The Agricultural Journal of India

EDITED BY

The Agricultural Adviser to the Government of India

VOL. XV

(1920)

PUBLISHED FOR

THE IMPERIAL DEPARTMENT OF AGRICULTURE IN INDIA

BY

THACKER, SPINK & CO., CALCUTTA

W. THACKER & CO., 2, CREED LANE, LONDON

PRINTED BY
THACKER, SPINK AND CO.,
CALCUTTA.

INDEX TO VOL. XV

1920

A

B

C

PAGE

N

O

P

T

U

V

W

Vol. XV, Part I January 1920

THE AGRICULTURAL JOURNAL OF INDIA

EDITED BY

The Agricultural Adviser to the Government of India

PUBLISHED FOR

THE IMPERIAL DEPARTMENT OF AGRICULTURE IN INDIA

BY

THACKER, SPINK & CO., CALCUTTA

W. THACKER & CO., 2, Creed Lane, LONDON

Price R. 1-8 or Two Shillings

Agents for the Sale of Government Publications

IN EUROPE

Constable & Co., 10, Orange Street, Leicester Square, London, W.C.
Kegan Paul, Trench Trübner & Co., 68-74, Carter Lane, E.C., and 25, Museum Street, London, W.C.
Bernard Quaritch, 11, Grafton Street, New Bond Street, London, W.
P. S. King & Sons, 2 & 4, Great Smith Street, Westminster, London, S.W.
H. S. King & Co., 65, Cornhill, E.C., and 9, Pall Mall, London, W.
Grindlay & Co., 54, Parliament Street, London, S.W.
Luzac & Co., 46, Great Russell Street, London, W.C.
W. Thacker & Co., 2, Creed Lane, London, E.C.
T. Fisher Unwin, Limited, 1, Adelphi Terrace, London, W.C.
B. H. Blackwell, 50 & 51, Broad Street, Oxford.
Deighton, Bell & Co., Ltd., Cambridge.
Oliver & Boyd, Tweeddale Court, Edinburgh.
E. Ponsonby, Ltd, 116, Grafton Street, Dublin.
Ernest Leroux, 28, Rue Bonaparte, Paris.
Martinus Nijhoff, The Hague, Holland.

IN INDIA AND CEYLON

Thacker, Spink & Co., Calcutta and Simla.
W. Newman & Co., Calcutta.
R. Cambray & Co., Calcutta.
S. K. Lahiri & Co., Calcutta.
B. Bannerjee & Co., Calcutta.
The Indian School Supply Depôt, 309, Bow Bazar Street, Calcutta, and 226, Nawabpur, Dacca.
Butterworth & Co. (India), Ltd., Calcutta.
Rai M. C. Sarkar Bahadur & Sons, 75-1-1, Harrison Road, Calcutta.
The Weldon Library, 18-5, Chowringhee Road, Calcutta.
Standard Literature Co., Ltd., Calcutta.
Lal Chand & Sons, Calcutta.
Higginbothams, Ltd., Madras.
V. Kaliyanarama Iyer & Co., Madras.
G. A. Natesan & Co., Madras.
S. Murthy & Co., Madras.
Thompson & Co., Madras.
Temple & Co., Madras.
P. R. Rama Iyer & Co., Madras.
E. M. Gopalakrishna Kone, Madura.
Thacker & Co., Ltd., Bombay.
A. J. Combridge & Co., Bombay.
D. B. Taraporevala, Sons & Co., Bombay.
Mrs. Radhabai Atmaram Sagoon, Bombay.
Sunder Pandurang, Bombay.
Gopal Narayan & Co., Bombay.
Ramchandra Govind & Son, Kalbadevi, Bombay.
A. H. Wheeler & Co., Allahabad, Calcutta, and Bombay.
N. B. Mathur, Superintendent, Nazir Kanun-i-Hind Press, Allahabad.
Rai Sahib M. Gulab Singh & Sons, Mufid-i-Am Press, Lahore.
A. Chand & Co., Lahore, Punjab.
Ram Krishna & Sons, Lahore.
Superintendent, American Baptist Mission Press, Rangoon.
Manager, the "Hitavada," Nagpur.
S. C. Talukdar, Proprietor, Students & Co., Cooch Behar.
A. M. & J. Ferguson, Colombo, Ceylon.
Manager, Educational Book Depôts, Nagpur and Jubbulpore.*
Manager of the Imperial Book Depôt, 63, Chandney Chauk Street, Delhi.*
Manager, "The Agra Medical Hall and Co-operative Association, Ltd." (Successors to A. John & Co., Agra.)*
Superintendent, Basel Mission Book and Tract Depository, Mangalore.*
P. Varadachary & Co., Madras.*
H. Liddell, Printer, etc., 7, South Road, Allahabad.*
D. C. Anand & Sons, Peshawar.*
Ram Dayal Agarwala, 184, Katra, Allahabad.*
Manager, Newal Kishore Press, Lucknow.*

* Agents for the sale of Legislative Department Publications only.

CONTENTS

(VOL. XV, PART I.)

ORIGINAL ARTICLES

SELECTED ARTICLES

NOTES

LIST OF ILLUSTRATIONS

The following Original Articles will appear in our next issue (March 1920).

SOME COMMON INDIAN BIRDS. NO. 2—THE BLUE-TAILED BEE-EATER (*Merops philippinus*).	*T. Bainbrigge Fletcher, R.N., F.L.S., F.E.S., F.Z.S.; and C. M. Inglis, M.B.O.U.*
THE MOTOR TRACTOR IN AGRICULTURE: SOME IMPRESSIONS OF THE TRACTOR TRIALS HELD AT LINCOLN IN SEPTEMBER 1919	*T. F. Maine, B.Sc.*
NOTES ON THE PROGRESS OF THE EUROPEAN OLIVE AT PESHAWAR	*W. Robertson Brown*
THE DEVELOPMENT OF CANE PLANTING BY THE EAST INDIA DISTILLERIES AND SUGAR FACTORIES, LTD.	
THE DRYING OF BANANAS	*W. Burns, D.Sc.; and P. G. Joshi*
PACKING SEED SUGARCANES FOR TRANSPORT ..	*T. S. Venkataraman, B.A.*
SWARMING CATERPILLARS OF NORTHERN GUJARAT	*T. N. Jhaveri, B.Ag.*

Original Articles

SOME COMMON INDIAN BIRDS.

No. 1. THE INDIAN ROLLER (*CORACIAS INDICA*).

BY

T. BAINBRIGGE FLETCHER, R.N., F.L.S., F.E.S., F.Z.S.,
Imperial Entomologist,

AND

C. M. INGLIS, M.B.O.U.

[THE importance of many common birds to agriculture in India is admittedly very great. Some birds are wholly or partially graminivorous and do a great deal of damage to crops, whilst others feed wholly or partly on insects and are in most cases beneficial by helping to reduce damage caused by insect pests. Many years ago I suggested that the recognition of the more important birds, from the agricultural view-point, might be helped by the issue of a series of coloured plates of such birds, but the difficulty has been to get such plates drawn, as work of this sort requires an artist who is also an ornithologist ; otherwise, the work produced is unnatural. We have therefore been fortunate in securing the services of Mr. C. M. Inglis to provide coloured illustrations of about two dozen of our commoner birds. The present paper will, it is hoped, be followed at regular intervals by others in the same series.—T. B. F.]

THE Indian Roller or Blue Jay (*Coracias indica*) is one of the birds of the Plains which must have brought itself to the notice of all if merely on account of its vivid colouring, which has been aptly described as a study in Oxford and Cambridge blue. Although commonly called a jay, this bird is more nearly allied to the bee-eaters and kingfishers, its relationship to the latter group being evidenced, as recorded by Gordon Dalgliesh, by the fact that it has been seen to plunge into the water like a kingfisher, this most unusual occurrence indicating an affinity to the kingfisher in habits, especially to the white-breasted species which is practically an insect-feeder. As a matter of fact, *C. indica* belongs to the group of rollers, so called because of the extraordinary aerial gymnastics indulged in by these birds, as may be seen especially during the early part of the hot weather, when courtship takes place.

The Indian Roller occurs throughout the Plains of India and Ceylon, neither ascending the Hills nor occurring in areas of desert or thick jungle. Calcutta seems to be about its eastern limit of occurrence and East of that it is replaced by the Burmese species, *Coracias affinis*, which is slightly larger and much darker, with a lighter tail which lacks the purple band at the tip which sets off so well the tail of the Indian Roller. In the Duars both species have been got and where they meet they hybridize freely. In Northern India a third species of Roller, *Coracias garrula*, which is a migrant from Africa and Europe, also occurs and may be distinguished by its lower parts being pale blue throughout, whereas in the Indian and Burmese Rollers, the lower parts are only blue in part. There is also a forest species, *Eurystomus orientalis*, the Broad-billed Roller, with a red bill and legs ; this is a rather silent bird and exceedingly wary and frequently nests in non-accessible holes in large *Simul* (*Bombax malabaricum*) trees.

Where it does occur, the Indian Roller is usually found commonly and is not a bird which can be overlooked when on the wing, as its brilliant blue colours are then displayed to advantage. When at rest upon a branch or telegraph wire, however, this bird is by no means conspicuous, as the wings are then closed and the colours are not very evident. Its usual habit is to sit on any convenient perch and watch patiently until some desirable prey comes into sight, when it flies down, secures its quarry, which is always swallowed whole, and returns to its perch. Ordinarily it appears to be a decidedly sluggish bird, sitting for hours on the same perch, occasionally jerking its tail and emitting a sharp harsh "Tjock." At the breeding season, which occurs in Bihar from March to the end of June, and as early as January in Ceylon, these birds, however, become more active and vociferous, their harsh, staccato gutturals being evidently pleasing to the opposite sex. It is at this time also that they indulge in the weird evolutions which have earned these birds the title of Rollers. As both sexes wear the same livery it is difficult to tell which is which, but two birds may often be seen sitting side by side on some exposed perch at this season of the year and uttering a sort of chuckling sound. One of them, presumably the cock bird, then flies off and up into the air to a considerable height whence he descends in a regular "nose-glide," displaying his vivid colours and uttering short harsh screams all the while, ultimately returning to perch beside his mate.

The nest is placed in a hole in a tree or building and is generally lined with a varying amount of vegetable fibre, grass, a few feathers or some old rags, but the lining is often omitted altogether. Four, or sometimes five, glossy-white eggs are laid. The young are quite naked at first, but, later on, when the feathers have grown, are marked with vivid blue like their parents. Mr. Aitken considered the parent birds very wary and the nests difficult to discover, but in Bihar at any rate this is not the case, it being one of the easiest nests to find, the birds continually chasing away any intruders that come near the nesting site.

Besides being an ornament to any landscape, the Indian Roller is an extremely useful bird, as its food consists almost entirely of large insects, such as grasshoppers, crickets and beetles, varied by an occasional small mouse, frog or snake. One kept by Mr. Finn even digested a toad, which must have been a very "tasty" morsel. The late C. W. Mason examined the stomachs of eighteen birds between January and October at Pusa and found[1] that of 412 insects taken by these birds, only 4 were beneficial, 111 were

---

[1] *Mem. Dept. Agric. India, Entl. Ser.*, vol. III, pp. 155–159.

injurious and 297 neutral. Of the injurious insects taken 52 were grasshoppers, 18 crickets and 23 caterpillars, mostly cutworms, so that the good done by the destruction of these injurious insects far more than counterbalances the fact that a very few beneficial insects were taken.

It is therefore unfortunate that the Roller's brilliant plumage should frequently lead to its being shot by Europeans, especially in the neighbourhood of military cantonments, for the sake of its wings. According to the late C. W. Mason, " being one of our common species of birds, and the gaudy colour very striking to any one new to the Country, numbers of these birds are shot by Europeans in order to send one or two wings home, and they are sent home not declared, or falsely declared. From what I have seen, I do not imagine that more than one out of six pairs of wings ever sees the destination for which they were originally obtained. Some specimens are not good enough, while others are put away, forgotten, and eventually thrown away." It should therefore be noted that the Indian Roller is protected, under the Wild Birds and Animals Protection Act, throughout the whole year in Bihar and Orissa and in Delhi. In view of its beneficial activities to the Indian *raiyat*, it is to be hoped that the numbers of this bird will not be allowed to diminish throughout the area of its occurrence.

This bird is sacred to Siva and it is said they are liberated during the Durga Pujah.

Falconers fly the Red-headed Merlin (*Æsalon chicquera*) at this bird. Jerdon says " it is often baulked by the extraordinary evolutions of the Roller who now darts off obliquely, then tumbles down perpendicularly, screaming all the time, and endeavouring to gain the shelter of the nearest tree or grove."

SOME LABOUR-SAVING DEVICES IN PLANT-BREEDING.

BY

ALBERT HOWARD, C.I.E., *Imperial Economic Botanist*; AND G. L. C. HOWARD, M.A., *Second Imperial Economic Botanist.*

THE investigator concerned with the improvement of crops is constantly liable to the danger of being overwhelmed by detail. Cultures multiply rapidly, the number of samples of seed involved soon runs into thousands and it is necessary to record every year a considerable amount of detail. To be of any value the work must be accurate and the experimental error must be reduced to the lowest limit. As long as the crops are in the ground, if the danger of cross-fertilization is avoided, no particular harm can occur. The moment, however, a culture is harvested many things are possible. Between reaping and sowing, any plant or any series of plants have to be handled a good many times, the seed has to be examined and afterwards stored till planting time comes round again. If the investigator aims at the personal supervision of all essential details, it is obvious that he must utilize every possible device which saves time and fatigue and which also prevents mistakes. The present paper deals with some of the methods employed in the Botanical Area at Pusa in dealing with the numerous cultures involved in the plant-breeding work. As correspondents and visitors have frequently asked for information on these matters, it is considered that a brief account of some of the labour-saving devices in use may prove to be of general interest.

THE PREVENTION OF CROSSING.

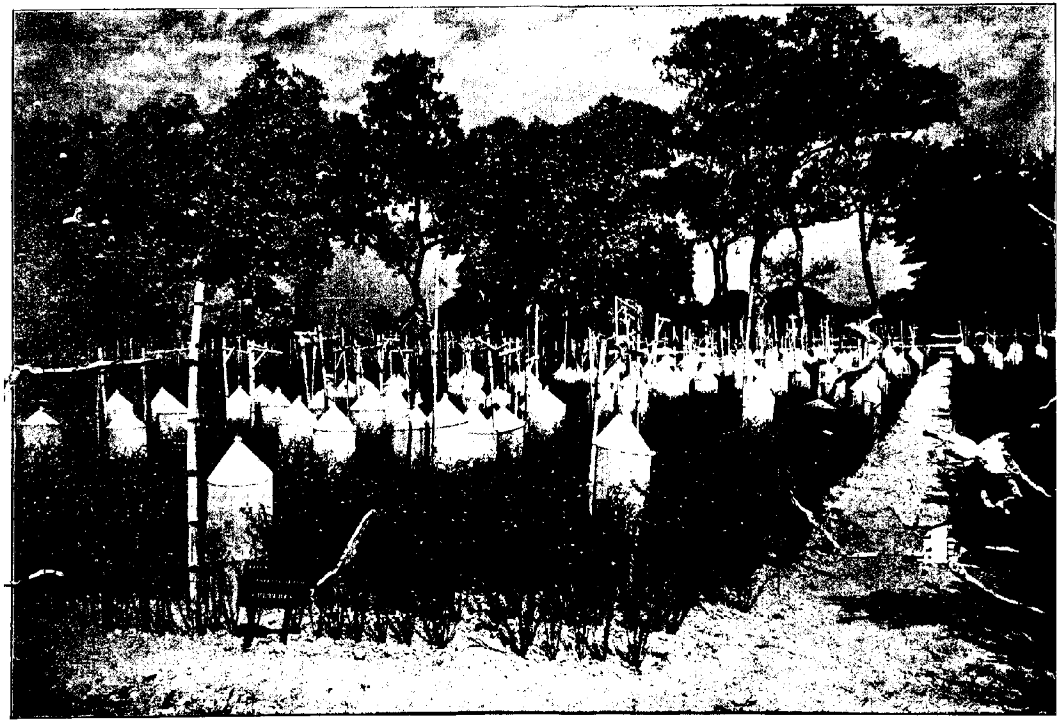
A combination of high temperature and high humidity reduces very considerably the value of the perforated parchment bag in

India for the exclusion of foreign pollen. The amount of seed set under these conditions is often small, the bags have to be moved constantly to allow for growth, while accidents due to wind and rain are frequent. Far better results are obtained with infinitely less labour and risk by the use of the cylindrical muslin cover illustrated in Plate I. These are made of three bamboo rings which are covered by the ordinary muslin of the bazaar. For most purposes the total length need not exceed 30 inches and a diameter of 13 inches is convenient. These completely enclose small plants like linseed or gram. For taller plants like tobacco, the inflorescence only need be covered. In cases of very tall plants like jute (*Corchorus capsularis*, L.) or *patwa* (*Hibiscus cannabinus*, L.), which bear flowers on a large portion of the stem, much longer covers are desirable which allow for growth, and which are best attached soon after flowering begins. These muslin covers are easily washed after use, they last for two seasons and are easily stored. No cases of cross-fertilization have been detected through their use.

THE HANDLING OF SINGLE PLANTS.

Both in investigations on the inheritance of characters and in selection work, the seed of numerous single plants has to be harvested and rigidly kept separate. Frequently, when the seed is saved, it is still too moist for examination and storage and one of the difficulties is to dry and keep separate these large collections of damp seed while at the same time preventing any admixture or loss.

Drying boxes, 5′ by 3′ and 5″ deep, the frames of which are made of $\frac{7}{8}$″ sal wood with wire netting ($\frac{1}{2}$″ mesh) above and below, are used for each set of cultures. These boxes are provided with hinged lids and snap locks, two pieces of $\frac{1}{4}$″ bar iron support the wire netting sides and thin galvanized wires are stretched across the frames inside the box to prevent the bags slipping about while the seed is drying. When the seed of any particular set of single plants has to be saved, the bags are placed at once in one or more of these drying boxes, the box is labelled and the lock closed. The locked boxes are placed out in the sun every day till an opportunity occurs for the examination and storage of their contents. By this



MUSLIN COVERS WITH LINSEED

means, personal supervision is only necessary at the collection, examination and storage of the samples. The rest is routine under conditions where no mistakes are possible. No time is lost in sorting the samples which would occur if several sets of loose seed bags were dried together.

After threshing, the seed of single plants has to be stored and it is often desirable to keep them together in sets. The seed envelopes of strong tough grey paper, known as the Girdwood post-sample bag,* have proved exceedingly useful for this purpose and they last for many years. They are 5″ by $2\frac{1}{2}$″ in size and are closed by a push-in flap which is very effective and which will stand frequent handling. No separate labels are needed as the culture numbers are written on the outside of the envelope. For examining the seed of single plants and for transferring it to and from these envelopes the flat triangular grain scoops used by corn merchants save much time. Besides their use for storage, these seed envelopes are very convenient in other ways such as the despatch of small samples of seed to and from correspondents. It is not unusual in India to send small samples of seed sewn up in pieces of cotton cloth or to despatch several kinds in ordinary thin letter envelopes enclosed in an outer envelope. In the first case, they frequently arrive with the labels torn and the place of origin lost. In the second case, the thin paper generally bursts in the post and the samples arrive all mixed together in the outer envelope. It saves a great deal of time and trouble to all concerned if empty seed envelopes are enclosed when writing for seed.

