THE

TROPICAL AGRICULTURIST

AND

MAGAZINE OF THE

CEYLON AGRICULTURAL SOCIETY.

VOL. XXVIII. COLOMBO, MARCH 15TH, 1907. **No. 3.**

Rhea or Ramie.

Once again the periodic boom in this fibre is upon us, and enquiries are coming in about it. The position may be summed up briefly thus. The actual fibre of the Rhea, Ramie, or China grass plant is about the best, longest, and strongest fibre known, and could it be easily and cheaply produced, would of necessity supersede cotton in many fabrics. Unfortunately, there is a kind of gum in the stem which is very difficult to get rid of, and which much enhances the cost of preparation. The result is, of course, that people buy the cheaper articles of cotton or mercerised cotton, though they may know well enough that the rhea goods will last so much longer that they will more than repay the extra cost.

In the second place the plant, though it grows freely in Ceylon or Malaya needs a great deal of manure if it is to continue to grow tall and not become short and almost useless. This adds a good deal to the cost of growing it. Again, the mills for spinning it are few and far between and too poor to give really remunerative prices, and take large quantities, while the planter will not grow the fibre unless he can see a good market.

In actual fact all who have tried ramie in the tropics so far have lost money over it. It is one of the most difficult things to do, to introduce a new fibre. No one will buy it on the market unless it is as good and cheap as one of the already existing standard fibres and unless it can be put there in guaranteed large quantities regularly; while no one will grow it unless he can easily dispose of it in small quantities at a remunerative figure.

The price recently offered by the ramie mills and largely advertised as being a wonderful price, calculated to make the planter rich beyond the dreams of avarice, was about £5 a ton below the price at which it begins to be remunerative, and at that price anyone growing the fibre would lose money.

GUMS, RESINS, SAPS, AND EXUDATIONS.

THE PRODUCTION OF INDIA RUBBER.

FROM THE OPENING ADDRESS BY PROF. WYNDHAM DUNSTAN AT THE BRITISH ASSOCIATION.

[*So much discussion, based on imperfect reports, has taken place on this subject, that we think it well, even at this late date, to reproduce the exact report.*—ED. "T. A."]

There is no more important group of questions demanding attention from the chemist at the present time than those connected with the production of india-rubber or caoutchouc. An enormous increase in the demand for india-rubber has taken place in the last few years, and last year the production was not less than 60,000 tons. Until recently the supply of rubber came chiefly from two sources—the forests of Brazil, which contain the tree known as *Hevea brasiliensis*, furnishing the Para rubber of commerce which commands the highest price, and the forests of Africa, where climbing plants, generally of the Landolphia class, also furnish rubber. The increased demand for caoutchouc has led to the extensive planting of the Para rubber tree, especially in Ceylon and in the Federated Malay States. Systematic cultivation and improved methods of preparation are responsible for the fact that the product of the cultivated tree, which begins to furnish satisfactory rubber when six or seven years old, is now commanding a higher price than the product of the wild tree in Brazil. It is estimated that within the next seven years the exports of cultivated india-rubber from Ceylon and the Federated Malay States will reach between ten and fifteen million pounds annually and that after fifteen years they may exceed the exports of the so-called wild rubber from Brazil.

The services which chemistry can render to the elucidation of the problems of rubber production and utilization are very numerous. Methods of treatment depending on a knowledge of the other constituents of the latex have led to the production of rubber in a purer condition. Much still remains to be elucidated by chemical means as to the nature of the remarkable coagulation of the latex. As is well known, the latex is a watery fluid resembling milk in appearance which contains the rubber, or, as I think more probable, the immediate precursor of rubber, together with proteids and other minor constituents. The constituent furnishing rubber is in suspension, and rises like cream when the latex is at rest. On the addition of an acid, or sometimes of an alkali, or even on mere exposure, coagulation takes place and the rubber separates as a solid, the constituents for the most part remaining dissolved in the aqueous liquid or "serum." The first view taken in the nature of the coagulation process was that, like the coagulation of milk by acids, it is dependent upon a process of proteid coagulation, the separated proteids carrying down the rubber during precipitation.

This explanation cannot, however, be considered complete by the chemist, and there are peculiarities connected with the coagulation of the latex which are opposed to the view that it is wholly explained by the coagulation of the associated proteids. The experimental investigation of the question on the chemical side is beset with many difficulties which are increased if access cannot be had to fresh latex. A number of experiments were made in the Imperial Institute with latex forwarded from India. The difficulties contended with in preventing coagulation during transit were great, but in the case of the latex derived from certain plants these were to some extent surmounted, and the results obtained, especially with reference to the behaviour of certain solvents towards the latex, led to the conclusion that "coagulation" can take place after removal of the proteids, and that in probability

it is the result of the polymerisation of a liquid which is held in suspension in the latex and on polymerisation changes into the solid colloid which we know as caoutchouc. Weber, by experiments conducted in South America with fresh latex, arrived at a similar conclusion, which later workers have confirmed. Although the nature of the process is not yet completely elucidated, there is little room for doubt that the coagulation is due to the polymerisation of a liquid and possibly of aliquid hydrocarbon contained in the latex. For the chemist the important question remains as to the nature of this liquid from which caoutchouc is formed.

The chemical nature of caoutchouc is a subject which has attracted the attention of the distinguished chemists from the middle eighteenth century, among them being Faraday, Liebig, and Dalton. Faraday was the first to examine the constituents of the latex of *Hevea brasiliensis*. It is only in recent years that our knowledge of the constitution of the organic compounds, and especially of the terpene group has rendered it possible to make any great advance. It is interesting to record that Greville Williams, in 1860, made most important contributions to this subject. He identified a new hydrocarbon, isoprene, as a decomposition product of caoutchouc, and recognised its polymeric relation to caoutchouc.

The results obtained from the analytical side, and especially the formation of di-pentene and isoprene by pyrogenic decomposition of caoutchouc, had pointed to the fact that caoutchouc was essentially a terpenoid polymer of the formula $C_{10}H_{16}$. Harries finds, however, that the oxonide of caoutchouc, when distilled with steam, breaks up into laevulinic aldehyde, laevulinic acid, and hydrogen peroxide, and he concludes from this that caoutchouc is a polymer of a 1 : 5 dimethyl cyclo octadien. Whilst Harries's work has brought us much nearer the goal, and has led to the discovery of a new method of investigation through the oxonides, which is obviously of wide application, it cannot yet be said that the constitution of caoutchouc has been settled or its relation to the parent substance of the latex definitely established. It has still to be shown how a closed-chain hydrocarbon such as Harries's octadien can under go polymerisation forming the colloid caoutchouc.

There are strong arguments for the view that the constitution of the parent substance present in the latex is nearly related to that of isoprene. This remarkable hydrocarbon of the formula C_5H_8, first obtained by Greville Williams from the dry distillation of rubber, is a saturated olefinic hydrocarbon which is found among the products, resulting from heating caoutchouc. It readily polymerises, forming dipentene. Bouchardt noticed that this hydrocarbon obtained from the pyrogenic decomposition of caoutchouc furnished a substance identical with rubber when acted on by hydrochloric acid and under other conditions. To Wallach and also to Tilden is due the further important observation that when isoprene prepared from oil of turpentine is kept for sometime, it gradually passes into a substance having all the characteristic properties of caoutchouc.

I have very briefly drawn attention to the present position of our knowledge of the chemistry of caoutchouc in illustration of the interest which attaches to the examination of vegetable products, and also because of the immense importance of the problem from the practical and commercial standpoint. Chemistry in this case holds the premier position in reference to this subject, and to a large extent may be said to hold the key to the future of the rubber industry in all its phases The discovery of better methods of coagulation, preparation, and purification will be affected through chemical investigation, as will also the determination of the manner of utilising of various other plants which furnish rubber-like latices. That the physical properties of raw rubber, on which its technical value depends, are to be correlated with the chemical composition of the material there can be no doubt. The chemical analysis of raw rubber, as at present conducted, is, however,

not always to be taken by itself as a trustworthy criterion of quality, and more refined processes of analysis are now needed. Although the finest caoutchouc for technical purposes is only yielded by some half dozen plants, under the names of which these varieties of caoutchouc pass, there can scarcely be a doubt, that the elastic substance in each case possesses a very similar, if not identical, chemical structure. Nearly all the latices and similar fluids furnished by plants contain more or less caoutchouc. Even opium, which is the dried juice of the capsule of the poppy, contains caoutchouc, whilst the opium yielded by certain Indian species contains a notable proportion. Chemistry must determine the means by which caoutchouc can best be separated from these relatively poor latices. In view of the increasing production of the nearly pure caoutchouc which is furnished by *Hevea brasiliensis*, *Funtumia elastica*, *Castilloa elastica*, *Ficus elastica*, and a few other plants which occur or can be cultivated in several of our tropical possessions, the question is not a pressing one at the moment.

Moreover, it cannot be doubted that chemical science will sooner or later be able to take a definite step towards the production of rubber by artificial means.

The production of caoutchouc by chemical means has, indeed, virtually been accomplished in its formation from isoprene. The exact nature of this change has still to be determined. When this has been done it will only remain to cheapen the cost of production to make the manufacture of synthetic rubber a purely practical problem. I should be the last to discourage the great extension of rubber planting which is now taking place. It is warranted by the present demand for the material. It has also to be remembered that the actual cost of producing raw rubber, which is at present about one shilling per pound, will probably be reduced, and the market price of rubber may eventually be so considerably lowered that as with quinine, the synthetic production could not be profitably carried on. That is a question which involves many factors at present unknown, and only time can decide. Chemists may however, confidently predict that before the British Association again meets at York the synthetic production of rubber will be a fully accomplished fact.

As I have said, our science is concerned with nearly every problem connected with the great rubber industry, and in concluding these few remarks I may allude to the production of vulcanised rubber depending on the formation of additive compounds of the hydrocarbon with sulphur. In this connection I should mention the recent experiment of Mr. Bamber in Ceylon, which appear to show that vulcanisation may be accomplished by acting on the uncoagulated latex with chloride of sulphur.* If this proves to be a practicable, it may mean the transference to the tropics of the subsidiary industry of vulcanisation, which is at present carried on in Europe.

Owing to the importance and interest which attach to the chemistry of rubber, it is to form an important feature in the work of this Section at the York Meeting. Papers will be contributed by some of the best known workers in this field, by Professor Tilden, and by Professor Harries of Kiel who will give an account of his recent work; whilst Mr. Pickles, of the Imperial Institute, will present a report summarising the whole of our chemical knowledge of the subject.

THE RUBBER INDUSTRY IN ECUADOR.

CONSULAR REPORT.

The tropical forests of the coast provinces of Ecuador are the native habitat of the rubber tree *Castilloa elastica*, and the exportation of the rubber derived therefrom has been now going on for upwards of half a century. For the collection

[* This is a slip on Professor Dunstan's part. Chloride of Sulphur cannot be used for this purpose, as it decomposes on contact with water!—ED. *T.A.*]

of this produce, the old system was to cut down all the trees, young or full grown, that were met with in the woods, and extract from them such rubber as might naturally exude from the trunks and boughs of the trees—but without any artificial means to secure the full supply that each tree should properly yield :—so that, added to the wilful and wasteful destruction of the rubber forests, there was the additional loss of a large proportion of the rubber left unextracted for want of proper care and appliances. This system still holds good, in many parts of the wilder and more distant forests—especially in those belonging to the Government ; but in the cultivated districts, or lands belonging to private owners, a more careful system is now adopted, the trees being only bled every year in the proper season.

Cultivation Methods.

Within the last ten to twelve years, property owners have begun to plant the *Castilloa elastica*, on the grounds found to be suitable for the trees ; and there are now considerable plantations in the country especially round the Balzar and Fenguel districts and in some parts of the provinces of Manabi and Esmeraldas. A moderate calculation of the number of trees under cultivation at present (though not yet all of an age to yield any result) would be about one million of trees. At the commencement, it was the custom to start these plantations in cleared grounds, and under the shade of banana trees—thus reducing the cost of the work ; since, whilst the rubber trees were growing, the banana would be giving fruit, the sale of which would repay the expenses of the plantation ; but it was found that these banana fields attracted enormous numbers of ants, which ate up and destroyed the young rubber trees and moreover, the shade of the bananas was not found to be sufficient to protect the young trees, and to allow them to grow up robust and healthy. It has been found preferable to plant the young trees in partially cleared forest land in "mangueos" or long avenues opened in a straight line through the woods, leaving corpulent high timber trees on either side, and the natural undergrowth beneath, thus preserving shade and moisture to stimulate the growth of the rubber trees.

The seeds are first planted in small nurseries at suitable places in the woods and when about eight months or a year old, they are transplanted at a distance of about six yards between each plant in straight rows, and under the shelter of the virgin forest, as above described. When the young trees have attained a height of about two metres, the surrounding shade trees are gradually thinned out or have their branches lopped off, so as to allow the rays of the sun to reach the young plants : and this system must be continued year by year for about fifteen years at which time the rubber tree will have attained its full growth, and be as tall and strong as the surrounding forest timber. These surrounding trees must not be destroyed, as experience has demonstrated that their presence and the shade, etc., they afford, are necessary to preserve the vitality of the rubber trees. The extraction of the rubber can be commenced about the tenth year after planting. The quantity obtained depends upon the age of the tree and its more or less robust development. The method of the extraction being the same as in other countries, does not require any explanation. Yield say ½ to 1 lb. per tree per year.

Rats, "grillos" (crickets, and a kind of locust) and a black bee are great enemies to the young plants of rubber, and destroy many of these : care has to be taken to replant such as may be destroyed by these means. Congress in 1904 passed a law to pay all planters a bounty of ten cents (2½ pence) for each plant of upwards of five years of age, which might be planted throughout the Republic : but, so far, it is believed that only one planter from the Tenguel district has applied to the Goverment to appoint an appraiser to count a plantation of upwards of three-hundred-thousand, trees ; but, up to the present, no steps have been taken by Government to comply with his request.

Exports.

Owing to the wanton destruction of the trees in the vicinity of the coast, the production of India rubber fell off very considerably whilst prices were low, as it did not pay to penetrate far into the distant woods to extract it: but with the increase in price and enormous demand of late years this has become possible and profitable and a gradual development of the trade can be noted. Moreover, as the trees are not now so frequently cut down but are bled so as to produce the finer and more valuable grade of "Andullo" or "sausage" rubber; we have good reason for believing that the actual rate of production can be easily maintained and will be even largely increased when the plantations begin to produce. The yearly exports from 1897 to 1905 have been as follows:

1897 ...	... 504,994 kilos	1902 ...	... 394,809 kilos
1898 ...	... 722,128 ,,	1903 ...	... 494,864 ,,
1899 ...	... 655,374 ,,	1904 ...	... 519,566 ,,
1900 ...	... 501,596 ,,	1905 ...	... 586,566 ,,
1901 ...	... 322,374 ,,		

It may be safely calculated that over ninety-five per cent. of this export up to the present is of wild rubber and only five per cent of cultivated rubber. Nearly the whole of the rubber exported goes to the United States.

Other Trees Giving Rubber.

Attention is being given at present to a search for other gum producing trees. A rather less elastic, but still valuable gum is gathered here called "caucho blanca," produced in "andullo" or sausage grade; also a kind of gutta percha was at one time extracted from a tree named "mata-palo"*—an enormous liana which climbing originally round the trunk of any other forest tree as a support, eventually kills the sustaining tree and forms an immense trunk of very great height. I am endeavouring to obtain details and samples of this gum. It is not now produced but could (if found to be a profitable business) be produced in considerabl quantities.

There are also many small shrubs of the Apocynum and Brosium genera which give a milky juice coagulating into a gum with the qualities of India rubber; but some mechanical process would be necessary to extract this from Apocynaceæ as the extraction by natural means would be tedious and unprofitable. Some samples of the ordinary strip and sausage rubber, and also of the "white rubber" duly marked and numbered accompany this report as well as various samples of other grades of rubber.

(Sgd.) ALFRED CARTWRIGHT.

Guayaquil, Dec. 3rd, 1906.

RUBBER INDUSTRY IN MADAGASCAR.

Britsh Consulate, Antanarivo, 31st July, 1906.

His Majesty's Principal Secretary of State
for Foreign Affairs.

My Lord,—In reply to your Lordship's Circular No. 13423 of April 28th, I have the honour to report that no systematic effort has yet been made in Madagascar to cultivate rubber, all the rubber hitherto exported from this country having been collected and prepared by natives. The few isolated attempts at cultivation made by individual planters from time to time, have proved entirely unsuccessful, and a similar absence of results attended an experimental plantation which was commenced in 1901 by the Department of Agriculture. These experiments were chiefly made with cuttings from an imported plant known as "Manihot Glasiovii" (referred to in enclosure No. 6) which it was hoped would yield a quality

* Undoubtedly a species of Ficus,

of rubber superior to any previously produced in the island. Unfortunately it was found that the imported plant could not be easily acclimatized, and all attempts at cultivation were for a time abandoned. A further experiment has quite recently been commenced by a planter on the north-west coast with the object of growing from slips or cuttings the more productive of the rubber trees indigenous to this country. This undertaking has not yet sufficiently emerged from its initial stage to form the subject of a report.

The export of raw rubber has shown considerable development during the past three years and I am assured that there is every prospect of the present annual supply being maintained. The Customs' returns from 1901 to 1905 are :

Exported in	1901	...	...	...	...	189 tons.
,,	1902	...	...	...	...	161 ,,
,,	1903	...	...	...	...	584 ,,
,,	1904	...	...	...	...	865 ,,
,,	1905	...	...	...	...	904 ,,

With the object of furnishing as full information as possible on the rubber industry of Madagascar, I have the honour to submit, enclosed herewith, the principal official notices that have been published locally with respect thereto. These comprise :—

Inclosure No. 1. An exhaustive treatise on the rubber producing plants found in the north-east of Madagascar, by Monsieur Thiry, Inspector of Forests. Chapters 2 and 3, contains an illustrated description of the trees and plants found in the North-East district, also of the methods employed by the natives in collecting and preparing the rubber. Chapter 4 treats of the nature and properties of the latex, indicating also the comparative production yielded by different plants. Chapter 5 gives the results of experiments on the bark of the trees by pounding in a mortar and passing through a sieve. Chapter 6 deals with the planting out of strips or cuttings (boutures) from rubber producing trees, estimates the probable expenses and yield of a plantation during 24 years, and concludes with a report from France on samples of Madagascar rubber submitted for examination.

Inclosure No. 2. A report (by Monsieur Thiry) on the production of a vine treated mechanically.

Inclosure No. 3. A report (by Michelie and Compagnie) giving full description, commercial value and analyses of rubber from various parts of Madagascar

Inclosure No. 4. The method of preparation in the Marolambo district (east)

Inclosure No. 5. Description and illustration of rubber producing plants in the Morandawa district, (west coast).

Inclosure No. 6. Remarks on the "Manihot Glaziovii" which has been unsuccessfully introduced with a view to cultivation.

I have etc.,

(Signed) T. P. PORTER,

His Majesty's Consul.

[We do not publish the long reports enclosed with this letter, but they may be seen in the library at Peradeniya by anyone interested.—ED. *T.A.*]

COAGULATION OF CASTILLOA RUBBER.

Manhattan Plantation, February 2nd 1906.

SIR,—Your favour of June 23rd, 1905 has just reached me. Replying to your enquiry about the Sinclair Coagulator, beg to say that it consists of a piece of board through which holes are bored 2 ins. by 2 ins. (holes should be about ¼ inch.). Over this board a sheet of absorbent paper is placed, (I enclose sample) ; paper must

be laid on board wet, if put on dry, it will warp and give an uneven sheet of rubber. Having the board and paper laid on wet, now proceed to tack on the rim or frame, which should be from 1¼ inch., high to 1½ inch. and your box will be ready for coagulating. As soon as the latex is brought in from the field, I add four times its volume of water, then strain through a fine metal sieve; then I place the whole in a cone bottom tin tank to settle, which takes about one hour. I then decant off the water until the latex becomes as thick as when it came from the tree, then I pour it in my boxes and the water that is in the latex, which cannot be decanted off will pass the absorbent paper in about ten minutes leaving the rubber.

I then expose it to a heat of 110 degrees F. for 5 or 6 hours, when the rubber can be lifted off the box. A new sheet has to be put on after being used 10 or 12 times. The time of exposure to heat varies and it is hard to give a correct formula in this respect, but one soon learns by the feel of the sheets, just when to take them from the boxes. I take them off as soon as my fingers do not stick, when pressed against them. I may mention here that this method is for *Castilloa elastica.* The *Hevea* latex passes through the absorbent paper. I am carrying on experiments now and expect soon to be able to handle both kinds of latex. Rubber coagulated on the above method becomes transparent like Ceylon biscuits, and runs it a close second in price; we aim to bring it up to par.

Bluefields, Nicaragua. S. W. SINCLAIR.

[*Bulletin of the Department of Agriculture*, Jamaica, May, 1906.]

INDIA RUBBER MARKET.

LONDON, January 18th, 1907.—At to-day's auction, 494 packages of Ceylon and Malaya plantation grown rubber were under offer, of which about 481 were sold. The total weight amounted to over 31 tons, Ceylon contributing over 7 and Malaya over 24. There was very strong bidding in to-day's auctions, and prices generally showed a decided advance, as much as threepence per lb. being frequently recorded. There were several attractive parcels of crepe, sheet, etc. The highest price, 5s 11d, was realised for an exceptionally fine parcel of Rangbodde Ceara biscuits. All kinds of crepe were again keenly competed for, and a fine lot from the Consolidated Malay Co. brought the highest price for this grade, viz., 5s 10¾d per lb. Plantation fine to-day.—5s 9½d to 5s 11d, same period last year, 6s to 6s 1½d. Plantation scrap.—4s 6½d to 4s 9d, same period last year, 3s 5d to 5s 3½d. Fine hard Para (South American).—5s 3d, same period last year, 5s 3½d. Average price of Ceylon and Straits Settlements plantation rubber, 481 packages at 5s 6¼d per lb., against 292 packages at 5s 3½d per lb. at last auction. Particulars and prices as follows:—

CEYLON.

MARK.	QUANTITY, DESCRIPTION AND PRICE PER LB.
Ellakande	3 cases fine pale biscuits, 5s 8¾d.
Nikakotua	3 do good darkish pressed crepe, 5s 2½d.
Culloden	3 do good palish biscuits, 5s 8¾d. 6 cases fine pale crepe, 5s 10½d. 6 cases good darkish crepe, 5s 4½d; 4 cases fine pale crepe, 5s 10½d; 4 cases darker, 5s 3½d; 2 cases dark, 5s 1¼d.
Ingoya	5 do fine palish to darkish biscuits, 5s 8¾d; 1 case good darkish scrap, 4s 7¼d.
Hattangalla	3 do good biscuits, 5s 8¾d; 1 case palish pressed crepe, 5s 4½d; 1 case black, 5s.
Langsland	12 do good biscuits, 5s 8¾d; 1 bag darkish sheet, 5s 8¾d.
Clontarf	2 do good palish to darkish biscuits, 5s 9¼d; 1 case brown crepe, 5s 3¼d; 1 case darkish and dark crepe, 5s 0¾d.

CEYLON.

