowing all the dissolved constituents of sewage—by far the most valuable portion agriculturally and chemically—to pass away in the efficient. Lime dissolved as lime water, sulphate of alumina, and perhaps proto-sulphate of iron, taken together and added to the sewage in the proportion of not more than 10 to 15 grains to the gallon, are the best, most economical, and most effective precipitants. Other more valuable substances, added to the sewage with the view of increasing the value of the precipitated sludge or manure, are in large proportion lost in the efficient water, and as they do not assist precipitation might just as well be added to the sludge afterwards, if fortification is required. Half-a-crown and no more is the value per ton of the precipitated solids of sewage. This value will generally pay for the cost of their carriage a mile or so in agricultural districts, but no further.

A great improvement in dealing with the semi-liquid sewage sludge has been lately effected. The sludge containing over 90 per cent. of water was formerly allowed to dry in the air or in a drying chamber, and a most intolerable nuisance resulted. It is now possible by means of hydraulic filter-presses to convert the semi-liquid sludge into solid cakes containing 40 to 50 per cent. of water, and in this form it is innocuous to the senses, and can be readily conveyed away by cartage.

The knowledge already acquired demands that now, and in the future, the sewage of towns should, whenever

possible, be utilised on land in the production of crops or dairy produce, failing this, the sewage should be freed from its solids by precipitation and subsequently purified on land laid out as filter-beds, efficient purification, and not the production of crops, being alone arrived at. If application to land is impossible, then precipitating processes alone must be relied on, and where the sewage can be turned into the sea, and effectually got rid of without nuisance, there it may be allowable to waste valuable matter which cannot be utilised except at a cost destructive of all profits from its utilisation.

Nature.

M. PASTEUR'S EXPERIMENTS.

(Continued from page 161)

In our first conversation with M. M. Pasteur and Chamberland it was stated that the work connected with anthrax had now passed out of the department of experimentation, and that the ability to prepare a "protective vaccine," which is the term given to the prepared virus, was an accomplished fact; that the use of this was regularly resorted to over large areas of France, and that the practice was steadily increasing.

Since the first public demonstration of the efficacy of protective inoculation for anthrax in fifty sheep at Pouilly-le-fort, near Melun, in 1881 the number of vaccinations had gradually increased until the returns for the first four months of the present year show that there had been sent to the provinces of France and other countries, vaccine sufficient to inoculate 153,125, animals. We were also informed that the results of this vaccination were highly favourable, as shown by the altered rate of mortality in districts where this method has been adopted [illegible]

from anthrax in cattle having dropped from fifty to one, and in sheep from fifteen to one.

Although a knowledge of the principles on which the present system of protective vaccination is based has been very broadly disseminated, it may not be out of place here to briefly state the most generally held views on the subject. In connection with many contagious and specific diseases of animals, certain microscopic organisms of a vegetable nature have been demonstrated, and experiments tend to prove that if these be not the actual cause of the disease, they bear some definite relation to it; so close a relation that the disease never exists without their presence in the blood or tissues of the affected. In each of the separate diseases to which reference has been made, there is an organism or virus which is special to each disease, and which may by microscopic, chemical, or vital manifestation, be differentiated from the virus of any other disease.

These organisms are capable of growing and multiplying in suitable media, and under favorable conditions of temperature; &c., outside the animal body. This process artificially carried out is termed cultivation. Without entering into the details of how any *mirco-organism* is proved to be the cause of any particular disease, we may state that the capacity of the virus to produce the full or fatal effects of the disease may be modified by certain circumstances; that is to say, by treatment outside the body the virus may be rendered capable of inducing only a mild form of the affection (attenuated); or this power may be intensified by other forms of treatment. On grounds which experience has proved secure it is held that the introduction into the body of a virus capable of giving rise to a mild form of the disease secures the

fatal effects of the more powerful virus. This protective virus Pasteur calls a "vaccine." As ordinarily carried out in France, protective inoculation is accomplished by the use of two "vaccines" known as first and second. The latter, much more powerful than the former, is employed within fourteen days after the weaker.

To meet the demands upon the laboratory work for the supply of anthrax vaccine, the preparation of this is now carried out in an establishment apart from the experimental laboratory in connection with the Ecole Normale, where it was originally started. In the Rue Vaquelin, under the charge of educated assistants, M. Chamberland carries out the preparation on a large scale—the necessity for this being apparent when regard is had to the statement of the quantity demanded for France and other countries. In this manufacturing laboratory, on the ground floor are arranged the larger apparatus for making the boiullon or meat liquor, and stoves for its sterilisation previous to its being sown with the organisms which induce the disease. Here too, are stoves in which the sowings are subjected to certain definite degrees of heat, in order to produce the required attenuation; and apparatus for the filtration of water for special purposes. The rooms above include the hot chamber, in which a certain temperature is maintained. Here the broth is tested after its sterilisation, and the different sowings and vaccines are kept for definite periods. In another apartment the decanting of flasks and filling of tubes with the vaccine is carried out, while close by these is a store for the broth, &c.

So true and correct has the preparation of this vaccine been maintained that for four years no fresh importation of anthrax material has been required.