Variety trials.

The difficulties to be overcome in the trial of varieties and in the interpretation of the results are well known. Such difficulties are by no means confined to the arrangement of the field plots but are encountered at other stages of the work. As in the case of single plants, it is equally essential in dealing with large cultures to ensure that no accidents or mistakes occur between reaping and

* These seed envelopes are manufactured by Messrs. Blake & Mackenzie, Ltd., Islington Liverpool, England.

threshing and between threshing and storage. After reaping, it is often necessary for the crop to dry for a day or two before threshing can be carried out and further drying is necessary before the grain is stored. Admixture and theft are almost bound to occur at all stages unless special precautions are taken.

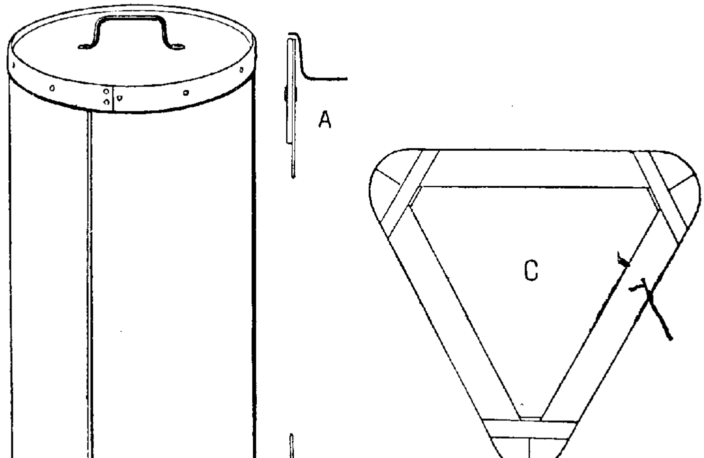
In connection with variety trials in the Botanical Area at Pusa, a large wire netting drying house, provided with a slightly raised brick floor, has been in use for some years and has been found of great assistance. The plots are reaped and immediately transferred to the drying house where the produce is allowed to dry under lock and key till threshed. This building is provided with sufficient floor space for two large plots with a vacant place between, across which a sheet can be stretched to prevent any admixture. There are large sliding doors at either end so as to admit of the easy entry and removal of produce. The floor of the drying house at Pusa is 50′ by 25′, the height to the ridge is 18′, to the eaves 12′. The sliding doors are 8′ by 9′. The wire netting used is $\frac{3}{4}''$ mesh and is supported by angle and bar iron at suitable distances.

The chief point in threshing experimental plots is speed. The whole process, including separation and weighing, should be completed in one shift and nothing should remain lying about at night. This is a powerful argument in favour of reducing the size of the plots as far as is agriculturally expedient. For threshing purposes a small machine driven by a bullock gear is employed. After weighing, the grain is dried for a day on strong sheets in the drying house before storage. If a good labour force is concentrated on threshing and separating, the work is got through very rapidly with the minimum of time and trouble in supervision. Such attention is obviously necessary as there is little purpose in laying out elaborate field experiments of this kind on paper and then leaving such essential matters as the actual determination of the yield to chance. In such work, principles and procedure must closely correspond.

THE STORAGE OF SEED.

The question of seed storage in connection with plant-breeding work is important. It is necessary, not only to keep seed during the rainy season but also to preserve the germination capacity for several years, so that any particular culture of a series may be repeated whenever required. The method adopted at Pusa is to dry the seed thoroughly in the sun and to put them away immediately in air-tight seed bins. Insecticides like [illegible] and carbon bisulphide have been found to be unnecessary as the [illegible] of stored grain are unable to attack *dry* seeds under these conditions and even if a few of these insects are sealed up with the produce no damage occurs.

The seed bins are, in principle, nothing more than the ordinary earthen *kothis* used by the people but they are made of the thin sheet iron ordinarily purchasable in any bazaar. They were designed for Pusa by Mr. S. A. S. Bunting, formerly Agricultural Engineer in the United Provinces. The essential structural details are shown in the figure below. The bins are cylindrical in shape, 36 inches high



and 18 inches in diameter. The method of constructing the lid is indicated at A and the details of the floor at B. The lid has to be pressed in firmly after the method often employed in tin canisters. To render the longitudinal seam air-tight, the thin sheet iron is folded. The metal can be preserved from rust by coating inside and out with hot tar in which a suitable proportion of pitch has been dissolved. A number [illegible] painted on the lid and on the cylinder, and as the lids [illegible] best in one position this should be indicated by a white line. The numbers not only prevent the lids being mixed but also greatly facilitate the search for any particular sample of seed. To prevent the condensation of moisture on the bottom of the bin and the destruction of the metal by rust, it should stand either on bricks or preferably on a wooden triangle about an inch thick provided with rounded corners. One of the wooden bases is shown in plan at C in the sketch. After the lid has been pressed in, the bin should be hermetically sealed round the upper rim with wax which will not melt during the hot weather and which will not crack during the monsoon. A wax mixture suitable for the temperature at Pusa can be obtained by melting together 4 parts of vaseline with 5 parts of bees-wax and slowly adding 2 parts of powdered rosin. For very high temperatures, the proportion of bees-wax and rosin should be increased. A large number of sample seed bins have been supplied to correspondents in India and many copies have been made. They are now manufactured in sets of 100 by Messrs. Burn & Co., Howrah. For storing seed in bulk for distribution, larger sizes are desirable. Seed stored in this manner retains its germinating power for many years.

CHARLES ALFRED BARBER, C. I. E., Sc. D. (Cantab.), F. L. S.

Dr. C. A. BARBER, C.I.E., Sc.D. (Cantab.), F.L.S.

BY

J. MACKENNA, C.I.E., I.C.S.,

Agricultural Adviser to the Government of India.

By the retirement of Dr. Barber, Government Sugarcane Expert, the department loses one of its most popular and most distinguished members.

Charles Alfred Barber was born on the 10th of November, 1860, at Wynberg, South Africa, son of the Revd. William Barber, missionary there. As a boy he was much interested in natural history and soon knew every beast and bird and plant. He came to England in April 1871, and was placed at New Kingswood School at Bath till 1877. Here no science was taught, but he worked at chemistry and geology privately.

He entered the Manchester and Liverpool District Bank, Newcastle-under-Lyme, in 1878; passed through the five years' apprenticeship, qualifying for a head-clerkship or for an accountantship in a small branch. But, during his spare time, Barber had been attending classes in chemistry, and had been privately studying geology and botany. He matriculated in honours and passed the First B.Sc. of London University.

He decided in 1883 to devote his time entirely to science and went to Heidelberg and subsequently entered Bonn University for a year (1883–84). Here he studied chemistry, physics, mineralogy, zoology and botany. In these studies botany soon took first place because of the excellence of the teaching. The full course under Professor Strasburger consisted of 184 lectures and there were special courses under Scmitz in mycology and Schimper in plant distribution. In chemistry the full course was under Professor Wallach, and for some time he worked in the same laboratory as Mr. J. W. Leather whom [illegible] he was to meet later in India.

Barber entered Christ's College, Cambridge, in 1884. He was too old for an entrance scholarship, but was placed equal with the senior science scholar in the first examination of the year, and was granted a major foundation scholarship which was continued for seven years. He gave up chemistry because of the poor equipment of the laboratories and took up botany, zoology and human physiology. During his first year at Cambridge, Barber acted as demonstrator in elementary biology and, in the third term, was asked to assist Dr. Scott at University College, London, in preparing students for the elementary and advanced examinations of London University. Owing to the sudden death of Professor Huxley, Dr. Scott succeeded him in the teaching of the botanical section at South Kensington, and Barber was charged with the whole work at very short notice. He continued this teaching for three years while carrying on his studies at Cambridge. He took Part I of the Cambridge Science Tripos in 1888, and Part II in 1889, obtaining a first class in each. Having assisted in teaching elementary biology for several years, Barber was offered work as demonstrator in zoology and also demonstrating work in human physiology by Professor Foster. But he decided to take up botany and became University demonstrator in 1889. Owing to the great expansion in the school then taking place, Barber had a large portion of the lecturing, especially for the second part of the Tripos, and was in chief charge of all the demonstrating in the school. He published six papers in the "Annals of Botany," chiefly on fossil botany, and became examiner in botany in Oxford University and assistant examiner in London University and elsewhere.

Barber left Cambridge in 1891 to take up an appointment as Superintendent of Agriculture in the Leeward Islands. He had charge of gardens in Antigua, Montserrat, Dominica, St. Kitts and Virgin Islands, with, later on, a fibre plantation in Anguilla and a sugar plantation in St. Kitts. Owing to the fall in the price of sugar, the Islands became bankrupt and the appointment ceased in 1895, ten years' pension being granted by the Colonial Office.

After temporary work at the British Museum, Barber was appointed to succeed Professor Marshall Ward in the teaching of botany at the R. I. E. College at Cooper's Hill. He commenced the study of the internal morphology of timber and published one paper on a fossil Gymnosperm in the "Annals of Botany." He also acted as Professor of Botany at the Royal Holloway College at Egham, and did a good deal of examining.

In 1898 Barber left Cooper's Hill to take up the appointment of Government Botanist, Madras, with the idea of completing the collections of the Madras flora and the preparation of a description of it. He was appointed Director of the Botanical Survey for South India, including Madras, Hyderabad, Mysore, Travancore and Coorg and Cochin. Almost at once, however, the study of diseases in crops was added to his other duties. Commencing with the sugarcane, this was afterwards extended to groundnut and later on to pepper. He founded three farms for the study of these staples, at Samalkota, Palur, and Taliparamba, respectively. In addition to the survey, therefore, a considerable amount of agricultural work was required and to this was gradually added economic botany, entomology and mycology. During this period his spare time was devoted to the study of Haustoria of the Sandal, *Cansjera*, *Olax* and *Ximenia* and four Memoirs were published in the Botanical Series of the Agricultural Department of the Government of India. For this and previous research work, the degree of Doctor of Science at Cambridge University was awarded in 1907. In 1908, while on ten months' study leave, he visited all the important agricultural colleges in the United Kingdom and prepared a history of Kew Gardens for the French Government.

Barber returned to India in 1908 and joined the new Agricultural College at Coimbatore, in charge of the botanical, entomological and mycological sections. Of the two latter branches he was relieved by the appointment of an Entomologist and a Mycologist. The stereotyping of a series of lectures on botany and agricultural botany for Madras was the chief work during these years, but he also commenced the study of Indian cottons and other economic work as time permitted. He was examiner in Madras University for 10 years and a frequent contributor of leaders to the "Madras Mail."

In 1912 Barber was appointed Sugarcane Expert for the whole of India, but was posted under the Madras Government, and opened the Cane-breeding Station at Coimbatore. This appointment was prolonged from time to time because of the war and the difficulty of finding a successor. As a reward for his distinguished service he was admitted a Companion of the Indian Empire in June 1918.

As a scientific worker Dr. Barber was distinguished for accuracy and method. He was possessed of enormous industry. The series of Memoirs on sugarcane published by the Department of Agriculture are a mass of accurate information on the subject, while his observations and conclusions have been tabulated with such precision that his successor will have no difficulty in taking up the work at the stage at which it was left. By his retirement Government has lost a worker of first class distinction, but it is to be hoped that we shall indirectly, for many years to come, benefit from his work.

Barber was possessed of a very fine physique and had a distinguished athletic record. At school he was a successful sprinter, while he won his colours at cricket and was one of the football captains. At Christ College, Cambridge, he won his colours for tennis and for Association football and was first in the high and long jump in the college sports. At Cooper's Hill he played regularly in the football and tennis teams. On the æsthetic, as opposed to the athletic, side, Barber was no less distinguished. He was a first class photographer and also did a considerable amount of painting, appearing frequently in the prize list of the Madras Fine Arts Exhibition.

Barber was no less happy in his home than in his official life, and many of us will remember with pleasure the kindly hospitality extended by Dr. and Mrs. Barber to visitors to Coimbatore. It is difficult to realize that the age limit forces on to the pension list men with such reserve of energy or so physically fit as Dr. Barber was when he left India, and we look forward to seeing further scientific contributions from his pen compiled in the peaceful and congenial atmosphere of Cambridge. We are sure that the good wishes of all members of the department follow Dr. and Mrs. Barber in their well-earned retirement.

CO-OPERATIVE LAND MORTGAGE CREDIT FOR INDIA.

BY

H. R. CROSTHWAITE, C.I.E.,

Registrar of Co-operative Societies, Central Provinces and Berar.

It is not by augmenting the capital of a country, but by rendering a greater part of that capital more active and productive than would otherwise be so, that the most judicious operations of banking can increase the industry of the country. ["WEALTH OF NATIONS."]

WITHIN the short space of a decade and a half the co-operative credit movement has made phenomenal progress in India. That fact it is impossible to dispute. True, there are those who lament the slowness of development. In opposition to them, critics have come forward to pounce upon a comparatively few instances of failure as proof of an unhealthy desire to show big results in the shape of what is termed "an imposing array of figures." "You are going too fast!" groans the one school, forgetting that if an aeroplane had never crashed Alcock and Browne could not have flown the Atlantic. "Hurry up!" grumbles the other, being in the happy position of watching people work while it does the talking. But, if there is any truth in the statement that the co-operative movement has been forced ahead too fast, then who, it may be asked, has made the pace? Certainly not the Registrars of Co-operative Societies, nor the small number of men working directly under them. Once started on its way by Government, the movement has gathered impetus, as Government hoped it would. Its finance is already far too big a thing for the commercial banks to handle. More than that, the amount of money required by co-operators is so enormous that it is impossible for the State to assume any specific responsibility for the safety and solvency of their institutions. What right, indeed, has Government, an entity which is responsible for every part of the body politic, to guarantee the solvency of one particular part of that body without the intelligent consent of the other parts? The tax-payer's money goes into one common purse; and as it is for their own benefit that men join co-operative societies, it is difficult to understand the argument that it is right to rob poor A, who is a private trader, in order to reward B, who is already trying to diminish A's profits—and incidentally put money in his own pocket—by means of co-operation! The simple fact is that the co-operative credit movement is spreading in India because, by means of good organization, it can provide borrowers with credit on reasonable terms and, at the same time, offer a safe investment to lenders. Incidentally, the organization of small credits has been of great service to the country because it has brought into circulation a vast amount of idle money; and it is in this direction, and not in adding to the strain to which the Presidency and other trade banks are subject, that further development is to be looked for. Sound economy and good morality march together, and it is not, as a rule, until a man has reaped some material benefit from listening to the advice of others that he is in a frame of mind to consider their professions of anxiety for his moral welfare. Money is said to be the root of all evil; but everybody wants to have the tree in his own garden. We may, therefore, bear with good-humoured tolerance the disparaging remarks of persons who affect to despise the quality of the co-operative movement in India because it has not converted human beings into saints. We can, also, neglect the views of those who urge that co-operative land mortgage is a sordid business which it is impossible to turn into a means of moral education, and that *for this reason* it should not be attempted. What it is necessary for the political economist to examine is (*i*) whether co-operative land mortgage can benefit India, (*ii*) whether, and under what conditions, this particular form of co-operative effort is possible in India, and (*iii*) whether the enormous sums of money which are required for organized land mortgage credit can be found in India. In discussing the questions thus raised it will not be necessary to weary the reader by any very detailed references to the methods employed by other countries.

The problems of India are peculiarly her own and bewilderingly complex. Land tenures vary from province to province and from district to district. But wherever a local law debars a holder of land from registering a deed of mortgage in respect of his rights, it is obvious that any kind of organized mortgage credit is impossible. The differences between co-operative credit, of the type which is based on personal knowledge and proximity, and co-operative land mortgage credit are radical in kind. The former, being based on the credit of character, is ephemeral, and is, therefore, unsuited to the making of initial contracts the terms of which cover long periods. The latter, being secured by real estate, is stable enough within the limitations imposed by prudent valuation and the credit of Government. The man who lends upon the security of land, with a tolerably wide margin between the amount he lends and the value he places on the land, is safe enough unless a wave of Bolshevism engulfs his investment. The same cannot be said of the lender who makes a long-term loan on the strength of personal character pure and simple. True, a co-operative credit society, of the type which pledges the unlimited liability of all its members, does back its debts with some real property. But just what that real property may happen to be in the event of forced realization is problematical at any time, and, in respect of a distant future date, is extremely problematical. The asset of character implies the possession of earning capacity, and it is, therefore, an asset which is peculiarly liable to deterioration and which, from the lender's point of view, must be carefully watched. An epidemic of influenza or of cholera may cause a flourishing society to disappear simply because the members who were its strength and support have left the world. Shocks of this kind are provided for in the various systems of personal co-operative credit by a large paid-up share capital, by reserve funds, bad debt funds, and other financial devices.

But the essence of the systems which are based on combinations of personal liability is really this. Borrowed money must be profitably used and paid back out of profits with the least possible delay. It must be understood, also, that the capital turnover of the provincial and central banks which serve rural credit societies cannot be as brisk as that of the banks which serve commerce, for the cycle of agriculture includes crop failures as well as bumper harvests. Nor yet can that same capital turnover approach in ease and rapidity that of a bank suitably designed for the purpose of granting land mortgage credit ; and, as, even with the best of good fortune, short-term agricultural loans have an uncanny way of becoming long-term ones, it behoves the directors of provincial and central banks,—banks designed for a certain class of work only,—to guard against the dangers which arise from locking-up too much of other people's money. To attempt to turn central and provincial banks of existing types into co-operative land mortgage credit banks would be an experiment attended by numerous dangers, and the wisdom of any such step may well be doubted. In addition to the financial difficulty just indicated there may be mentioned the problem of land valuation. A big landed estate is, in India, frequently valued by the simple process of taking a low multiple of the land revenue assessed upon it ; and the same method has, at times, been employed in Germany and other countries. But, as we all know, this method of valuation is, at best, a rough and ready one. It has this virtue,—it will not, as a general rule, overvalue the property. On the other hand, it is defective from the borrower's point of view because it deprives him of the benefit of the true money equivalent of his estate. Half a loaf, in the shape of an inadequate loan, is not always better for the borrower than no bread at all. There are many men who, finding themselves in financial trouble, pay off the most importunate of their creditors by borrowing where they can. They go down the road to ruin by stages, as it were,—each stage more expensive than the one before it. Their interest charges increase, they have to fee lawyers and to keep up an appearance of prosperity lest it may be supposed that they have reached the end of their financial tether.

For such men, the relief obtained from commercial banks and private lenders is, as a rule, of a temporary nature. We cannot blame the commercial banks and private lenders; their point of view is the ordinary business one. They are intent on making money for themselves or for their clients, and the moral and material benefit of the borrower is not their affair. Bitter experience has taught them how difficult it is to value agricultural land; how troublesome it is to bring it to sale; how large the margin between loan and assumed value must be. They know that, as a rule, they cannot avail themselves of that proximity which alone can produce an accurate appreciation of borrowing capacity. These are some of the disadvantages of lending money on large estates, and they become very much more formidable in the case of small ones.