MARK.	QUANTITY, DESCRIPTION AND PRICE PER LB.
Aberdeen	1 case fine palish biscuits, 5s 9½d; 2 cases similar, 5s 9¼d; 1 case darker, 5s 8½d; 1 case darkish pressed scrap, 4s 6¼d; 1 case thick rejections, 4s 7¼d.
Elston	2 do good darkish biscuits, 5s 9¼d; 3 cases palish scrap, 4s 7½d; 1 case lump scrap, 4s 7d.
Tallagalla	2 do good dark biscuits, 5s 9d; 1 case darkish pressed scrap, 4s 7¼d.
Warriapolla	1 do fine palish biscuits, 5s 9¼d; 1 case darker, 5s 9d; 1 case good scrap, 4s 7½d.
Taldua	2 do dark biscuits, 5s 9d.
C.Y. (in Estate Mark)	4 do fine palish sheet, 5s 9d; 1 case darker, 5s 9d; 6 cases good scrap, 4s 7d; 1 case dark rejections, 5s 7¼d; 2 cases cuttings, 5s 0¼d.
Northumberland	1 do mixed dull biscuits, 5s 9¼d; 1 case good scrap, 4s 7¾d.
Clara	1 do thick biscuits, 5s 9d; 1 case good palish scrap, 4s 7¾d.
Ayr	1 do good palish biscuits, 5s 9¼d; 1 case good pressed scrap, 4s 7¾d.
Rangbodde	1 do very fine pale Ceara biscuits, 5s 11d.
Doranakande	2 do good dark biscuits, 5s 9¼d; 1 case rough dull biscuits and sheet, 5s 8½d; 3 cases fine darkish scrap, 4s 8d; 2 cases dark cuttings, 4s 9d.
Warriagalla	1 do fine blocked worm, 5s 8¼d; 1 case similar, 5s 8¼d; 1 case barky scrap, 4s 6d; 1 case good blocked worm, 5s 6d; 1 case darker, 4s.
J.J.V. & Co., A.	3 do good pressed scrap, 4s 9d.
J.J.V. & Co., M. T.	1 do lace scrap, 4s 11½d; 1 case dark scrap and rejections, 4s 4d; 1 case similar, 4s 4d.
Ambatenne	2 do low earthy scrap, 1s 9d.
C.L.	1 do palish to darkish crepe, 5s 3¾d; 15 cases darkish scrap crepe, 5s 2½d; 1 case black crepe, 4s 11d; 3 cases good darkish scrap, 4s 7½d; 2 cases dark pressed scrap, 4s 6¾d; 1 case barky scrap, 4s 4d; 1 case rejections, 4s 5½d; 1 case heated pressed sheet and crepe, 4s 4d.

STRAITS SETTLEMENTS.

MARK.	QUANTITY, DESCRIPTON AND PRICE PER LB.
V.R. Co. Klang F.M.S. (in triangle)	15 do fine amber washed sheet, 5s 8½d; 2 cases fine palish to darkish crepe, 5s 5d; 1 case darker, 5s 2¼d; 18 cases good dark block, 5s 5¾d to 5s 6½d; 4 cases similar, 5s 4¾d to 5s 5¾d; 3 cases good block, 5s 1¼d; 22 cases fine washed sheet, 5s 8½d; 2 cases fine pale pressed crepe, 5s 6¾d; 4 cases darkish, 5s 3¼d; 2 cases good brown crepe, 5s 0¼d.
S. R. Co.	15 do good palish to darkish sheet, 5s 8½d; 2 cases palish to darkish crepe, 5s 4¼d; 11 cases darker, 5s 1¾d; 1 case dark crepe, 4s 11½d.
F.H. (in diamond)	2 do good darkish sheet, 5s 8½d; 1 case similar, 5s 8½d; 1 case darkish pressed crepe, 5s 2¾d; 2 cases dark pressed crepe, 4s 11d; 1 bag fine scrap, 4s 5½d.
R.B. (in diamond) S.	2 do good sheet, 5s 5½d.
S. (in diamond) S.R.	1 do fine scrap, 4s 6½d.
V.R. Co. Klang F.M.S. (in triangle)	11 do good brownish crepe, 5s 3¾d.
Highland Est.	17 do good washed sheet, 5s 8¾d to 5s 9d; 5 cases darker, 5s 8¾d; 8 cases good palish scrap crepe, 5s 5¼d; 3 cases good palish to darkish crepe, 5s 4d; 3 cases darker, 5s 2½d; 8 cases brown, 5s 3¾

B.R.R. Co. Ltd.	12 cases	good palish to darkish scored sheet, 5s 9¼d 4 cases fine palish crepe, 5s 6d; 8 cases good darkish crepe, 5s 3d; 1 case darker, 5s 1¾d.
Linggi Plts. Ltd.	22 do	very fine pale crepe, 5s 10½; 4 cases palish to darkish crepe, 5s 6d.
Jebong	14 do	very fine pale crepe, 5s 10⅝d; 2 cases darker, 5s 5¾d 1 case good dark crepe, 5s 2¾d; 5 cases similar, 5s 3¾d 1 case dark crepe, 5s 1¾d.
S.S.B.R. Co. Ltd. (in triangle)	4 do	fine dark sheet, 5s 9¼d; 4 case good palish to darkish scrap, 4s 7d; 1 case thick rejections, 4s 7d .
Gapis	1 do	good pale sheet, 5s 9¼d; 2 bags scrap, 4s 8d.
M.C.I. 1 (in diamond)	3 do	good rambong ball, 4s 7d.
M.C.I. 4 (in diamond)	1 do	thick rejections, 4s 8½d.
Bila	1 do	fine pale sheet, 5s 9¾d; 4 cases darker, 5s 9¼; 1 case good scrap, 4s 7¾d.
M.C.I. (in diamond)	1 do	good rejections, 5s 0½d.
M.C.I. 6 (in diamond)	1 do	good pressed scrap, 4s 8d; 3 cases fine amber sheet, 5s 9¼d.
S.P.S. (in circle)	1 do	good pale scrap, 4s 8d; 1 case rejections, 4s 8d.
S.P. (in circle)	4 do	darkish washed sheet, 5s 9¼d.
G.K.K.B. (in diamond)	1 do	fine amber sheet, 5s 9¼d.
T.E.B.C.	1 do	darkish scrap crepe, 5s 4½d; 1 case similar, 5s 4½d.
Pataling	9 do	darkish crepe, 5s 3¼d.
K.M.A.	1 do	pale sheet, 5s 9d; 1 case similar, 5s 9d.
B.N.S.K.L.	1 do	palish to darkish sheet, 5s 8¾d; 2 cases dull pale biscuits, 5s 8¾d.
Batu Tiga S.R.C.O.	1 do	good dull biscuits, 5s 9d; 1 case similar, 5s 9d.
B.K.A.S.	2 do	palish to darkish sheet, 4s 7½d.
C.M.R.E. Ltd.	9 do	fine pale crepe, 5s 10¾d; 8 cases fine palish to darkish crepe, 5s 9½d; 7 cases somewhat similar, 5s 8d; 10 cases dark, 5s 2¾d.

LONDON, February 1st, 1907.—At to-day's auction, 362 packages of Ceylon and Malaya plantation grown rubber were under offer, of which about 226 were sold. The total weight amounted to over 20¾ tons, Ceylon contributing over 7½ and and Malaya nearly 13¼. In sympathy with Para grades, the market was quieter and competion less animated, orders not being so plentiful as at last auction. Most of the offerings changed hands at a slight decline on last sale's rates, all grades being affected. There was another very fine small lot of pale clear Ceara biscuits which again realised the highest price of the auction, namely, 5s 10½d per lb. A small lot of good Rambong crepe also attracted attention and sold at 5s 1¾d per lb. Plantation fine to-day.—5s 8¾d to 5s 10½d, same period last year, 5s 8d to 6s 2d. Plantation Scrap.—4s 3¼d to 4s 7½, same period last year, 3s 11d to 5s 3¼. Fine Hard Para (South American) 5s 2¼d. same period last year, 5s 4¾d. Average price of Ceylon and Malaya plantation rubber 226 packages at 5s 5d per lb., against 481 packages at 5s 6¼ per lb. at last auction. Particulars and prices as follows:—

CEYLON.

MARK.	QUANTITY, DESCRIPTION AND PRICE PER LB.	
C.L.	1 case	fine palish to darkish crepe, 5s 3¼d; 1 case brown, 5s 2¾d; 4 cases fine pale scrap, 4s 7¼d; 3 cases darker, 4s 7d; 2 cases daarkish, 4s 0¾d; 2 cases good darkish scrap, 4s 6¾d.
T.E.B. C.	2 do	dark pressed crepe, 4s 10d.
T.E.S. B.	2 do	ball scrap, 4s 3¼d.

B.N.S. K.L.	2 cases	rejected biscuits, 5s; 3 cases good scrap, 4s 6¾d.
Arapolakande	7 do	fine darkish and dark biscuits, 5s 8¼d; 1 case fine pressed scrap, 4s 6d.
Glencorse	4 do	good palish to darkish biscuits, 5s 8d; 1 case very fine pale scrap, 4s 7½d; 1 case dark, 4s 2d; 1 case rejections, 4s 8d.
Culloden	3 do	fine amber biscuits, 5s 8½d; 5 cases fine pale crepe, 5s 9¾d; 7 cases good pale to darkish crepe, 5s 2¾d; 3 cases fine pale biscuits, 5s 8¾d; 3 cases fine pale and darkish biscuits, 5s 9¼d; 3 cases good darkish crepe, 5s 3¼d; 3 cases dark, 5s 0¾d; 1 case black pressed block, 5s 2½d.
Ellakande	1 do	very fine amber biscuits, 5s 8¾d.
Heatherley	3 do	very fine pale amber biscuits, 5s 8¾d.
Ambatenne	1 do	good darkish biscuits, 5s 8½d; 1 bag good sheet, 5s 8d; 1 case good rough biscuits, 5s 6d.
V.S. K.M. (in square)	1 do	good rough and pressed biscuits, 5s 8d; 1 bag barky scrap, 4s 7d.
Taldua	2 do	good biscuits, 5s 8¼d; 1 case good scrap 4s 7d; 1 case darker, 4s 6½d.
Densworth	1 do	good dark biscuits, 5s 8¼d.
Tallagalla	2 do	good dark biscuits, 5s 8¼d; 2 cases good pressed scrap, 4s 7d
Sirigalla	1 do	fine pale scrap, 4s 7½d.
Rangbodde	1 do	very fine pale Ceara biscuits, 5s 10½d.

MALAYA.

MARK.	QUANTITY, DESCRIPTION AND PRICE PER LB.	
Highlands Est.	7 do	fine palish crepe, 5s 5d; 5 cases darker, 5s 3¾d; 9 cases brown, 5s 2¾d.
T.E.C. C.	2 do	dark pressed crepe, 4s 10d.
V.R. Co. Ltd. Klang F.M.S. (in triangle)	20 do	fine washed sheet, 5s 8¼d; 2 cases very fine pale crepe, 5s 9d; 6 cases fine palish crepe, 5s 6d; 1 case darkish, 5s 3½d; 1 case brown, 5s 2¾d; 32 cases darkish smoked blocks, 5s 4d to 5s 5¾d; (part sold).
P.S.E.	7 do	good large sheet, 5s 8½d; 1 case darkish presed crepe, 4s 10½d.
Sungei Krudda	7 do	good palish sheet (mouldy), 5s 8¼d; 2 cases fine scrap, 4s 7¼d; 3 cases mixed scrap, 4s 5¼d; 6 cases fine amber sheet, 5s 8½d.
Bila	3 do	very fine pale sheet, 5s 8¾d; 6 cases little darker, 5s 8¾d.
C.M.R.E. Ltd.	9 do	fine pale crepe, 5s 9d to 5s 9¼d; 10 cases fine palish crepe, 5s 8¼d to 5s 8½d; 4 cases good dark crepe, 5s 1d.
Shelford	4 do	fine amber sheet, 5s 8¼d; 1 case scrappy rejections, 4s 7¼d; 1 case Rambong crepe, 5s 1¾d; 1 case Rambong scrap, 4s 7d; 1 case dark crepe, 5s 2½d.

GOW, WILSON & STANTON, LTD.
LONDON.

FIBRES.

PHILIPPINE FIBRES AND FIBROUS SUBSTANCES:

Their Suitability for Paper Making: Raw Materials for Paper Making.

From the earliest Egyptian papyrus to the paper of to-day, the predominant characteristic of this material is that it consists of the enduring portions of vegetable growth known as cellulose, although animal and mineral fibres such as wool, silk, and abestos are occasionally employed. The art of modern paper-making consists of uniting or felting together any fibrous material so as to form a continous sheet. Linen or cotton rags are no longer exclusively employed; indeed these substances at present constitute but a small fraction of the raw material of the paper-making industry. Any vegetable matter possessing sufficient fibrous structure can be utilized.* Notwithstanding the great variety of available cheap materials, rags of various kinds continued to form the chief substances for paper making both in Europe and America, until the middle of the nineteenth century, at which time they ceased to be obtainable in sufficient quantities to supply the demand and paper makers began to search elsewhere for a cheaper and more inexhaustible material for their rapidly growing industry. In 1854 wood-pulp was first used in the United States, and three years later Mr. G. Thomas Routledge introduced esparto grass into England. The simultaneous introduction of wood and grass furnished the first important sources of raw material for paper making and provided the first evidence that perennial grasses are suitable for making stock.†

It is interesting to note the direction which search for suitable paper material was taking when the adaptability of wood for this purpose was first discovered and also to predict the lines of future enquiry when woood no longer meets the demand. When, in 1861, all import duties in Great Britain were repealed, the resulting establishment of a vast number of weekly and daily papers and journals created so great a demand for paper and paper pulp that manufacturers were forced to supplement the imported Spanish and North African esparto grass with the cereal straws, but even these proved insufficient to meet the requirements and, as the prosperty of English paper mills appeared at a stake, the demand seemed justified that the Indian bamboo forests be thrown open to private enterprise; accordingly, Mr. Thomas Routledge, a prominent paper manufacturer of Sutherland to whom the introduction of esparto is due, sent investigators to India to study the problem in that country. However, about this time the manufacture of paper stock from spruce timber had been developed on the Continent, particularly in Germany and Sweden, and supplies of this new material from those countries brought the much-needed relief; nevertheless, experiments were carried far enough to demonstrate that bamboo fibre is much superior to spruce for paper stock and there seems but little doubt that the bamboo-paper question will eventually be reopened.

In America the evolution of raw material for paper making followed somewhat different lines. The transition from rags to wood was direct and was later followed by the use of straw in those regions far removed from spruce forests. No recourse to perennial grasses or bamboo has thus been necessary.

---

* In order to give some idea of the variety of materials from which paper can be and has been prepared, we may cite a book published in 1765 at Regensburg, Germany, by Jacob Schaeffer, the paper of which was made from about sixty different sources, among which the following are curious and interesting examples: Sawdust, hop vines, hornets' nests, pea straw, cabbage stumps, moss, and thistle stalks." Thorpe: *Dictionary Applied Chemistry*, 3,105.

† As fibres and cotton flax in the form of cotton and linen rags have already undergone purification and have been subjected to processes of manufacture, they can not, strictly speaking, be considered as raw materials.

For half a century wood-pulp has met the rapidly increasing demand for paper stock. However, we are now confronted with the fact that the supply of this material will soon be exhausted, so that we are afforded a curious example of the manner in which the development of an industry sometimes brings one back to the conditions of the beginning, although the new point reached, owing to the persistence of the scientific enquiry which was undertaken regardless of an utter lack of apparent practical benefit, is on a much higher plane.

Until wood-pulp had been proven to be suitable for paper stock, the world's supply of fibrous material was divided between the textile and paper industries, one being complementary to the other. Such vegetable fibres as cotton, hemp, jute, flax, and abácá are eminently suited for the manufacture of paper, but their primary value for textiles and cordage excluded their use in the raw state for paper and, therefore, the paper makers obtained their material largely from the refuse of these industries. Good cotton and linen rags have become the luxury in the paper-making world. They are only indulged in now for making the best class of stationary, and by fortunate coincidence, this is about the only use to which they can be put. At first glance, wood might be considered too valuable for other purposes, but fortunately, those varieties which find most favour for the making of paper pulp are considered rather worthless for the many other uses for which wood is usually employed; furthermore, the demands of the spinner and cordage maker need to be considered. Twenty or twenty-five years ago statements " that there is not the slightest ground for believing the supply of this raw material would ever fail " were common in regard to wood as a material for paper making. The marvelous growth of the paper industry of the last two decades was not then foreseen nor were the many other uses for wood-pulp, which modern advances in the industrial world have brought about, taken into account.

P. H. Clutterbuck, referring to the numberless uses of wood-pulp, writes: * " Printing paper alone eats an enormous hole in our natural forests yearly and the future requirements can only be conjectured. The huge procession of railway cars all over the country run, to some extent, on paper wheels; carpenters are begining to use boards of paper, handsomely veined, requiring no planing, twice as durable as the wooden variety and costing only half the money. The builder is introducing paper bricks, showily enameled, which will not burn and possess many advantages over those of clay. The ship-builder introduces masts and spars of the same substance, which is likewise used for telegraph and telephone and flagstaffs. These are not fanciful experiments but serious procedures, justified by superior durability of the articles so produced. This same quality is claimed for the paper horse shoe recently invented and so extensively used."

Already, paper manufacturers in the United States are looking for new sources of supply for raw material. A recent report of the United States Department of Agriculture† recommends that investigations be made on the suitability of new raw materials for paper and paper pulp.

" Our well-known pulp woods are being used up faster than they are growing and as a consequence the demand for new material has led to efforts to utilize many waste products among which bagasse or sugarcane refuse, cornstalks, southern pine waste, rice straw, and hemp stalks present exceeding promising fields."

The United States Government recently has established a laboratory at Washington for investigations along these lines, and this fact emphasizes the importance which the question is assuming.

---

* P. H Clutterbuck: Indian Forester (1899), 25,231.

† U. S. Department Agrl.: *The Report of the Chemist* (1904).

PULP AND PAPER MAKING.

During the nineteenth century there were remarkable changes and improvements in the methods employed for converting paper stock into paper pulp and paper. These advances have been due to two causes—one, the revolution in the nature and supply of the raw material itself, and the other, the increased demand for the finished product. The method of preparation of paper pulp or half-stuff has thus far largely been dependent upon the nature of the material treated, where as the making of the pulp into finished paper in sufficient quantities to meet the marvelous growth of the industry has caused the laborious hand process to be superseded by the huge automatic machines of the present time. However, the principles involved in the making of paper remain unaltered, regardless whether the material is removed from a vat with a small hand sieve and turned out a single sheet at a time or is allowed to flow on to an endless wirecloth web under heavy rolls and over the steam-heated drying cylinders of a Fourdrinier machine. Generally speaking, the purpose is just the opposite of that which obtains in the isolation of fibres for the textile and cordage industries; instead of so treating the fibrous substance as to preserve the fibre bundles or filaments in their greatest length, it is necessary, by some mechanical or chemical means, to convert them to the invidual fibres or cells of which the filaments are composed.

There are five distinct steps in the preparation of paper pulp from any vegetable material. Two of these are entirely mechanical, whereas the remainder are of a distinctly chemical nature. Arranged in their order of procedure, they are:

1. *Cleaning.*—A purely mechanical process which consists in removing all foreign matter such as sand, dirt, weeds, chaff, etc., either by hand or machinery.

2. *Boiling* or *digesting.*—This results in eliminating the soluble plant constituents and incrusting matter by chemical means.

3. *Bleaching* consists in further chemically purifying the resistant cellulose by removing adhering coloring matter.

4. *Beating* or *refining.*—This procedure mechanically disintegrates the pulpy mass of fibres into fragments of requisite length.

5. *Loading, sizing, and coloring* so modify the bleached and beaten pulp by the addition of mineral or animal substances, that a non-porous resistant of the required shade is given to the finished product.

BOILING OR DIGESTING.

At the present time there are two main groups of processes in general use for the isolation of paper cellulose, namely, the alkaline and acid treatment. The first and older methods depend upon the action of solutions of caustic soda, soda ash, caustic lime, or mixtures of these chemicals, under varying conditions of strength of solution, pressure, and duration of digestion.* Therefore it is evident that in valuing an unknown material for use as paper stock these differences need carefully to be considered. The second method for the resolution of raw fibres is of comparatively recent origin and consists in cooking then under strong pressure with sulphurous acid, either free or combined with soda, lime, or magnesia in the form of the bisulphites of these bases. The development of this process has been slow, owing to the many mechanical difficulties involved, the strong chemicals employed attacking and soon rendering the digesters worthless. However, within recent years resistant digester linings have been invented and now this process is established as the leading method for the preparation of chemical wood-pulp. Comparatively little has been done to show its adaptability to materials other than wood, but the

* Esparto grass is invariably subjected to the alkaline method of treatment, but the pressures carried vary from 5 to 50 pounds, the time of digestion from one to six and one-half hours, and the strength of the caustic liquor from 10 to 20 per cent, calculated upon the gross weight of the material.

process has so many features of superiority over the alkaline one that its application in the treatment of various other materials will be considered in a subsequent paper when work on the value of Philippine woods for paper stock will be reviewed.*

Bleaching of paper pulp.—All fibres do not act alike with bleaching agents. Jute, for example, does not bleach white by any known method which does not also seriously injure the fibre while other substances reqnire varying proportions of bleach liquor and special conditions of treatment to secure satisfactory results. Therefore, it is important to subject new, raw materials to quantitative bleach operations in order to determine the right method of procedure and the amount of bleaching powder required. The loading, sizing and coloring, of paper are not materially affected by the source from which the pulp is derived and need only concern us here with respects to the kinds of chemicals in general use for these purposes and the possibilities of obtaining them in the local market. This question of chemicals for this and the other steps in the process of pulp manufacture is an important one and will be throughly discussed in a later number of this journal.

VEGETABLE FIBRES.

Botanical classification.—Fibre-producing plants are included in two great divisions of the vegetable kingdom—i. e., Dicotyledons and Monocotyledons. The most evident characteristic of these two great divisions of plants is found in the arrangement of the leaf veins. Dicotyledonous plants are characterized by netted-veined leaves, whereas the monocotyeldonous ones may usually be identified by leaves with parallel veins. The chief fibre-yielding families of the first division are:

Linaceæ: Flax family; example, flax.

Malveæ; example, cotton.

Tiliaceæ; example, jute.

Urticaceæ or nettle family; example, hemp.

Moraceæ; example, mulberry.

Of the second division the *Gramineæ* or Grass family, *Liliaceæ*, *Palmæ*, or Palm family, and *Musaceæ* or Plantain family are the more important orders of fibre producers. While a number of netted-veined fibrous plants such as ramie and jute are distinctly tropical in habitat, only a few unimportant species are found in the Philippines and hence it appears that families of Monocotyledons are the only ones represented by plants of commercial importance in these islands.

Structural classification.—With the exception of fibres like cotton, kapok, etc., which are unicellular seed hairs and termed surface *fibres*, practically all fibres may structurally be classified according to the two main groups of families from which they are derived. The dicotyledonous plants produce the so-called *bast fibres*, contained in the inner fibrous bark of stems and twigs, while on the other hand the commercial fibres of monocotyledonous plants are generally found distributed throughout the entire stem, where they form the frame work which gives rigidity and toughness to the plant structure, and hence they are termed *structural fibres*. Such fibres occur in the sheathing leafstalks of plantains, in the fleshy leaves of maguey and pineapple, and in the leaves and stalks of palms and grasses.

* "On account of the considerable proportion of silica present in straw, it has generally been assumed that this material would not easily lend itself to treatment by the sulphite process. Practical experience has, however, shown that this is not the case, and this process has recently been applied to the preparation of straw pulp with excellent results." Griffin & Little: Chem. of Paper Making, 161.

Economic Classification.—A discriptive catalogue of the useful fibre plants of the world by C. R. Dodge* enumerates over one thousand species, the important of which are fully described and treated from the botanical, structural, and industrial stand points. His classification of fibre plants based on their uses is both so simple and natural that we incorporate its main features, at the same time drawing on local fibre plants for illustrating the numerous divisions of the scheme:

A Spining fibres.

1. Fabric fibres; pineapple, abaca, ramie, etc.

2. Netting fibres; palms. rattans, bamboo.

3. Cordage fibres; abaca, maguey, bamboo, rattan.

B. Tie material (rough twisted). Palms, rattans, bamboos, grasses.

C. Natural textiles. Fibrous sheaths of palms.

D. Brush fibres. Palm fibres, bamboo.

E. Plaiting and rough weaving fibres.

1. Articles for attire; hats, sandals, etc. Abaca, palms, bamboo.

2. Mats and mattings; also thatch materials. Grasses, bamboos, palms, etc.,

F. Forms of filling. Kapok, straw, grasses.

G. Paper material.

1. Textile papers. All waste from A, including old rope.

2. Bast papers.

3. Palm papers. From the fibrous material of palms and similar monocotyledonous plants, including rattans.

4. Bamboo and grass papers. This includes all material from graminaceous plants, including bamboos, cereal straws, and true grasses.