To satisfy our interrogations, and to give us familiarity with manipulatory details, a rabit was placed at our

disposal for inoculation with virulent vaccine, *i.e.*, the virus of anthrax, which has the power of inducing the fatal effects of the disease if inoculated into a healthy animal. This gave us an opportunity of actually carrying out the preparation of the protective material from the starting-point of the process, which we continued to do under the superintendence of our instructors as long as we remained. From this series of cultivations the impregnated bouillon is carried through the various stages, until the production of what is known as first and second vaccine. These two degrees of strength, it must be understood, are those invariably employed at present in securing in the animals operated on, immunity from either artificially induced or naturally occurring anthrax. The obtaining of a proper first and second vaccine for the double inoculation of all animals to be protected, although secured by time, a properly regulated temperature, and the action of oxygen, can only be determined exactly by direct trial upon living animals. The proof by experiment is alone sufficient and satisfactory. M. Chamberland emphasised this, particularly remarking that its non-recognition and strict carrying into execution be regarded as the chief cause of what failures had been reported where the Pasteurian method of preventive inoculation had been attempted. Without entering further into details which, in this report would be unnecessary, I would only desire to state that the perfect regularity and exactness with which all details relating to the manufacture of this vaccine, from the first preparation of the bouillon to the filling of the tubes which are to transport it, impress the conviction upon the mind of even the uninitiated that all is directed upon the recognition of some fixed principle or idea, and with the view of attaining some definite object.

The same general principles and regulation of details in force in the preparation of the vaccine employed as a

protective against anthrax regulate the manufacture of that which is used as a prophylactic for "rouget." With the latter, however, the modification of the virus is more generally effected by passage through rabbits than through the stove, although it was stated that this same end could be attained by either method. The proper attenuation of this virus, like that of anthrax, is arrived at by means of experiments on living animals. And, as in the latter disease, a first and second vaccine is said to be requisite.

In the consideration of this part of the subject it will be necessary to have regard to the fact that, while there can be no doubt as to the identity of charbon or anthrax of France and splenic fever of Britain, it has not yet been so clearly demonstrated that "swine fever" and "*rouget*" are identical. To determine their identity or *differentiation* seems to us absolutely necessary before we presume to reason from analogy.

Summary.—The two diseases for which a protective vaccine is provided by M. Pasteur, are "anthrax" or "splenic fever" and "rouget."

That the thoroughly careful and scientific method of procedure in the laboratory, the exactness in preparing, and implicit faith in the potency of the preparations, all warranted and supported by experiment and statistics, indicate their adoption where prevention of either of the diseases is deemed necessary.

That it is highly essential, in order to provide protective inoculation in Great Britain, it will be a matter for consideration, as to anthrax, whether it be economical, having regard to the comparatively small fatality from the disease, to use the virus prepared by Pasteur and imported direct, or to have it prepared in the Society's Laboratory here, always bearing in mind that it is

absolutely necessary to test the strength of the virus, whether prepared abroad or at home, by direct experiment.

That the preparation and practical use of the vaccine can be carried out in England.

That before any further steps be taken respecting providing a protective vaccine for swine fever on the lines carried out by M. Pasteur the identity or non-identity of rouget must be proved. This question, I believe, is now under the consideration of the Agricultural Department of the Privy Council, and I hope we shall shortly be in a position to form a definite opinion on the subject.

That we accord our thanks and gratitude to M. M. Pasteur, Chamberland, Roux, and the laboratory workers for the courteous and ample assistance which they yielded us in the attainment of the objects in view.

Appended is a table of statistics procured from M. Pasteur's business agent, showing the number of animals vaccinated and the rate of mortality. This table shows results corroborating the figures mentioned in the body of the report, and which were the estimate given by M. Chamberland in conversation which we had with him.

Preventive Vaccinations against anthrax, rouget, and fowl cholera.

	Anthrax.			Rouget.	Fowl Cholera.
Date.	Horses.	Cattle.	Sheep.	Swine.	Fowls.
1881	242	7,231	74,550	None	None
1882	2,029	41,823	306,870	None	None
1883	1,346	32,230	353,330	3,216	700
1884	384	40,500	361,198	5,371	3,160
1885	1,298	41,982	401,625	13,269	4,620
1886 to April 30	No figs. given.	20,541	132,584	6,966	2,230

Since the first annual report of the Veterinary surgeons on the results of the vaccinations, the rate of mortality from anthrax, amongst animals preventively vaccinated has fallen to from two to five per thousand as compared with a rate of mortality of from 100 to 250 per thousand, which obtained previous to the introduction of the system into the localities.

The Committee recommended that a sum not exceeding £100 be alloted from their annual grant to Professor Robertson to enable him to carry out experiments with the virus of anthrax and of quarter-ill, and that a sum of £50 be granted to Professor Brown for further experiments on the lung worm in cattle and sheep.

This report was adopted.

COMPOSITION OF CASTOR CAKE.

By Mr. Hughes, F. C. S.

During my residence in Colombo in 1878 several analyses of the abovenamed cake were made by myself on behalf of the Planters' Association, and the results are to be found on page 15 of my official report. These analyses, however, deal only with the organic constituents, and give the proportions of oil, albuminous compounds, mucilage, fibre, &c., and do not afford information respecting the chemical composition of the mineral portion or ash of the cake. I have, therefore, obtained a fair average sample direct from India and hope the particulars of the analyses may be of interest to the readers of the T. A :—

In 100 parts of white castor cake :—

Water	7·94
Organic matter (containing Nitrogen 7·55) ...	85·17
Mineral matter*	6·89
	100·00