Next, let us glance at the circumstances which affect the market value of small holdings. First of all, there is the productive capacity of the soil which often varies from field to field. Then, there is the fact that the average value of an acre of land in a village area is based, as a rule, on a very wide range of values. The parcel of land in question may be split up, and usually is split up, into bits and is scattered over the village area. One field may be close to the *basti* and exceptionally valuable; another, on the fringe of a patch of jungle, may be ravaged by wild pig; the crops grown on another may, for some mysterious reason, be peculiarly subject to wilt. Add to these sufficiently formidable complications those which arise from the vagaries of the many laws which govern the conditions of land tenure, and the lending of money on the mortgage of small holdings stands revealed as a very dangerous kind of business for those who, lacking the needful equipment, would go in for it on a large scale. On a small scale, and in cases in which full local knowledge is available, it is probably safe enough for parsimonious lenders,—but whether it is to the ultimate benefit of a borrower to execute a first mortgage in consideration of a loan which is small in proportion to the credit which his land can support, is another matter. In particular, although a man who wants certain fields in order to cultivate them himself, can always get his money back unless he has been led astray—as sometimes happens—by miscalculations caused by an unreasoning hunger for land, prices secured at court sales and, as a last resource, cultivating profits are notoriously small when an absentee owner, whether a bank or an individual, is forced into reluctant possession. There is, for instance, the classic instance from Germany, in which a co-operative society found itself the proprietor of a theatre and of dwelling houses saddled with heavy charges. If, then, co-operative central and provincial banks, designed for the express purpose of dealing in personal credit, are misled by sentiment or bad advice, and, in the end, find themselves in possession of villages, houses, and land which they cannot maintain but must sell, there will indeed be some bargains on the market. But the people getting the bargains will do so at the expense of the banks. As for the banks what, it may be asked, was the ultimate fate of the foolish virgins in the parable ? And, on the other hand, what of the over-confident borrower who has mortgaged his land for inadequate consideration, and then finds himself deprived of further credit because the lender does not wish, or does not find it convenient, to reduce his original margin of security ?

However, let us attempt to find some way out of Indian difficulties and find answers to the three questions already stated. Firstly, "Can co-operative land mortgage benefit India?" To this there can be no hesitation in replying that undoubtedly it can. For the improvement of agriculture, for the adoption of machinery and modern methods, the employment of capital is necessary ; and there must be many owners of considerable estates, whether in the shape of large home-farms or otherwise, who would like to turn the expert demonstration and teaching of the Agricultural Department into something concrete, and of direct personal interest, in the shape of additional income. Modern farming, however, is a business which must be supported by plenty of ready money ; and cash in hand seldom figures as one of the main items in a landholder's balance sheet. Then, again, many a landholder, solvent enough at present, has contracted a mortgage debt on conditions which he finds far more onerous than he expected. For him, the amortisation of existing debt on easy terms must precede any investment of capital in agricultural machinery, in wells, in pumps, in large quantities of manure. There are at least three great problems which India has to solve if she is to develop into a well-balanced country. One of these is the increase of her population in order to supply labour for industries ; another is the increase of her food supply in order to feed an industrial as well as an agricultural population. It is not necessary, surely, to elaborate the argument that capital will be wanted, in very large amounts, by the land, which, if it is to meet a growing demand for food, will have to be made far more productive than it is at present. The third problem is that of prices. Unless industrial expansion is accompanied by the intensive development of agriculture, the price of food and wages will rise to such an extent as to prejudice the sale of the products of Indian industry. There has never yet been a country which could confine its trade to itself ; the different classes of which could live, as it were, by taking in each other's washing. India will certainly want to buy from and sell to other countries ; and, in the vortex of world trade, the prices at which she can sell will be limited by competition. Agricultural credit is, therefore, a subject which demands the closest attention, for it is, in fact, the foundation on which the future of India is based.

The second question with which we have to deal is whether, and under what conditions, co-operative land mortgage credit is possible in India. This form of co-operative effort is, of course, possible. But such a statement rests on several important assumptions. It must, for instance, be taken for granted (*i*) that the laws of the land will be modified, where necessary, so as to favour an organized system of land mortgage credit, (*ii*) that owners of land will combine with each other in order to better their credit because they understand (*a*) the necessity for intensive cultivation, and (*b*) how to cultivate intensively, and (*iii*) that the necessary organizing agency is placed at the service of landowners. It is easy to argue that if landowners cannot organize themselves nobody else can do it for them. The argument is a resounding one which appeals to vested interests and to overworked officials. It belongs to the same family as the statement that "Nature abhors a vacuum"—which served the purposes of Natural Philosophy for nearly two thousand years until Galileo observed that water could only be raised to a limited height by the creation of a perfect vacuum. But it does not fit in, somehow or other, with the lessons which the war has taught us. The sounder point of view appears to be that which envisages the imparting of all essential education as a duty which the State cannot shirk, and which understands that the question of a country's food supply is one which cannot be neglected with impunity. The justification for the existence of a department of agriculture is that it provides a means of education,—not that it can till the fields itself but that it can teach the cultivator to obtain heavier crops. Food being a necessity for all men, and the State being merely another name for its inhabitants, measures to make food better, cheaper, and more plentiful are essentially the business of the State. For this reason, public money is rightly invested in State departments which educate the producer to better business, better farming, and better living. It is the special work of such departments to inculcate the principles of self-help, and to train and strengthen certain parts of the body politic so that there may be a contented and prosperous whole. It is certainly not the legitimate business of any Government department to weaken the body politic by spreading economic fallacies,—by teaching ignorant people that State help, whether in money or in service, is a substitute for self-help. If the members of a family say, each one of them to himself, "I need not work. The rest of the family will feed me," that family must consume either its savings (if it has any), or its borrowings, or exist on charity. In the end, the members must produce food or starve. And in the task of production every member ought to take a suitable part. The economy of a State is very like that of a family. Before proceeding further, then, it may be postulated that the introduction of a regular system of land mortgage credit in India will certainly require State guidance and supervision, but not State money whether in the shape of subsidy or loan. The success of a land mortgage credit association depends entirely upon the capacity of its members to manage their own affairs up to a certain point. Beyond that point, a system of co-operative mortgage credit becomes the business of the State and merges in the general scheme of State finance.

Societies dealing in co-operative mortgage credit have a semi-official character. They work under Government supervision and inspection, though their members do the detailed work themselves. In case of non-payment by a member they have the right to proceed to the administration of the mortgaged lands or to compulsory sale by auction, without recourse to the law courts. But the levy of a fine or penal interest always precedes drastic action. The servants and officers of the societies are indirectly servants of the State, and generally they have authority to sign certain public documents, such, for instance, as the certificate required before summary procedure is taken. The universal type of co-operative land credit society is a non-profit seeking association of proprietors of land, organized for a province or for some other administrative unit. Individuals become members when the association becomes a mortgagee of their property. Membership ceases with the redemption of the mortgage. Just as in all other co-operative credit the main merit of this particular form of it lies less in the substitution of wholesale dealing for retail, than in the interposition of a body between borrowers and lenders, which, although composed exclusively of borrowers, has a supreme interest in safeguarding lenders. As a class, all co-operative land credit societies have in their organization and in the management of their affairs certain features in common. Their object is to obtain for their members the credit they require by means of bonds, freely transferable and readily negotiable, which the holder can convert into cash, at any time if he sells in the open market, at six months' notice if he demands payment from the society. To provide for demands of this nature (*a*) reserve funds are accumulated, (*b*) the right is sometimes retained to charge mortgagor members the same rate of interest as a society may have to pay for loans taken and consequent on such demand, (*c*) members undertake a limited liability for supplementary contributory payments (as temporary accommodation to the society) amounting to from 5 to 10 per cent. of indebtedness incurred. Methods (*b*) and (*c*) are not common, (*a*) being sufficient as a rule, as all sinking fund payments,—*i.e.*, payments towards the fund which accumulates at compound interest and from which the debts of members are extinguished by the society,—are made available as a reserve not only for this purpose but to meet claims put forward by bondholders whose bonds have matured, should the collections from members fall below the requisite amount. By this means the society gains time, and keeps neither its members nor its creditors waiting for cash. Formerly, a society's bonds were guaranteed by the landowners of the province or unit collectively. In some of the oldest European countries this collective guarantee is still in force, either for all the estates entitled to obtain mortgages or for the estates actually mortgaged. It seems improbable that Indian landowners, even though close neighbours, would ever consent to furnish a collective guarantee; and it is, therefore, satisfactory to be able to record that, in the more modern societies, the specific security held by the society for its loan, *plus* a limited contributory guarantee, is considered all that it is necessary to ask a member to provide. The latest type of society appears to favour the initial guarantee which is furnished by a substantial share capital, but this, also, is a development which would probably be unsuited to Indian conditions. In all societies the supreme authority is vested in the general meeting of the members. Then come the central committees of management, and then the local or district committees. The Syndics, or expert legal members of the committee of management, conduct the current business of the society. They are paid and, in most cases, are bound exclusively to the service of the society. The landowning members of the committee are generally unpaid. The task of land valuation is performed by the Local Committees who are selected from members resident in the neighbourhood of the land to be valued and not very heavily in debt to the society. Local knowledge, in fact, is always made the utmost use of. To be quite safe, no society grants loans in excess of a certain proportion of the valuation made on the land, the usual limit being 66 per cent. Great care is taken to see that payments both on account of interest and amortisation (or to sinking fund) are regularly made, and that mortgaged property is not allowed to deteriorate. On the other hand, if the objects stated by the borrower are approved and the valuation shows that the security is good, loans are never refused and cannot be called in suddenly except, of course, as a penalty for misconduct. The mortgagor is at liberty to redeem his property before the date stipulated and, in fact, he can repay as fast as he likes. Members who borrow have to make certain contributions towards working expenses and reserve fund—the "reserve fund" being, in the case of these societies, something quite different to the permanent and indivisible reserve fund of the Raiffeisen system. Loans are paid to members in bonds not in cash. The borrower either disposes of the bonds in the market, or, in those cases in which the societies have established their own special banks, takes them to the society's bank for sale or for pledge against a loan. Holders of bonds issued possess no right against any specific real property, but only a right to recover from the society. Conformity between bonds and mortgage claims is, however, fully secured; bonds do not become legally valid documents until completed by the supervising officials, upon whom it is incumbent to ascertain by inspection of the public register of title that a like amount is secured by mortgage upon property and that such mortgage claim is also definitely assigned to meet the bond claim. In face of this assignment the registry official may only cancel the mortgage charge on proof that bonds of like value have been withdrawn from circulation. Bondholders have not, however, claims against specific properties thus mortgaged and earmarked; the method indicated merely guarantees that there are never more bonds in circulation than are covered by mortgages, and that other credit operations likely to weaken the security of the bonds are not undertaken by the societies. First mortgages only are dealt in; but societies grant loans to pay off previous mortgages. The bonds, as ought to be the case in British India, are legally recognized as trustee securities. Issues of bonds are made in distinct series; every series carries the same rate of interest, and is dealt with as a distinct issue, having its own management fund, reserve fund, and sinking fund. In order to float the bonds the societies have united to form their own special banks which are more or less under State control, are recognized as places for the deposit of trust moneys, and are not conducted for the sake of profit. All the profits made by these banks, which are at liberty to engage in any banking business which is not speculative, go to the reserve amortisation funds of the societies. The regulations concerning amortisation differ widely. It is, however, the general rule that the contributions towards redemption are not applied to the immediate reduction of the debt, but are accumulated in a special fund. The fact that most societies allow the withdrawal of accumulated contributions or readily grant fresh mortgages prevents the proper aim—complete removal of indebtedness—from being realized. On the other hand, it is urged that, unless such facilities are granted, landowners may be obliged to seek mortgage credit elsewhere and on more unfavourable terms. Various proposals have been made to secure complete removal of indebtedness; one, for instance, is that the mortgagor should pay an insurance rate for a redemption policy in addition to his annual amortisation payment to the sinking fund; another that the amortisation payment should be devoted to a life insurance policy.

The principal merits attaching to a mortgage credit association as an agency for providing the landowner with long-term credit may be summarized as follows :—

(1) They enable landowners to mobilise the wealth represented by their landed possessions by the creation of bonds passing into the general system of securities. These bonds are not, like an ordinary mortgage security, of very restricted currency but are realizable at any time in the open market.

(2) The loans granted are not subject to recall.

(3) The rate of interest is as moderate as possible—far more moderate than the borrower could secure if single handed, and is regulated by the market rate.

(4) The rate of interest cannot be raised.

(5) The right is conceded to reduce the debt by payments made at the mortgagor's convenience.

(6) The necessary extinction of the capital debt is accomplished gradually.

(7) The costs for valuation and other charges are low.

(8) The administration is at once relatively inexpensive and the officeholders highly qualified for their work.

Even this cursory examination of the machinery for co-operative land mortgage credit will, it is hoped, show that there is nothing to prevent the establishment in India of societies and banks for this special work. It may be exceedingly difficult to organize and start such societies and banks; but that is no reason for not starting them. It may be that landowners will, at first, view the new idea with suspicion. That, however, is not an excuse for refusing to take action. It may be that the State will have to appoint special officers to organize and assist this very difficult branch of co-operative work. That, however, is exactly what other countries have had to do. The co-operative movement in India is still too young to be able to think out for itself advanced applications of the main principles upon which all forms of co-operation are based. And in order to organize mortgage credit societies and to manage the special banks there must be skilled and experienced men who will devote their undivided attention to the work. It is not understood, perhaps, that banks of the kind we are now discussing can discount the paper of the existing types of central banks and rural credit societies and can, under certain conditions, make loans to them, adding profits to their own fund for debt extinction and thus making agricultural money help agriculturists. It is, in fact, only by making the fullest use of the solid backing which landownership gives to their operations, a backing which is particularly acceptable to trustees, banks, corporations and to all investors who make security their first consideration, that the members of co-operative mortgage credit societies contrive to provide themselves with long-term credit at very moderate rates of interest. That the credit obtained is for long terms may be gathered from the fact that amortisation payments are frequently as low as half per cent. per annum.

The question which remains is "whether the enormous sums of money which organized land mortgage credit requires can be found in India." In considering this question, it must be remembered that mortgage credit societies are eminently suitable as a means of substituting debt on reasonable terms for debt contracted on terms dictated, perhaps, by dire necessity or the folly of an ancestor. The end in view is, in substantial part, not so much that of creating fresh capital as of a redistribution and economic adjustment of capital already sunk. Looked at from this point of view, the bearing of a well-organized system of mortgage credit upon industrial and commercial development becomes clear. It was clear enough to the Germans; and though Germany has been beaten in the war, only the purblind will refuse to believe that, in many respects, German industrial, commercial, and agricultural organization and method had many lessons to teach to the world. Germany lost the war because her cause was cruel, selfish, and bad, and because, blinded by pride in her own achievements, she failed to appreciate the moral no less than the material might of the British Empire with its very much longer, less calculating, and infinitely more humane history. Germany, the Germany of the Hohenzollern dynasty, set out to conquer the world. It was an adventure that was doomed to fail. Had it succeeded, success could only have been for a time. The very fact that Germany's attempt upon human freedom has upset the world's balance should make us understand that German domination would, sooner or later, have brought about a veritable catastrophe. Looking to the future, it is evident that the countries which have the most to hope for and the least to fear are those which are ready to understand the necessity for internal organization. Departments of industry, commerce, agriculture, and education must have their essential complements in the shape of departments of finance. And, in India, there is scope enough for the organization of finance.

Speaking from personal experience, I have seen one small provincial co-operative credit banking organization, guided by a very meagre number of officials and non-officials, accumulate a working capital of more than a crore of rupees,—and that within a period of fifteen years. Given sufficient staff for propagandist work and for teaching and training, there is firm reason to believe that co-operative finance can be made to keep pace with, and to accelerate the pace of, general progress. It is certain that without improved finance, the efforts of such departments as those of agriculture and industries cannot meet with anything but a superficial success. The question is really an administrative one, and resolves itself into the fashioning of a lever, big enough, but no bigger than necessary, to raise a weight which is imponderable. Paradoxically, the heavier the brains of the weight, the lighter and less expensive need the lever be. Hence, the conclusion may be arrived at that all reasonable and prudent expenditure by the State upon practical education—the right kind of education given by competent persons—is, in reality, only the premium for an endowment insurance which will mature and, in the end, do more than merely recoup the State.

Within the space of an article such as this it is not possible to make more than a passing reference to the very large sums of money which lie idle in the Government Treasuries during certain months of the year, to the notorious manner in which India absorbs and withdraws from circulation vast quantities of gold and silver—an absorption which even the ancient Romans found it necessary to protect themselves against by prohibiting the export of gold to this country,—and to the fact that Indian exports exceed imports. In addition, it must be pointed out that the essential function of co-operative mortgage credit banks is to convert funds which have been locked up and have become immobile into a form of security which is readily negotiable and is, therefore, fluid. Split into bonds of small denomination and in the hands of many holders, landed securities become something differing as widely from the usual mortgage lock-up as the silver rupee is distant from the Sanskrit *rupya* (meaning a herd or flock) which is its direct but remote ancestor. In the course of trade, amongst enlightened people, mortgage bonds can be made just as good a medium of exchange as currency notes, and can be backed by a reserve of real estate instead of by a metallic reserve. Lastly, as the industries and agriculture of India become more and more productive, the amount of money in circulation will certainly increase. On the whole, therefore, it is safe enough to conclude that there will be no lack of money, for, as a system of organized land mortgage is gradually developed, production and consumption will increase, and industries and trade will flourish.

A NEGLECTED SOURCE OF SUGAR IN BIHAR.

BY

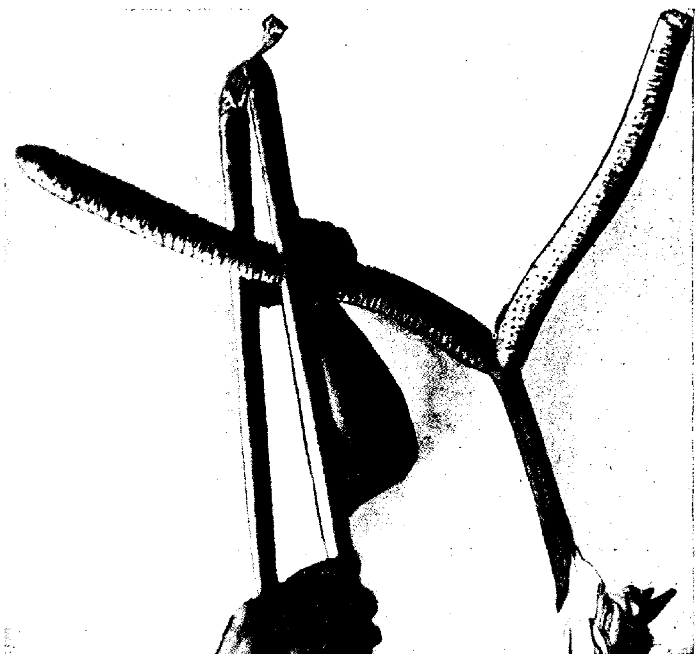
MANMATHANATH GHOSE, M.A.,

Assistant Professor of Chemistry, Agricultural College, Sabour.