5. Wood-pulp papers. Philippine soft woods, (Lauan Shorea), Cupang (Parkia), Grewia, etc.

It will be seen from this scheme of classification and from the native plants selected to examplify each division of use, first, that a comparatively small number of plants supply fibre for all the present requirements; for instance, plantains, grasses, bamboo, rattan, and palm fibre are made into fabrics, fish nets, hats, baskets, mats, twine, rope, thatch, brushes, and brooms; second, that those plants which find such general use are without exception monocotyledons and their fibres are of the class termed *structural*; third, that with the exception of maguey and pineapple they are either plantains, grasses or palms; fourth, that, leaving out of consideration native woods as a possible source of paper stock, the available supply of material for any future paper industry in the Philippines must come from one or more of these three sources. †.—*Philippine Journal of Science. Vol. 1 No. 5 June, 1906*

---

* Report No. 9, U. S. Department of Agriculture.

† Maguey culture is rapidly increasing in northern Luzon, and the waste from the stripping of the plant may become an important factor in paper making.

EDIBLE PRODUCTS.

The Result of Transplanting in Paddy Cultivation at Dikdeniya, Hanwella.

By G. E. Amarasekera.

The leaflets issued in July 1906 by the Superintendent of Government School Gardens, *re* transplanting in paddy cultivation, were just in time to be distributed amongst the paddy cultivators here, for the Maha season had just commenced. I got down about 250 leaflets and distributed them amongst the goiyas in this district, besides those I sent to the village headmen requesting them to instruct the villagers of the usefulness of this practice. Though every man saw and acknowledged the usefulness of transplanting, yet no one cared to give it a trial.

I therefore thought of taking the lead. Having selected a paddy field of about two pelas sowing extent (about 1¼ acre) I had a good tier prepared for a nursery in which I put in one measure of mada elvi and another measure of mavi, on the 28th of July last. Whilst the plants were coming up, the rest of the field was well tilled and irrigated. On the 30th of August 87,300 seedlings were transplanted at 9″×9″. A severe drought which prevailed for about a month immediately after planting parched up nearly 5,000 seedlings that were on hard soil. The rest grew up very well throwing out from 15 to 30 shoots each.

The crop was gathered with very good results. The two measures yielding 2 amunams, 3 pelas, and 4 lahas or 456 measures. A return equal to 228 fold Had it not been for the drought, the return would have been much greater.

The following is the cost incurred :—

	Rs.	cts.	Rs.	cts.
By value of two measures Paddy ...				
,, Bone dust manure		15		
,, Tilling, fencing, mudding, sowing &c., ...	6	00		
,, Reaping and thrashing	6	85		
,, Transplanting	3	00		
To value of 2 am. 3 pel. and 4 meas. @ Rs. 3/00 per pela (present value)...	2	05		
,, Value of straw			34	20
By balance to credit	16	65		50
	34	70	34	70

I may add that the same field was hitherto sown with about two pelas of seed paddy and never yielded more than seven pelas.

Paddy Cultivation in Badulla, Ceylon.

TRANSPLANTING AND ORDINARY SOWING.

BY D. H. KOTALAWELA.

Paddy fields in the town and in its neighbourhood are usually cultivated twice a year at the the "Maha" and "Yala" cultivations. The period of cultivation between March and August is called the "Maha" cultivation, and that between September and February the "Yala." The goiya is usually lucky in his "Maha" cultivation, because during this period he gets no more rain than is needed. But during the "Yala" cultivation great loss is often sustained by the goiya, owing to the incessant rain; and the crop produced by this cultivation hardly repays the trouble and expense. An experiment was made in transplanting during this season, which proved very successful and the crop seems to suffer very little from the rain, as compared with the broad cast sowing. It was suggested to many cultivators to adopt this method, but it was found very difficult to convince them of its advantages over the ordinary broad cast sowing, as they usually have a conservative prejudice against any new ideas. In sowing broad cast an enormous waste of seed is incurred. Experiments and experience clearly show that the out-turn of transplanted paddy is very much greater than that obtained by sowing broad cast; and the growth itself is not so luxuriant as when transplanted.

In cultivating a field there are several items of work to go through viz:— manuring, cleaning of the elas, fencing, ploughing, sowing or transplanting, and reaping. With regard to manuring, scientific manuring will of course be the best, but considering the climate, the soil and the situation of the land, it could be fertilised by ordinary manure. Bone dust which is used in the lowcountry not known to the goiya, and it is so difficult to procure it, particularly in a place like Badulla, where the cost of transport from the metropolis is not within the reach of the ordinary goiya. Farm yard manure is available here, and this too in not very large quantities. Cattle dung is no doubt the best all round manure in Ceylon, and is the most suitable for the rice plant. Garden rubbish and green manures have their own value, but none of these are tried except by an enterprising goiya, and of such a 10% is not found in the district. Unfortunately an experiment made with green manures has proved a failure resulting in excessive foliage and less grain. Of all green manures karande and wal-suriya leaves have proved to be the best, and especially the former as it is effective in destroying worms and insects in the soil. Next to manuring the cleaning of the elas should be attended to properly. After the elas are cleared and the fields well watered the "puranhiya" or the first ploughing is done. All that is needed is to loosen the soil thoroughly well. The rice plant does not take root deep, so that the depth to which the soil is furrowed by the ordinary native plough is all that is required. Besides, deep ploughing is said to be pre-judicial to the goiya's interest, although he give no satisfactory explanation. About ten or fifteen days after the first ploughing, the ketuma, or the turning over of the soil is done. Then there is the made-heeya or the second ploughing, and the repairing of the ridges, followed by the levelling of the soil called the ketageheme or goigame, after which the sowing takes place. The seed paddy must be carefully selected, and must be free from chaff. Very old or very new paddy should not be used. The germination of the paddy must also be carefully attended to, and the safest course is to get the services of an experienced goiya.

In transplanting, the preparation of the nursery is exactly the same as that for ordinary sowing. It is important that great attention should be paid to the selection of the variety of paddy. There are a great many varieties of paddy suit-

able for transplanting, while there are some others which should be rejected. The best varieties for transplanting are kaivara samba, mutu samba, thanga nellu, suddudurn and kadippu all of which belong to Indian agriculture. By experiments made kaivara samba has proved to be the best. A few indigenous varieties were also experimented with, with little or no success. Of these panniti or tail paddy is about the best, but it is only suitable for the consumption of man. It is not suitable for horses or elephants owing to the sharp long tails attached to the grains. Experiments were made with small quantities of balavi (60 days paddy) including kiushu paddy, which were a total failure. The longer the life of the plant the better it is. The method of transplanting can be done only once in the year as over half of the year is required for each crop, while the remainder can be taken up for sowing a kind of balavi or for a leguminous crop. It is always during the yala cultivation that transplanting is done. By experiments made it was proved that the "maha" season is unfit for transplanting with the above metioned Indian paddy. Several other varieties were experimented with, but they were total failures. The plants grew to the height of 5 or 6 feet, but they never blossomed.

When the seedlings are about a month old they are transplanted. They may be planted singly or in bunches of two or three at a distance of 4 to 6 inches apart. A bushel of paddy is usually sufficient for an acre of land. In transplanting, the removal of the seedlings from the nursery is usually done by men who are paid 36 cts. a day, while the transplanting is always done by women who are paid 24 cts. a day. Harvest Harvesting. usually commences within six months of the time of sowing. August is the time the nursery should be laid, and the transplanting should be done in September, and the crop harvested during February and March. After transplanting, the plants ought to be cut when they are barely ripe, as the grain drops when it becomes too ripe. The straw of transplanted paddy is not very much liked by cattle as the leaves and the stems of the plant grow very much larger than those obtained by ordinary sowing. This straw can, however, be used for roofing purposes. The yield of the paddy from an acre varies according to the richness of the soil, but with really good lands and careful cultivation, the return will always be between 35 and 80 fold per acre, while on ordinary land the maximum is 12 fold. A yield of 80 fold has been obtained in a field in Badulla in 1900. The superiority of the transplanted paddy should also be taken into consideration. The rice from the transplanted variety is good for the table, and there is also a great demand for it. The threshing of transplanted paddy differs from that of broad cast sowing. The former is done by men who separate the seed out, by a process of beating the sheaves on the ground, while the latter is treated by cattle.

Annexed is a statement of the average yields of the two different methods of cultivation :—

TRANSPLANTING.

Extent of land where one bushel of paddy could be transplanted.	one acre or one amunam.
Time between laying out of the nursery and harvesting	6 months.
Expenses per bushel (including expenses incurred in the nursery) till the time of reaping.	Rs. 10·00.
Produce per bushel	35 bushels.
Price per bushel.	Rs. 2.50.
Value of produce	Rs. 87·50.
Profit on one bushel	Rs. 47·50.
Extent of land where one bushel of paddy could be sown.	¼ of an acre or one pela.
Time between sowing and harvesting	4 months.
Expense per bushel sown	Rs. 8·50.
Produce per bushel...	8 bushels.
Price per bushel	Rs. 1·75.
Value of produce	,, 14·00.
Profit on one bushel	,, 5·50.

NOTE BY EDITOR.

The two previous papers set forth the results of transplanting in paddy cultivation. The advantages of this method have been demonstrated almost *ad nauseam* for very many years, and yet it is not employed in Ceylon—for the so-called transplanting about Kandy is not real transplanting from a nursery. The villager objects to any interference with his time honoured customs and the fact that Ceylon gets the poorest return of paddy per bushel sown in the whole world does not appeal to him in any way. The only thing to be done is to keep on demonstrating the advantages of the method, and for the larger paddy growers to enforce its use upon their land.

CEYLON'S IMPORT DUTY ON TEA.

Some philosopher has been guilty of perpetrating an epigram on the futility of endeavouring to convince a certain class of person against his will. That particular class of person appears to us to be represented by the planters of Ceylon in the attitude they have finally taken up in regard to the import duty levied at Colombo on Indian tea. So much has already been said and written on the subject that there would appear to be nothing left to be said. Let us see how the matter stands. The duty is 25 cents. per lb., or in other words, 4 annas per lb. Now taking the average price of Indian tea to be 6 annas per lb., the incidence of the impost levied by Ceylon works out to 75 per cent. of the market value of the article. No one is insane enough to import Indian tea into Ceylon with such a duty. Had Ceylon not been a tea-producing country, the tax would perhaps have been quite as equitable as the British import duty on Indian and Ceylon tea: that is to say, it would have been a revenue-yielding duty, and there might have been some show of excuse for levying it. But Ceylon planters and tea shippers hold very strong views on the justice and equity of the British import duty on British-grown tea, and what Ceylon people have *not* said against this duty, is not worth saying. Yet, here are Ceylon men deliberately (and obstinately) trying to justify their duty against Indian Tea. Here we have a British Crown Colony separated from India, a British possession, by a few miles of water, levying a preposterously high duty on a British grown product, not for revenue purposes, be it noted, but as a protective duty! The lame excuse put forward in defence of the duty is that "inferior" Indian tea will be imported into the Island, and palmed off as "pure Ceylon tea" on the unsuspecting public. When this duty was first levied, it was a revenue producer, because Ceylon did not produce any tea at that time, and there was some excuse for it. As the *Pioneer* said the other day: "There do not appear to be very strong reasons in these days for maintaining the duty. Local competition need not be feared much more than the landing of coals at Newcastle; and the system of bonding is quite sufficiently developed to prevent export under false and misleading marks. Ceylon planters appear to take a rather insular and short-sighted view of the matter. A change of policy would probably bring about so great a demand for tea that growers on the spot would be the first to feel the benefit of a change, and Colombo would get all the advantages of a new and extensive line of business." A ten-rupee note would probably cover the revenue at present derived from this duty.

Here is what the two important Colombo daily papers have to say on the subject. Writing on the 22nd instant, the *Ceylon Observer* (which has always been noted for its broad-minded views) says: "The last word has apparently been said by our Planting and Mercantile bodies in reply to the repeated requests that the import duty on Indian tea should be removed. At the informal Conference held yesterday at the Colonial Secretary's Office, called together, we understand, with the object of affording officialdom an opportunity of thoroughly securing the views of these bodies on the subject, all the planting representatives and two of the mer-

cantile delegates opposed any change in the present position. The Chairman of the Chamber of Commerce, Mr. Alex. Fairlie, who has throughout recent agitation consistently fought for the removal of the duty, urged his views, we understand, but failed to convince his planting and mercantile colleagues. The Imperial Government having admitted that it is a matter on which local opinion ought to prevail, will probably be informed of the result of yesterday's meeting. We regret the decision. We have ever been consistent advocates of the removal of the duty—we have seen men individually and collectively (and even a newspaper in Ceylon) waver and turn on the subject—and our opinions are well-known. Ceylon planters and local agents are determined not to be convinced, and our Indian brethren, we fear, must for the present grin and bear it." *The Times of Ceylon*, on the other hand, says: "We have pointed out with painful frequency the unanswerable reasons which have dictated our action in the past, and it is surprising that in Madras, at all events, which is so closely in touch with our industrial politics, there should be still so much misapprehension of our motives. There is no desire on our part to keep out Indian teas from our market, and we would gladly welcome the means to be allowed to extend to India a privilege which we do not intend to give China, Java and Japan. The veiled threats of interference with our coolie labour are puerile. It would be much more to the point if Madras were to help us to a way out of the difficulty."

The "way out of the difficulty" is clear enough, but none are so blind who will not see. Indian tea, especially South Indian tea, seeks a favourable outlet *via* Colombo; while dealers and blenders in Colombo, having an extensive trade with foreign countries, desire to import Indian tea for blending purposes. The advantages to Ceylon of this system have been pointed out *ad nauseam*, but without effect. India levies a small 5 per cent. *ad valorem* duty on Ceylon tea imported into India; but this duty is so small that it pays Indian tea traders to import increasing quantities of Ceylon tea every year for the purpose of adding to their blends. As an instance of this we have the curious spectacle of Ceylon green tea being imported by certain large blending firms in Calcutta, for the reason that they cannot buy Indian green tea, as all such tea can only claim the bonus on the quantity of green tea exported. Here we have Ceylon green tea competing unfairly with the Indian product; as, having been exported, the Ceylon product has earned its bonus, and the 5 per cent. *ad valorem* duty levied by India is not sufficient to keep out Ceylon's product. As a last resort, the Indian Tea Association have decided to ask the Government of India to refer the matter to the Secretary of State for India, "with a view to the protective character of the Ceylon import duty being taken up with the Secretary of State for the Colonies;" and we shall await with interest the attitude Lord Elgin will take up in this matter.—*Indian Planting and Gardening*. June 30th, 1906.

[The question is one of great difficulty, but it seems to us that it would be wise to remove the duty. Ceylon tea is nowhere sold nowadays unmixed with Indian. Ed. "T.A."]

THE GROUND-NUT OR PEA-NUT. II.

(*Arachis Hypogæa*, Linn.)

USES.

Chief and foremost amongst the uses to which this plant is put must be placed its yield of oil. The trade between the tropics and Europe, by which India and Africa pour the seeds they produce into modern oil mills in France, Germany, England, etc., is of recent growth. Older than it is the primitive method by which the negroes, both of Africa and America, extract a portion of the oil for their service.

The oil, which closely resembles olive oil, replaces it largely in Europe, and is used as salad oil, also in soap-making, burning, dyeing, tanning, and cloth-cleaning. It enters into such salves as cold-cream, pomades, &c. As an oil for lubricating it has some use, and it forms a very important ingredient in the manufacture of oleomargarine. It also forms an adulterant of olive and almond oils, and is in its turn adulterated with poppy, sesamum, and cotton-seed oils. In India the sweet oil of the bazaars is a mixture of this with safflower and sesamum oils, the seeds being pressed together (Dymock, *Materia Medica, India*, ed 2, p. 246). Arachis oil finds a further use as an adulterant of "ghi," or clarified butter, and is recognised as officinal in the Indian Pharmacopoeia replacing olive oil.

Almost wherever grown, a portion of the produce is converted into oil for local use. In Java it has long served as an oil for illuminating, and for a less period in India. It burns with a clear and smokeless flame, and lasts longer than olive oil in the proportion of 9½ hours to 8 hours per oz., but gives less light. Japan and China produce a small quantity of oil, which, however, hardly finds its way into the European market, as in a small measure does that from India. In China a medicinal value is attributed to it (Debeaux, *Sur la pharmacie des Chinois, Paris*, 1865).

The use of the seed as a food is very extensive. It may be eaten when unripe, and has then, when cooked, the flavour of kidney beans. When ripe, it is too oily to be more than an adjunct to the diet, and Monterio (*Angola and the river Congo*), narrates how a balanced food is obtained by the negroes by adding to it such starchy fruits as bananas. Roasted in the shell it is sold in immense quantities in the streets of the cities and towns of Eastern North America. The seeds in Europe have served as adulterants for coffee, cocoa, and spices. For adulterating coffee they are pressed in moulds and passed as coffee beans (Vogl. *Die wichtigsten vegetabilischen Nahrungs u. Genussmittel, Berlin*, 1899, p. 321). The liquor from them is a clear reddish-brown with little taste. "Austrian coffee" is the name by which this counterfeit product goes. As cocoa they are pounded and mixed with the true material, and the Algerian name, "Cacaouette" has reference to this use. Sweetmeats are made from them to a small extent. The seeds ground finely after being roasted make a butter-like mass, sold as "Pea-nut butter" in the United States (*Agricultural Journal, Natal*, ii., 1899, p. 437). Monterio, again, states that such a preparation highly seasoned is used to stave off hunger by the people of Angola when on the march. Pounded nuts in the tropics enter into stews and curries. The roots are said to have been used for adulterating liquorice.

The cake left after oil-expression as performed in European mills is a valuable animal food, and some use of it for human beings has been made recently. The meal which the more primitive mills of China, Java, and India leave serves as a manure in these countries.

The hay is rich in feeding stuffs, as analyses shew (see Uhlitzsch in *Die landwirtschaftlichen Versuchs-Stationen*, xli., p. 388, and *U. S. Dept. Agric. Farmer's Bull.*, No. 25, p. 5). It is made use of in Asia to a small extent, and on a larger scale

in the Eastern United States. Here, too, after the harvest is gathered hogs are turned on to the land, and grub up pods which have not been collected. As a green manure for the tropics Arachis has been suggested, for it adds when ploughed in, not only the materials drawn directly from the soil, but also the other food stuffs taken from the air, including the nitrogen which the root tubercles acquire.

Chemistry of the Seed.

Analyses of the seed shew, as already stated, a richness in oil which varies considerably. This oil is a non-drying oil, becoming turbid at+3° C., and congealing at—3° C. It consists of the glycerides of four fatty acids, viz:—olein, arachin, hypogaein, palmitin. The similarity of ground-nut oil to olive oil is apparent when we remember that the main constituents of both are olein and palmitin. Starch is present to a small amount. Albuminoid matter is more abundant, and cane sugar has been detected (Schulze & Frankfurt in *Zeitschr. fur physiolog. Chemie*, 1895, p. 511.) Oils, starch, and albuminoids when found in seeds are reserves for the use of the young plant and are absorbed in germination. Immediately growth starts absorption of these products commences, and the chemistry of the seed is considerably altered. In the place of the fats appear the corresponding fatty acids and glycerine. Obviously oil extracted at this juncture will not have that freedom from taste in which should lie its real value.

We cannot record observations made directly on *Arachis hypogoea* but analogy indicates that oleic, arachic, hypogaeic, and palmatic acids appear in the seed when germination has commenced. The same acidifying process is produced by fungi, and as these rapidly attack the seed rancidity is developed when they are present. It is well known that seeds of many plants cannot be induced to germinate until they have passed a certain period of quiescence. This is not so with *Arachis hypogoea*. At any time a small amount of moisture is sufficient to start the process; so readily is it induced that occasionally in India germination starts before the crop is dug. Germination started and then checked results in the death of the seed. Such a dead and partly germinated seed contains rancid oil.

A similar amount of moisture will favour the growth of moulds—*Eurotium*, *Penicillium*, &c.,—and these finding entrance into the tissues of the seeds by bruised places add to the acidity. Unfortunately Indian nuts shelled by being beaten and thus bruised, shipped or even stored damp, become rancid; and experts maintain that they can distinguish oil-cake made from this source by the abundance of fungal threads in it.

Ground-nut seeds do not require much moisture to stimulate growth, though in the complete process of germination they absorb almost their own weight (Bogdanow, see *Just's Bot. Jahresbericht* 1887, i., p. 207); light does not conspicuously deter it (Pauchon in *Ann. Sci. Nat.*, ser. 6. x., p. 98.) The great precautions necessary to prevent growth in seeds reserved for sowing will be mentioned under the head of cultivation. There is reason why the same precautions should not be neglected in the case of seed destined for the oil-mill.

Origin And Dispersal.

That *Arachis hypogoea* is of South American origin admits of no doubt. Writers of fifty years ago, not as abundantly provided with evidence as we are, incorrectly placed its home in the Old World. Those who wish to read the arguments for its origin in America will find a masterly summary in De Candolle's *Origine des plantes cultivées*, to which very little can be added. When the Spaniards were colonising the New World they found that the Indians knew and grew the plant, and one, Oviedo, who was a director of mines in Cuba from 1513 to 1524, says that it was very abundant in their gardens. How long they had grown it we cannot guess, but we find evidence that it was more or less a staple food with them from the

occurrence in Peruvian tombs of seeds left with the dead as food for the departed soul on its journey. In the tombs at Ancon, interments of not later date than Pizzaro's conquest of Peru, no seed except that of the maize is more abundant (Rochebrune in *Actes Soc. Linn. Bordeaux*, sér. 4, III., p. 350).

The French colonists sent by Admiral Coligny to the Brazilian coast became acquainted with it in 1555, and Jean de Léry described it unmistakably. Ficalho (*Plantas Uteis da Africa Portugueza, Lisbon*, 1884, p. 136) shows that the first distinct mention of its cultivation in Africa is by André Alvares de Almada who published in 1594 an account of travels on the Senegambia coast undertaken thirty years earlier. It was seen by him in considerable quantity in the Archipelago of Bujagoz (Bissagos). Portuguese voyagers of the sixteenth century were ever ready to leave economic products on new shores. The work of colonising St. Helena was begun by them at its very discovery (Melliss, *St Helena*, p. 2) and probably in the same way Arachis was left on the shores nearer home which we know they frequented for two centuries from this date in pursuit of slaves. Hawkins, our English navigator. led slave-hunting expeditions to this part of Africa, and in 1564 visited the Bissagos Archipelago for the purpose; the narrative of his second voyage frequently mentions the Portuguese. These facts are given because Ficalho argues the possibility that the ground-nut is alike native in America and Africa, and in order to show that between the date of the discovery of America and of Alvares' travels, there is time for the establishment of Arachis in frequented parts. Then, as later with the Arabs, it was the practice of the slavers to ally themselves with a native king in order to raid another's territory.