BENGAL has a considerable industry in date-palm sugar, but no great attention seems to have been paid to the palmyra palm as a sugar-producer. Nor has it received any recognition in Bihar where the richly saccharine juices yielded by this tree are converted into toddy which supplies a cheap intoxicating drink for the lowclass people. The tree flourishes fairly abundantly and if the juice is collected judiciously it can supply a large part of the sugar consumed by the people. Not even 10 per cent. of the trees are tapped, so that, even allowing the people their drink, a considerable commercial possibility exists, and in April and May when the flow of the juice is most abundant, toddy sells so cheap that there can be little doubt that the manufacture of sugar will pay. In the Madras Presidency large quantities of sugar are annually produced from this source and though its commercial success is assured there, the climatic conditions of Bihar being apparently different from those of Madras during the juice-yielding season, it is considered worth while to study the question here.

Tapping. The method of tapping is important, as on it depends the flow of the juice. In the female tree, after the fruits have just begun to form, the flowering stalk is rubbed with a rough skin detached from the leaf-stalk and is then struck with the back of the tapping knife, the object being to destroy the fruits and to provide a local irritation which is perhaps necessary to encourage the flow of the juice. The spaces between the fruits are

rubbed with care and force and in the end the tip of the stalk is cut off. The toddy-collector, or the *pasi* as he is called in Bihar, then waits for some time, cutting every day the end of the stalk about three times. In three or four days, juice begins to drop. The inflorescence of the male trees is subjected to a harder treatment. The finger-like bunches on which flowers appear are squeezed along their lengths (Plate III, fig. 1) by an improvised pair of tongs (locally called *danta*) formed by two sticks, about a foot long, one



The *danta*—an improvised pair of tongs used for squeezing the male fingers.

end of which is tied together by a string. This requires experience and technical skill, as too gentle a pressure will not make the juice flow, and too hard a pressure will destroy bunches and make them dry. The *pasi* is always careful not to begin the squeezing operations till late in the afternoon when the temperature has gone down as otherwise the wounds inflicted will kill the delicate fingers. tips are then cut off and the fingers are at once collected together and let into the mouth of an earthen pot in which the juice afterwards collects, in order to protect the portions, exposed by cutting, from getting dry. The secretion of the juice generally takes place in the course of a week and, during the whole period the juice is yielded, the tips of the flowering stalks must be cut twice a day. Occasionally, while the flow of the juice is going on, a dark spot appears on the clean cut surface of a finger as the result of previous injury by the *danta*. The finger then ceases to yield juice, but the flow reappears when the affected portion is cut off.

Flow of the juice. The flow of the juice is apparently regulated by the heat of the day and the weather. Shady trees, as a rule, yield more juice than those of which leaves are cut. Careful attention must always be paid to see that the juice-yielding bunches and stalks are protected as much as possible from direct sun's rays. Weather is, perhaps, the most important factor in determining the yield. Unlike the date-palm this tree yields juice at a time when sudden changes of weather are frequent. When the trees are in full inflorescence, dry west winds usually blow and the tapping operations should, as far as possible, be done before the weather has changed. Any bunches that survive the preliminary treatments and begin to yield juice at this dry weather, are expected to yield copious quantities when the atmosphere becomes humid. If, however, the operations are done in moist weather with damp east winds blowing, the juice, though at first abundant, is liable to diminish considerably and cease altogether when a change back to a dry wind and high temperature, lasting for days together, takes place. A reference to the yields of the trees S_2 (v) and S_3 (v) will make this clear. These were male trees tapped for the first time, just when some local showers of rain had caused the previous dry weather suddenly to change to a moist one. The collections were good at first, and up to the time when the maximum day temperature was not higher than 100°F., but as the heat increased and the temperature remained very high for three days together, a sudden diminution of the quantity took place from 2,200 grm.

(in tree S_2) on the 8th May to 300 grm. next morning and to almost nothing afterwards. Compare this with the results of SiF_4 which was tapped earlier and in the dry season. The latter was yielding profuse quantities when the two former dried up.

Table of yields.

	$S_2(v)$	$S_3(v)$	SiF_4	Maximum temperature	Minimum temperature
	grm.	grm.	grm.	°F.	°F.
4th May Morning ...	2,850	2,400	6,300	90	74
4th May Evening ...	1,050	840	3,400	100	75
5th May Morning ...	2,900	2,000	6,600	83	71
5th May Evening ...	1,200	680	3,400	100	78
6th May Morning ...	3,000	1,600	6,850	80	71
6th May Evening ...	1,600	740	3,700	103	75
7th May Morning ...	3,000	1,250	7,800	97	71
7th May Evening ...	1,500	670	4,100	109	79
8th May Morning ...	2,200	340	7,950	96	73
8th May Evening ...	550	nil	4,800	120	76
9th May Morning ...	300	nil	7,650	93	65
9th May Evening ...	negligible	nil	4,800	115	87
10th May Morning ...	nil	nil	7,550		
10th May Evening ...	nil	nil	4,700	123	87

Our experiments were carried on with 17 trees of which ten had never been tapped before and a few of the latter were also not sufficiently shady. As a result, we did not obtain a very large quantity of the juice, but learnt enough of the habit of the tree to arrive at the following conclusions: The quantity of the yield is different with different trees. Of the trees which were tapped for the first time, a good many yield no juice in the first year and others yield only a small quantity at first, but in two or three years they improve and then begin to yield the maximum they are capable of. In good trees a quantity of 5,000 to 7,000 grm. of juice, morning and evening, can be expected in the beginning, *i.e.*, from the middle of April till the end of May. In June the flow begins to diminish gradually to about half the quantity, and finally in the beginning of July the yield dwindles down abruptly to a negligible quantity. There are male trees which give out a second inflorescence and yield a second crop of juice, and there are also some female trees in which the juice comes out after the fruits have grown big and some in which when the fruits are nearly ripe, but as their number is not very great, they have been left out of account. When a tree is to be tapped care should be taken to leave out of account those bunches which are not shaded from the direct rays of the sun and are thus not kept cool. As has been said, too high a temperature of the flowering stalks or bunches hinders the flow of the juice. One will very often come across trees almost denuded of leaves by poor people who cover their huts with them in the absence of more expensive straws. Such trees should best be left alone.

Collection of the juice. The collection is made twice a day morning and evening. The evening collection, which consists of the juice yielded during the day, is necessarily much smaller than that collected in the morning on account of the high temperature during the day. In the date-palm, all the juice of any one tree collects in a single pot, but in the palmyra palm, the number of collecting pots attached to a tree depends upon the number of juice-yielding flowering bunches or stalks, and it is a common sight to see five, six, and even eight pots attached to a single tree. The juice-collector fixes in his waist-band or belt a hook from which as many as six or seven *labnis* or pots can be conveniently suspended, and the man feels no difficulty in climbing up the tree with the pots hanging from the hook behind (Plate III, fig. 2). As the juice-yielding season coincides with the hottest part of the year the juice seldom remains fresh if collected in pots without any treatment. As the practice in Bihar is to collect the fermented liquor, the pots are purposely kept dirty with even yeast added so as to present conditions as favourable to fermentation as possible. Experiments have been conducted in Bengal with pots variously treated for the collection of fresh date-palm juice.[1] It was found that smoked pots preserved the juice when the temperature was low, but pots the inside of which was coated with lime could be relied on at all temperatures. Even in Bihar, with the palmyra palm, we found that early in the season, at low temperatures, the juice in smoked pots gave a sucrose content, often comparable with, and at times higher than, that in limed pots. The juices in the limed

[1] *Memoirs of the Department of Agriculture in India, Chemical Series*, vol. V, no 3.

pots, however, kept remarkably fresh at the highest day temperature and there was no sign of inversion, the amount of glucose, found at any time, being practically negligible. Little changes were observed in the composition when the limed juice was kept overnight. This preserving action of lime is, however, not shared by the carbonate. The juices collected in the pots coated with a thin paste of finely powdered chalk were mostly fermented during the day, and were so slimy that no readings could be taken to find out what amount of sucrose was still left.

The loss of sugar due to the combination of lime with sucrose is not much. The exact amount was not, however, measured. The limed juice, on standing, gave a clear yellowish liquid with flocculent white precipitates settled down, much of which consisted of unchanged lime from the linings of the pot. When, however, coarse grained lime was used, *i.e.*, lime which was not very well slaked, the precipitate refused to settle down and a clear liquid was not obtained. This was witnessed also when the juice was comparatively poor in sucrose, especially when the juice, owing to an insufficiency of lime, had just begun to ferment. The reason in the latter case probably was that the calcium saccharate formed was breaking up by the action of carbon dioxide evolved during the fermentation, and the milky appearance of the juice was due to the finely divided lime compound which took long to settle down. The lime used should therefore be well slaked and a too great excess should be avoided.

Composition of the juice. Fresh juice has a sweet smell and an alkaline reaction. Fermented toddy is a dirty foul-smelling liquid, containing, among others, a large percentage of acetic acid, so that it can be of value as a fruitful source of vinegar. The percentage of sucrose, average 12·5 per cent., is remarkably constant throughout the season, and did not show a tendency to increase as the yield diminished. Unlike the juice from the date-palm of which the day juice is apparently richer than the night yield[1], no appreciable difference is perceptible in the day and night collections,

[1] *Memoirs of the Department of Agriculture in India, Chemical Series*, vol. V, no. 3.

notwithstanding the fact that the yield during the day is considerably lower than during the night. Whatever difference in richness has been found can be accounted for as being due to the greater evaporation during the day and the consequent greater concentration of the day juice. The similarity of the day and night juices is illustrated by the table below:—

Tree	Date	Yield	Sucrose	REMARKS
		grm.	Per cent.	
Female F_3	25-5-18 26-5-18	E 3,000 M 3,700	12·70 13·45	E Day juice collected in the evening.
Male S_3	29-5-18 30-5-18	E 2,950 M 2,225	14·16 13·13	M Night juice collected in the morning.
Female F_3	1-6-18 2-6-18	E 4,100 M 4,500	13·12 12·46	
Male S_3	5-6-18 6-6-18	E 1,400 M 2,700	15·76 14·39	
Female F_3	8-6-18 9-6-18	E 1,700 M 1,800	13·01 13·29	
Male S_3	12-6-18 13-6-18	E 1,900 M 2,050	12·05 14·00	

It is also evident that there is nothing to choose between a male and a female tree in point of richness of the juice, and nothing has been found by us to confirm the popular belief that male trees, as a rule, yield more stimulating toddy than females. The juice-yielding period is also the same in both.

Gur. When the supernatant clean juice from limed pots is decanted and boiled, the *gur* (crude sugar) obtained, has, on account of its containing lime, a caustic taste, and is, therefore, unsuited for direct consumption. On, however, passing a slow current of carbon dioxide until all the lime is precipitated, and then boiling the filtered juice, the *gur* obtained is highly sweet and palatable and is remarkable for its lightness of colour and flavour. It is suggested, as in the analogous case of the limed juice of the date-palm, that citric and tartaric acids or the water extract of unripe tamarind fruits may precipitate the lime, and, when used in proper quantities, give the juice a proper acid reaction so necessary to impart a light colour to the *gur*. In the latter case, it would make *gur*-making from palmyra palm within easy reach of all. The ash content of the *gur* lies between 2·5 to 3·0 per cent., and, on account of its containing deliquescent salts, even the driest *gur* absorbs moisture in moist weather. This property goes against the keeping qualities of the *gur*, as it is then liable to get fungoid attacks. As the *gur* will be made in the dampest season of the weather, this difficulty of preserving the *gur* is a serious drawback against its commercial success. On the other hand, limed *gur*, *i.e.*, that made from the juice from which lime has not been removed, keeps wonderfully well. Though unsuited for being used as such, such *gur* can be used in the refineries for making white sugar. The removal of lime by the introduction of carbon dioxide or an acid involves a loss of sucrose in the *gur*. Samples obtained by us by directly boiling the limed juice contained approximately 85 to 88 per cent. of sucrose, while, when lime was removed from the juice, the sucrose content of the *gur* averaged only 80 per cent. As much as 58·7 per cent. of white sugar has been obtained from a sample of limed *gur* from the date-palm juice.[1] Similar, if not better, results can fairly be expected here also. Chances of inversion and of fermentation are greater in the date-palm juice before it reaches the pot, as the exposed cut surface of the tree is large and the pot too has a wider open mouth. Here only the tips are cut and the exposed surface is well inside the pot and thus protected from the sun, while the mouth of the pot is narrow and almost closed by the bunches.

As the production of palm sugar from the wild date-palms in Bengal has so far been satisfactory and as improvements are being suggested which are expected to yield still better results, it can be said, with sufficient fairness, that the palmyra palms in Bihar might be fruitful sources for the manufacture of cheap white sugar and that the industry is worth giving a trial. In Madras and in Burma, these palms yield a not inconsiderable quantity of sugar.

[1] *Memoirs of the Department of Agriculture in India, Chemical Series*, vol. V, no. 3, p. 97.

SOME FAMINE FOODS IN AHMEDABAD.

BY

G. P. PATHAK, B.Ag.,
District Agricultural Overseer, Ahmedabad.

In the west of the Ahmedabad District, or, to be more precise, to the west of the Sanand and Dholka talukas and to the south of the Viramgam taluka of that district, there lies a large depression locally termed the *nal*. This area is waterlogged and contains usually a large lagoon, and has a length of about eighteen miles and a breadth of five to six miles. The villages lying on the border of this waterlogged *nal* are termed the *nalkantha*.

The *nal* itself lies low, and receives nearly all the drainage from the three talukas named during the monsoon, and at that time forms a large lake. The bordering areas are composed of somewhat low-lying flat lands (*kyari*) used almost entirely for rice, of higher black cotton soil usually considered suitable for *wagad* cotton and for unirrigated wheat, and of a certain proportion of light land termed *thalian*, suitable for *jowar* (*Sorghum vulgare*), *bajri* (*Pennisetum typhoideum*), pulses, and *til* or sesamum. The subsoil over most of the area is a yellow earth, impervious to moisture, and the soil is usually somewhat salt with rather brackish subsoil water. The cultivators are chiefly Talabda Kolis, Nadoda Rajputs, and Girasias. The cultivation in the *nalkantha* is fairly good, and the returns in an ordinary year are sufficient for the people. In years of deficient rainfall, the tract suffers badly from want of food and fodder.

Under these circumstances the cultivators, and especially the poorer cultivators, have turned to the *nal* itself for the means of supporting life, both for themselves and their cattle, and have utilized several materials, an account of which may prove interesting. Those of which I propose to write are—

(1) *Bid* or the rhizomes of the sedge *Scirpus kysoor*, Roxb.

(2) *Thek* or the rhizomes of the sedge *Cyperus bulbosus*, Vahl.

(3) *Poli* of *pan* or the inflorescence of *Typha angustata*, Bory and Chaub.

(4) The tubers (*kanda*) and (5) the fruits (*lampdi*) of *poyana* (*Nymphæa stillata*, Willd.).

Of these the most important would seem to be the rhizomes of the *bid* plant, a common sedge in the brackish *nal*. The name *bid* is really given to the rhizomes, while the aboveground portion is termed *gundari*. In ordinary years the milch cattle eat the grassy portion of the sedge when green during the cold weather, and it is also employed for thatching the houses of the poorer people. The use of the rhizomes as food and fodder is no new thing. Watt[1] says, in fact, "The roots are dug up in large quantities in the cold weather, sliced and eaten uncooked by the natives of many parts of India. They are sweet and starchy, and are considered cooling and highly nutritious." This year the use of them in the *nalkantha* has, however, been far more extensive than usual.

In order to obtain them, when the water in the *nal* dries up, the land is dug with hand picks or *kudalis*. Then the big clods are broken down with a wooden hammer, and the *bid* with the roots attached is taken out and heaped into a long ridged heap, covered with the dried *gundari* and other materials. These inflammable materials are then ignited in order to burn up the roots adhering to the *bid* rhizomes and to facilitate the removal of the attached earth. The process of covering and burning is repeated, if necessary. The resultant product has been sold at eighty to one hundred pounds per rupee during the present year.

The product is not yet, however, free from earth, and hence, before feeding to cattle, the material is steeped some time in water. This removes the earth and softens the rhizomes, so that when the

---

[1] "Dictionary of Economic Products of India," vol. VI, part 2, page 491.

latter have been beaten by a heavy stick to break them up, they be eaten easily by cattle. The soaking is also of advantage in preventing a loss of the flour contained in them, which would otherwise certainly be partly washed out.

When the material is intended for human consumption, the digging up of the clods containing the rhizomes takes place as previously described, but the clods are left unbroken for several weeks. Thus the rhizomes are dried up thoroughly in the soil and become sweeter to the taste. Then the small rhizomes are separated as described above, and are collected and dried in the sun for four or five days. They are powdered on the ordinary household powdering stone and sifted through a cloth to separate roots and fibres. The dried rhizomes yield about sixty per cent. of flour. The flour is mixed for use either with wheat or barley flour to the extent of from twenty-five to fifty per cent., and the mixture (locally called *setaru*) made into loaves.

On analysis the materials gave the following figures :—

(*a*) *Bid* rhizomes prepared for cattle food.

(*b*) *Bid* rhizomes prepared for human food.

(*c*) *Bid* rhizome flour, for human food.

	a %	b %	c %
Moisture	3·80	3·00	3·45
Ether extract (fat)	0·90	0·66	0·65
Proteids	7·56	11·81	8·78
Digestible carbohydrates	62·69	69·78	78·82
Woody fibre	14·95	9·65	3·10
* Ash	10·10	5·10	5·20
	100·00	100·00	100·00
* Containing sand	6·30	3·00	0·23

The second of the materials we are considering consists of the rhizomes of *Cyperus bulbosus* locally termed *thek*. Like that of the *bid* rhizomes the use of these is no new thing. Watt (*loc. cit.*) notes that the roots are used as flour in times of scarcity, and eaten roasted or boiled. He states that when roasted these roots have the taste of potatoes and would be valuable for food if they were not so small. Balfour writes as follows :—" Dr. James Anderson in an excursion in the southern part of the peninsula of India discovered that *perus bulbosus*, growing in sandy situation by the seaside, and requiring but little water, was the common food of the natives during a famine when other grains are scarce. It is nutritious, pleasant to the taste, and makes a pudding somewhat resembling that made of sago." On the same subject Drury notes that some dry the tubers in the sun, grind them into meal and make bread of them, while others stew them in curries and other dishes.

The *thek* plant naturally grows in the salt lands on the edge of *nal*. When this land is dried up it is divided into small beds; water is then let in and the bed is dug up under water. Under these circumstances the *thek* roots and tubers separate from the soil, and being lighter, float to the top of the water, and are collected in a sieve made of grass. When thus collected, they are dried in the sun, spread over the ground, covered with any available inflammable rubbish, and the latter burnt. The material thus obtained is then beaten with a stick to remove the coverings of the tubers themselves and a final winnowing gives the fresh roasted *thek*. The *thek* thus prepared is used as a substitute for *jowar pankh** either on fast days or it is sent to market and used by town and city people as a novelty. It cannot be kept long, as it quickly goes bad.

When used for loaf-making the process is different and the tubers as floated out of the ground are only dried completely in the sun and not burnt or roasted. It may then be used alone or mixed with either wheat or barley flour.

The third plant whose use for food in the *nalkantha* has come specially to notice during the present famine season is the common nymphea water-lily of the *nal*, known locally as *poyana*. Little seems to have been recorded hitherto of this material, but it has been largely employed in the present season as human food in two forms. The first of these consists of the tubers of the *poyana* plant, termed *kanda*, which are roasted in ashes in exactly the same way as is done with onions or potatoes, and consumed in this condition. Though this is the usual method of consumption, yet the tubers are also prepared by boiling in the manner usual with other vegetables.

* Roasted green *jowar*.

The second part of the *povana* plant used as food consists of fruits, termed *lampan*, or *jitolan*, and the seeds termed *lampdi* ... *lampan*. In order to prepare the seeds for use, the fruits are collected and dried in the sun for three or four days. The seeds are then gathered, and cleaned of refuse by the usual method of the *sup* (winnower), and are finally milled into flour. The flour so prepared is mixed with wheat or barley flour to the extent of twenty-five to fifty per cent. and made into bread as usual. The taste is unpleasant and the smell is objectionable, but the bread made is very light.

The analysis of the tubers and seeds of *poyana* gave figures as follows :—

	a Dried tubers %	b Seeds %
	...	...
Moisture	4·20	5·40
Ether extract (fat)	0·45	1·30
Proteids	14·56	11·31
Digestible carbohydrates	67·49	70·59
Woody fibre	5·45	7·45
* Ash	7·85	3·95
	100·00	100·00
* Containing sand	0·28	0·45

The *poli* of *pan*, derived, as already stated, from the fibrous rush *Typha angustata*, consists of the pollen from the inflorescence of this plant, which is used as flour. Its use for this purpose has been frequently recorded. It is stated to be commonly employed in Sind, and it has certainly been eaten in various parts of the Bombay Presidency in previous famines. The method of use in the *nalkantha* is to collect the inflorescence in the morning when there is no wind, and then to rub the pollen off on a cloth. The flour thus obtained is moistened with water and made into cakes termed *dhokalan*, which are wrapped in cloth and then roasted over a heated brass vessel. The cakes are sweet, yellow in colour like turmeric, and are quite palatable as human food.

A FEW HINTS ON LABELLING IN EXPERIMENTAL STATIONS.

BY

T. S. VANKATARAMAN, B.A.,

Ag. Government Sugarcane Expert, Coimbatore.

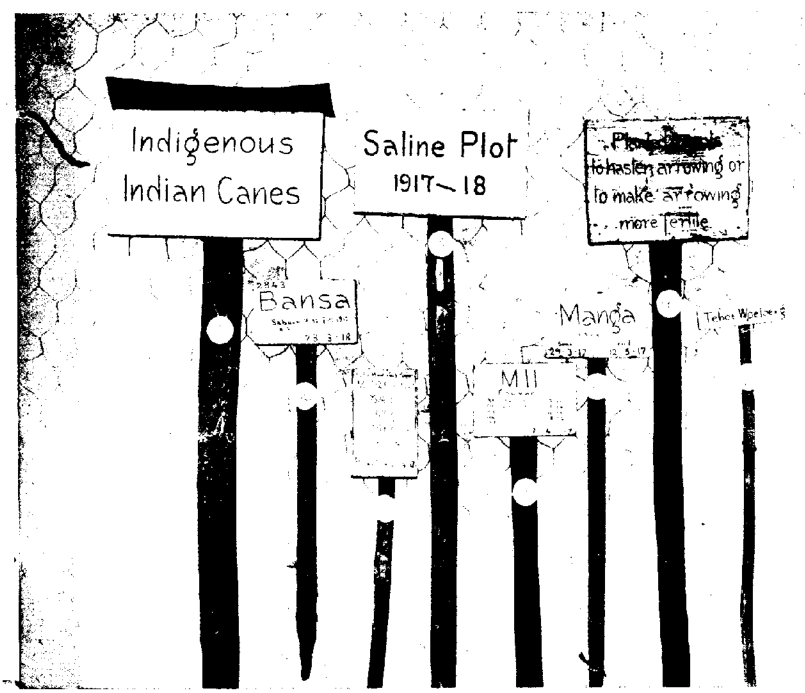
IN every farm where experimental work is being carried on, a quick, cheap and efficient system of labelling is often of very great importance. Occasionally one comes across farms where there are practically no labels in the field, and the officer in charge has to unroll each time a parchment scroll in which the plans of plots and other details are fully entered up. Besides the waste of time involved in the process, the visitor, especially if new, always feels some uncertainty that, in the particular instance, the plan has perhaps not been correctly interpreted with reference to the plots.

The ideal would appear to be to give in the labels as much information as possible. This will enable the visitor to obtain a general idea of the nature of the experiments being carried on without much help from the staff who may not be always available. Again, the members of the staff would be enabled to form certain ideas as to the various plots without always having to carry with them bulky notes and diagrams. It is a matter of common knowledge that while taking an evening stroll along the plots certain ideas force themselves on one's attention much more readily than when the plots are examined with the idea of "study." On such occasions the use of plot labels with full details is obvious.

Owing to the very large number of varieties that are planted at the Cane Breeding Station each year—of late we have been planting as many as 2,000—the need was felt even from the outset for a cheap and efficient system of labelling. In fact, it is felt that the absence of an efficient system of labelling has been a fruitful source of mistakes in naming in the past. It was further found that the requirements at the Cane Breeding Station were of a varied character, and different types had to be evolved to meet all the requirements.

One of the earliest to be tried was the type represented in Plate IV. These labels consist of pieces of deal-wood from old packing cases thinly coated over with white paint and nailed to bamboo or iron uprights. They are easy to write over with pencil, and retain the impressions fairly well for over a year. The deal-wood boards can be used over and over again by merely cleaning the surfaces—occasional sand-papering or planing being required in cases where the surfaces are badly injured—and recoating with white paint. The picture opposite (Plate IV) is a photograph of labels of this class. Nos. 1 and 2 are fresh having been in the field only 2 to 3 months, No. 3 is 4 months old, Nos. 5, 6 and 7 over 14 months, and No. 4, 18 months. No. 8 represents what may be called a war-time label. With the scarcity of deal-wood boxes their prices rose very high and an attempt was made to use a thin slice of the bamboo rind with successful results. This label (No. 8) is over one year old and was quite satisfactory at the end of the period.

The white paint used for coating these label boards is easily available from any bazaar and is sold ready mixed in kegs of 8 to 10 lb. When freshly opened the paint is in a satisfactory condition and all that is required is to mix it with a little turpentine. If too much turpentine is added the coating shows a tendency to peel off in flakes. There are many brands in the market and the proportion of turpentine varies with each brand and the condition of the contents when opened. This is, however, soon learnt by experience. To obtain the best results it is essential that the paint should be laid on the labels in a thin even layer. When, by frequent opening of the lid, the paint gets solidified small quantities of linseed oil have to be added and the paste well ground and mixed. Great care should be taken not to mix too much oil or else a glossy surface is produced on which it is difficult to write. Each keg of white



LABELS WITH DEAL-WOOD BOARDS COATED
OVER WITH WHITE PAINT.

Nos. 1 and 2 about three months old; No. 3, 4 months; Nos. 5, 6 and 7 over 14 **months;** No. 4, 18 months; and No. 8 over a year. In No. 8 the board is made of a thin **slice** of the bamboo rind.

The zinc board seen over No. 1 is intended to prevent the label surface being soiled **with** excreta of birds perching on the top of the labels.

point, sufficient to coat 800 label boards 6″ × 3½″, which previous to the war cost Rs. 3-8-0, now cost Rs. 12. The following statement gives the relative cost of the different types of labels represented in Plate IV.

Statement showing the relative cost of 100 labels of the different types represented in Plate IV.

Sizes	Nature of stake	Total cost per 100	Cost of annual renewal of stakes	Remarks
		R. A. P.		
Label 10″ × 6″, stake 4′ high	Iron	47 12 0	No renewal needed	Nos. 1, 3 and 4 are of this class.
Ditto	Pieces of areca-nut palm	9 0 0	3 8 0	
Ditto	Bamboo	7 8 0	1 12 0	
Label 6″ × 3½″, stake 3½′ high	Iron	23 8 0	No renewal needed	Nos. 2, 5, 6 and 7 are of this class.
Ditto	Pieces of areca-nut palm	5 4 0	2 8 0	
Ditto	Bamboo	4 2 0	1 5 0	
Label 3½″ × 1″, stake 4′ high	Bamboo	1 0 0	These can be used only once	No. 8 is of this type. The label board consists of a thin slice of bamboo rind in place of wood.

Note 1. This statement is based on figures obtained when the Indian market was unaffected by the war but the altered prices chiefly affect only those with iron stakes.

Note 2. The gradual disappearance of the iron stakes led to their substitution by pieces of the areca-nut palm or bamboo.

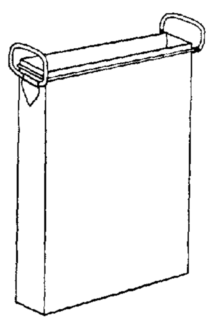
Note 3. In the above statement the cost of deal-wood boxes is included, but it is to be noted that odd bits of deal-wood are frequently available in any large office.

Note 4. The zinc hood seen over the label board in No. 1 is intended to prevent birds perching on the top and disfiguring the label surfaces with droppings.

Note 5. As a precaution against white ants, portions of stakes driven into the ground should be carefully painted with tar.

It was found, however, that these deal-wood labels were not suitable where a certain amount of detail had to be entered up.

This introduces us to a system of "plot labels," which have been found to be of great use at the Cane Breeding Station. In examining each plot of seedlings, for instance, it was felt that it will be a great convenience to have in the field a plan of each plot together with a certain amount of information about the parents. Reference to lists or papers, while in the field, is cumbersome and liable to miss out important details. Plate V is a photographic reproduction of such labels. No. 1—Fig. 1, and Nos. 1 and 2—Fig. 2, are 6 months old, while No. 2—Fig. 1, and No. 3—Fig. 2, are over 14 months old. The labels when laid down give an exact plan of the plots against which they are placed. These labels are prepared in the following manner. The label is first written with pen or pencil on thin mounting paper or thin cardboard and subsequently dipped in melted paraffin. The pen is not so easy to write with as pencil but the labels are much clearer [Plate VI, fig. 1 (Nos. 2 and 3)]. White paraffin wax 135-140° F. is quite suited for the purpose. The labels should be dipped in paraffin which has been melted for some time, and taken out almost immediately. The right temperature is soon learnt by experience. If too hot the label comes out brittle, and if not quite fully and uniformly melted the paraffin shows a tendency to stick to the paper in odd patches. To economize the quantity of paraffin and to avoid the labels having to be bent at the time of dipping—if thus bent the labels show a tendency to return to this shape for a time—it has been found useful to employ a tin vessel shaped according to the sketch in the margin.



The vessel used to melt paraffin wax in.

Such a vessel, with pieces of solid paraffin in it, is immersed to below its mouth in a bucket of water and the water brought almost to a boil. This melts the paraffin inside the tin vessel and keeps it in a liquid condition for a fairly long time.

The labels after treatment with paraffin are fixed to label boards similar to those figured in Plate IV by means of eyelets and copper

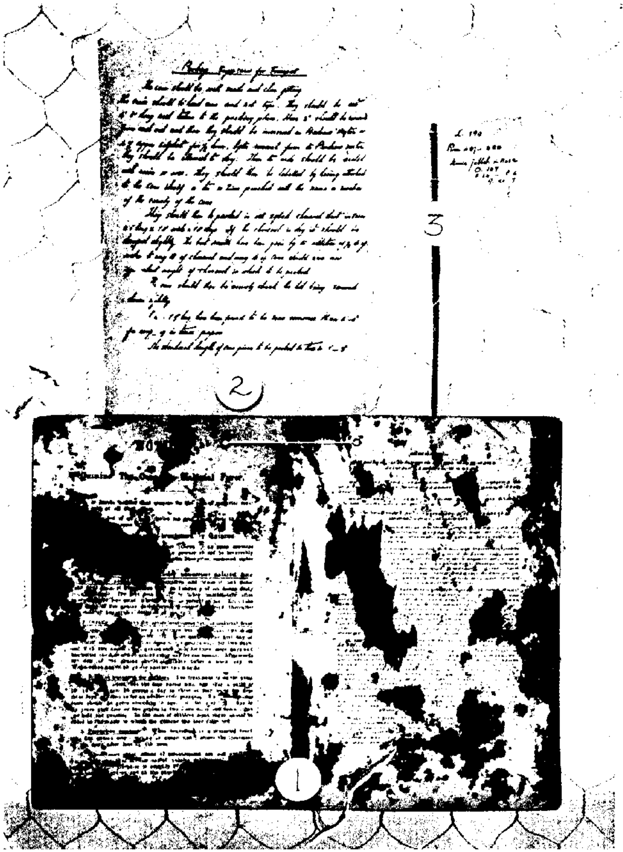
EXPLANATION OF PLATE V.

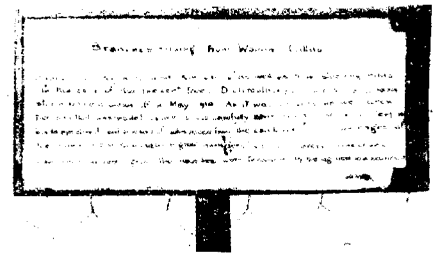
These labels are made of paraffined paper and are useful in cases where it is desired to enter a certain amount of detail on the labels. These are unaffected by sun or rain and can be washed with soap and water.

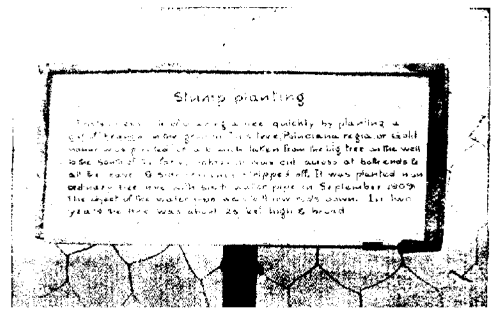
No. 1 (Fig. 1), and Nos. 1 and 2 (Fig. 2), are over 6 months old.

No. 2 (Fig. 1), and No. 3 (Fig. 2), are over 14 months old.

The paraffining renders the labels shiny, a serious handicap to a successful photographic reproduction. The actual labels are much clearer.


1
2
3




Stump planting
quickly by planting a
Poinciana regia or Gold
taken from the big tree on the well
across at both ends &
It was planted in an
September 1909
years the tree was about 25 feet high & broad

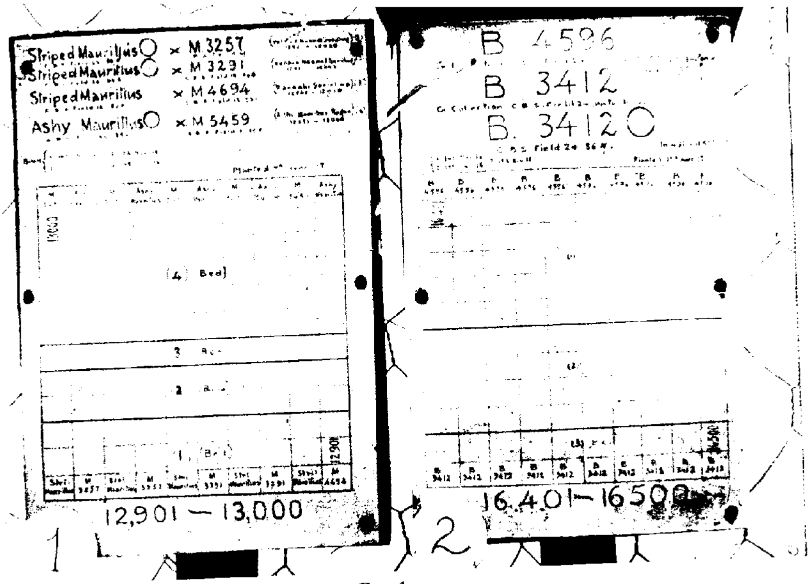

Striped Mauritius
× M 3257
Striped Mauritius
× M 3291
Striped Mauritius
× M 4694
Ashy Mauritius
× M 5459
12,901 — 13,000
1
B 4596
B 3412
B. 3412
16,401—16500
2

Fig. 1.

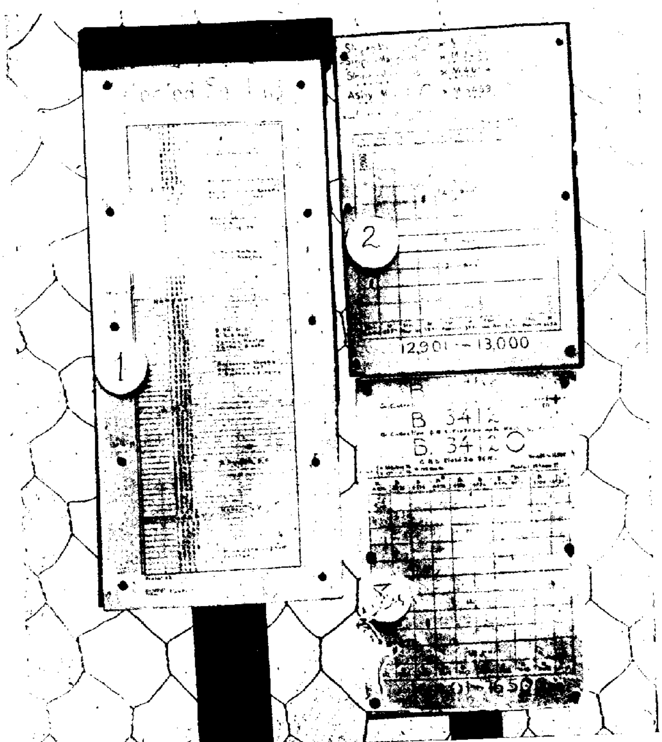

1
2
12,901 — 13,000
B 3412
B. 3412

Fig. 2

tacks. Iron tacks are not satisfactory as they soon rust. These labels are not affected by sun or rain and can easily be washed with soap and water if they get soiled with mud or dirt. Occasionally, during close moist weather ring-shaped outgrowths (probably fungus) are seen, but these are easily kept out by occasional cleaning with dilute copper sulphate solution. In the preparation of these labels the cost of paper and paraffin is only nominal and the prices of the labels as already given in the statement hold good for these as well.

Plate VI, fig. 1 (No. 3) shows this form of label as used for seed-pans at the Cane Breeding Station. In the earlier stages of germination sugarcane seedlings require to be watered sometimes as often as six times during the day. The quality of being unaffected by water has made these paraffined labels very useful for the purpose and they are very cheap, costing less than an anna per hundred.

Another use of paraffining is illustrated by Nos. 1 and 2, Fig. 1, Plate VI. The need often arises to hang, against wall surfaces, plans, tables, charts or notices of a permanent nature and in such conditions the silver-fish is very troublesome, frequently eating them so badly as to make them useless for reference. Nos. 1 and 2 have been hanging against a wall, side by side, for over three years, and the effect of paraffining (as shown by No. 2) is very striking.

A very neat and permanent, though rather expensive, form of labelling is illustrated in Plate VI, fig. 2. Glasses are ground and the details written on the ground surface by means of waterproof ink. The glasses are now backed with white paint and slipped into a zinc frame, the front being protected by an extra glass to prevent the rain getting on to the label. Air spaces are provided behind the label glass, and in between the label and the front glass. The bottom picture, represents such a label re-written after over seven years and the top one as it was after this period. The front protecting glasses have been removed for purposes of photography. Such labels are very neat, more or less permanent (perhaps requiring just a re-writing once in six or seven years), and their use as permanent labels in botanic gardens and museums is obvious.