Clusius (*Rariorum Plantarum Historia*, II., p. 79, 1601) informs us that the slavers took as food for their captives on the voyage from the Guinea Coast to Lisbon, roots of the sweet potato, which is an American plant, "besides certain nuts" and these nuts Sir Hans Sloane (*The Natural History of Jamica* I., p. 184, London, 1707) identifies as fruits of Arachis. Though Clusius does not give information which puts Sloane's identification beyond doubt, the fact that in the latter's day these seeds were used "to feed the Negroes in their voyage from Guinea to Jamaica" is itself strong evidence. And though in 1707 the earth-nuts thus used were brought from Africa with the slaves, a century earlier they were evidently brought from the West Indies (St. Thomas etc.) with the roots of the sweet potato. The spread of Arachis in Africa must have been rapid. It is now grown from the Mediterranean almost to the extreme south. Ficalho adduces this wide extension in the continent as an argument against an introduction subsequent to the discovery of America. But other undoubtedly American species have now a similar range, having reached the very heart of the continent from the east and west coasts (P. Ascherson in *Sitzungsbericht d. Gesellschaft Naturforschende Freunde zu Berlin*, 1887, pp. 141-157), nor are parts unknown to which its extension has only just reached (Stuhlmann, *Mit Emin Pascha, Berlin*, 1894, p. 498)

Nearly as early, some region in Malaya or South China seems to have received the plant, which spread rapidly and deceived Loureiro into calling it, in 1790, a native of Cochin China; Rumpf saw it in Amboyna and figures it (1691) as *Chamæbalanus japonicus*. The people of South China seem to have early taken to its cultivation, and thence it spread to Japan and Bengal, getting for itself in both countries, as well as in Java (Hasskarl, *Hortus Bogor.*, p. 233), a name meaning "Chinese bean." It is interesting to note in passing that, according to Bretschneider (*Study of Chinese botanical works*, p. 18) one of its name in China is "Foreign bean." Africa seems to have sent it to the Bombay coast of India a century ago, and about Bombay it has the nam of "Mozambique gram" (*Dymock, Materia Medica India* ed. 2, p. 247), Madagascar Mauritius, Reunion, &c., have probably received it from the same source.

To North America it spread more than a century ago, and it was cultivated by the slaves in Carolina in the eighteenth century. There is evidence that it was grown in Virginia in 1781 (Sturtevant in *American Naturalist*, XXIV p. 150).

At the end of last century its cultivation as a crop in Europe was first attempted; and at a later date Australia and some of the Polynesian islands received it. To how wide a range of latitude it is suited is shown by this extensive dispersal Probably the furthest north to which it can be grown is in Central Europe, e. g. Austria; in the United States it is grown to 38°N., while the furthest south at which it is found is 30°-35° s. latitude.

ORIGIN AND GROWTH OF THE TRADE OF EUROPE.

Mention has been made of the use which the slavers made of groundnuts as food for their captives. They drew their supply at first it seems, from the West Indies; later it came from the Guinea Coast. This traffic and attempts to grow the nut in other more northern places helped to familiarise industrial Europe with it. Even as early as 1697 Stisser grew it in Brunswick (Flückiger and Hanbury, *Pharmacographia*, ed. 2, London, 1879 p, 187); in 1712 it had been cultivated under glass in England (see *Tropical Agriculturist*, III., 507), and in 1723 it was at the Royal Garden at Montpellier, where however, it soon died out (Honzé, *Les plantes industrielles*, II., Paris, 1893, p. 130.) Tenore says that in 1774 it was again in England; and in 1769 Sir William Waston showed pods and the oil to the Royal Society, while he read a memoir on it, communicated to him by George Brownrigg of North Carolina (*Phil. Traps.*, lix.. pp. 379-383).

In 1787 a great quantity of seed was brought to Spain and Portugal where its cultivation promised well, and it is of great interest to learn from Tenore, who himself experimented with it in Italy, (Napoli, Atti Ist. Incorr., I, 1811, p. 31), that in 1807 the uses of its seeds were to yield an oil for soap-making and as a substitute for almond oil in pharmacy, while powdered, they served as a substitute for cacao (1/3 Arachis seed mixed with 2/3 Cacao) or were added to flour in making bread. France was anxions to obtain it, and from Heuze's account—more correct than that of any other recent writer—the following is borrowed:—

"In 1801, Lucien Bonaparte, Ambassador at the Court of Madrid, sent seeds to M. Méchin, prefect of the department of Les Landes (the province to the south of Bordeaux) suggesting that he should try to grow it on the sandy soil of those parts When the first trials had succeeded, M. Méchin printed a detailed account of how to cultivate it and circulated it among those who were willing to repeat his experiments. As a result Arachis was widely grown on a large scale in the departments of Basses—Pyrénées, Pyrénées-orientales, Gard, Bouches de Rhone, Vaucluse, Isère, Aude, and Drôme. Everywhere people were convinced that it was a reliable oil seed, and would assuredly grow in Southern France. The political troubles of 1808 to 1815 stopped the experiments, and the cultivation of Archis was abandoned. Again in 1820 to 1822, at the time when the olive yards were in a large measure destroyed by frost, fresh experiments took place, ill-conceived, ill-directed, and without result. The farmers who had undertaken them, in abandoning the enterprise, reported that shelling the seeds was necessary before obtaining the oil, and that this was a difficult operation, and, secondly, that there was no market for the oil."

Again the winter of 1830 wrought serious havoc in olive-yards (Coutance *L'Olivier*, Paris, 1877, p. 210), and for some time olive oil remined at a high price. This led the wool-carders to seek some lubricant as a substitute. Ground-nut oil, in 1837, was found to serve. A Marseilles firm had put on to the market as an experiment some four or five kilogrammes (Dumas ex Poiteau in *Ann. Sci. Nat.* sér. XIX., p. 270) derived from the crushing of seed sent from Gambia. From this the trade takes its origin. French settlements benefitted first and Gambia, where

they possessed one, as well as Senegal sent increasing quantities to Marseilles year by year. Other parts of Africa commenced to export nuts notably Algeria, Sierra Leone, and Angola. Pondicherry, too, began to send shipments, and the trade thence received a great stimulus by the opening of the Suez Canal in 1869.

Some idea of the growth of the trade may be obtained from the statement that ten or twelve years after the first importation the output of Marseilles had reached seventy million killogrammes of oil (1,377,482 cwt.) Barcelona, near which as already mentioned, experiments in growing Arachis had commenced in 1787, entered into competition with Marseilles. Spain proved not unsuited to the crop, and thence comes the record that 700 pods have been obtained from a single root; but the putput of oil from Spain is not great.

Another attempt at production in France took place in 1839 and 1840, when a M. Chaise, who had been in Senegal, grew near Dax some five hectares (12⅓ acres) with results beyond his expectation. Still, as Naudin reports (Naudin and Mueller, Manuel de l'Acclimateur, 1887, p. 139), the cost of production was too great, and despite M Chaise's big crop no further attempts to produce the plant in France have occured. From Losconcz in Hungary a more recent successful attempt is reported (Just, *Jahresbericht* 1878, ii., p. 478) but it is not clear that profit can be derived.

The trade in ground-nuts thus remains one by which the tropics feed the mills of Europe. Genoa, Bordeaux, Nantes, Dunkirk, London, Rotterdam, Hamburg, and the Baltic ports have entered into competition with Marseilles, and the Mozambique coast of Africa has commenced to export in large quantity. In this process of decentralization, though France still remains *facile princeps*, Marseilles no longer holds the share in the commerce which fell to that port thirty years ago. Almost 100 million kilogrammes of Arachis were imported into France in 1898 chiefly in the pods, but partly decorticated, to a value of over £836,000, and representing 76,900,984 kilogrammes of kernels. In the same year Marseilles imported Arachis to the amount, represented as kernels, of 27,098,100 kilogrammes. The proportion of the trade which fell to Marseilles was then a trifle more than one-third of the total of France.

The figures upon which the above statement is based were kindly supplied to Kew by the Statistical Department of the Board of Trade. From figures from the same source the following table of recent imports to France has been calculated: -

Average.	In the shell.	Decorticated.	Total as kernels.
1892-4 ...	75,123,313 ..	105,816,151 ...	163,661,102
1895-7 ...	57,516,807 ...	46,791,922 ...	88,513,197
1898 ...	93,684,247 ...	4,764,114 ...	76,900,984

The imports of Germany, which between 1880 and 1887 (Unlitzsch, l. c., p. 397) averaged 8,395,000 kilogrammes have increased so that during the last three years they have been:—

Year.	Kilogrammes.
1896	12,390,600
1897	15,187,800
1898	12,776,100

Italy, too has increased her imports of oil-seeds, but no special statistics for ground-nuts are available.

SUPPLY OF EUROPE.

Gambia, which sent 13,200 cwt. to Marseilles in 1837, was followed by Senegal in 1840 with a small shipment. The increase in the exports then became rapid. In 1860 Gambia exported to the value of £79,612, and Sierra-Leone to £34,515; in 1870

these two Colonies exported the one to the value of £121,329, the other to £92,605; and the trade became the most important one of this part of Africa, and continues to be so. Angola entered into competition with Gambia but heavy taxation checked and partly destroyed the Angolan trade Monterio, op. cit., i., p. 13 and Ficalho, op. cit., p. 139).

The Indian trade, owing to the length of the journey round the Cape took no great dimensions until after the opening of the Suez Canal in 1869. Then came a rapid development, Pondicherry being the chief centre. Indigo had been a leading concern of this French settlement, but the natives who dealt in it suddenly discovered that Arachis offered a better market, and for a time the trade taxed the capabilities of the port to the uttermost. In 1883 the demand for storage space was so great that every available dwelling-house was rented by the merchants. In 1886 three special "nut" trains had to be run daily for some time from Panruti in the chief producing district to Pondicherry, while Pondicherry, Panruti and the surrounding villages remained full of them (*Tropical Agriculturist*, i p. 12; vi., p. 31). In 1891 space was totally inadequate to meet the incaeased traffic, despite the use of "twelve new export sheds and ten large naval coal go-downs" (*Tropical Agriculturist*, x., p. 867.)

About three-quarters of the nuts exported from Pondicherry were grown in the British territory adjacent to the French settlement. Nuts likewise found an outlet through Madras, and those produced in the Bombay Presidency through Bombay.

Statistics are available of the exports from British India, but not from Pondicherry; under these circumstances it is hardly useful to give them. As a substitute a table is offered of the acreage under the crop for the years from 1882 to 1898 in the Madras Presidency; it shows the increase to the climax in 1890 and the subsequent fall. The figures are taken from Subba Rao's paper quoted before, and from the *Revenue Report* on the crop in Madras (G.O., Nos. 773,773A, p. 7).

Acreage Under Ground-Nuts in the Madras Presidency.

Year.	Acres.	Year.	Acres.
1882-83	73,568	1890-91	258,313
1883-84	98,536	1891-92	201,344
1884-85	145,976	1892-93	226,905
1885-86	161,607	1893-94	247,796
1886-87	153,013	1894-95	226,147
1887-88	141,507	1895-96	243,350
1888-89	211,890	1896-97	157,234
1889-90	279,355	1897-98	83,715

The fall in interest subsequent to 1890 is not peculiar to Madras, it is observed, too, in the Bombay Presidency. and the French Chamber of Comerce at Pondicherry has recognised the necessity of investigating the cause, while the decreased imports to Marseilles have caused concern there.

As most of the nuts sent to Europe from India are decorticated first and those from Africa are sent undecorticated, we can recognise the effect in the following table of Marseilles imports. In the third column the total imports are calculated as kernels, *i.e.*, 23 per cent. of the weight of undecorticated nuts is deducted for the shell. The basis of the table is one in the *Comptes Rendus de la Chambre de Commerce de Marseille*, 1897 and 1898, and the proportion of kernel to husk is based on figures given by Uhlitzsch (*l.c.*, p. 388). Simmonds (*Tropical Agriculture* London 1887, p. 402, only allows to the husk 1 per cent of the total weight, an impossibly smal

amount; Heuzé gives it as 26-28 per cent., and in some pods weighed at Kew, in a very dry condition, it was found to be about 25 per cent. To place 27 per cent to the kernel is therefore a liberal allowance.

Average Annual Import of Ground-nuts in quintals into Marseilles in periods of three years. (1 quintal=110¼ lbs. or approximately 1 cwt.)

Years.	Undecorticated.	Decorticated.	Total as Kernels.	Decorticated Average price per 100 kilos.
				Francs.
1877-79	584,782	69,532	519,814	43
1880-82	627,579	316,930	800,166	35
1883-85	398,700	499,612	806,611	33
1886-88	124,535	739,468	835,301	28
1889-91	208,740	1,084,023	1,244,753	28
1892-94	336,147	1,010,517	1,269,350	26
1895-97	265,407	464,473	668,836	26
1898 —	632,860	54,660	541,962	—

It is true that the export of oil from Madras etc., has slightly increased, as the next table below shows, but this is in no measure proportional to the great decrease in exports of nuts.

EXPORT OF OIL IN GALLONS FROM MADRAS PRESIDENCY.

	Foreign.	Coastwise.	Total.
Average of 5 years ending 1887-88 ...	6,456	266,925	273,381
,, 3 ,, ,, 1890-91 ...	7,126	46,919	54,045
,, 3 ,, ,, 1893-94 ...	7,907	14,997	22,904
,, 3 ,, ,, 1896-97 ...	1,459	609,790	611,249
,, year ,, 1897-98 ...	3,049	508,254	511,303

It seems that to meet the demand in Marseilles in 1898 large shipments were made of undecorticated nuts from Africa, judged by the extensive cultivation on that continent it is possible that the demand may be fully met. The possibilities of the West Coast of Africa are not yet fully developed. W. W. A. Fitzgerald remarks (*Travels in Coastlands British East Africa*, p. 213) that "the soil of the coast lands is just what is required for its cultivation."

Exact information on the subject of the trade of this side of Africa has hitherto been wanting, and in view of the evidently considerable possibilities the following abstracts from a report by H. M's Consul at Mozambique will be of interest. "The ground nut is collected by natives, by whom it is largely used as an article of food; it is also sold by them in great quantities to the Indian merchants or to the holders of Prazos (*i.e.*, tenants), by whom it is either passed on to European firms on the coast or exported independently. From such statistics as I have been enabled to obtain from the Portuguese Custom Houses on this coast it would appear that the bulk of the ground-nuts which find their way to Europe from Portuguese East Africa are shipped from the northern ports of the province, that is to say, from Ibo, Mozambique, Quilimane, and Chinde. It is evident from the figures I have received from the three first-named places that Quilimane is by far the most important of them in relation to this commodity; but although, unfortunately, I have been unable to procure any precise information from the Custom House at Chinde, I am able to state from my personal knowledge of the place that the output from Chinde approaches that from Quilimane, its neighbouring port. This will be the more

readily understood, perhaps, when it is explained that Chinde receives the entire trade of the extensive Zambezi valley, and, similarly, all the articles of import received, not only from Zambezi, but from the vast countries to the north and west, are shipped from Chinde. It will, therefore, be seen that the amount of ground-nuts exported from the two places is very large. Moreover, there has been established at Quilimane during the past year an extensive soap and oil manufactory, which possess certain profitable monopolies for the manufacture of those two articles in the province and elsewhere. As these goods are manufactured entirely from ground-nuts and other locally produced oil seeds. it follows that a considerable quantity is used in this way. If we were in a position to add to the quantity of of ground-nuts actually exported from Quilimane and Chinde the number of tons used locally in the soap and oil manufactory, the amount of this produce collected in the district, with that shipped from the Zambezi, would doubtless reach an astounding total. On the table which follows it will be noted that the increase in the exports of ground-nuts, in 1898 is considerable, and this is more remarkable when it is understood that the natives in the northern portion of the province have often great difficulty in reaching the coast with their produce by reason of the terror inspired by the marauding tribes by which the country is infested. I am informed that a large quantity both of rubber and ground-nuts is annually lost to commerce, the natives being surprised in the act of conveying it to the coast and put to flight, while the result of their labours for, it may be, many months is left rotting on the ground.

"As I have previously endeavoured to explain, the ground-nuts are collected entirely without supervision, and in quite a haphazard way, and sold to the exporter on the coast. From what I have been enabled to glean very few find their way to the United Kingdom, the bulk going to Hamburg and Rotterdam, whilst a certain quantity are despatched to Marseilles."

Return of Ground-nuts exported from below-mentioned Ports in 1897 and 1898.

Ports.	1897.				1898.			
	Tons.	Value.			Tons.	Value.		
		£.	s.	d.		£.	s.	d.
Ibo...	55	742	10	0	85	1,147	10	0
Mozambique ...	2,065	27,877	10	0	5,190	70,065	0	0
Quilimane	2,470	33,345	0	0	6,397	86,359	10	0
Chinde (approximate)...	2,000	27,000	0	0	4,500	60,750	0	0
Total	6,590	88,965	0	0	16,172	218,322	0	0
Total Export during 1897 ...					6,590	88,965	0	0
Increase during 1898 ...					9,582	129,357	0	0

Like the Indian trade, that of the Argentine Repulic, never very large has fallen since 1891; a table of the importations of Europe thence may be seen in Semler's *Tropische Agricultur* (ed. 2, II., p. 461).

Lastly, a word about China. China, as stated above, an early home of Arachis in Asia, still grows large quantities, especially in the Yangtze-Kiang valley. Chief of all as a port of shipment, not only of nuts, but of oil, is Chinkiang at the mouth of this river, and a large proportion of the exports find its way to Hongkong

thence to be shipped to other countries. Shanghai, too, in the same region sends a considerable quantity of oil to Hongkong, as also Cheffo in the north, and Pakhoi in the south. In the extreme north Tiensin has a large trade in nuts, but for the most part internal. Besides Hongkong, Swatow, Lungchow and Cheffo export nuts and oil from China to foreign countries, but in small measure, and the effect on the European market remains very small.

DEMAND AND PRODUCTION IN THE UNITED STATES.

After the Civil War there sprang up in the cities and towns of the Northern United States a liking for roast ground-nuts, which are sold in the streets at every corner. The soldiers of the Northern army brought back the taste for them as a result of their occupation of the South (Annual Report, U. S. Depart. Agriculture, 1868, p. 220). Both armies had occupied Virginia in turn, where the farmers all grew small patches for their own use.

Reference to the monthly reports issued by the United States Department of Agriculture enables us to follow the growth of the demand. In those for 1869 we learn that in Virginia tobacco land which did not pay was being put to the new use of growing pea-nuts. In those for 1870 an account of the North Carolina crop is given showing its extension. In 1871 (see Reports of that year, p. 494) the crop of Viriginia had reached 225,450 bushels, in 1874 (Reports for 1875, p. 512) it had reached 382,610 bushels, and in 1882 (Jones *The Pea-nut Plant,* New York, 1896, p. 66) it reached 1,250,000 bushels. Other States meanwhile were growing pea-nuts, and Tenessee, in which it was extending in 1872 (see Reports, p. 488) produced in 1862 460,000 bushels, while North Carolina raised in the same year 140,000 bushels. The heavy demand and insufficient production within the United States fostered a trade between Africa and New York. &c., which the increase of internal cultivation, as shown above, and a tax on all nuts imported from Africa ultimately more or less arrested. Statistics derived from the Year Book of the U. S. Department of Agriculture, 1897, p. 340. demonstrate the decrease.

Average Annual Import of Pea-nuts and other Ground-nuts into the United States, by decades.

Years.	Quantity.	Value.
	lb.	$
1865-1870	6,522,844	184,564·49
1871-1880	1,849,645	46,662·16
1881-1890	170,593	3,314·24
1891-1897	149,672	2,655·13

Shelled pea-nuts being excluded from the preceding table, that which follows from the same source supplements it.

Average Annual Import of Shelled Pea-nuts and other Ground-nuts into the United States, by decades.

Years.	Quantity.	Value.
	lb.	$
1865-1870	391,006	13,713·89
1871-1880	375,342	14,974·95
1881-1890	54,960	2,223·97
1891-1897	21,658	2,623·09

The imports of decorticated nuts in 1897 were only 1,000 lbs. of ground-nuts in the shell, 138,102 lbs.

The exclusion of foreign nuts is well shown by the above figures, which may be taken in conjunction with the statements that in years of low prices the cost of transport precluded the importation of African nuts (*Journ. Applied Science*, 1881, p. 81), and that in 1894, owing to the tax, nuts sent from Africa met with no market (U. S. *Consular Reports*, Oct., 1894, p. 240).

EXPRESSION OF THE OIL IN EUROPE.

The oil is expressed from the seeds in the following manner, as described by Dr. P. Uhlitzch (*Die landwirtschaftlichen Versuchs-stationen*, Xli., 1892, p. 400):—"When by means of brushing the pods the unshelled nuts have been cleaned, they are broken between rollers and passed on to a fan which winnows out the light pieces of husk. When the seeds are sufficiently broken they are packed into a cylinder in thin layers, each layer separated by a cloth of horsehair. The first pressing is but slight the resulting cakes are very flat, loose, and easily broken. The cakes are then broken and ground up finely in a mortar, sprinkled with water and mixed with any meal which passed through the holes in the cylinder at the first pressing. Then follows the second pressing. Mills which make only table oil express twice in the cold, or on the second occasion in very slight heat; but usually the nuts are pressed three times.

"The first expression in the cold gives an almost colourless oil with agreeable taste and smell, which serves as pure table oil, and is used for making oleo-margarine; the second yields a "sweet oil," and the product is also used for burning; the third expression, made with heat, gives an oil—rabat oil—of a yellow colour and hardly agreeable taste and smell, which is used in soap-boiling. "By these different pressings 30-40 per cent. of the oil is removed in something like the following proportions:—

,, 1st expression, 16-18 per cent. of a fine table oil.
,, 2nd ,, 7-8 ,, of a table oil or illuminating oil.
,, 3rd ,, 7-8 ,, of an indifferent oil.

"The oil cake left contains about 7·5 per cent." Such is the result of expression carried on at the mills of Hamburg, Berlin, Marseilles, Rouen, &c. According to Houzé, the nuts in Spain, when pressed as soon as gathered, often give 60 per cent.; in Italy 50 per cent. is obtained, in India, 43 per cent., in Senegal, 30-33 per cent., and at Pondicherry, 37 per cent.

The bags used in the process are made of horse hair or wool. The cake varies in shape according to the machinery used. Those made in Riga are twice as long as those made in West and South Germany. When it is intended to devote the whole of the oil to soap boiling chemical means are used in its extraction—carbon bisulphide, petroleum-ether, benzene or canadol. The use of such substances as carbon bisulphide obviously leaves the cake unfit for food.

THE INDIAN OIL MILL.

The Indian oil mill was described by Subba Rao in the Bulletin of the Department of Land Records and Agriculture, Madras, (p. 283 no. 28, 1893) in the following way:—

"The oil is expressed locally in native mills of the ordinary rotary pestle-and-mortar pattern. The chief centres of this trade are Valavanur (700 mills), Panruti (200 mills), and Pondicherry (200 mills). A single charge for a mill is from 15 to 18 Madras measures of seed (about 15-18 lbs.), which must be first thoroughly dried. During the pressing water is added to the seed in small quantities. After working for about half-an-hour, oil begins to collect and the kernels to cake. The cake is then loosened with a crow bar, and about ¼ lb. of old ground-nut cake dust is mixed with the mass, and work is then resumed. In 45 minutes from the commencement of

the work about three measures of oil are ladled out of the mill. The cake is then again loosened from the sides of the mill and the crushing continued. About five minutes afterwards a strip of cloth is dipped in the mill and the oil absorbed is squeezed into the pot. In this manner about a measure of oil is taken out. Thereafter the oil is taken up on a brush or a bunch of fowl's feathers and squeezed out into the pot. The cake is then again loosened and broken up. About an hour after commencing the work, the oil collected in the lower cavity is removed by a strip of cloth fastened to an iron rod about 2 feet long, which is dipped into it. In this manner another measure of oil is removed. Then another handful of ground-nut cake dust is added to prevent the adhesion of the cake to the pestle. After about one hour and a quarter a torch at the end of an iron rod is lit and moved slowly all round close to the cake while the mill is working. For about 10 to 15 minutes the cake is thus heated, the object being to increase the out-turn of oil. In an hour and a half the work is over and the cake is dug out and put by. The last of the oil (about 3/4 measure) in taken out. In North Arcot and Chingleput districts the use of the torch in connection with the work of the oil mill is unknown. The out-turn of the oil is about 25 per cent. by measure, or 33 to 37 per cent. by weight of the kernels crushed. The oilmongers are paid for crushing the seed Rs. 7 or Rs. 8 per candy of oil delivered to the merchants."

OIL-EXPRESSION ELSEWHERE.