With $3\frac{1}{2}'$ iron stakes they cost Rs. 2-8 each before the war. The ground glasses need not be purchased as such. Broken panes or washed negatives could easily be ground by rubbing against one another with finely sieved wet sand in between.

Though it first appears simple yet the position of the label in a plot is of some importance. In many of the farms the label is placed in the centre of the variety to which it refers and it is often difficult to say where one variety ends and another begins. At the Cane Breeding Station the label is always fixed at the left hand bottom corner of each plot.

This article is based on experience in labelling gained at the Botanic Gardens, Coimbatore, and the Cane Breeding Station during the last ten years. I am indebted to Dr. C. A. Barber, C.I.E., Government Sugarcane Expert, for help and advice in the course of this work.

THE IMPROVEMENT OF FRUIT PACKING IN INDIA.

BY

ALBERT HOWARD, C.I.E., M.A., AND G. L. C. HOWARD, M.A.,

Imperial Economic Botanist; *Second Imperial Economic Botanist.*

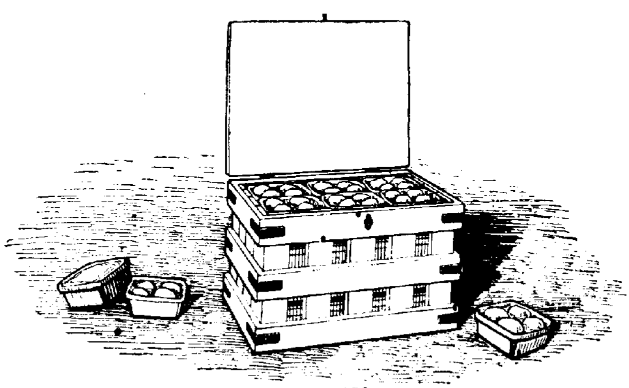
WHEN the Quetta Fruit Experiment Station was established in 1911, one of the main items of the programme of investigations was the best means of improving the packing and transport of the fruit produced in Baluchistan. The earlier results were published in 1913 in Bulletin No. 2. A second revised edition was printed in 1915 and during the present year, 1919, a third edition has been called for. In the present paper it is not proposed to repeat the contents of these bulletins but to direct attention to the main results obtained and to refer briefly to certain general principles which have emerged from the work.

Improved fruit boxes were first placed on the market at Quetta in 1912 when the sales reached Rs. 700 in value. The demand rapidly increased during 1913 and 1914 and in 1915 boxes to the value of Rs. 5,000 were sold by the middle of the season, by which time the available stocks had disappeared. During the three succeeding years, 1916–18, the provision of adequate supplies became difficult due to high prices, to the shortage of timber and to the railway restrictions in force throughout India. The work however was continued and the sales reached Rs. 8,000 during the present year (1919) although the stock of the popular non-returnable crates was exhausted early in the season.

In 1919, the Frontier fruit trade laboured under many disadvantages. The war with Afghanistan was in progress and for a time the supply of Kandahar fruit stopped altogether. The border was disturbed, raids were frequent, and delays on the railways were unavoidable. That the sales of fruit boxes reached the highest point under such adverse circumstances speaks for itself.

Two railway concessions have proved of material advantage in the introduction of modern packing methods among the fruit dealers. In 1916, the Railway Conference Association agreed to our proposals that all parcels, including fruit, should be grouped for purposes of charge and that four types of returnable boxes, recommended by the Fruit Experiment Station, should be returned free from all stations in India to Quetta and Chaman. These concessions are now being very generally utilized and they have greatly stimulated the use of the 24-punnet returnable grape crates and of the cardboard peach boxes.

Seven types of fruit boxes are now on sale at Quetta. For peaches, nectarines, cherries, apricots and plums, three sizes of compartmented cardboard boxes have become popular. For the grape trade, the 2-lb. punnet is the unit adopted. These are set up in crates holding 8, 16 or 24 punnets arranged in tiers separated by lath floors. One of the returnable 24-punnet grape crates is shown in the figure below.



A 24-punnet returnable crate.

About a thousand of these returnable crates were sold during 1919, the retail price being Rs. 5-8 each. This is a high price to pay for a fruit box considering the fact that the ordinary baskets and boxes in use can be purchased for a few pence. The dealers readily pay cash for these expensive crates and the only difficulty is to assemble sufficient to meet the demand. The advantages of packing the grape crop direct into punnets in the vineyards are now being recognized and the large returnable crates supplied by the Fruit Experiment Station are a common sight on the roads leading to Quetta. Already the larger dealers are considering the question of getting this type of package introduced into the vineyards of Kandahar.

There is no reason why the strongly made standardized returnable fruit package should be confined to Baluchistan. The principle could be easily adopted in the North-West Frontier Province, in Kashmir, in Kulu, Kumaon and in other parts of India. The Railways have shown their willingness to assist, by means of valuable concessions, the efforts made to improve fruit packing in Baluchistan, and there is no reason to suppose that equally effective assistance would not be given to other fruit-growing localities. The non-rigid type of fruit package of the basket type is not adapted for long journeys under Indian conditions and its place should be taken by returnable boxes and crates by which the carrying capacity of the railway vans can be greatly increased and by which the traffic can be more easily handled. By such methods, the product reaches its destination undamaged and therefore commands an enhanced price.

Our experience in removing the disadvantages under which the fruit trade in Baluchistan formerly laboured and in establishing modern methods of fruit packing has brought out two things—the rate at which time-honoured practices and ideas change in India, and the importance of time and patience in implanting a new idea. When in 1911 we commenced these investigations, we were told on all sides that cheapness was the first condition of success in placing new packages on the market. We were constantly reminded that the grape baskets and old kerosine oil boxes then in use were cheap and that they could be purchased for very small sums. When the 24-punnet returnable grape crates were first brought to the notice of the dealers, they were considered too expensive and altogether unsuited to the conditions of the local trade. A few of the more advanced merchants, however, agreed to try them. The grapes were found to travel perfectly even to places as distant as Madras. A change in the attitude of the trade then began to make its appearance. A demand from the more advanced cities like Bombay that Baluchistan grapes should be packed in punnets followed and from that time success has been assured. The difficulty has been to meet the demand rather than to sell the crates. Nothing is now heard about the cost.

Time is a factor in India in the introduction of new methods, to which insufficient attention is often paid. This is specially important where trade is concerned. Dealers of all kinds have little leisure and practically all their working hours are spent in details connected with purchase, sale and finance. Particularly is this the case with the Frontier fruit dealers whose output of work during the fruit season, considering the means at their disposal, is extraordinary. They have absolutely no time for experiments or for anything else beyond the day's work. To reach such men, patience is essential and they must be given ample time for new ideas to sink into their consciousness.

This experience proves that too much attention can be paid to the first ideas of the people of India towards new methods. They are certain to be frankly sceptical at first and to exhibit that conservatism which is so valuable in protecting the race from disaster. The inventor must therefore be prepared for this and when he is fortunate enough to discover a real improvement and the best thing possible under the circumstances, he should resolutely persist in keeping it before his public year after year.

Selected Articles.

PLANT-BREEDING AND TROPICAL CROPS.*

BY

W. BATESON, M.A., F.R.S.,

Director of the John Innes Horticultural Institution.

KNOWLEDGE of what can be done by scientific plant-breeding in the improvement of varieties is gradually, though very slowly, spreading among those engaged in the raising of vegetable products commercially. In Europe and the United States, work, both experimental and directly economic, is being undertaken on a considerable scale. The most vigorous and extensive of these enterprises are naturally to be found in temperate countries where the prosecution of science is endemic, and of necessity it is to the products of such countries that attention has been chiefly devoted. The crops of these regions, however, have already with one or two exceptions been put through several stages in the process of improvement. Most of them have been in the care of man for long periods of time, their cultivation being indeed one of the earliest signs of incipient civilization. Such plants as wheat, maize and the other cereals, the grape, the olive, and our garden fruits have been so long the subjects of human attention and effort that, though certainly new and better types may still be created, no advance comparable with that which distinguishes them from their nearest wild relatives can be expected. Of the exceptions among these very anciently domesticated plants, flax is by far the most remarkable. Though so long in cultivation that its wild origin is uncertain, its improvement seems to have stopped before history begins. When a plant has no thoroughly distinct and named

* Reprinted from *Production*, Agricultural Number, July 1919.

varieties we may be pretty sure that it has been neglected by the breeder.

Domesticated flax (*Linum usitatissimum*) has been separated into two distinct groups, those for oil and those grown for fibre. There are several forms of oil flaxes, in all probability recently differentiated, but fibre-flax, at least as grown in Europe, though sold under various names according to the place where the seed was raised or whence it was shipped, shows only trifling differences. If any field of flax is examined plants will be found, perhaps one in many thousands, which are about a third as tall again as the ordinary plants. If the flowers of these tall plants are covered to exclude insects, their seeds will be found to give exclusively tall plants like the parents. Flax is commonly a self-fertilizing plant, and all that is necessary to the fixation of such an improved variety is to breed it in conditions of isolation until a bulk of seed sufficient for economic purposes has been raised.

The improvement of a plant is to be achieved only by the deliberate act of man. Each such act is in its degree of the nature of an invention. The ordinary man is content with the type he finds. He is devoid of imagination and unable to free himself from the limitations of conventional practice even to the very moderate extent necessary for the application to a new example of methods long ago developed in other cases. In order to improve the familiar and long cultivated plants two distinct kinds of interference are generally necessary. The new variety has not only to be selected and multiplied but very often it must first be created. This is a much more complicated operation. Laymen still vaguely suppose that improvement is a mere incidental consequence of prolonged cultivation. Almost all novelties, however, are really the result of an act of cross-fertilization between distinct types. The novelties do not usually appear in the offspring *immediately* resulting from the cross, but in the later, derivative generations, sometimes by recombination of elements which the parents respectively introduced; but sometimes, and perhaps more often, a process of disintegration of the elements supervenes, which leads to the production of inter-gradations possessing new properties.

To this disintegrative process, for example, the beautiful series of Sweet Peas, which have been such an astonishing addition to horticulture, is almost wholly due. To carry out these operations and turn them to account is a very intricate business.

The object of this paper is to attract the attention of practical men to the immense field of profitable activity which is open in the improvement of many exotic crops by the simple selection of valuable types already existing.

That this has been so long deferred seems to those accustomed to handle plants truly amazing. The profits to be gained by the fixation of improved varieties are incalculably large. No one plants an orchard by sowing seeds of any tree which can be called a plum or an apple, regardless whether it be a sloe or a Victoria, a crab, a Cox's orange, or a Bramley. Yet thousands of acres of rubber and coconuts are sown in a fashion of which this description is scarcely a caricature. It is to crops of this order, plants which are grown from seed and have only been deliberately cultivated by civilized man for comparatively short periods, that these comments especially apply.

Coconuts and dates are both the fruits of palm trees. Of dates there are scores of named varieties, but coconuts are just coconuts.* What is the reason of this striking difference ?

It is a consequence of the fact that whereas coconuts are all grown from seeds, dates, whenever they are cultivated by intelligent people, are grown from off-shoots. The off-shoots provide a means of vegetative reproduction, so that all the plants raised from the off-shoots of one tree are pieces of one individual and merely replicas of it. In the course of ages many good date-palms with various fine properties have been noticed and multiplied in this way, so that large uniform plantations of them exist. In Mexico, I understand, dates are grown from seed, with the result that the crop has no uniformity, and, consisting of good and bad indifferently mixed, is comparatively worthless. Such a crop cannot compete with the produce of a properly constituted plantation. Coconut

* There are, of course, some local races, very imperfectly differentiated.

palms, like almost all plants, differ enormously, some individuals producing many, others few fruits, and the differences in quality are doubtless equally great. It is true that no one has, I believe, yet succeeded in multiplying the coconut palm by division, but I doubt whether really exhaustive experiments have been made with this object in view. Assuming, however, that the coconut cannot be vegetatively multiplied, and that it must, as heretofore, be raised from seed, the next best course is to make certain that the nuts used for sowing are the produce only of specially selected trees. In the case of coconuts planters are indeed advised to choose nuts from good trees, but they seem to think that they have done all that is requisite when they have selected them from the best *mothers*, no effort or inquiry being directed to the paternity of the seeds chosen. Whether this plant is capable of self-fertilization has probably never been determined. The male and female flowers, though near each other, are separate and it is not unlikely that by the males and females coming to maturity at different times, or by some similar contrivance, a considerable percentage of crossing is effected.

No very serious labour would be needed to ensure that nuts chosen for planting were not merely borne by first-class trees, but the result of pollination either from the same tree, or perhaps preferably from others equally good. To accomplish this would be no very difficult undertaking. It is to be remembered that the plantation is to be cropped for some seventy years. With this long prospect in view it seems scarcely credible that such obvious precautions should be neglected.

If coconut were a European plant we should certainly have varieties differentiated for the production of copra, coir, etc., respectively, but such *finesse* in the circumstances would be premature.

Rubber is another product to which what has been said regarding coconuts conspicuously applies. I am speaking, of course, of rubber as produced by the cultivation in various tropical countries of *Hevea brasiliensis*. One has merely to walk through a rubber plantation to perceive the urgent need for selection. The rubber trees are all raised from seed, just as coconut palms are, with the same result, that good and bad and indifferent are all grown together. Each takes the same area of the clearing prepared with great labour for the plantation. Each needs the same attention and care, but the output of the several trees is altogether different. In a recent discussion on these subjects at the Royal Society of Arts, I ventured to call attention to the opportunity that was being missed by rubber planters, pointing out that if plantations were planted with only the moderate amount of care which ordinary selective methods demand, the output might be rapidly increased. In reply, the Chairman, a gentleman largely interested in rubber, stated that there was no direct evidence of a great variation in yield amongst different trees, and that in consequence the use of seed was not objectionable. I had in mind, however, not merely verbal reports of persons familiar with rubber-growing, but several precise records giving actual measurements. For example, W. H. Johnson (*Culture and Preparation of Pará Rubber*, 1909, p. 27) states that "the yield of rubber from different trees growing under similar conditions in the same plantation varies to an enormous extent." He further quotes experiments of Vernet (*Jour. d' Agric. Tropicale*, 1907) which gave differences ranging between the following extremes: in volume of latex, from 4 to 48; in percentage, *caoutchouc* from 29·28 to 39·74.

R. H. Lock (*Rubber and Rubber Planting*, 1913, p. 74) wrote: "It is well known that rubber trees possess marked individuality as regards the amount of latex which can be drawn from them. Tapping coolies, if left to themselves, soon discover these differences and confine their attention to the best yielding trees.......... Among a group of 29 trees of uniform age tapped daily, the highest and lowest average yields for the first 30 tappings were, respectively, 166 and 8 cubic centimetres. The circumference of these two trees was 52 and 32 inches, respectively, and they were not the largest and smallest trees in the group. The yield per inch of bark removed was in the ratio of 317 to 25, or more than 12 to 1." Lock was, of course, not only a sound botanist, but an expert plant-breeder. He urges a rigorous seed-selection in the founding of rubber plantations. Had he lived he would probably have done much to reform tropical agriculture, infusing the practice of planters with the spirit of accurate knowledge. The rubber tree would indeed be a remarkable exception among cultivated plants grown from seed, which have never been strictly selected and purified, if it did *not* vary enormously. Such variation is almost universal. Plants like our modern cereals and peas which present an approximation to complete uniformity have been reduced to pure strains by the seedsman's art. Each variety of wheat or of peas, though it may now be represented by many millions of plants, descends from a single individual which was deliberately chosen as showing desirable properties. From various causes, impurities occasionally get introduced, and these it is the seedsman's task continually to extirpate. In wheat and peas, which are usually self-fertilizing plants, this process of purification is comparatively simple. But in most plants which are habitually fertilized by pollen from other individuals, borne by insects or by the wind, pure strains are only maintained with great difficulty, elaborate precautions to ensure isolation being part of the regular routine of seed-raising. If it were true that a pure strain of a plant like *Hevea* (which is almost certainly insect-fertilized) has come into existence without the intervention of human agency, the fact would constitute something of a natural curiosity.

In the case of *Hevea* the most obvious course is to multiply good trees by means of cuttings. At Peradeniya the attempt to do this on a large scale failed, only one cutting in 3,000 succeeding, but others have cuttings without special difficulty, and it can scarcely be doubted that after a little experimenting a satisfactory and reliable mode of procedure would be discovered. The plantation which first succeeds in putting this simple suggestion into practice must infallibly outstrip competitors who are content to follow primitive methods. The life of a coconut plantation is, as was said above, reckoned at over seventy years. Rubber planting in the East Indies is an undertaking of such recent origin that no one yet knows how many years the trees will continue to yield rubber in quantity, but certainly the period is a long one, and during the whole life of the plantation the benefit will accumulate.

Though rubber and coconuts are the crops to which these suggestions apply with the greatest force, there are several more which will occur to those acquainted with tropical agriculture. Lock, in the passage quoted above, refers to the extraordinary results obtained by the Dutch in Java by applying methods of seed-selection to *Cinchona*, thereby nearly doubling the yield of alkaloid.

In these cases simple selection of the best types already existing would have incalculable effect. To suggest experimental breeding of these trees with a view to still further improvement may be a counsel of perfection. Not improbably, however, though the reward of that work might be distant, it would eventually be ample. So much work is already set on foot under the auspices of our own and other governments for the development of tropical agriculture that the comparative neglect of these important tree-crops is not easily explicable.

There are other tropical crops which, though liable to much cross-fertilization, must be raised from seed. Of these, cotton is one of the most important. To the improvement of cotton, much highly skilled work has been devoted. Leake in India and Balls in Egypt, not to speak of plant-breeders in America and elsewhere, working on strict genetic lines, had a considerable measure of success in their attempts to raise new varieties of commercial value. Burkill and Finlow have made a beginning with jute, which at present consists of a mixture of most divergent forms. The difficulty is first to work up the seed to a quantity sufficient for economic purposes, and if that were effected, to maintain the new variety pure when distributed among the agricultural population. Seeing that the country will, of necessity, be full of the old unpurified forms hitherto in use, even a small percentage of crossing must soon lead to serious deterioration. The only proper solution is to separate the seed-raising as a distinct industry. To grow the crop may tax the intelligence of the average agriculturist, but to raise good seed is altogether beyond him. Ordinary farming practice in the case of mangels will serve to illustrate what I mean. No farmer thinks of raising the mangel seed which he wants to sow for his own crop of roots. If he saved a few roots for seed, his neighbours doing the same, nothing but a lot of heterogeneous mongrels would result. Raising mangel seed is an art, and only a trained seedsman can carry it through. I have no doubt that in the future seed of high class cotton, etc., will be specially raised as seed. To do this with accuracy it is not unlikely that special areas will be set apart for seed-raising and some of the smaller islands, for example in the West Indies, might perhaps do well to take up such an industry.*

Provided that cross-fertilization by inferior varieties is excluded, there is no likelihood of deterioration by mere variation. Upon this subject the deepest ignorance still prevails even among professed naturalists. It is common, for instance, to meet the statement that the seeds of cultivated apples give mostly crabs. In the light of modern knowledge, we may feel practically sure, if such a phenomenon really occurs, which is not often, that the "reversion" is not due to the variability of the seed-bearing parent, but to crossing. To such crossing, the pollen of some wild form in uncultivated ground nearby may sometimes contribute. It is, no doubt, conceivable that two cultivated varieties of apples crossed together may produce a crab, but there is no evidence which suggests that this consequence is in the least degree likely, and at any rate we may feel perfectly sure that only by some rare exception could a self-fertilized fine apple produce a crab, or a self-fertilized fine plum produce a sloe or a bullace. Those who are engaged in practical agriculture, and in the administration of agricultural interests, have come to realize that science in the form of plant-pathology and entomology can aid them. Yet in the case of the hitherto "unimproved" crops of the world, the call for the services of the plant-breeder is, I am disposed to think, far more urgent. No improvement in the conditions can convert a poor variety into a good one, a truth which lies at the root not only of agricultural progress but of social reform also.

* Since writing this I hear from Mr. S. C. Harland, of St. Vincent, that a small island, half a mile distant, is there actually used for seed-raising.

THE WORK OF THE ROTHAMSTED EXPERIMENTAL STATION FROM 1914 TO 1919.*

BY

E. J. RUSSELL, D. Sc., F.R.S.,

Rothamsted Experimental Station, Harpenden, Herts.

THE work of the Rothamsted Experimental Station during the last five years falls into two main groups: problems connected directly with the war, and those connected with the development of agriculture after the war. The war work had the advantage that its significance was obvious, but on the other hand some of it was only of temporary importance, and depreciated considerably in value with the passing of the emergency with which it was intended to deal. The other work has more permanent value; it holds good even after the emergency has passed, but during the war it was sometimes overshadowed by the more pressing and immediate needs of the moment.

WAR WORK AT ROTHAMSTED.

During the first year of the war very little direct war work was done at Rothamsted. Food was still coming into the country in large quantities and there was no great interference with food production at home. Supplies of fertilizers and feeding stuffs were ample. There was, however, fear of unemployment, and three schemes were examined at the request of the Board of Agriculture with the view of ascertaining whether they would usefully employ any considerable number of men, and if so, whether they would contribute to the national profit. These were a proposed development

* Reproduced from *The Journal of the Board of Agriculture*, vol. XXVI, no. 5.

on Foulness Island in Essex, the suggested afforestation of the spoil heaps and pit mounds of the Black Country, and the reclamation of Pagham Harbour in Sussex. None of these schemes was further developed, though two of them—the planting of the spoil heaps in the Black Country and the reclamation of Pagham Harbour—possess aspects of permanent interest. The spoil heaps are useless and unsightly; they can, however, be planted with trees, when they take on a very different appearance, as shown at Reed Park, Walsall. Although the financial returns may not be very great, the improvement in the amenities of the district would be considerable. The proposition is, however, hardly an agricultural one.

The most important war work began in 1916, when the food situation gave cause for much anxiety. The position was really very serious. The submarine menace was looming before us, terrible in its unfamiliarity, conjuring up visions of food shortage, if not of starvation; the only way out of the situation seemed to be the production of our own food in our own country. At the time we were producing only one-half of our total food, and the remainder was coming from abroad. When examined in detail the position was found to be more serious than it looked. The food produced at home included more of the luxuries than of the essentials. It included, for instance, the whole of the highest quality meat, but only one-fifth of the bread. The farmer was, therefore, called upon to perform a double task; he had to produce more food, and different food. He had to give us, not one loaf out of every five that we ate, but three or four out of every five, and to do this without causing too great a shortage of milk, meat, and, if possible, beer. The situation presented many difficult administrative, financial and technical problems. The technical problems involving soils and fertilizers were dealt with at Rothamsted.

The fertilizer problems arose out of the necessity of making the very best use of the limited stocks of the ordinary fertilizers, to which the farmer was accustomed, and of examining any and every substitute that promised help in eking out the supplies. Fortunately, a good deal of information could be drawn from the

Rothamsted and other experiments as to the best way of using fertilizers on particular crops. This was systematized and put in order in a little handbook called "Manuring for Higher Crop Production," issued at a cheap price (1917: 3*s*. 6*d*. net) by the Cambridge University Press so that the farmer could readily obtain it. In addition, a series of notes was issued in "The Journal of the Board of Agriculture" showing how the available supplies might best be utilized.

It was more difficult, however, to give useful information about the substitutes that would be needed if and when the fertilizer supplies became too much reduced. Ordinarily fertilizer tests have to be continued for two or three successive seasons before a definite opinion can be expressed as to their value; during the war, however, some sort of opinion had to be given in three or four weeks. Rapid methods of laboratory testing were therefore developed: growing seedlings were used to indicate whether (as not infrequently happened) toxic substances were present; rates of nitrification in soil were determined to find out how far the substance would yield nutrient material to the plant; farm crops were grown in pots to afford opportunities for testing any material that might seem promising. A considerable number of possible fertilizers were sent in for examination by the Board of Agriculture and Food Production Department, the Ministry of Munitions, the National Salvage Council, and other bodies.

Much of the information was wanted for the purpose of economizing sulphuric acid, so that the maximum quantity might be handed over to the Ministry of Munitions for the manufacture of explosives. In peace time the farmer had been the chief consumer of sulphuric acid; in 1917, however, the Ministry of Munitions were requiring all the acid they could find, and were leaving much less than usual for the fertilizer manufacturers. Even in pre-war days the farmer had required 870,000 tons of chamber acid per annum (equivalent to 580,000 tons of pure acid), and the extra food production programme was calling for even more than this. The Ministry of Munitions were, however, obdurate, and cut down supplies at a rate which seemed to some of the more nervous to threaten a very serious situation. The production of sulphate of ammonia fell from 350,000 tons per annum to little over 250,000 tons, while that of superphosphate fell from 800,000 tons to 500,000 tons per annum.

Fortunately a substitute for sulphate of ammonia was available in the form of nitre cake, and although no fertilizer manufacturer liked it or had a good word to say for it, it seemed as if it might have to be used extensively in the manufacture of superphosphate and of sulphate of ammonia. Important and difficult technical problems were involved both at the factory and on the farm, necessitating a considerable amount of experimental work. Thanks to the co-operation of the manufacturers, working solutions of the difficulties were found, and there is little doubt that both sulphate of ammonia and superphosphate could have been made from nitre cake had the necessity arisen. Fortunately it did not, and the situation was eased before it became too serious.

A considerable amount of work was also done in the examination of new sources of potassium compounds to take the place of the Stassfurt salts which had previously been our sole source of potassium compounds. A certain number of residues from manufacturing processes were available, but in the main they suffered from one or both of two defects—very low content of potash likely to be useful to the plant, and the presence of toxic substances. After much sorting out of possible materials it appeared that certain blast furnace flue dusts would prove suitable, and accordingly the Food Production Department took steps to make the necessary arrangements for distribution among farmers. Considerable quantities have been used, generally with distinct advantage. With the re-establishment of peace conditions, supplies of potassic fertilizers may be expected from the Continent.

Investigation was also made into the possibility of using to better advantage the farmyard manure produced on the farm, and of using as fertilizer various substances now wasted.

It is estimated by Hall and Voelcker—admittedly good authorities—that some 50 per cent. of the value of farmyard manure is lost on the average farm of the country through avoidable causes.

*Thanks to the generous assistance of the Hon. Rupert Guinness, it has been possible to retain an expert chemist, Mr. E. H. Richards, expressly for the purpose of elucidating the causes of the loss, this being necessary before one could hope to find a remedy. The causes of the loss have been traced in an extended series of laboratory investigations, and the conditions necessary for its avoidance have been ascertained.

Broadly speaking, the conditions to be secured in the making of the manure as ascertained by Dr. Hutchinson are sufficient supplies of nitrogen compounds and of air to allow the cellulose decomposing organisms to effect the decomposition of the straw. For the storing of the manure, however, Mr. Richards' experiments show that it is necessary to have shelter from the rain and also to prevent access of air. The best methods for securing these conditions have required working out for particular cases, which can be done only after consideration of all the local circumstances.

Field experiments have shown that farmyard manure stored in conformity with these conditions is of higher fertilizing value than the ordinary material, the crop being 10 per cent. or more beyond that given by manure kept in the usual way. During the war, when all sources of loss had to be studied and as far as possible stopped, the necessary conditions were vigorously brought to the notice of farmers and Executive Committees by the Food Production Department, and at different times attention has been drawn to the matter in "The Journal of the Board of Agriculture." Savings of several units per cent. on old-established practice are possible, and every one per cent. saved would mean in the aggregate some £200,000 a year at present prices.

A beginning has been made with a much more difficult problem—the handling of manure on a dairy farm. The conditions here are very different from those on an ordinary mixed farm where bullocks are fattened: it is desirable that the dung should be as little in evidence as possible and that the urine should be quickly

*An article on the subject appeared in *The Journal of the Board of Agriculture* for December, 1914, p. 800.

and completely removed from the cow-sheds. So important is this that it must be done even if loss is thereby incurred. Two methods have been studied :—

(1) The removal of the solid excreta and its storage under cover and out of reach of air; collection of the liquid manure in a tank, and its application to temporary or permanent grass land and on the stubbles prior to taking a root crop.

This method is already in use on certain dairy farms, but careful examination revealed a considerable deficit on the nitrogen account: the liquid only contained about one-half of the nitrogen expected. The loss was traced to the broken straw and solid excreta which always find their way into the liquid and cause an absorption of nitrogen which, though of scientific interest, may prove costly to the farmer, and at any rate deprives the liquid of much of its value.

Further investigation of this absorption is being made; it may be avoidable, in which case the value of the liquid manure, already high, could be enhanced still further. In case it seems to be unavoidable, however, a second method of procedure is being adopted :—

(2) The solid manure is collected as before, but the liquid is allowed to run through straw under conditions which encourage the absorption of nitrogen compounds. By suitable arrangement the straw increases in fertilizer value, while the liquid loses part of its valuable constituents, and can more easily be sacrificed.

This second method is still in the laboratory stages, but may prove of considerable value. Mr. Richards is carrying out the laboratory experiments at Rothamsted and the large scale experiments at Woking on the Hon. Rupert Guinness' home farm.

THE MAKING OF FARMYARD MANURE WITHOUT ANIMALS.

Two years ago there seemed a prospect of a considerable surplus of straw, and methods of utilization were examined; in particular the possibility of converting it into a useful manure was studied at Rothamsted.[1] The prolonged drought of this season

[1] *The Journal of the Board of Agriculture*, April, 1919, p. 15.

has dispelled any prospect of excessive straw, but the value of the work remains.

The investigation is being carried out by Dr. Hutchinson and is the logical continuation of work that he has had in hand for some time. Laboratory work has shown that the breaking down of the material of straw, the so-called cellulose, is effected by a remarkable organism which had eluded all previous investigators, but which Dr. Hutchinson succeeded in obtaining in pure culture so that he could study its properties. In order that it may bring about the decomposition of straw it requires two conditions, air and soluble nitrogen compound, as food. If either of these is missing it ceases to act. Moreover, it will only attack cellulose: it is unable to feed on sugar, starch, alcohol or any organic acid yet tried.

Given, however, the necessary nitrogen compounds and a sufficiency of air, the organism quickly decomposes straw, breaking it down to form a black, sticky material, looking very much like farmyard manure. A ton of this material is now being prepared for the purpose of fertilizer tests.

Sewage sludge as manure.

Many efforts have been made in the past to utilize sewage sludge, but until recently without success. A new process is now being studied which seems more promising; it gives a sludge containing 6 per cent. or more of nitrogen, in an easily available form. There are, however, a number of problems to be solved before its agricultural value can be established, and work on these is being pressed forward as vigorously as possible. An experimental plant has been erected at the Harpenden Sewage Works, where sufficient material for new tests is being prepared.

The importance of the problem is manifest from the consideration that the total excrements of the inhabitants of the United Kingdom would be worth nearly £18,000,000 per annum as fertilizer if they could be applied to the land. Only a fraction is so used at present, but the need for national economy is such that nothing of value should be wasted.

Other aids to production, lime and artificial fertilizers.

Lime. Most farmers know by experience whether or not they require lime, but few use it as regularly as they ought, with the result that clover often fails to do well, and swedes become liable to finger-and-toe. Numerous analyses made at Rothamsted of soils from different parts of the country show how widespread is this lack of lime.

In trying to remedy the deficiency, however, difficulty has arisen because it is not always possible to tell a farmer how much lime the soil needs: often indeed one can only say that he should apply between 10 cwt. and 2 tons per acre. Of course, if farming were independent of costs this vagueness would not matter, but the delicate financial balance under which agriculture has to be conducted leaves no margin for indecision between 10 cwt. and 2 tons. A method has, therefore, been devised by Dr. Hutchinson for estimating the degrees of lime requirement, and when it is known how much lime one part of the land needs, the quantities wanted for the rest are readily ascertained.

Calcium cyanamide. Two new artificial fertilizers have been studied in some detail. Calcium cyanamide, commonly known in this country as nitrolim, is a fertilizer of distinct promise, about which, however, experts still have a good deal to learn.

In field practice it has varied considerably in effectiveness. On the average of all field trials in the United Kingdom, when the effect of nitrate of soda is taken as 100, that of sulphate of ammonia is 97 and of cyanamide 90. The cyanamide results, however, sometimes fall as low as 26 and occasionally rise as high as 238. Mr. Cowie has shown that cyanamide under certain conditions contains another substance, dicyanodiamide, which is poisonous not only to plants but also to the nitrifying organisms. It is less toxic to other organisms, however, and has little effect on the bacteria developing on gelatine plates, the rate and extent of the decomposition of dried blood, or the rate of production of ammonia from cyanamide. In its presence ammonia accumulates in the soil and the normal oxidation to nitrate does not take place.

Dicyanodiamide, therefore, not only injures the plant, but cuts off the supply of nitrate, substituting instead ammonia, which in most cases is less useful, and in some cases directly harmful to the crop. The conditions under which it is formed are known and fortunately can be avoided.

A further investigation is being made into the breaking down of nitrolim in the soil. Nitrolim itself is not a plant food; under suitable conditions, however, it readily changes into such. Usually changes of this sort are brought about by living organisms under conditions which are now well understood. In this particular case, however, something else is involved, the exact nature of which is not yet clear, although Mr. Cowie is on its track. There is little doubt that some of the cases where nitrolim gave disappointing results arose through lack of the decomposing agent, whatever it may be.

Ammonium nitrate. Another investigation arose out of the necessity of making the best possible use of the materials employed in the making of munitions, one of which—ammonium nitrate—had been accumulated in great quantities.

It was known some time ago that at the end of the war large stocks of this ammonium nitrate might be available for agricultural purposes. Experiments were, therefore, made to ascertain its properties as a fertilizer.[1] The material available before the war had been too deliquescent for ordinary use. A much less deliquescent modification is, however, now available; it has been stored for months in the Rothamsted manure shed without giving trouble. Further, it can be drilled with the utmost ease, either alone or mixed with superphosphate (though the mixture should not be stored). It gave good results on mangolds and potatoes and as a top-dressing to cereals. It is highly concentrated, containing 35 per cent. of nitrogen.

Basic slag. Considerable attention has been devoted to basic slag. During the war there has been a great change in the composition of this material in consequence of the extension of the basic

[1] *The Journal of the Board of Agriculture*, February, 1919, p. 1332.

open-hearth process for making steel. The new material contains less phosphate than the old, and less is soluble in citric acid. Field experiments have been made to ascertain its actual value, and inquiries have been made in conjunction with Dr. Stead, of Middlesborough, into the possibility of improving its value.

CONTROL OF SOIL ORGANISMS AND PESTS.

Most farmers have learnt to their cost that soil is inhabited by a number of organisms capable of doing a great deal of mischief ; it is well known that there are others that do very much good. Considerable attention has been devoted at Rothamsted to the soil organisms, and much information has been gathered about them.

The wireworm furnishes a good example of the harmful organisms in the soil. In a general way its life-history has long been known, but little exact knowledge was available before Mr. Roberts began his work at Rothamsted ; in consequence, no sound method of dealing with the pest could be suggested.

Mr. Roberts has, however, succeeded in tracing the precise history of the wireworm from the egg through the larval stage to the beetle, and has brought to light a great deal of new and useful information about it. Further experiments are necessary to discover the best way of using this information. Dr. Malcolm Laurie has carried out some interesting experiments which promise valuable results.

Mr. Tattersfield and Mr. Roberts have also devoted much attention to the effects of poisons on the wireworm. A large number of substances have been systematically tested, and many have been found far more poisonous than the naphthalene sometimes recommended. Ammonia is distinctly harmful to the wireworm—not the sulphate of ammonia used as a fertilizer, but ammonia itself—and it is interesting to note that this is produced in the soil when liquid manure is applied, or when sheep are folded on the land. Either of these methods may be expected to keep down wireworms.

It is hoped that the information obtained in these experiments will enable works chemists to make a satisfactory soil insecticide—

one of the most urgent needs of the arable farmer and market gardener.

Some years ago it was shown at Rothamsted that the treatment of the soil with poisons led to increased productiveness if the poisons could subsequently be removed. The search for a soil insecticide is combined, therefore, with the search for a soil-sterilizing agent, and this part of the work is carried out by Mrs. Matthews, the W. B. Randall Research Assistant, Mr. Randall having generously provided the funds that enable the Station to secure Mrs. Matthews' services. The results are too technical for discussion here, but they show beyond doubt that simplification of the soil population is an advantage to the grower. For the present this information is of direct value only to the nurserymen working under glass. For cucumber- and tomato-growing under glass the most efficient method is to steam the soil, when the undesirable forms are reduced or eliminated, and the useful forms are less affected. Various poisons are now being used successfully, and are, fortunately, much cheaper than heat.

The co-operation of the chemist has led to some interesting developments. It was found in the early stages of the investigation that carbolic acid, which is sometimes phenol and sometimes cresol, was effective in dealing with important pests, but Mrs. Matthews and Mr. Tattersfield have greatly improved on this substance. They find that chlorphenol is about four times as toxic as phenol; dichlorcresol, which is easily prepared on the large scale, is about five times as effective as cresol, hitherto the most potent agent available for practical purposes.

Some of the so-called poison gases are very effective and if the practical difficulties attending their use could be overcome, they would form a valuable addition to the growers' equipment. This, of course, is work for the future; already, however, the sterilizing methods have considerably increased the output of glasshouse production in the Lea Valley.

A highly useful soil organism, the clover organism, has been studied in some detail and an important advance made by Mr. Bewley. Before this work was done little had been known of the way in which this organism lives when it is out of the plant. Bewley has now shown that it can exist in two forms—one form can move about, while the other cannot. The addition of soluble organic matter causes the latter to change into the motile form.

This fact is of great interest in connection with another result recently obtained at Rothamsted. It was found that clover makes more vigorous growth in a rotation where farmyard manure is used than where artificials only are used.[1] It seems legitimate to suppose that the farmyard manure helps the organism to become motile so that it can easily move about and enter the plant root; this hypothesis is being tested.