In China, Java, and Japan, a certain amount of oil-expression is done. No one, it seems, has described the Chinese mill used for the purpose, but presumably it is the same as that used for expressing other oils. In Java the seeds are dried in the sun before being passed into the press. The method of obtaining the oil in Angola is thus described (Monterio, *Angola and the River Congo*, I., p. 132):—"The nuts are first pounded into a mass in a wooden mortar; a handful of this is then taken between the palms of the hands, and an attendant pours a small quantity of hot water on it, and on squeezing the hands tightly together the oil and water run out. Since the great demand for, and trade in the ground-nut, but little oil is prepared by the natives, as they find it more advantageous to sell the nuts than to extract the oil from by the wasteful process I have just described."

OIL-CAKE.

After the expression of the oil a rich cake remains. This has been extensively used as an animal food, and when more or less free from fragments of shells and adulterants such as the starchless crushed seeds of the poppy—the commonest admixture—is of high nutritive value. Naturally the composition of the cake varies considerably according to the degree of completeness in which the oil has been removed, Subjoined are five analyses given, drawn from various sources; in the sixth colum is tbe mean of seven closely similar analyses given by Dr. Uhlitzeh (l. e., p. 413).

	Nordlinger, ex Masori in U.S. *Consular Reports* April 1894, p.686. Pea-nut grits made from (? German) cake.	Muters in Food Journal, iii., (1873), p.104.	Voelcker in *Improvement Ind. Agric*, p.417, made from Indian cake decorticated.	Tuson in *Pharm. Journ. and Trans.*, Ser. 3 vii., 332, made from Marseilles cake, 1876.	Watt in *Agricultural Ledger* 1893, No. 15, p.31 made from Calcutta cake.	Uhlitzch in *Die Landwirtsch Versuchs-Stat.* xli, p 413, essence of seven analyses made in 1892 from cakes chiefly G'man.
Water	6·54	9·6	8·10	9 58	10 10	8·6
Oil	19·37	11·8	7·26	7·40	9·16	7·4
Nitrogenous Matter	47·26	31·9	47·81	42·81	48·55	48·1
Stareh and digestible fibre ...	19·06	37·8	25·02	27·63	22·53	23·5
Indigestible fibre	3·90	4·3	4·86	7·87	4·73	5·1
Ash	3·87	4·6	6·95	4·71	4·93	5·9

All these agree in allowing an extreme richness to the cake, and this is borne out by experiments in stock feeding which need not be detailed.

Subba Rao (l. c., p. 283) tells us of the use of cake for human food when famine presses in India; Handy speaks of its use in the Southern States between 1861 and 1865 (l. c., p. 21). Of further interest are the attempts to use it in the same way in Europe. The first advocate was Dr. Muters whose analysis is quoted above; a second is Dr. Nördlinger. Both avail themselves of the removal of much of the oil to obtain a highly nitrogenous and nutritous food, not over-rich in one of the elements of a balanced diet.

Dr. Nördlinger's preparations are made by the Rademann Food Product Factory and take four forms :—

Pea-nut grits (Erdnussgrütze).
Pea-nut flour (Erdnussmehl).
Pea-nut biscuits.
Diabetic chocolate biscuits.

The first is a coarse meal, the second a flour, both giving on analysis the following :—

Water	4·8
Protein substances	48·5
Oil	22·0
Carbohydrates	17·9

The first kind of biscuits is composed of the pea-nut flour with the addition of a starchy flour, which raises considerably the percentage of the carbohydrate elements, while the second kind, in which starchy stuffs are a disadvantage, is composed of the pea-nut flour with no considerable admixture.

For some time the Soja bean has been employed as a dietetic for those suffering from diabetes, and Dr. Nördlinger points out that Arachis, besides being very much cheaper, has, after the extraction of the oil, a greater percentage of nitrogenous food and not much less fatty food.

Since 1893 these products have been in the market. They have further been the subject of experiments under Dr. Führbringer in a hospital in Berlin, where, it is reported, most of the patients, who were suffering from the usual variety of complaints to be met with in a public hospital, willingly ate pea-nut soup offered to them. Also the experiment of supplying them in the army rations has been tried.

It is worth noting in passing that Dr. Nördlinger's analysis—the first of the series given—shows a richer cake by far than is usual. It cannot be denied that on chemical investigation the feeding value compared with the cost is immense. The great question is in the palatability of the products offered.

Poison in Food Plants, Especially Cassava.

By T. B. Pohath-Kehelpannala.

The occasional development of poisonous properties in many plants used for food, frequently attended by fatal results, is a great hindrance to their more extensive cultivation. In the case of Manioca, especially, the prejudice is so strong that in the Kandyan districts very little is grown; whereas the Cassava, if a wider knowledge of its cultivation and cooking existed, might be produced in enormous quantities. It is hoped that the following notes on this and other food-stuffs may be of some service :—

Cassava.

This plant (*Manihot utilissima*) appears to have been first brought to Ceylon from South America by the Portuguese, and was later introduced to the Kandyan districts by the Caffirs of the Ceylon Rifle Regiment. There are some four varieties at present grown :

(*a*) A small kind producing yellow tubers, this is called "*butter Manioca*," on account of its sweet flavour; its stems are short and twisted.

(*b*) "*Rata*" *Manioca*: literally, the imported or foreign kind, the stem is of a light pinkish colour.

(*c*) *Ratu or Red Manioca*, the petioles are of a bright red.

(*d*) "*Wal*" *or* "*Sudu*" *Manioca* (wild or white) manioca, the bark and leaf-stalks are dull green.

Of these, the last, which grows to a much greater height than the others, is generally avoided as being poisonous; its yams are whiter and larger than the others. The Kandyans usually call this variety "Mat *Manioca*," on account of its intoxicating properties. This is the kind that chiefly serves as sticks for live fences.

The question of the cultivation of Cassava in Ceylon has been ably dealt with by the Hon. Mr. J. P. Lewis, C.C.S., in a paper published by the Ceylon Agricultural Society. The paper mainly treats of the subject from a Jaffna point of view. Amongst the Kandyans there is no systematic cultivation of the plant, and it is grown only on a small scale in their home gardens or chena lands.

Cassava as a Food-Stuff.

The Kandyans usually eat the yams boiled or converted into curry. The low-country Sinhalese, who grow the plant on a more extensive scale, besides cooking the yams in this way, cut them into slices and, after drying in the sun, pound them into flour, which is used for cakes, conjee, etc, ; owing to its starchy properties, it forms a palatable and nutritious diet. The leaves make a good dry curry and the rind is made into cakes and fried.

In some parts of South America, Cassava forms the staple food of the population, and large quantities are used for feeding cattle. In Africa and the West Indies it is largely used for making a sort of bread, and the yams are baked and eaten like potatoes. In some parts of South America an extract prepared from the core of one species of Cassava is said to form the basis of the table sauces so largely manufactured in England. Tapioca obtained by scraping the starchy tubers, was, it is said, an important article of food among the Caribs, when they were first discovered by Europeans: they call it "*Yuca*." In Brazil and other countries where the cultivation is very extensive, tapioca forms a very important article of export, and it has recently been reported that in the Malay States a large proportion of the crop is used in the manufacture of a spirit which is extensively used to adulterate Scotch whisky. It would be interesting to learn whether the Cassava yams in these countries develop poisonous properties as in Ceylon.

Poisonous Characteristics: Precautions.

The eating of Cassava is very frequently attended by symptoms of violent poisoning, often ending fatally. At Gampola, lately, a Moorish woman purchased some manioca tubers at the Local Board market and cooked them for the evening meal. Soon afterwards she fainted and began to vomit and purge in quick succession, and died the same night. The other members of the household also exhibited the same symptoms, but gradually rallied. Some of the villagers of Keerapone (a suburb of Gampola) who also partook of the ill-fated food, suffered in a similar manner, but recovered under native treatment. Quite recently a case occurred on a tea estate close by: the parents left on a pilgrimage to Alutnuwara (Kegalle District) leaving their elder boy and two little ones at home. Unfortunately the children ate manioca yams for dinner. On their return, the following day, the parents were struck with horror at finding all three children dead. Not long ago, at Lunugama, a village in Udunuwara, a boy died of eating a dry curry of manioca leaves. Fatalities of this nature may be mentioned by scores; hardly a year passes without some casualties of this description being reported, and a large number of cases are, of course, unrecorded.

There is a general belief that Cassava yams are rendered especially dangerous when the venomous snakes—the Tic Polonga or the Naya (Cobra)—resorts to the plants. It happens in this way. The Cassava is an underground stem, but the tubers in the course of development spring to the surface, and the earth cracks above them. The reptiles bite the surface tubers in their movements. The leaves of such snake-attacked plants are distinguished by their curls at the apex, as in the *Niyagala* (*Gloriosa superba*). When these yams are boiled, the water assumes a reddish hue; such yams should be rejected.

The Cassava tubers have two pericaps, the exterior one being a thin succulent skin, and the other, a creamy white, strong rind sheathing the tuber. Both these are poisonous, and should be removed before boiling for food. There is another fibrous midrib in the core of the tubers called the "*Naratiya.*" This is also dangerous and should be thrown away.

The yams of all the varieties should be dug before the plants blossom. The boiled yams should be eaten immediately after cooking and should never be taken on an empty stomach. It is never advisable to eat Cassava alone for dinner without a mixed diet, nor should the yams be kept long after being dug up; a fungus soon develops on any part that is cut, broken or bruised. The poison is known to be prussic or hydracanic acid.

In Manioc cultivation, sometimes the portion towards the roots of the cuttings get mixed up, and instead of the root end, the upper portion is planted in the hole. The poison is also attributed to this accidental method of planting, which is described as "*Agamula maruvenava.*" Cattle-trespasses on Manioc plantations tends to make the tubers hardened and render them very indigestible. As a precautionary measure, the villagers, when boiling Cassava, *invariably* add the leaves of the *Murunga*, (*Moringa pterygosperma*), *Tora*, *pepper* (*piper nigrum*) or guava with or without a mixture of turmeric or the green fruits of the Papaw. This has been tried and found to be very efficacious, as the poisonous effects are entirely dispelled by this means. To test the existence of poison, sometimes a silver ring is cast into the pot, and should it get blackened, it is an indication of the existence of the noxious substance. It appears the Tamils also put a copper coin into the water with Tora or Murunga leaves to counteract the poison. Some Kandyans smear over the tubers with chunam during boiling. This is also considered a good antidote for suppressing the mischievous effects. In every case, however, the yams should be thoroughly boiled and the water drained off. An additional preventative is to boil the Cassava in coconut milk with a dilution of salt.

SYMPTOMS AND REMEDIES.

Persons of a bilious temperament are the most liable to be attacked. Cases have been recorded of persons who have partaken of the same Cassava tubers in common, some have died of the effects, a few recovered, while others have suffered no ill-effects whatever.

THE OPERATION OF THE POISON ON THE SUFFERERS.

Sufferers first produce symptoms of a heavy intoxication or giddiness, followed by excessive vomiting and purging. The bodies turn icy cold. The patients become wholly unconscious and fall down fainting. Medical aid should be sought at the first indication of the illness; it is often difficult to bring a victim round when the illness has gained ground and the man is in a state of collapse. And if time is lost, recovery is often impossible. The illness is of such a short duration, that the sufferer of last evening is a corpse this morning.

THE COMMON NATIVE REMEDIES

For Manioca poisoning consist of a decoction of the leaves of the *Pera* (guava) or *Evariya*, or an extract of the green fruits of the *Kabarangá*; Kitul or Palmyrah jaggery dissolved in lime juice, coconut-milk mixed with Kitul (*peni*,

treacle, the juice of the ash-pumpkin or the leaves of the *Batala* (sweet-potatoes). Besides these, there are other effective decoctions and stimulating ointments used, which any Kandyan village doctor of ordinary intelligence would prescribe on reference.

OTHER PLANTS OCCASIONALLY POISONOUS.

Beside the Cassava, there are many other food-stuffs which also produce a poisonous or morbid effect upon life, always preceded by a sensation of intoxication. These cases occasionally result in a fatal termination. Of the Cycads (*Cycas circinalis*) the flowering species, known as "*Mal madu*" is unwholesome, while the *Gedi madu*, the fruit-bearing variety, is relished as a palatable dish. The "Madu" should be boiled in rice-dissolved water (Halpan-Watura). Patients suffering from piles take it with great advantage.

Among the following kinds of grains and cereals, there are both good and noxious varieties of each kind. They bear a very close resemblance to each other, so that their selection depends upon the proper exercise of the judgment of the eaters. Very frequently on the spur of the moment, the bad kind is chosen and the result is disastrous. In *Honda* (a creeping plant that clings to trees by means of tendrils; *Modecca tuberosa*), the variety called *Potu-honda* is decidedly poisonous, and the *Kekiri-honda* is the eatable variety. Last year, two Kandyan boys of Unambuwa, a village near Gampola, died of eating *Potu-honda* fruits. The best efforts of the local District Medical Officer were of no avail. The variety of *Amu*, known as *Bada Amu*, the kind of *Bimmal* (mushroom) known as *Puwakbada*, *Nai*, and *Polon Bimmal*, the *Vel Avara* * (sabre-podded beans), *Potu Dambala*, *Daluk Dambala*, and *El Dambala* being the good varieties; *Wadura Mé*, *Karal Batala*, the *Ginitilla*, *Kandu Miyana*, etc., all afflict the eaters with distress, frequently terminating in premature deaths.

At Polwatte Pansala, Gampola, several priests suffered from eating the bad variety of *Bimmal*, and at Galaha estate a cooly died of eating *Wadura Mé*. Only the other day at Sinhapitiya a man was cut off in his early youth by having very injudiciously eaten some *Potu Dambala* pods. It is a known fact that venomous snakes also infest some of these plants, as Amu, Madu, &c. A scientific analysis of the food stuffs found risky for human consumption would be an interesting and useful research. And the publication of such results embodying the necessary hints as to cultivation would very considerably reduce cases of accidental poisoning to a minimum, and lead to the extended cultivation of many neglected food-plants among the Kandyan population.

[In the West Indies, where Cassava is more universally cultivated than in Ceylon, the tubers are nearly all of the poisonous kind, which is considered to give a better return, but instead of being eaten as yams, they are grated up small, and hung in a bag made of woven palm leaves, with a heavy weight at the end. This squeezes most of the juice out, the rest being easily dissipated by heat. The juice is boiled down, and becomes non-poisonous, forming a useful antiseptic known as *cassareep*, which may be used for preserving meat, &c.—ED. "*T.A.*"]

I.—*PASPALUM DILATATUM*: AN AMERICAN FODDER-GRASS.

Paspalum dilatatum, Poir., commonly known as "Hairy-flowered Paspalum," "Large water-grass," and, in Victoria, as "Leichardt grass," is indigenous in Brazil, Uruguay, and the Argentine Republic. According to Doell (*Flora brasiliensis*) the plant has also been collected in Chile, but it is improbable that it is native on that side of the Andes. It is widely distributed in the Gulf States of

* "Gas Avara" is the edible variety.

North America, and is said to be one of the commonest species in the prairie region of Louisana. It is found along ditch-sides and in other wet places in Tennessee and the littoral States from South-eastern Virginia to Florida, and westwards to Texas. Throughout this region, in which it is probably naturalised, it is a highly valued fodder-plant, and is widely planted in favourable situations. Introduced into Australia by Baron F. von Mueller, its cultivation was commenced in the Richmond River district, New South Wales, in 1892. Thence it has spread to Queensland, Victoria, and Western Australia, and is now regarded as one of the best fodder-grasses in the country. From the Wollongbar Experimental Farm (Richmond River) seeds were sent to India, and the grass has been grown, with but moderate success, in the fuel and fodder reserves at Nagpur, though it promises to do well in the plains of the Central Provinces. The Agricultural and Horticultural Society of India report (*Annual Report*, 1900) that it grows vigorously at Mussoorie, in spite of "intense cold." The roots of a clump grown there measured over 3½ feet in length. In the *Annual Report* of the Superintendent of the Royal Botanic Garden, Calcutta, for 1900-1901, occurs the following statement:—

"The use as a fodder-grass of *Paspalum dilatatum* a native of America, which has proved very valuable in Australia owing to its drought-resisting qualities, has led to its introduction to India on as large a scale as possible. Finding that very little seed could be spared by Australian correspondents of the Garden, the assistance of the Agrostologist to the Department of Agriculture of the United States was invoked. Thanks to the kind help of that officer, a large supply of the seed of this grass was obtained from America, and has been freely distributed throughout India."

The attention of South African agriculturists has recently been directed to the valuable properties of *Paspalum dilatatum* as a fodder-grass. A few plants were found at Newcastle (Natal) by Mr. J. Medley Wood in 1897, though when or through what channel introduced is not known. It is now found to be fairly abundant in the neighbourhood of Newcastle, and, in all probability, numerous patches occur in various parts of the Colony. In New Zealand it has been in cultivation since 1896, at the Momohaki Experimental Station, where it has produced a yield of grass equal to 9½ tons an acre. It is, however, killed by the cold of the New Zealand winter. The plant is found also, as a weed or escape, in Porto Rico, Mauritius, and the Straits Settlements.

This grass is a coarse leafy perennial with a tendency to grow in clumps; it attains a height of 2 feet and over—in favourable situations even reaching 6 feet. It thrives best upon rich moist land, and grows very luxuriantly in black alluvial soils. It is said to succeed also in sandy soils, even when a considerable proportion of salt is present. Being a very deep-rooted grass it has a remarkable capacity for withstanding conditions of drought. In Western Australia it flourishes in poor mountain soils. When once established it withstands frosts, if not continuous, and, in Victoria is successfully cultivated up to an elevation of 2,000 feet. It is, in fact, admirably suited for cultivation in tropical and sub-tropical climates.

As a permanent pasture grass, *Paspalum dilatatum* holds a high position among tropical grasses. Notwithstanding its luxuriant habit, its tissues are soft and succulent, and contain only a normal proportion of woody cells. There is "no part of it, from the crown to the head, that stock will not eat." When well-established it endures long periods of drought without injury. It starts its new growth early in the spring, and continues to grow vigorously until late autumn. It thus affords excellent late summer and autumn feed. Its permanence on suitable soil is undoubted, for at Wollongbar, after four years' grazing, "the paddocks are still improving and giving an increased quantity of feed." (H. M. Williams, in N. S. W. *Agricultural*

Gazette, 1898.) Excellent results are obtained by using *Paspalum dilatatum* as a constituent of a mixed pasture, which contains also Cocksfoot (*Dactylis glomerata*) or other grass which makes growth in the winter, at which time the Paspalum is at its worst. The pasture should be allowed to seed during the second year, that the Paspalum may distribute its seed, as it spreads very slowly from the roots. For dairying purposes, Paspalum is of great value, as it has great milk-producing properties.

For hay, this grass is rather coarse, and usually has a bad colour when dry. It is, however, of excellent quality, and the yield is very large. A sample grown on the Wollongbar Experimental Farm gave the following results on analyses (F. B. Guthrie, in N. S. W. *Agricultural Gazette*, 1897 :—

Moisture	10·55		
Albuminoids	10·31	soluble...	1·38
		insoluble	8·93
Digestible fibre... ...	29·96		
Woody fibre	27·95		
Ash	6·37	soluble	4·32
		insoluble	2·05
Amide compounds, Chlorophyll, &c. ...	14·86	total nitrogen ...	2·66
		amide nitrogen ...	1·01
	100·00		

This analysis compares very favourably with that of ordinary English hay, and shows a larger proportion of digestible and nourishing material. In deeply worked rich soils at least three crops may be obtained per annum when the plant is well established. On the Richmond River (N. S. W.) Goverment Farm, in one year, 14 tons per acre were obtained on the first cutting, 8 to 10 on the second, after which a third crop of 6 to 7 tons was gathered, making a total yield of 28 to 31 tons per acre.

An analysis of a sample of the crop grown on good cultivated land on the creek flats of the Queensland Agricultural College, and cut on April 22nd, 1901, compares rather unfavourably with the foregoing. The yield of grass in this crop was 10·525 tons per acre, and of hay (air dried grass), 2·858 tons per acre. The analysis of the hay yielded the following figures (J. C. Brunnich, F.C.S., in *Queensland Agricultural Journal*, 1901, pp. 245, 246) :—

Moisture	10·72		
Albuminoids	4·81	soluble	0·96
		insoluble	3·85
Digestible fibre... ...	26·97		
Woody fibre	34·45		
Ash	10·14	soluble	6·06
		insoluble	4·08
Amide compounds, Chlorophyll, fat, &c., ...	12·91	total nitrogen ...	0·882
		amide nitrogen ...	0·112
	100·00		

There is a remarkable difference in nitrogen yield between this sample and that analysed by Mr. Guthrie. The apparent inferiority of this crop is attributed by Mr. Brunnich to the facts that the grass was over-ripe when cut, and had been grown in exceptionally dry weather, and on a larger scale than the Wollongbar sample.

From the time that the first seeds in each spike are mature, the ripening of the whole spike occupies about three weeks. In consequence, the harvesting of the seeds is a matter of some difficulty. Those collected during the first few days of ripening are of better quality than those shed later, for a much larger proportion of them are mature, and will germinate. To produce a good pasture on well-prepared

land, 5 to 8 lbs. of seed per acre is recommended as being sufficient. The plant should be allowed to shed its seed until the growth is established. The best time for sowing is in the beginning of the warm season, just before the rains are expected. Under favourable conditions the seeds germinate in 18 to 21 days. For quick results, and also on account of the difficulty of obtaining reliable seed, the planting of "roots" is recommended, particularly when a mixed pasture is being formed. At Wollongbar the "roots" are planted 4 or 5 feet apart, each way, and the ordinary grass or clover seeds are afterwards sown in their proper seasons.—*Kew Bulletin*, No. 1, 1902.

[This grass is now a very common fodder grass up-country in Ceylon.—ED. *T.A.*]

THE USE OF PRICKLY PEAR AS FODDER.

According to the United States Department of Agriculture (Bureau of Plant Industry, No. 74) the use of prickly as fodder is, in the arid and semi-arid regions of the United States, not only resorted to in seasons of drought but, along with other dry foods, finds a place all the year round in the forage list of many stock-keepers. No definite feeding tests have yet been reported from that country, but the experience of practical men invariably point out its utility in times of scarcity.

2. In India, however, much certainty exists. During the famine of 1877, a great deal was made of this plant, and in many cases depôts were established where the ryots' cattle were, sometimes forcibly, fed on chopped cactus. The results in many cases were extremely satisfactory, though the native cultivators could not, except in rare cases, be induced to feed it of their own accord, fearing the loss of their cattle from diarrhœa or dysentry. Since then occasional reports have been issued in a more or less favourable spirit of its value as fodder.

3. Certainly from its analysis one would not be led to expect as much as is sometimes claimed for it. The following analysis is by Mr. Hopper, and was carried out in connection with some feeding experiments at Poona and Nagpur in 1903:—

Water	16·96
Organic matter	60·64
Ash	22·40

This sample had been sun-dried for four days and had lost 80 per cent. by weight of moisture.

4. Two sets of feeding experiments have been carried out, both by the Bombay Agricultural Department. They are curiously at variance. In 1892 Mr. Mollison fed three cattle ranging in age from 18 months to two years for a period of a month on a diet consisting of 15 lbs. of pear and 4 lbs. of hay per day. At the end of 32 days, the animals were in a thriving condition and had increased in weight. Shortly before this the experiment was tried of feeding prickly pear to pampered milch cattle which resulted in complete failure. The animals had to be starved before they would touch it, and the experiment involved so much cruelty that it was discontinued, though the experiment was held to have proved that even these animals by severe stinting could have been kept alive.

5. On the other hand Mr. Mehta, believing that Mr. Mollison had not tried for a sufficiently long period, fed prickly pear to three small cattle of the local Deccan breed for nearly five months. Much trouble seems to have been experienced in getting the bullock to eat it at first, but they eventually came to consume 15 lbs. per diem. 5 lbs. hay was added after a fortnight when the consumption of pear fell off at once. Finally in such a poor condition had the bullocks got that 1 lb. oil-cake was given, along with which they consumed 25 lbs. pear. No improvement could be seen, and the experiment was stopped as its continuance would have killed the beasts.

6. As regards the preparation of the prickly pear for fodder, the method adopted in India has generally been to remove the thorns by means of tongs, somewhat like sugar tongs, by which means the complete group of thorns, bristles and adjacent woody tissue may be pinched out together. The leaves may them be wiped, though this is not universal, or dipped in water to wash off small adherent bristles and sliced into fingers. Another very common practice especially in America is to burn the leaves slightly when the distal end of the thorn will be destroyed and the cactus may then be fed to cattle direct. In this connection American experience seems to show that over-toasted leaves induce laxity of the bowels, and this may be a partial explanation of the poor results of Mr. Mehta's experiment. In Mr. Mollison's the pear was merely cleaned and sliced, no heat being applied. Other methods are steaming or boiling the plant whereby the thorns become as softened as to be almost innocuous. Machines are in vogue in America for pulping the whole plant, reducing it to such a fine state that the thorns are rendered harmless. The introduction of cactus into the diet should be very gradual, and it will, in most cases, be found necessary at first to sprinkle a little salt and bran or gram flour or cholam flour over it to induce the animals to touch it.

7. There seems to be no reason then save the prejudice of the ryot why cactus in some form should not form a valuable adjunct to the fodder resources of the country. That in normal times it will ever be largely used seems unlikely since if it is really an economical fodder, the thrifty cultivator would probably have used it long since; but it may certainly be looked upon as a most valuable auxiliary food in times of distress.—[*Bulletin No. 4, Central Agricultural Committee, Madras.*]

[The prickly pear is very common on the North coast of Ceylon, and in places inland.—ED. "*T.A.*"]

MISCELLANEOUS.

AGRICULTURAL METHODS IN MADRAS.

That agricultural enquiry should precede efforts at agricultural improvement is a sound maxim. By agricultural enquiry, knowledge is obtained of not only where defect lies in the ryots' agricultural practices, which is half way to remedy, but also of the numerous good points in their practices which have won the admiration of famous European agricultural experts, and which, being still confined to but small parts of the country by no other cause than custom, should, by every means, be diffused as widely as possible at an early date. The excellence of the agricultural system in some, as compared with other, parts of the country may, in many cases, be accounted for by differences of soil, climate, etc., over which man has little control. For instance, the ryots of the Godavari delta, which for the most part enjoys better natural drainage, are on that account able to grow sugarcane, plantains, coconuts, etc., unlike their brethren of the Kistna delta. But soil and climate have nothing to do with some questions. Thus, why should not the Coimbatore ryot, with the aid of one pair of bullocks sow by the *gorru*, or bamboo seed-drill, at least three and a half acres of land in a day with, say, cholam, using not more than five Madras measures for that area, and cover in the seed with the *guntika* with another pair of bullocks, instead of doing what he does now, that is broadcasting about twenty Madras measures over the same area and employing six pairs of bullocks for covering in the seed in a day. Similarly, the threshing stone roller which has proved very economical and is in general use in the Deccan districts except Bellary (viz., Kurnool, Anantapur and Cuddapah) might be introduced in all parts of the country, independently of the conditions of soil and climate. It is worth while to note how such implements, tools, and methods happened to come into use in the particular parts of the country to which they are yet confined; what opportunities the people of other parts have had for knowing those things, and what influences have prevented the material extension of their use.

The Reddis, Naidus, etc., known in the Tamil country by the generic name *vadugars* (literally Northerners) are the descendants of people who migrated into the Southern districts from the Telugu country centuries ago. The ancestral immigrants appear to have been warriors. Consequently, when they settled into peaceful occupations on the advent of peace to the country, like the Ironsides of Cromwell, they had forgotten all about the arts in their original home. There is a tradition among the Reddis of Perambalore that their ancestors came from the neighbourhood of the Malikarjuna Paruatum or the famous Srisailam Hill in the Naidikotur taluk. Nobody in Perambalur, I observed, knew the whereabouts of the hill. The economical implements and tools used in the Nandikotkur taluk, in the neighbourhood of the hill, are well adapted for use in the black cotton soil which prevails in the Perambalur taluk. And yet the only implement which at all betokens the immgrations of the ancestors of the Perambalur Reddis from the country of the *gorru* is the *korru parambu*, or a sort of wooden rake which, strange to say, is still known by the name *gorru* in Samvatsaragudem and other villages in the neighbourhood of Nidadavolu, where the system of dry cultivation is rather of a primitive type, and which is commonly used in the ceded districts under the names *pandluanu*, etc.

Another circumstance which indicates the immigration above referred to is the fact of the Reddis, Naidus, etc., occupying the major portion of the black cotton soil of the Tamil country. As will be shown by further instances, there is a

strange affinity between the Telugu cultivators and black cotton soil, so much so, that if a census were taken of the owners of such soil in the Tamil districts of Coimbatore, Trichinopolly, Madura and Tinnevelly, 90 per cent. would, no doubt, prove to be *vadugars* or the descendants of Telugu immigrants. The black soil having been at most the only class of soil with which those who migrated to the Tamil country had been familiar (the other classes of soils having apparently been brought under cultivation in later times under pressure of population), the immigrants or their descendants occupied the black soils in the South to the almost utter exclusion of the Tamilians, who cared, and do now care, chiefly for wet cultivation, which is dignified with the name *nunsei* (literally "good cultivation), dry cultivation being called *punsei*, or "trival cultivation." As a counterpart to the *vadugars* occupying the bulk of the black cotton soil in the South, I saw a large number of *dakshanudulu* (Southerners) attracted from Tanjore and other Tamil districts to their favourite wet cultivation, for which there was much scope under the Kurnool-Cuddapah canal, the water-supply from which had been rejected by the local ryots, though the migration from the South stopped on account of malaria and other unfavourable conditions. So great indeed is the attachment of the *vadgan* to the black cotton soil that the Tamilians mock him by saying that, when God offered paradise to the *vadgan*, the latter hesitated by enquiring whether there was black cotton soil there. It is a great pity that the original immigrants from the Telugu into the Tamil country had not stuck as fondly to the implements and tools particularly designed for black cotton soil as they did to the soil itself of that kind.

The influence of a comparatively recent immigration from the Telugu into the Tamil country, in connection with the introduction of the economical agricultural implements and tools of the former country, may now be noticed. During the Guntur Famine of 1833, a number of Telugu Christian ryots left Phiringipuram and migrated into the Chingleput district, where the then Collector, Mr. Place, granted them land near Sriperumbudur. From this centre they gradually spread in the Conjeeveram, Trivellur, Madurantakam and other taluks of the district. If one finds a stiff clay soil cultivated with cholam in those parts; one may be nearly certain that the cultivation is by one of the Telugu colonists. For instance, in Badalur and certain other villages on the banks of the Kallar, in the Madurantakam taluk, the cultivators of cholam on the stiff soils there were found about twelve years ago to be all descendants of the immigrants from Phiringipuram. Nothing has struck me as more singular in all my travels than the strange affinity which the immigrants from the North have for the black and other stiff soils capable of producing cholam and cotton. The immigrants from Phiringipuram being an agricultural people (unlike the original *vadugars*), brought with them the *gorru*, the *guntika*, the *dante*, called in the Cuddapah and Kurnool districts *metla guntika* and different from what is called by the same name in the Bellary district, and also the *gidda*, *padda*, *pisa*, and *palapu* varieties of *jonna* (great millet) still grown in the Guntur district. They were led by force of custom to cultivate the same sort of land (other kinds of lands have now been taken up) with the same crops (except cotton, which on account of the climatic difference proved a failure), with the same implements with which they were familiar in their original home. That the various kinds of implements are really more economical for their respective specific kinds of work, viz., preparation of the soil for sowing, sowing seed, covering seed after sowing, and bullock hoeing, than the poor country plough which has to perform all the different functions just referred to, being the Tamil ryot's all in all—is evidenced by the fact of the Tamil neighbours of the immigrants (who had stood gaping at the curious implements, slowly adopting them at last, especially the *gorru* together with the name, calling it *gorru kalappai*. The force of custom is again manifest in the fact that the *gorru kalappai* of the Chingleput district is used, not so much in connection

with dry cultivation as for sowing paddy, and has been modified for the purpose by the ingenuity of the Tamil ryot. Those who travel between Egmore and Tindivanam on the South Indian Railway may occasionally see paddy sown beautifully in lines with the *gorru kalappai*. The Telugu ryot's own modification of the *gorru* in the Deccan districts for sowing paddy is not so ingenious as that of the Tamilian who borrowed the idea of the drill from the former. For instance, the *kurigi nellu* or the *bailu nellu* (dry paddy) of Kosgi is sown by a comparatively clumsy and inefficient drill.

There are people who say:—"Only convince the ryot that a given implement is really advantageous, and he is sure to adopt it at once." In the first place, the ryot is not open to conviction. He is too lethargic to take the pains to properly compare things. Otherwise the *gorru* and the *guntika*, which have been within the view of the Sriperumbudur ryot for more than seven decades, would have been adopted by thousands. It is no more easy to convince the ryot than to teach swimming to a man who cannot be induced to plunge into water, or to awake a man who only pretends to be asleep. The threshing stone roller which has proved so advantageous for threshing *jonna* (the great millet) in the Cuddapah, Anantapur and Kurnool districts has not, during the three decades after its invention by the ryots themselves, found its way into the Bellary district, excepting its adoption by the Reddi of Molagavalli; nor has the heavy cotton soil plough, which is being used by thousands in the Bellary, Alúr and Adóni taluks, found its away into the other districts (excepting the Uravakonda division) for use in similar soils. About ten years ago a plough of the kind was seen rusting under an old tree in a certain village in the Kurnool district. The owner, an educated ryot, who had given up quill-driving in favour of plough-driving, promised to bring it into regular use if shown how to work it. This was done. The advantages of the plough were so well understood by the man that he himself explained them to the spectators. But the plough was taken back to its place under the tree, and there I saw it five years afterwards in fatal communion with the oxygen of the air as before. I daresay that the man was really convinced of the advantages of the implement, let alone his own admission. Apathy accounts for its disuse.

It is well known that the women belonging to certain classes in Madura and Tinnevelly disfigure their faces by enlarging the holes in the lobes of their ears to such a degree, by putting on numerous heavy iron rings during their girlhood, that the lobes often touch the shoulders and sometimes descend below them. Many a young woman is no doubt convinced how hideous it is. But does conviction avail against custom? It is not all that will at once follow the example of a young woman in Koilpattu, who recently heriocally cured the hideousness of her ears by submitting to a surgical operation, so as to reduce the holes in her ear-lobes to normal dimensions and adapt them for the wear of diamond earrings so as to make her agreeable beyond recognition. As in ordinary life, so in agriculture, custom has a very tenacious hold on people and is inimical to the introduction of reforms.

If one enters a ryot's house in any of the Tamil districts, he sees that all-sufficient plough, and he may see, besides, *mamuti*, the *kalaikattu*, or small hand-hoe, and the old fashioned sickle. In the Deccan districts, on the other hand, a large part of a Reddi's house is set apart for his *koramutti*, or collection of implements and tools. One can see there not only the plough, the *guntika*, the bamboo seed-drill, a *papatam*, or bullock hoe, and other draught implements, but also specific kinds of each such class of implements suited to specific kinds of work, such as the *ontala*, *rentala*, and *pedda medakas* (ploughs), *pedda* (heavy), *chinna* (small), *bara*, (long), *mirapa* (for chillies), *patti* (for cotton, etc.), *guntikas* (for scuffle), *chinna gorru*, *bara gorru* and other kinds of seed-drill with seed-cups (zadigam) of different kinds for sowing the seeds of different crops such as the

great millet, cotton, Bengal gram, etc. ; *metla guntika* (bullock hoe with rectangular shares), *dante*, *pilla guntika*, *a'ia* or *usi gorru*, and other sorts of bullock hoes ; the threshing stone roller, and various tools worth immediate adoption by the Tamil ryot, such as the *acchu kattu dante* (an efficient time and labour-saving wooden *mamuti* with a long handle for laying out irrigation plots) ; *kurchige* and *ullari* for weeding young crops, improved forms of reaping knives, etc.

The implements and tools above referred to are for the most part used not only in the Telugu, but also in a large part of the Canarese country in this Presidency (the Western and Southern parts of Bellary, the Kollegal Taluk, and part of South Canara), the Mysore State, the Canarese and Marata country in the Bombay Presidency, and many other parts of Northern India where dry cultivation prevails, including parts of Punjab. It was in the Punjab, if I recollect right, that Sir James Caird, the Famine Commissioner of 1876-78, and one of the greatest agricultural authorities in England, was simply beside himself with admiration at the simplicity, efficiency, and cheapness of the bamboo drill, the offspring of the country plough costing rupees which may be counted on the fingers of one hand as compared with Garret's, Bird's and other seed drills invented by Jethro Tull, on the principal of the piano, costing several hundred rupees and doing scarcely more or better work in a given time. The *gorru*, *guntika*, etc., are probably an Aryan invention adopted by the undivided Dravidian stock of Telugu and Canarese people after the separation of the Tamilians and the Malayalese. Reference may be made on this point to a certain Bulletin of the Madras Agricultural Department, price one rupee.

It is strange that the *gorru guntika*, etc., should have been in use from time immemorial in the Kollegal taluk of the Coimbatore districts without being taken the slightest notice of by people who have gone there from other parts of the district, and seen them at work. Being a Coimbatorean, I had opportunities to enquire of many a ryot who had gone to Kollegal what he thought of the *kurige* (Canarese term for the bamboo seed drill). What one of the men who had returned from Kollegal, to a village near Tudiyalur, said, shows the general implement was as much a *desacharam* (custom of the country) as the smoking of the cigars by the Brahmins of the Northern country, and he cared no more to enquire the merits of that implement than about the benefits which might accrue to the Southern Brahmins from smoking cigars.

The question may arise as to whether the cultivators of the arid black cotton soil tract who manifestly invented the *gorru guntika*, etc., are, as a class naturally more intelligent than the people of Tanjore, etc., where the plough alone, as said above, performs multifarious functions. It is a well established fact that an organ of the animal economy, or an instrument for physical work, which is designed to perform any of several kinds of work cannot so well perform any of those kinds of work as an organ or instrument specially for doing one specific kind of work alone. The various economical implements of husbandry came to be invented by the cultivator of the black cotton soil tract who had to contend against scantiness of rainfall, absence of irrigation and other difficulties, adversity having its uses, and necessity being the mother of invention. It is the Tanjorean's boast that he has scarcely anything to do except to kick the field bund aside and let in water to raise a bumper crop of paddy. But the Tanjorean, his cattle and his plough, when placed by the side of the Deccan Reddi and his corresponding chattels, looks as dimunitive as would the Pigmies of Africa standing side by side with the Patagonians. That wet cultivation engenders perfunctionary habits of cultivation has been the opinions of agricultural observers like the late Mr. W. R. Robertson.

In no part of the Presidency have I come across such wretched patterns of plough, piccotah, and in short a more backward system of husbandry in many respects, that in the Ganjam district, which, as its very name implies, is a rice growing country, being blessed with comparatively abundant rainfall. The body of the Ganjam plough has a very broad and flat surface, both above and below, and its work may very appropriately be called "scratching" in comparison with the work of ploughs elsewhere. For some reason, the plough of South Canara, which is also a rice-growing country, happens to be quite the reverse of the Ganjam plough and seems to be of a superior pattern to that used anywhere, being hollow at the bottom, like the English plough, and perfectly wedgeshaped in front, so as to reduce the friction to a minimum. It is a crude veritable double mould board plough. From what has been written above, it will be manifest that the agriculture of the country might be very materially, readily, and surely improved by diffusion, as it were, of the present localised superior methods pending successful results at experimental farms and the importation of exotic methods which may be universally applicable.—*Central Agricultural Committee Madras Bulletin*, No. 3.

[These suggestions are worth consideration by those who have to do with agriculture in Ceylon, more especially in the North.—Ed. "*T.A.*"]

BOTANY IN THE PUBLIC SCHOOLS AND ON THE FARM.

By Professor J. B. S. Norton.

There are many persons, young and old, who have a desire for increased knowledge, and have a natural taste for work in natural science, but who cannot leave their work for a course at College. To such persons there may be no more delightful or instructive pursuit than study and observation at odd moments of the mineral, plants and animal objects found on the farm, or even city lots, and their relations to one another. And there is no better way to develop the child's mind in a sane and healthful way than by such exercises reasonably directed. Many persons while hindered by sickness, or otherwise, from doing harder work, could make life enjoyable and useful by such pursuits indoors or outdoors. This Committee can probably do no better work than to encourage such studies of the vegetable life of the farms, gardens and yards of the State. Moreover, such work by individuals without technical training may bring new ideas to the professional scientist, who, too often, gets into scholastic ruts.

Public school teachers could direct their pupils in such work, and some time is now being devoted to elementary natural science in many schools. If the pupil's attention could be attracted to roadside plants in coming and going from school, as well as in the meagre time that can be devoted to that work in school hours, much will be gained. In such work the first thing to be borne in mind, by teachers as well as pupils, is that plants are living things which feed, respire, move, and in the most fundamental life relations differ but little from animals. This attitude of mind makes them seem much more worthy of attention, although the supporting evidence of such a view is not so readily apparent as with animals without some investigation. And here I would say that the *little* things should not be neglected. The mosses, lichens, mushrooms, even the green water ecum, are as interesting, not to say beautiful, as larger plants like oaks and apple trees; the weeds on city lots and in back yards offer material for almost every line of botanical work the city teacher needs to take up, and the life process going on and the variety of plant structures to be found under the snow or underground in winter, are only somewhat less varied, but more interesting because less known than the above ground vegetation

Several lines of observation of plants could be taken up. One of the first thought of would probably be a consideration of the different kinds of plants to be found on a farm, a city lot or close to a certain strip of road, or if taken up by several persons, the flora of a whole town, district or community. The names can be learned from the teacher or other persons who may have some knowledge of them, or possibly from a manual. A more correct method would be to send specimens of flowers, seed vessels and leaves of the unknown kinds to a professional botanist. In connection with this work, a herbarium or collection of dried specimens could be made in which the plants observed could be preserved for comparison with others and arranged according to their resemblances. The young student would soon learn to pick out representatives of many of the natural families of plants like grasses, legumes, composites, etc. It is a very simple matter to make such a collection by pressing the specimens, which should consist of whole plants, if small enough, or at least contain all the characteristic parts between several thicknesses of newspaper, which should be placed in a pile under a heavy weight, and changed daily until the plants are dry. With each specimen should be kept notes of all that is known about the plant, where it came from, when collected, the comor of the flowers, its abundance or rarity, what kinds of plants grow with it, whether stock eat it or it is useful in any way, or a weed or poisonous; the kind of soil grown in, the insects found on it or anything interesting in its structure or method of life.

This collection of plants or notes would furnish a basis for all other botanical observations and studies, and it is hard to do connected work of other kinds with plants, without some knowledge of the species and without some kind of names by which to designate them. Then, too, the acquiring of the names of the plants (common as well as Latin) finds a more proper place in the elementary schools than in the higher institutions, where botany is naturally concerned chiefly with the more important problems of morphology and physiology. These two branches just mentioned should, by no means, be neglected in the work of which this report treats, since they are vitally connected with the practical operations of farm and garden. Many of the common life functions of our cultivated plants, and the structures and the arrangements of roots, stems, wood, bark, leaves, flowers, etc., for the performance of these functions can be delightfully unfolded to young minds by many simple observations or experiments; the planning of which to avoid possible sources of error in conclusions will give excellent mental training. Some of the advanced problems relating to the manner in which crops live and supply the products desired by man, are of course more complicated and their solution vastly more important than those of the higher mathematics taught for mental training in colleges and universities, but many are simple enough to interest the youngest. A few examples may be mentioned to begin with.

Can plants move? Watch a sunflower bud at intervals from morning to night. Observe the manner in which clover leaves close at night. Such observations will also indicate that plants are sensitive to light and other forces and conditions. How do the leaves act? Test by removing one-half of the leaves from some potato plants, all from others, none from some. What difference in the potatoes produced? How can it be shown that this is not due to wounding or other cause rather than loss of leaves?

Does cold weather or moisture injure seed corn? Try by keeping some over winter in wet, cold, dry and warm places. Cut a ring of bark off growing branches of different kinds of trees each month, and note the effect next year, as compared with uninjured ones on the same tree. Germinate some garden seeds of different kinds between moist cloths or paper, and watch the process of development and the new organs formed as well as the changes of those already in the seed.

An interesting and very valuable line of observation would be the study of kinds of plants found on various parts of the farm, and the differences in the soil composition, state of cultivation, water content, etc., which are found with the various associations of plant? The development of forests from cultivated land could be followed up for several years, noticing first the appearance of annual weeds, then perennial weeds and grasses followed by shrubs, next pine and cedars, and these possibly followed by other trees, springing up under the evergreens. Another good ecological problem would be an examination of different orchard varieties with reference to their power to set fruit without the help of insects. Considerable could be learned by tying bags of fine netting over the buds before they open, to prevent the access of insects, leaving them on until the flowers are gone. A collection of notes on the local uses of wild plants would be highly desirable.—*Maryland Agricultural Experiment Station Bulletin*, No. 59, June, 1904.

RECENT PROBLEMS IN AGRICULTURE.

WHAT A UNIVERSITY FARM IS FOR.

Liberty Hyde Bailey, Professor of Agriculture in Cornell University delivered a lecture for the University of California in August, 1905, on "Present Problems in Agriculture." That portion of the lecture which dealt with the question of the purposes of a University Farm is here printed as a contribution to a question of pressing public interest.

The Agricultural College idea is by no means new; it is at least two hundred years old. In this country the Agricultural College, as an established fact, originated about fifty years ago. Year after next will be celebrated the fiftieth anniversary of the Agricultural College, near Lansing, Michigan. The first agricultural colleges were established as a protest against the older kind of education that did not put men into touch with real affairs. The Land Grant Act of 1862 marks one of the greatest epochs in the history of education; it is the Magna Charta of Education. Its purpose was to give instruction in those subjects and affairs which have to do with real life. And, what are they? They are largely agriculture and the mechanical arts. As these agricultural colleges were largely a protest against the older education, it was perfectly natural that at first they should be separate institutions.

About one-half of the agricultural colleges of the Union are separate from the universities proper. They are doing good work, and I am saying nothing whatever derogatory to them. There are some reasons still given for having separate agricultural colleges. It is said that other courses will attract the young men from the farm. Now, if the agricultural college can't hold the young men it ought to lose them; the time is past when we shall put blinders on the young men. Again, it is that the farm boy will be looked down on, but students will not look down upon him if his work is of equally high grade as that pursued in other courses. Sometimes the agricultural college is wanted in a separate locality to satisfy local pride. A locality wants to have an agricultural college and offers inducements to get it. This does not consider the merits of the case in some cases, a broom factory might be just as satisfying to the community. The university idea is coming to be a unifying dea in the community, and all university work should be kept together. The time is past when the agricultural college should be torn out of the university and be set off by itself.

The agricultural college is founded on the conception that education must relate itself to life. Important corollaries follow. In the first place, agricultural education should not necessarily be bound by academic methods. The teaching work in a college really divides itself into two parts, (*a*) the true college work, leading to

a Bachelor's degree; (*b*) postgraduate work, leading to two degrees, the first of these being the Master's degree, which should be given for experimental and investigational work, the work involved and in the collection and accumulation of facts, etc., and the Doctor's degree, which should be given for a philosophical consideration of the facts and the collections of data.

Two great enterprises have now come into the college—the experiment station and university extension. They are not university work in the old academic sense, The extension enterprises form the best illustrations of the leadership the university has now acquired in public affairs. The university is required to do university extension work, and it goes beyond the academic ideals. Agricultural education also rests upon a large and quickened idea of the laboratory methods into every school in the country; the kindergarten, manual training, the school garden, and science work—all mean the laboratory method. And now we also introduce the affairs of every-day life into the schools. All laboratories are pedagogically valuable in proportion as they are in vital connection with theoretical instruction. No school, whether in California or elsewhere, from the primary school to the university is a good school unless it has laboratory work. The effort is now being made to introduce into every high school in New York a year's work in biology for the first year.

All this brings up the whole question of the university farm. The college or university farm developed with the Land Grant Act. In its history it has gone through several phases. It was first conceived of largely as a model farm, and of course the model farms became the laughing stock of the farmers of the state; and they will always be. If they are model farms they have little pedagogical use. One farm cannot be a pattern farm for all conditions. There are thousands of model farms. Model farms are good farmers' farms. The state cannot afford to go into the model farm business in connection with university work.

In the second place, the farms came to be used merely to illustrate farm practices. In the old days we had museums in our colleges, and persons could go and exclaim as they saw the wonders. We still need museums, but we also have collections with which to work. It is not enough that students merely see things growing or see different breeds of animals. They must come nearer than merely to look; they must use and handle.

Again, college farms were sometimes run with the idea of making a profit; but you cannot run a farm with profit with student labor. If the state is to make money out of a farm, then it must not be used for teaching purposes, but must be conceived of as an out-and-out business enterprise.

In the next place, there was an idea that these farms ought to represent the commonwealth—that a farm should be "typical" of the state. It is a mighty poor state that can be typified in one farm. If the state wants a typical farm let it have it, but do not burden the University with it. Put it in charge of a Chamber of Commerce or other advertising organization. Anybody can farm typical land.

Then there was a long period of years when the college was used very little or even not at all. Not knowing just what to do with them, many of them have been allowed to drift.

Then there came the passage of the Hatch Act in 1887, which established the experiment stations; and this afforded a means of utilizing the college farm. There are a good many of our institutions which are now carrying farm lands as experiment stations. Of course we should have farms for research. There are two kinds of research work on farms. One kind of research is in farm practice; the other is research in the fundamental physical, chemical, and physiological problems, which must be done on some farm directly under control.

Now we have come to the final and proper stage,—the farm must then be a laboratory. Thus primarily it must be a laboratory enterprise, and the pattern and model idea are only incidental and secondary. If your people do not believe in this idea, then you must educate your people. A college farm is not primarily for the purpose of growing model or perfect crops. I should rather have the opportunity to teach one student by means of a farm than to show one hundred persons a field of perfect pumpkins.

If we study plowing in the class room, we must also study it in the field, even if we destroy a crop. We must determine and test the relation of plowing to moisture, æration, microbic life, and many other questions. It is more important that a man learn how and why to plow than it is for the college farm to grow a crop of wheat. Even if I tore up the drainage on a farm in order to teach it, I wont be able to do it. The botanist pulls up the plant to study it. In learning how to grow potatoes one should pull them up to study the root system. Not long ago I was asked how deep potatoes should be planted in a certain soil. I asked, "How many of you know whether the tubers form above or below the feeding roots." Four or five guessed, but no one knew. But on that fact depends much of the success in planting potatoes. If your students want to see a model orchard, they have a thousand of them in California. We want such an establishment as will allow us to drive our cattle right into the class-room. We are this day building a class-room at Cornell which will hold stock, and which has seats for the students on the sides. They will study real live cattle, not pictures and models. The young men study those cows and find out why they are good and bad cows. They examine their conformation, etc. These cows are just as much laboratory material as the plants of the botanist or the chemicals of the chemist. Next week, if we should study the question of beef cattle, they are brought into the building and the students study them just the same way your students study stratification of rocks. Ten acres of land to use when I want it, and as I want it, is worth more pedagogically than a thousand acres to look at.

The value of a university farm from a university man's point of view consists in its usefulness as a means of teaching. If you do not want to call it a farm, call it land. The better it is as a farm, the better it ought also to be as a laboratory; but the laboratory utilization of it should always come first. If you are not using farms as a means of training men you are not using them for university purposes. A director of an agricultural college said some years ago when a visitor complained that he didn't consider the college farm to be a model farm, "I would rather have a good man with a flower pot in a window than have a poor man with a thousand acres of land." A university farm justified from the university or pedagogical point of view must be made a true laboratory to collate and articulate with the theoretical instruction, otherwise the future will not justify your possession of it.—*California Agricultural Experimental Station Circular.*

Literature of Economic Botany and Agriculture. XIV.

J. C. WILLIS.

Guizotia.—Niger-seed oil. Ind. Agr. Sept. 1905, p. 274.

Gums.—Ceylon gums and resins. Ceylon Forester. IV. 1898 p. 6.
Gum Guiacum, &c., see B.C. Beih. IX. 1900 pp. 154. 155.
Acacia gums. Notizbl. Berlin. II. Aug. 1898. p. 176.
Macaranga Roxburghii. Agr. Ledger. V.P. Ser. 56.
Pial or Peal gum : do 58.
Boswellia serrata : do 59.
Bauhinia retusa : do 60.
Jingan gum (Odina Wodier) do 62.
Bocquillon on gums. Just's Jahresb. 1899 II. 7.
Lewton on classification of gums. Just's Jahresb. 43.
Gum tragasol. Chem. & Drug. 1901. p. 1027.
Gummi von Acacia detinens. Tropenpfl. June 1901.
Note sur une gomme de Madagascar. Rev. d. Cult. Col. Sept. 1901. p. 184.
Gomme Arabique : les recents travaux allemands. Journ d' Agri. trop. I. 16.
Chicle gum (Achras Sapota). Chem. & Drug. Mar. 1902. p. 410.
Einige Mittheilungen über Kordofan u.a. Gummi-arten. Tropenpfl. 1903 p. 231.
The Chicle industry of Mindanao. *T.A.* June 1903 p. 809.
Indian Acacia gums. *T.A.* Nov. 1903 p. 303.
The commercial uses of the Indian Acacias. Imp. Inst. Bull. I. 1903 p. 91.

THE TRADE OF HAWAII.

Statistics have recently been published by the Bureau of Statistics of the Department of Commerce and Labor, showing the trade returns between Hawaii and the United States mainland for the twelve months ending June, 1906, as compared with the previous fiscal year. A careful analysis of the returns show that during the year just ended, encouraging progress has been made, chiefly in what are known as our diversified industries. The shipments to Hawaii from San Francisco, New York and Los Angeles in each case decreased during the year in question, while Puget Sound increased its shipments from $738,380 to $1,266,367.

With regard to Hawaiian exports to the mainland our staple product only amounted to $23,840,803 as against $33,946,036 in the previous year, leaving the enormous deficit of $10,105,233. It is, however, gratifying to learn that our exportation of refined sugar increased by over half a millon dollars during the same period. The refining of sugar in Hawaii is confined to one plantation and is among one of the newest of our industries. The increase in this direction may therefore be regarded as of special importance.

Exportation of honey and bees-wax increased to the extent of $46,450, coffee increased $74,976, canned fruits increased $85,706, hides and skins $42,333, leather $14,592, tallow $7,046, rubber $1,028. and rice $141,598.

The increase in canned fruits is chiefly attributable to the development of the pineapple industry, and this item will no doubt continue to develop with marked strides for many years. The export of rubber will, in a very short time, figure conspicuously in the return and will probably form one of our most valuable assets. The production of leather, another of our new industries, has also materially increased, and promises to still further develop. While the sales of Hawaiian rice

on the coast have about doubled during the last fiscal year, the figures are not to be relied upon as a true criterion of the condition of this industry. This commodity figures largely in the importations from the coast, and the statistics at hand do not show the importation of rice from Japan. The consumption of Japanese rice in these islands is very large and would throw an interesting light on the question. There is no doubt, however, that the Hawaiian rice industry has improved its condition materially during the last year. The coffee growers and bee-keepers are to be congratulated on the excellent progress they have achieved in their departments.

Among the exports which have lost ground in the last fiscal year, sugar has already been referred to. Fibre has, we regret, diminished to the extent of $982. This is surprising in view of the excellent quality of Hawaiian grown sisal, and we hope in another year to see the old figures again attained. At present there is only one plantation exclusively engaged in sisal production, but there are several smaller growers who will no doubt be soon marketing their produce which will help to redeem the situation. Another item, akin in nature to fibre and which has also depreciated in the amount of its export, is that designated as "straw and palm leaf manufactures." Although the value of these for 1905 was insignificant, viz., $747, yet this could not be maintained last year and fell to $559. During the same period our importation of straw and palm leaf manufactures increased $7,864 in value and made the imposing total of $28,864. There seems to be a good field indicated here for the establishment of a factory for the manufacture of articles made from palm-leaf, straw and similar products.

Of imports from the mainland during the past two years, the following items are quoted as affecting more nearly the question of our home industries :—

Articles.	1905.	1906.
	$	$
Breadstuffs, animal feed, etc.	202,337	243,588
Cocoa, etc.	9,541	10,788
Coffee	13,431	11,029
Eggs	14,925	12,995
Fruits and Nuts	147,300	138,495
Hay	143,420	132,123
Provisions comprising Meat and Dairy Produce	524,372	587,334
Rice	303,029	164,863
Salt	7,104	6,034
Tobacco, manufactures of...	528,373	494,818
Vinegar	5,241	5,886

While Hawaii will never be able to exclude certain commodities from her list of imports, a full development of her agricultural resources should materially diminish some of the above totals. This appears particularly true of the items enumerated above as Cocoa, Coffee, Eggs and Vinegar. Although certain proprietory brands of cocoa may be preferred and probably account for the value of this import, there appears to be little reason why this article is not grown here and does not even figure on our exports. The production of vinegar from bananas and other articles is a profitable operation and should repay experiment. The large importations under fruits and nuts would seem unnecessary in a country whose climate and soil is particularly adapted to fruit culture. Although much of the imported California fruit, such as apples, pears and plums could not be produced here, yet the islands should not depend upon other countries for their orange supply. The paucity of Hawaiian grown oranges in the market is remarkable in view of their excellent quality. The interest which is now being diverted to Hawaiian grown tobacco, makes the value of the importations of this article noteworthy. With an annual local consumption of half a million dollars worth of

tobacco, growers of the local leaf should find a home market for their produce to the value of at least one hundered thousand dollars. A valuable export trade would no doubt also attend the production of a cigar possessing superior and characteristic qualities.

Taken as a whole the statistics which are to hand show a marked development of our island industries and indicate that in the near future a greatly increased production will be attained. With sisal and canned fruits already taking a place among our exports, and with rubber, tobacco and fresh fruits promising to establish themselves in the near future, the material prosperity of an increasing number of small producers will be advanced to the immense benefit of the Territory.

The report of the British Consul at San Juan, Porto Rico, upon the trade and industry of the island during the past year, has recently been issued. The most important development of the year has been made in the sugar industry which has been stimulated by the free market of the United States. Much capital is being attracted and many new plantations are in process of construction. The average sugar production is about two tons per acre, which could be greatly increased by fertilization and modern methods of cultivation and extraction. The total value of sugar exported, including molasses, was valued at $13,433,000, an increase of nearly four million dollars.

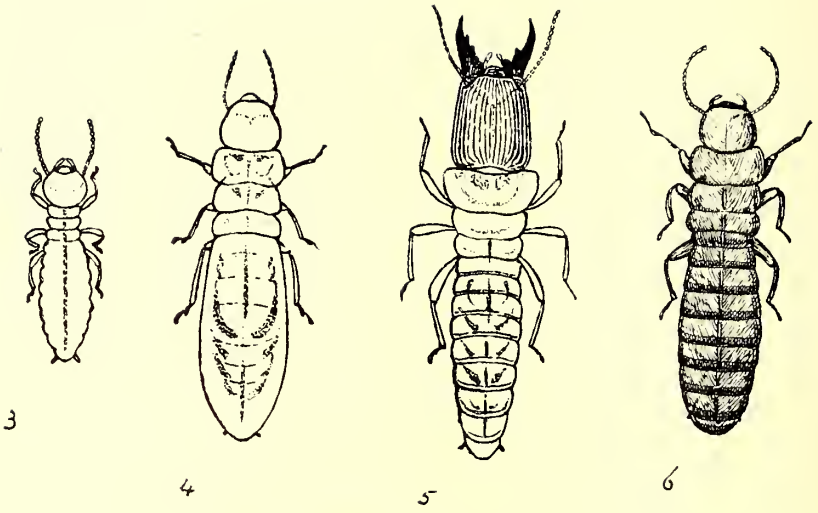
About 7,000 acres are devoted to citrus cultivation, seventy per cent. of which is planted in oranges, twenty-five with grape fruit and five with lemons. Few of the citrus plantations have arrived at full yield, but the fruit is of good quality and has obtained high prices in New York. The freight on a box of oranges to New York is about 28 cents, as compared with 72 cents from Florida and 98 from California. Cuba pays 35 cents freight in addition to 56 cents duty per box.

The tobacco industry is rapidly improving the quality of its production. The main crop is exported as cigars to the United States and the inferior grades as raw tobacco to Germany and the Netherlands. The coffee production showed little advance on last year's depression. Before the great hurricane in 1899 coffee was the principal product of Porto Rico. In 1896 the crop was valued at nearly eight million dollars, while in 1905 it amounted to approximately two millions.

Canning factories are working successfully in two parts of the island, and more will be erected as soon as a good supply of fruit is assured.—*The Hawaiian Forester and Agriculturist.*

A WHITEWASH THAT WILL NOT RUB OFF.

A first-class whitewash is made by dissolving 2 lb. of ordinary glue in 7 pints of water, and when all is dissolved, adding 6 oz. of bichromate of potassium, dissolved in a pint of hot water. Stir the mixture up well and then add sufficient whiting to make it up to the usual consistency, and apply with a brush in the ordinary manner as quickly as possible. This dries in a very short time, and by the action of light becomes converted into a perfectly insoluble waterproof substance, which does not wash off even with hot water, and at the same time does not give rise to mould growth, as whitewash made up with size often does. It may be coloured to any desired shade by the use of a trace of any aniline dye or powdered colouring, while by the addition of a small proportion of calcic sulphite its antiseptic power is much increased.—*Queensland Agricultural Journal.*



TERMES MILITARIS.

Fig. 3, Larva. 4, Worker. 5, Soldier. 6, Adult Female.
(All Magnified 6 Diameters.)

From Original Drawings by E. E. Green.

PLANT SANITATION.

Entomological Notes,

By E. Ernest Green.

(*Illustrated.*)

A species of 'White Ant' (*Catotermes militaris*, Desneaux) that attacks and hollows out the stems of living tea bushes has been known for some years. It occurs sporadically in most of the tea districts, independently of elevation. Its life history has hitherto been a complete mystery, no definite nest or abnormally developed breeding females having been observed. Recent investigations in the Lindula district have now enabled me to solve the puzzle. On the estate in question the pest has been known for some years, but no attempt to eradicate it was made until last year. It has consequently spread considerably. In some instances whole patches of tea trees have had to be eradicated. Usually, some two or three trees only are affected at one spot. Examination of a number of affected trees showed that the main stem and roots, together with the larger branches, are completely hollowed out, the stem being frequently merely a hollow shell (see fig 1). In spite of this extensive damage the bushes continue to flush well and show no external signs of injury (see fig 2). Only the heart wood is devoured, the sap wood remaining intact and carrying on the functions of the plant. The devoured tissues are replaced by earthy matter into which adventitious roots are thrown out—apparently from the *inner* walls—and evidently obtain much nourishment from the earthy matter. In digging out the infested trees no signs of extension of the galleries were observed, and no insects were found in the excavated soil. It appears from this that each colony is self-contained in the individual tree, and extends its depredations only when that tree is fully occupied. On splitting open the infested stems and branches, insects in all stages could be found, but no eggs. There were larvae (fig 3)—quite small up to fully grown, full grown workers (fig 4) and soldiers (fig 5), and a few wingless adults (fig 6) of the same size as the workers, but distinguished by their uniform reddish colour and more chitinous integument. The larvæ are translucent white; the workers creamy white with darker cloudy markings on the abdomen; the soldiers with large reddish heads and prominent falcate mandibles. No eggs were observed; and nothing resembling a differentiated queen. Nor were there any indications of special brood cells or honey-combed nest. On subsequently dissecting some of the adult insects, their bodies were found to contain well-developed ova—of a very much larger size than those deposited by the specialized queens of other species. I gather, from these observations, that the life history of this species is very distinct from that of the common mound-building termite; that no specialized breeding queens are produced; but that the ordinary adults (which are never very numerous in one colony) are apterous and remain in the nest in which they are raised, and carry on the brood *in situ*. It is possible that living larvæ (instead of eggs) may be produced, but the evidence on this point is inconclusive. Each colony is therefore self-contained, and the removal and destruction of the tree should destroy the complete colony. The presence of the pest can seldom be recognized until the bush has been pruned, when sections of the galleries are exposed. In recently attacked bushes, only collar pruning can disclose the infection, as the insects apparently effect their entrance through the roots, working up first into the stem and later into the branches. Seeing that infected trees are still able to carry on their functions and to yield (apparently) as much crop as sound trees, it seems a pity to have to eradicate them if some means could be employed to destroy the insects *in situ* and so to prevent

the extension of the injury to the surrounding trees. With this view I experimented with the patent 'Ant Exterminator' recently received from South Africa. This machine pumps a deadly gas (generated from sulphur and arsenic) through the galleries, and has been found most effective in the destruction of the ordinary mound-building termites. The nozzle of the machine was inserted first into the exposed galleries in one of the branches, and afterwards into a hole drilled through the stem into the main cavity. But the ventilation was insufficient, owing to the blocking of the cavities with earthy matter, and it was found impossible to force the fumes through the system of galleries. Other plants were collar pruned, and small quantities of vaporite placed in the cavity which was then plugged with clay. The results of this latter experiment will not be available for some weeks.

In a former number of this Magazine (Nov. 1906, p. 396) reference was made to a novel method of destroying the shot-hole borer *in situ*, by scorching the bushes immediately after pruning. The inventor of this method is Mr. C. W. R. Tyler, of Sanquhar Estate, in the Gampola district. I have now had an opportunity of seeing the work in progress, and am very favorably impressed with the results. The following notes were made on the spot:—

Gangs of women and children are supplied with torches made of dried coconut leaves. They pass the flaming torches round each bush, beneath the branches, holding them there long enough for the heat to penetrate the wood. On splitting open the branches, the insects—both young and adult—are found to be quite dead. I was able to satisfy myself of this result in the smaller ('pencil') branches. The older branches, though previously badly infested, were now deserted by the insects, so it was impossible to determine here whether the treatment would be equally effective in these thicker branches. I was shown a field that had been treated in this way when pruned in August of last year. The treatment was said to have been applied very severely, and not a single surviving insect could then be found. A good many of the smaller branches had been killed, but fresh healthy shoots were in every case being thrown up from the lower parts of the bushes, promising a rapid recovery. This system seems to me to be preferable to collar pruning as—while ridding the plant of the pest—it affords a more rapid recovery. It should be understood that, to be of permanent value, the treatment must be carried out systematically over the whole of the affected area. Otherwise re-infection from surrounding fields will occur sooner or later. In the meantime, it has the advantage of bringing the plant into a condition that enables it more successfully to resist the attacks of the borer. That nature can and does repair the injury under favourable conditions was abundantly evident on this estate. On splitting open the more healthy free growing branches, the entrance holes were repeatedly found to be plugged by an ingrowth from the cambial tissues. The cost of the treatment is largely influenced by the cost of the torches. On this estate the dried coconut fronds had to be bought in Kandy (some 13 miles distant,) and transported by rail and cart to the estate. Each torch costs, on the estate, approximately two cents, and is exhausted after the treatment of eight bushes. A cooly can satisfactorily treat 250 bushes for his day's name. This works out at Rs. 13·55 per acre; but Mr. Tyler informs me that the actual cost is nearer Rs. 11. Experiments were tried with artificial torches composed of coconut fibre, kitul fibre, and old sacking—tied on sticks. These substances were steeped in kerosene oil and liquid fuel. The kitul fibre proved to be slightly the better medium, but owing to the difficulty of obtaining it in sufficient quantity and at a cheap cost, it must give place to coconut fibre for practicability. Our experiments showed that this fibre—when properly tied will form a really useful and economical torch. The fibre should be tied in a tight pad—without loose ends. Of the two oils, the heavier and cheaper (liquid fuel) was found to be the more satisfactory. In application one podian accompanies some five or six torch bearers, with a tin of oil and a small scoop with which he replenishes the torches as the oil is exhausted.

FIG. 1.

STEM OF LIVING TEA BUSH SPLIT OPEN TO SHOW THE WORK OF *TERMES MILITARIS*.

From Photograph by G. Lionel Cox.

FIG. 2.

LIVING TEA BUSH ATTACKED BY *TERMES MILITARIS*.

(AN OPENING HAS BEEN MADE IN THE STEM TO SHOW THE HOLLOW INSIDE.)

From Photograph by G. Lionel Cox.

Another experiment consisted in laying straw down the rows, surrounding each pruned bush, and a train of straw connecting bush with bush. The straw was fired at the lower end of each line and ran up the row, slightly scorching each bush. This proved to be quite as effective as the torches, but can be employed economically only on sloping fields and in the neighbourhood of patna or grass-land. The cost of straw or of the lengthy transport of grass would be prohibitive, or would—at any rate—be more costly than the fibre and oil torches. Dried prunings might also be employed in the same manner as straw or grass. This sorching system would be found particularly useful on places where only a single field is attacked and—in conjunction with the destruction of the prunings—should be effective in the extermination of the pest on such limited areas.

The idea that dense shade is inimical to the borer was also investigated on this estate and was partly confirmed and partly negatived. Tea that was growing under a fairly thick shade of Dadap trees (*Erythrina*) was found to be remarkably free from the pest. Tea under Grevillea shade was less exempt, and some bushes growing under dense shade of Cacao (but without other shade trees), was as badly affected by the borer as any of the more open fields. These facts suggest that exemption may be dependent upon the nature of the shade. It is well-known that tea grown under Dadaps produces a much freer and more sappy growth, while the bushes grown under Cacao alone were stunted and hard of wood.

SCIENTIFIC AGRICULTURE.

THE VALUE OF BASIC SLAG.

Speaking before the members of the Nantwich Farmers' Club, Mr. W. A. Cox, in a lecture on the use of basic slag on various crops, recommended that farmers, when buying, should obtain three guarantees, viz., the total phosphate of lime; that 80 per cent. of the total phosphate of lime was soluble in a 2 per cent. solution of citric acid; and that 80 per cent. of the powder would pass through the standard sieve. Speaking of its effect on grassland, he pointed out that generally the best results were obtained on heavy soil and those rich in organic matter. When dealing with sandy and medium soils, especially the former, it should be used in combination with kainit or some other potash salt, as the combined use of these two fertilisers on light and medium soils was usually followed by satisfactory results. The beneficial effects of basic slag on leguminous crops was touched upon, and also upon root crops. On these latter he claimed that it grew sound, useful roots of good keeping qualities and high nutritive value, and when it was more widely understood that basic slag put on in drills at the time of seeding gave certainly as good, and probably better, results than when broadcasted in the winter, farmers would more fully appreciate its value in this connection.

In Ceylon, Basic Slag has had good effects on tea, coconuts, oranges, &c.; with the former it is generally applied with the prunings to hasten their decomposition and promote nitrification.

Two grades are imported into Ceylon which are sold under the following guarantees:—

Ordinary Basic Slag, 17½ to 19 % phosphoric acid and a fineness of 75 to 85 %; and Superior Basic Slag, containing 20 to 22 % phosphoric acid and 80 to 90 % fineness, *i.e.*, the amount passing a mesh of 10,000 holes to the square inch.

M. K. BAMBER.

HORTICULTURE.

MULCHING.

The term "Mulching" is often used in gardening literature. To the professional gardener the meaning and application of the term is clear enough; but we are often asked by amateurs to explain the exact significance and uses of mulching. They say, in effect; "In your issue of so-and-so, I find the following: 'A good mulch at this season will be found very beneficial!' What is a 'mulch'? and how do you do it"? It may therefore be useful to explain fully for the benefit of our amateur readers what mulching is. In brief, it is the process of applying various substances as a covering for soil above the roots of trees and plants, in order to prevent evaporation, and so preserve a uniform degree of heat and moisture. Mulching is also practised for other reasons, more particularly, that of supplying a top-dressing of rich manure to established plants, so that its nutritive properties may be washed down by rain or artificial watering. All recently transplanted trees and shrubs, especially fruit trees, are greatly assisted by being provided with a mulching of litter, half-rotted manure, leaves of something of a similar nature. This acts beneficially in retaining warmth and moisture, thus materially neutralising the evil effects of drought, extreme cold or heat. Straw chaff, short litter, coconut fibre and spent tan are considered to be excellent non-conductors, where enriching properties are not required. For plants and trees needing help in summer, to perfect their flowers or fruit, a mulching of fresh horsedung, or good rotten manure, laid on the surface of the soil, and well watered occasionally, is often found of immense permanent benefit. Such are the uses of mulching, as applied to regions situated in temperate zones—our hill stations for example.

On the plains of India, where the temperature in the summer and rainy months may be anywhere between 90 and 115 degrees Fahr., the uses of mulching have to be carefully considered. For instance, if fresh horse-dung were applied to fruit trees during the summer, there would soon be set up very high fermentation, and a great variety of insects would soon establish themselves in the mulch, some of which might do incalculable harm to the trees. There might arise a colony of white ants, for example, which might do more damage than the good effects of the mulch. Such a contingency would undoubtedly arise in the United Provinces, for instance, in Rajputana, Sind, and other dry regions, where the termite is one of the worst enemies the gardener has to deal with. On the other hand, a mulch is given on the hills, say in December, would not only supply heat and moisture in the winter, but keep the roots moist in the dry summer, when water is very scarce, and orchards and gardens suffer from a prolonged drought. Falling leaves in forests afford a valuable mulch to the trees. They supply humus to the soil, and retain the moisture in the soil during the seasons of scanty rainfall and prolonged droughts. The removal of these leaves is serious loss to forests, and the Forest Department should, we consider, make it a rule not to allow the removal of fallen leaves by natives, who use them for fuel, thereby depriving the soil of valuable manurial agencies. In gardens on the plains fallen leaves are usually gathered and stored in pits for leaf mould. No doubt this is a very useful purpose to which leaves can be applied; but where there is always a prospect of a short rainfall and a season of drought, these leaves might with great advantage be used for mulching fruit trees and other plants likely to suffer much from dryness or short water supply. On most of our hill stations there is very thick vegetation, and the accumulation of humus is unusually large. There is therefore no harm in taking some of this for use in the garden for purposes of mulching. In the tea

districts of North-East India there is also a plentiful supply of humus, and those who keep gardens have ready to their hand an unlimited supply of valuable mulching material. In fact, mulching is so little practised in India, that we doubt whether the majority of those who go in for gardening know the value of this practice. Anyway, we have seen very little mulching done in India, hence the frequent enquiries we receive as to what constitutes mulching. In fruit growing especially the practise of mulching will be found a great help. Even such big trees as the mango, lichee, etc., are greatly benefited by a mulch put on during the winter months. We have often tried a mulch of leaves on mango and lichee trees with very remarkable results. The usual practice is to remove the soil round the roots, which are allowed to remain exposed for a few weeks and thereafter manure applied and covered in with soil. This is not necessary when mulching is resorted to, and the results are infinitely better, especially in the case of lichees and loquats. We have proved this from actual practice, and can recommend it to all who go in for fruit culture, whether on the plains or the hills.—*Indian Planting and Gardening.*

Correspondence.

PEPPER STEM DISEASE.

DEAR SIR,—It may interest your correspondent, who asks in the current number of your Magazine if there is any known remedy for pepper stem disease, to know our experience here. I suppose we have suffered more than any one in Mysore from this scourge, and the conclusion I have come to is that it is closely allied to, if not identical with, stump-rot. In clearing the original jungle the stumps of the felled trees were not removed, and in some cases the trees were simply ringed with the result that, after a period of years, radiating from the stumps of the Curry-haegle (Botanical name unknown to me) and Ramanudike (*Myristica magnifica*) trees, the vines all died out, and where a ringed tree has since fallen, the vines on both sides of the fallen log have gone out. Besides the vines the under-growth is also affected; most of the young standards within the affected area perishing, especially the Hammuddy (*Tetranthera Wightiana*) and Sagady (*Schleichera trijuga*) trees.

As prevention is better than cure (the only cure meantime being the drastic one you mention, that of burning all affected vines, root and branch), I trust the above will be of use to your correspondent if he is thinking of trying his luck at pepper cultivation.

Yours faithfully,
RODERICK F. LAMB.

February 11th, Hassan District, S. India.

CHARACTERISTIC PLANTS OF NORTH CEYLON.

I.

DEAR SIR,—In the *Tropical Agriculturist* for January, 1907, page 44, for "*Mud-Kilaori*," wherever it occurs read "*Mud-Kilavai*." For "*mud-mut*" read "*mud=mul*." For "*Mullaithivu*," read "Mullaittivu." For "Jennet" read "Jemmett."

J. P. LEWIS.

Kandy.

II.

DEAR SIR,—Mr. Lewis in his paragraph on the "Mud Kilaori" in the January number, is unable to say if this plant is found in the Trincomalie District. I supply the information. The plant is known as "Kiluvai" in Tamil, the thorny variety being known as "Mud-kiluvai." Both varieties grow well here, the thornless

variety being found in greater numbers and sold for fence sticks at R2-50 per 100, The Sinhalese here call the plant "Kurunte" and "Kaddu-kurunte" respectively. The plants no doubt revel in droughty climate, and as live fence sticks they are very useful. There is no tendency, however, to extend its planting for fear of goats which, when there are no leaves on the plants even bite away the bark. The owners of goats are also partial to this plant in their desire to find food relished by their animals. For this reason the town people are beginning to prefer for fence sticks Ceara rubber cuttings which splendidly grow on the fences here and are not touched by man or beasts.

The live "Kiluvai" twigs are very much valued as tooth brushes, owing to the medicinal effect the juice produces on the gum and parts of the mouth. For sore-mouth the natives chew the raw nuts as a specific.

The plants are ornamental in systematic fences, especially the thorny variety and should never be omitted in neat gardens and compounds in the dry districts. The number of plants in this district is not so large as to supply cuttings to be removed to other districts, but an effort should be made to distribute the sticks from Jaffna.

P. C. NICHOLAS, *Mudaliyar.*

Trincomalie, 20th February, 1907.

CASHEW NUT.

SIR,—Mr. Donald Ferguson makes some interesting remarks about Cashew nuts in the "*Ceylon Observer*" of December 18th, 1906, and February 6th, 1907. These nuts would now appear to be appreciated at their proper value. In 1900 a small lot was sent to Paris through the Local Exhibition Committee, but though the nuts were highly thought of, the price quoted by likely dealers was 2d. per lb. which is under their average selling price in Colombo.

The mistake made in estimating the value of the Cashew nut was to compare it (as was really done) with the Groundnut, commonly used in the roasted form as dessert.

When travelling in India last December I noticed large quantities of these nuts being sold at the railway stations between Madras and Trichinopoly.

The seeds were clean of all "skin" and sundried, in which condition they are to be preferred to the roasted seeds. I also noticed that trees were more or less systematically planted and tended: but if the Indian grower is satisfied (as "Aborist" makes out in the "*Ceylon Observer*" of February 6th) with less than 2d. per lb., this is only another instance of the results of cheap labour in India which ousts Ceylon produce.

On the other hand, however, the huge discrepancy between the buying price (2d. per lb.) and selling price (1s. per lb.) makes it possible for Ceylon produce to drop in between.

Yours truly,

Colombo. C. DRIEBERG.

RAMIE (RHEA)—AN INDUSTRY FOR THE BRITISH EMPIRE.

DEAR SIR,—It is proposed to form a Ramie Growing Association to foster the growth of Ramie throughout the Empire, and thus add a valuable asset to British agriculture, commerce and industry. At the present time Ramie is grown largely in China and in smaller quantities at different points throughout the British Dominions. It is a fibre which for general utility is without a rival. It provides one of the best of clothing materials, being a non-conductor of heat, and, consequently, cool in the sun's rays and warm in winter. It is beautifully lustrous, in this respect resembling silk, and it retains its lustre undiminished after washing. It is exceedingly durable, and resists the roughest handling in laundry operations,

Used as a tunic in the South African War, it outwore three cotton tunics served to the men in the same company, and with slight repairs to cuffs the Ramie tunic in question would still be serviceable for a considerable time to come.

Ramie is equally suitable for ropes and cordage, nets, tent cloth, and all forms of coarse material for which hemp or jute are now ordinarily used. It is far stronger and more lasting than either of these fibres, and for rope-making it has many special advantages peculiar to it. The merits of Ramie have long been known to textile manufacturers and fibre consumers in this country, but the supply has hitherto been too intermittent and unreliable for them to be able to adopt it on a large scale. Its superiority over all other fibres is coming to be generally admitted, and the demand for the fibre at the present time far exceeds the regular supply. If the production of the fibre were so increased that a large and constant supply could be assured to manufacturers, there is no doubt that it would be adopted on a much larger scale than at present is possible.

There is scarcely any plant which can be so widely cultivated over the earth's surface. It will grow and flourish in the temperate zone as well as in the tropics, and under almost any conditions of climate or soil. It is felt that encouragement alone is needed to induce planters in the British Colonies to adopt it on a large scale, and from every quarter letters and correspondence indicate that the Colonist, more particularly in sub-tropical countries, is alive to the possibilities of this fibre.

The demand for Ramie will, as pointed out above, largely depend for some years to come on the magnitude of the supply, and there is no fear that the supply can outrun the requirements for a very long time to come. The objects of the proposed Ramie Growing Association will be (1) to give general encouragement to Ramie growing by popularising knowledge concerning its value and uses; (2) to supply information, seeds and assistance to planters desirous of embarking in Ramie growing; and (3) to give assistance to both grower and manufacturer by placing them in touch with one another. Members will be enrolled for purposes of co-operation.

Pamphlets will be distributed and will be supplied to members for distribution alike in this country and throughout the Colonies. The assistance of the Press will be sought in making the objects of the Association known, and in publishing articles on the merits and possibilities of the fibre, and the benefits to a Colony introducing the industry. Seed will be supplied to all those who desire to establish Ramie plantations, and from the outset sufficient to start a large plantation will be despatched on a nominal charge of 5s., which includes full cultural directions and entitles purchaser to a report on the production gratis. Pamphlets dealing with the whole method of growing, harvesting and preparing Ramie will be distributed gratis. A register of all planters growing Ramie will be kept by the Association, and also a register of all manufacturers who use or are willing to use Ramie, and the price at which they are prepared to deal in it, and the extent of their requirements. The Association will be ready at all times to give advice to planters, to test and report on samples, to find a market for produce, and to introduce buyers, and in any other way further the interests of those who have embarked in the industry. It is hoped that in course of time the Association may come to be looked upon as the recognised organisation for the promotion and protection of the Ramie industry.

All who are disposed to help in the development of this most promising industry are invited to take part in the formation of the proposed Association by sending their names.

Yours faithfully,

D. EDWARDS-RADCLYFFE,

Hon. Secretary, Staines, England.

ALOE VERA.

DEAR SIR,—This plant (known to the Sinhalese as Komarika), is much employed in native medicine, and may frequently be seen growing in utensils attached to travelling carts, together with *Plectranthus aromaticus*. Its value in English medicine is of course as the source of the drug "Aloes."

When in Bangalore last December I saw this or a closely-related species of Aloe suspended at the entrance to the dwelling apartments in the Maharaja of Mysore's palace, with the object, as I was informed, of keeping away mosquitoes.

Colombo. Yours truly,
C. DRIEBERG.

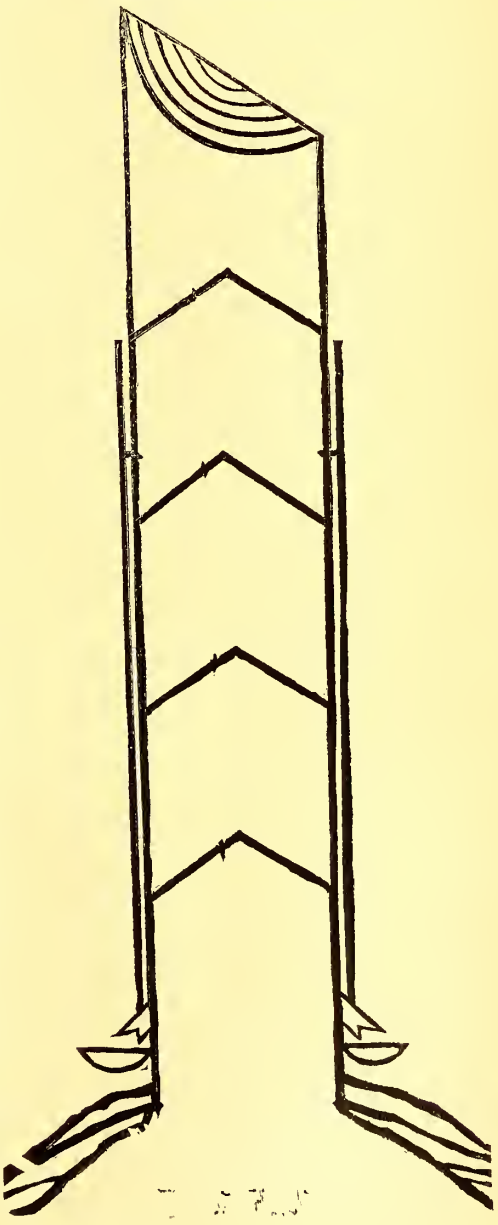
THE INVERTED V SYSTEM OF TAPPING.

DEAR SIR,—That the half-herring bone system of tapping out of the several systems is largely in use and very much in favor goes without saying; but it requires some modification, and in its modified form I call it the "Inverted V System." Its advantages and sketch will be found herewith, which, I think, will be of some interest to those who prefer the half-herring bone system of tapping.

Yours faithfully,
T. L. SRINIVASAGAM.

Neboda, February 16th.

HALF OF THE STEM.



MERITS AND ADVANTAGES OF THE INVERTED V OR MODIFIED HALF-HERRING BONE SYSTEM OF TAPPING.

1. Serves the same purpose as the half-herring bone system.

2. Only requires *two* vertical channels instead of four as with half-herring bone.

3. Incisions being shorter than half spiral, latex runs into the channel more easily, consequently less scrap.

4. Prevents the cooly from tapping more area on the stem of the tree than allotted.

5. The tapping knife is used both ways, right and left, and both the cutting edges are in use resulting in uniform wearing away of the edges; consequently the tapping knife can be used for a longer time than is possible with one side tapping either right or left.

6. Like the half spiral, the inverted V leaves half of the stem untouched for future use.

Minutes of the Board of Agriculture.

The Twenty-ninth Meeting of the Board of Agriculture was held at the Council Chamber at 12 noon on Monday, the 4th March, 1907.

Dr. Willis, Director, Royal Botanic Gardens, and Officiating Vice-President, presided.

The others present were:—The Hon. Mr. C. T. D. Vigors, The Hon. Mr. S. C. Obeyesekere, The Hon. Mr. John Ferguson, C.M.G., Dr. A. Willey, F.R.S., Messrs. Don Solomon Dias Bandaranayeke, C.M.G., E. E. Green, G. W. Sturgess, H. D. Lewis Wijesingha and C. Drieberg (Secretary).

Visitors:—Messrs. S. Freudenberg, M. Hohl, J. Whitehead and C. Rasanayagam.

BUSINESS DONE.

1. The Minutes of the Meeting held on February 4th were read and confirmed.

2. The Progress Report (No. 28) was presented and taken as read.

3. The Secretary read a report made by Messrs. Geo. H. Brown & Co., cotton brokers, Liverpool, on a sample of Caravonica cotton grown by Mr. J. W. C. de Soysa in the Kurunegala district.

4. Mr. C. Rasanayagam, Mudaliyar, Secretary of the Dumbara Branch, read a paper entitled "Results of experiments in the scientific manuring of Dumbara tobacco." The Chairman, the Hon. Mr Ferguson and the Hon. Mr. Obeyesekera, Messrs. Booth, Harward, Whitehead and Freudenberg took part in the discussion on the paper.

Agricultural Society Progress Report. XXVIII.

Secretary.—Mr. T. A. Carey, C.C.S., who was acting as Secretary to the Society from December, 1906, relinquished his duties on the 4th February, when Mr. C. Drieberg succeeded to the post of Secretary.

Dr. J. C. Willis, Director of the Royal Botanic Gardens, was at the same time appointed Organizing Vice-President of the Society.

Branch Societies.—The *Dumbara* Agricultural Society held a meeting on the 21st February, when it was decided that meetings of the Committee should be held successively at Balalla, Teldeniya, and Urugala. The Society resolved on holding an Agricultural Show at Teldeniya in the latter part of August, 1907.

A meeting of the Co-Operative Credit Society in connection with the Dumbara Branch Society was also held the same day. The business included the adoption of the following resolutions:—

> "It was resolved not to purchase any more paddy until the paddy lent was collected, and to restrict loans to Rs. 500 value."
>
> "It was resolved to call for an estimate to construct a bin for storing the paddy at Madugoda, and the Secretary was directed to obtain the permission of the Government Agent to cut the necessary timber on Crown land."

The *Telijjawila* Branch has decided on converting its seed paddy into a cash capital, and to lend money to cultivators to purchase their seed. This course was found necessary owing to the difficulties experienced in handling paddy. Rs. 500 out

of the money raised by the sale of the paddy has been lent for the present *yala* season to a Committee of ten accredited persons in the district, for the purpose of purchasing seed paddy for the most needy cultivators in the villages of Tambuttegoda, Bonala, and Palalla, where it was discovered there was very great scarcity of seed for sowing.

The *Batticaloa* Branch has for the present abandoned the Agricultural Show originally proposed to be held early this year, owing to the want of sufficient support. The Government Agent, Eastern Province, offered to give a liberal donation towards the Show, but support from other quarters did not come up to expectations, the year 1906 having proved a very bad one for the district.

The *Welimada* Branch has decided to hold an Agricultural Show early in May. Mr. D. A. M. Fernando, the Honorary Secretary, offered to supply shoots of sugarcane to members willing to experiment with it, and the teacher of the Welimada school has distributed seeds of Kangaroo grass and cotton. A prize of Rs. 10 has been awarded to the school gardens at Welimada for good work during the year.

The *Balangoda* Branch held a meeting on the 16th February, when among the subjects considered was the question of castration of cattle. A demonstration was fixed for the 25th May. Several headmen agreed to open private gardens to serve as seed-distributing centres and object-lessons to the villagers.

The *Vavuniya* Forwarding Agency continues its operations. Consignments of eggs and limes were sent down during the last week in February, and negotiations are in progress for sending down a further consignment of cattle. A meeting of the Special Committee appointed to consider the question of establishing a Central Receiving Agency in Colombo was held this morning.

The *Telijjawila* Society proposes to take over the Sultanagoda Experimental Farm from the Village Committee, under whose control it has hitherto been managed, and to finance and work the institution on improved lines. The success of the venture will mainly depend on the sagacity of its Secretary, Mr. James Wickramaratne, Mudaliyar of Weligam Korale.

The Society's Medats.—The Society is still in communication with Messrs. Spink & Son, Ltd., London, with regard to the design for the Society's medal, but it is hoped that arrangements will shortly be completed, as details have practically been settled.

Agri-Horticultural Shows.—The Show proposed to be held at *Batticaloa*, as above mentioned, has been abandoned.

Dumbara Society will held a Show in August, 1907.

The Show in *Colombo* under the auspices of the Colombo Agri-Horticultural Society will be held in June.

A Show will be held in *Katana* under the auspices of the Branch Society. The object of the promoters in organizing the Show will be gathered from the following extract from a letter received from Mr. J. D. Vanderstraaten :—" I may mention that we intend this to be purely a local Show, intended to foster and develop a taste for floral and vegetable growing and fruit culture, and give encouragement to village industries, such as carpentry, &c. ; and I have suggested that, as the Negombo district is well known as a tobacco-growing area, we should show not only cured leaf for chewing but for cigar-making, and that prizes should be offered for locally-manufactured cheroots, whether made from Negombo tobacco or from tobacco grown in other parts of the Island." The Show will be held some time in November.

The *Kegalla* Branch proposes to hold a Show at Kegalla on the 28th and 29th June.

The *Telijjawila* Branch has altered the date of its Show from 15th March to April.

The Shows so far fixed are :—

Telijjawila	April
Trincomalee (Market Fair)	April 2
Nuwara Eliya	April 2 and 3
Uva (Badulla)	April 26 and 27
Welimada (Market Fair)	May
Matale	June 21 and 22
Colombo	June
Dumbara	August
Katana	November

Sterilization of Milk.—The apparatus ordered from England arrived last month, and was set up at the Dairy Farm. The first experiment in sterilization of milk was conducted on the 28th February, before the Members of the Committee, whose report is being awaited.

Apicutture.—A meeting of the Bee Committee was held on the 25th February, Mr. Herbert Campbell, Mr. Shanks, and the Secretary being present. The hives at the Government Stock Garden and Mr. Shanks' apiary were inspected, and it was decided for the present to adopt the Langstroth as the standard hive for Ceylon.

Cotton.—A supply of cottou seed has been sent to Kegalla for experimental cultivation, mostly on chenas.

A report on samples of Ceylon-grown Caravonica cotton by a firm of brokers in Liverpool is tabled for information.

Jamaica Yams.—A report has been received from the Honorary Secretary of the Jamaica Agricultural Society with regard to the yams sent by him. He says: "The yams sent were of one variety, a variety of Negro yams, called here Lucea yams, as it is much shipped from the port of Lucea to other parts of the Island and Central America. It is a good keeping yam, and one very much preferred in the local market."

Pea Seeds.—Mr. D. A. M. Fernando, Honorary Secretary of the Welimada Branch, offers to supply pea seeds to members of the Ceylon Agricultural Society, free of charge. The seeds are now available—about 500 to 600 packets containing 25 to 30 seeds in each. Applications may be sent to me stating the quantity required by intending cultivators, who will have to bear cost of postage.

Transplanting in Paddy Cultivation.—Mr. G. E. Ameresekere, of Hanwella, has sent in useful information regarding an experiment in transplanting paddy. His experiment was confined to only two measures, which yielded 456 measures, a return equal to 228-fold, in spite of the drought prevailing at the time. The total cost incurred was Rs. 18·05, and the price realized by the crop Rs. 34·70, showing a profit of Rs. 16·65.

Feeding Silk Worms.—The Superintendent of the Silk Farm at Shillong, writing on the 7th February, says:—"There is no special variety of castor for feeding Eri worms. One kind is likely to do just as well as another. The Silk from Eri cocoons has to be spun out by hand, as is done with cotton. It cannot be reeled."

Bellary Onions.—The Society expects to obtain from India a limited quantity of Bellary onion seed about the middle of April next. Applications for seed from intending cultivators are now being received.

Indian Agricuttural Implements.—The Society imported specimens of the improved Agricultural implements from South India, which, however, did not appear to be satisfactory; besides, there has been considerable delay in executing

the order sent to India in March, 1906. In view of these circumstances it has been decided to cancel the order sent on behalf of several applicants for the implements. am in communication with the authorities in Assam with a view to securing a better type of plough, which I had the opportunity of inspecting at Calcutta, where it was on show at the recent Exhibition.

Castration of Cattle.—A grant of Rs. 1,500 has been allowed for carrying on operations during this year also. Arrangements are now being made by the Government Veterinary Surgeon's Department for conducting demonstrations.

Publications.—The Editor of the *Sihala Samaya* having kindly forwarded 50 copies of his paper containing translations of the proceedings of the last meeting of the Board of Agriculture, they were distributed among the Branch Societies as usnal.

The report on my visit to India is now in the press, and will be circulated to members as soon as it is ready.

A Sinhalese translation of the "Hints on the Cultivation of Vegetables" is now being printed for distribution among Sinhalese members. Any members requiring copies are requested to write for them.

C. DRIEBERG,

4th March, 1907. *Secretary, Ceylon Agricultural Society.*