Special attention is being devoted to the processes whereby plant food is made in the soil. These processes are of vital importance because on them depends the proper utilization of farmyard manure, clover residues and grass residues ploughed into the land. At present there is good reason to fear that only 50 to 60 per cent. of the potential value of these materials is ever realized: the rest is lost to the farm, and, of course, to the country. Improvements do not come from sensational discoveries; indeed many of the sensational discoveries announced in the press turn out to be nothing but mare's nests. It is the steady advancement of knowledge that helps to solve agricultural problems; link by link the chain is forged until one day, unnoticed and unrecorded, the last link is made and the definite advance is achieved. Practice advances in the same way; a one per cent. improvement here, and a one per cent. improvement there, represents a much more solid achievement than many of the supposed discoveries that sometimes attract so much attention.

WEEDS.

The study of the weeds of the farm is in the capable hands of Dr. W. E. Brenchley, whose results have been published from time to time in "The Journal of the Board of Agriculture" and in the Journals of the Bath and West, and of the Royal Agricultural

---

[1] *The Journal of the Board of Agriculture*, May, 1917, p. 124.

varieties; these results are now being collected, so that it is unnecessary to enter into any detailed account of them here.

PLANT PATHOLOGY.

Farmers suffer great losses every year through the attacks of insects and fungi; in consequence the Board of Agriculture have recently set up at Rothamsted an Institute for Plant Pathology, the purpose of which is to study plant diseases.

Dr. A. D. Imms is in charge of the entomological work and Mr. W. B. Brierley of the mycological investigations. The primary purpose here, as in the rest of the Station, is to gain information and not to cure particular diseases: indeed it is not too much to say that, until some of the information at present sought is obtained, there will be little hope of cures for many of the ills affecting plants. The treatment of plant diseases is now in somewhat the same position as the treatment of human diseases in the days of the barber surgeons, and further advance can only come when more knowledge is obtained.

THE CANNING OF FRUIT AND VEGETABLES.*

THE preservation of fruit and vegetables by canning has many advantages over bottling, especially when carried out on a commercial scale. The initial outlay is not so heavy, and packing and transport difficulties are much reduced, while breakages of bottles are avoided, and a great saving of time is effected, as large quantities of produce may be dealt with quickly.

Furthermore, if the canning be carefully done the flavour of canned fruit is considered superior to that of fruit preserved by other methods. This is due to the fact that the cans are hermetically sealed before being sterilized, and all volatile oils and flavours are, therefore, retained.

APPARATUS NECESSARY FOR CANNING.

The apparatus necessary for canning by the "water-bath method" depends a great deal upon the quantity of fruit to be dealt with. For ordinary household purposes a large pan fitted with a false bottom can be used, or special sterilizing pans holding 18–20 3-lb. cans may be purchased. When using these pans the cans must be submerged in boiling water. If desired, an ordinary copper can be used; in this case it is advisable to obtain the special tin trays with handles which fit into the copper, so that the cans are easily lifted in and out.

Complete outfits of canning apparatus may be bought, and attention may be drawn to the following types:—

* Reproduced from the *Journal of the Board of Agriculture*, vol. XXVI, no. 5.

The Royal Home Canner (Fig. 1.) is suitable for domestic purposes and is so constructed as to generate steam quickly. This apparatus will hold three dozen 3-lb. cans at one time. It is portable, and wood, coal or gas may be used to generate the steam.

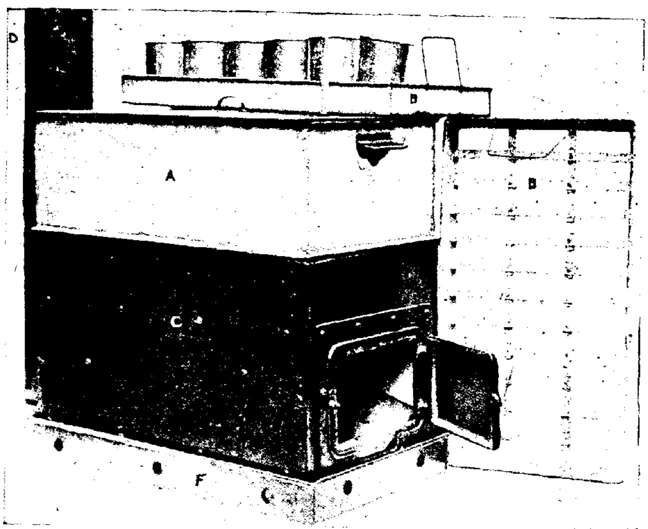


FIG. 1. The Royal Home Canner, showing the following parts:—A, covered boiler or sterilizer made of galvanized iron and fitted with handles; B, tray to hold cans; C, japanned iron carrier lined with asbestos; D, chimney to carry off smoke when wood or coal is used as fuel; E, grate for wood fuel, etc.; F, loose tray in which the canner stands.

The Pressure Canner is a more complicated apparatus than the Royal Home Canner. It generates and retains steam under pressures varying from 5–30 lb. per square inch, and must be fitted with a pressure gauge and safety valve. It enables canning to be carried out very rapidly, and is the only sure method of canning meat, fish, and such vegetables as peas and beans, but is not essential for fruit or tomatoes.

Full particulars of large commercial or pressure canning outfits may be obtained through the trade journals.

Preservation of food by sterilization.

It is a well-known fact that food decay is caused by germs present in the air. These germs are of three classes, two of which, yeasts and moulds, attack both fruit and vegetables, and a third, bacteria, attacks vegetables only.

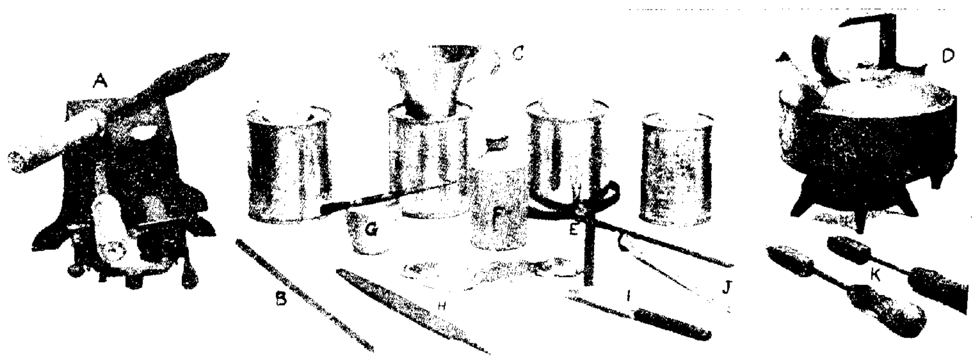
The destruction of these organisms by heat is known as "sterilization." If this is properly carried out and reinfection is prevented, food is preserved for an indefinite period.

A temperature of 150° F. to 190° F. is sufficient to kill yeasts and moulds, but bacteria are not destroyed except at a temperature of 212° F. (boiling point). In each case the temperature must be maintained for the proper length of time.

Equipment required for canning (Plate VII).

Successful canning can only be accomplished if all the equipment is ready to hand before starting. The following are essential:—

1. *Sterilizer.* This may consist of any large pan or, better still, a specially made canner.
2. *Cans and lids.* The cans are made of tin in nominal 1, 2, 3 and 7-lb. sizes. A reputed 2-lb. can will hold 2 lb. of pulp or jam, but only 1¼ lb. of fruit in water; the other sizes are in proportion. Each lid should have a small vent-hole, and cans with wide mouths are the most suitable.
3. *Solder.* This is used for soldering on the lid and sealing the vent-hole.
4. *Flux and small brush.* Flux or soldering fluid is used for cleansing the tin to ensure that the solder adheres.
5. *Soldering irons.* These have copper ends and must be kept smooth and bright.
6. *File and Emery paper.* Necessary to clean the irons.
7. *Clean cloths.* For wiping the cans, etc.
8. *Boiling water.* In plentiful supply.



EQUIPMENT FOR CANNING.

A, soldering iron heater; B, stick of solder; C, cans with caps and funnel for fi purposes; D, kettle to ensure a supply of boiling water; E, can tongs for carrying hot cans; F of flux; G, small basin and brush for using flux; H, file; I, knife for preparing the J, thermometer; K, soldering irons.

PREPARATION OF FRUIT AND VEGETABLES.

Grading. Vegetables and fruit must be graded carefully according to colour, size and ripeness. This ensures the best "pack" and uniformity of flavour and texture to the canned product: these points are very important and should always be kept in mind.

Blanching. Prior to canning it is very necessary for all vegetables and many kinds of fruits to be "blanched." Thorough cleansing and the removal of acid and acrid flavours are thereby ensured, and the colouring matter sets; the bulk of green vegetables is also reduced, and the splitting and cracking of cherries, damsons and plums are prevented. Peaches and pears are rendered more transparent and given a better texture and more mellow flavour. Soft fruits do not require "blanching."

The operation consists of plunging the vegetables or fruit into boiling water for a time, which may vary from 1 to 15 minutes according to the state of maturity and the kind of fruit and vegetables used.* After the necessary time has elapsed, the fruit or vegetables should be removed from the boiling water and plunged immediately into cold water two or three times, but they should not be left in the cold water to soak. The plunging into cold water sets the colouring matter, and is termed "cold-dipping." Vegetables are made more crisp if salt is added to the cold water.

Vegetables	Time of blanching
Peas and beans	2-3 minutes.
Carrots (according to size and age)	5-15 ,,
Celery (according to thickness)	3-5 ,,
Beets	5-10 ,,
Tomatoes	5-10 ,, to loosen the skin.

* A wire basket or piece of cheese cloth is useful for this purpose.

FILLING AND SOLDERING THE CANS.

Packing the cans. Wash the cans in *boiling* water immediately before filling. Take one can at a time and pack with fruit or vegetables to within $\frac{1}{4}$ in. of the top, but without crushing. To ensure a good "pack" the cans should be *weighed,* particularly if the product is for market purposes. Cans after being packed should be dealt with as quickly as possible and not allowed to stand about open.

Adding water, syrup or brine. Immediately after packing sufficient liquid must be added to cover the produce. Fruit may be canned in either water or syrup, but the latter is to be preferred as it imparts a better flavour to the canned product. For vegetables brine should be used. The syrup, brine or water used for filling the cans should be boiling (*see* page 83 for strengths). Next place the lid on the can and wipe dry with a clean cloth.

Soldering on the lid or capping. Apply a little flux with a small soft brush around the groove of the cap, taking care that none enters the can. With the hot iron, well tinned, in the right hand and the solder in the left hand, melt two or three drops of solder round the cap in the groove (Fig. 2). Steady the cap with the stick of solder, but do not cover the vent-hole. Then draw the melted solder round the cap in an even, smooth stroke with the hot iron.

FIG. 2. Soldering a can, showing correct position of hands, the soldering iron held in the right hand and stick of solder in the left. A small portion of solder has been dropped on the rim of the cap, and is being drawn round by the hot soldering iron. The stick of solder, meanwhile, holds the cap in position.

Sealing the vent-hole or tipping. If boiling water has been used in filling the cans, then tipping may be done immediately after the lid is soldered on, as enough *air will have been exhausted* or driven out through the vent-hole. To tip a can, place the point of the hot iron over the vent-hole and touch the iron slightly with the solder stick. A bead of solder will then drop on to the vent-hole and make a neat tip. The description of the contents must then be marked on the can with an oil crayon.

EXHAUSTION.

The operation of "exhaustion" or driving out the air from the cans before "tipping" is very important. By using boiling liquid to fill the cans, and "capping" them immediately, the centre of each can will register from 170° to 190°F., and sufficient exhaustion then takes place. No can should be tipped below a temperature of 170°F.

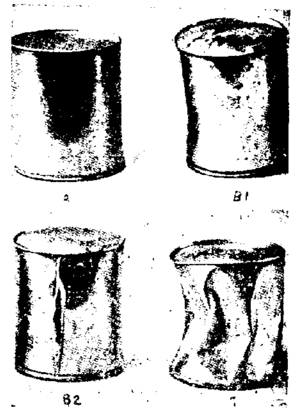


FIG. 3. Comparison of perfect and imperfect cans. A, perfect can; B1, bulged can, showing how the top and the bottom of the can has bulged owing to fermentation caused by insufficient sterilization; B2, burst can, caused by insufficient sterilization and weak joints in the can—although bursts from the latter cause very seldom occur; C, collapsed can, due to insufficient filling and over-exhaustion.

When "tipping" is not done immediately after "capping" and the interior temperature of the can has fallen below 170° F. the air should be exhausted by placing the cans, with the vent-holes open, in the canner for 5 to 15 minutes until the temperature is brought up again to 170°–190° F. The cans are then removed from the canner and immediately dried and tipped. Great care must be taken if this method is adopted, for by over-exhaustion the cans collapse (Fig. 3 C) on cooling and the contents, although properly sterilized, become mushy.

Sterilization. This is the term applied to the process of heating the cans to ensure the destruction of the organisms responsible for decay. The time allowed for sterilizing must be reckoned from the moment the water *boils after* the cans have been lowered into the canner. For sterilizing in steam, a thermometer is absolutely essential.

Time table.

Products to be canned	Preparation	Time of sterilizing
Soft fruit. Gooseberries, Currants, Strawberries, Raspberries, Loganberries.	Graded	15-20 mins. at 212° F. (according to ripeness).
Stone fruit. Cherries, Plums, Damsons, Apricots and Peaches.	Blanched and cold dipped.	15-20 mins. at 212° F. (according to ripeness).
Hard fruit. Apples and Pears ...	Peeled, cored and blanched and cold dipped.	20-30 mins. at 212°F. (according to ripeness).
Tomatoes	Scalded and peeled ...	20-30 mins. at 212° F.
Vegetables	Blanched and cold dipped.	2 hours. Green vegetables to be redone after 48 hours.

NOTE.—Very ripe fruit always requires more sterilizing than unripe fruit.

Cooling the cans. All tinned products must be cooled as quickly as possible to check subsequent cooking, which would otherwise continue for some time, and so spoil the colour and reduce the fruit to pulp. To cool the cans plunge them into a bath of cold water, or, if large numbers are being dealt with, spray them with a hose pipe. The cans must not on any account be piled up one on top of the other until thoroughly cold. Before storing, the cans should be first dried to prevent rusting, and then lacquered and labelled.

TINNING OR PREPARATION OF IRONS FOR SOLDERING.

See that the irons are bright and smooth, and heat thoroughly in a clear fire or over the gas. Place some soldering fluid (flux) in a stone jar for cleaning the irons, and also a small quantity in a clean glass jar for brushing the tins. Dip the irons into the jar of flux and rub the ends with the stick of solder, then immediately dip again into the flux and the solder will be found to run evenly over the iron. This "tinning" is most important, for if the irons are not kept clean and well tinned, the soldering of the cans cannot be carried out successfully. So long as the irons are not made *red hot* they will remain "tinned" and need only be dipped into the flux before using. When once the operator becomes accustomed to the handling of the tools, the soldering may be done very quickly perfectly. A pound of solder will seal a gross of cans, and an efficient operator can do sixty cans an hour.

Brine and syrup.

Brine or syrup is made by boiling the correct amounts of salt or sugar in water for ten minutes. All impurities are then skimmed off the top.

For brine, one tablespoonful of salt is required for each quart of water.

The strength of syrup will vary according to the class of fruit to be canned.

1.	Soft Fruit, Plums and Cherries ..	Thin	$2\frac{1}{2}$ lb. sugar to each gal. of water.
2.	Pears	.. Medium	$4\frac{1}{2}$ lb. sugar to each gal. of water.
3.	Peaches and Apricots	.. Heavy	$6\frac{1}{2}$ to 8 lb. sugar to each gal. of water.

Strawberries and raspberries should be canned in syrup made from the juice of the berries, in which case no water or syrup is used.

Causes of failure in canning.

1. *The use of unfit material.* Fruit and vegetables for canning must be perfectly fresh and in good condition, and must be canned as soon as possible after gathering. Failures known as "Flat Sours" are caused by using material which has fermented or heated through standing for some time. Fruit gathered wet and kept together in too large quantities, or peas remaining in closed baskets or bags are very liable to be spoiled in this manner. The contents of the cans are sour, although there is nothing to indicate this condition until they are opened.

2. *Insufficient sterilization.* Swollen or bulged cans (Fig. 3 B) are usually caused by the produce fermenting through insufficient sterilization. The ends of the cans become distended with the gas which is generated. The contents are unfit for consumption and have an offensive odour.

3. *Careless sealing.* This causes cans to leak and results in the contents going bad. Great care must be taken to detect any leaks before storing, and if found they must be repaired at once. Cans should be tested *after soldering* by lowering each one into a bath of hot water. If a leak is present bubbles will rise to the surface of the water.

4. *Overpacking or sealing when too cold.* This also causes bulged cans. If due to overpacking, the cans can be made to resume their normal shape on cooling by pressing in the ends. The contents of the bulged cans due to these causes are quite wholesome.

5. *Shrinkage of produce in the cans during sterilization.* This may be caused by—

1. Improper blanching and cold dipping.
2. Loose packing through careless grading.
3. Sterilizing too long.

6. *Cloudy peas* are caused by—

1. Using peas with cracked skins.
2. Blanching too long.
3. Using hard water.

7. *Discoloration of fruit* is due to—

1. Careless blanching.
2. Continued cooking due to piling the cans on top of others before they are cool.
3. Using over-ripe fruit.

NOTE.—*Rhubarb* should never be canned unless a very heavy syrup is used. Otherwise the lacquer of the cans will not withstand the excessive acidity of the rhubarb and the inside of the tins will rust. The contents of cans in this condition are unfit for consumption.

Notes

A SUSPECTED CASE OF POISONING FROM LINSEED CAKE.

THE occurrence of a considerable proportion of cyanogenetic glucoside in linseed cake is well known, and is of considerable interest in view of the fact that this cake is generally considered to be one of the safest cattle foods. Ingle[1] refers to this subject as follows :—" A point of some interest is the almost universal occurrence of a cyanogenetic glucoside, Linamarin, identical with phaseolunatin, in linseed cake. Fortunately the hydrolysing enzyme, capable of liberating hydrocyanic acid from this substance, which is present in the seed, is destroyed by the high temperature employed during the extraction of the oil, so that the cake is rarely, if ever, poisonous from this cause."

The probability that the feeding of linseed cake may occasionally become dangerous has been the subject of several investigations. G. D. Lander[2] carried out feeding tests on sheep with a linseed cake containing 0·025 per cent. HCN, giving a ration of from 1 to 5 lb. of moist cake per diem, and obtained no definite result. The same observer also fed rations containing HCN in the form of potassium cyanide and only obtained definite results when 30 grains of HCN were administered. He concludes that linseed cake, such as is usually employed, is harmless.

Collins[3] studied the rate of evolution of hydrocyanic acid from linseed cake under digestive conditions, and found that the amount of HCN produced depended upon the amount of enzyme

[1] " Text Book of Agricultural Chemistry," Chapter XIV, p. 282.
[2] Lander, G. D. *Jour. Bd. Agri.*, XVII (1911), 11, pp. 904–907.
[3] Collins, S. H. *Proc. Univ. Durham Phil. Soc.*, IV (1911–1912), 3, pp. 99–106.

present, and the temperature and the degree of acidity of the liquid, and concluded that, in normal health, the acidity of the stomach is too high for the production of HCN from linseed cake, but abnormal conditions may cause its production.

Auld[1] found that the majority of linseed cakes examined by him produced prussic acid on maceration with water, the amount varying from 0·001–0·052 per cent. In only a few cases was no prussic acid found owing to the enzyme having been destroyed. The total HCN content of the cakes examined varied from 0·023 per cent. to 0·056 per cent., the average being 0·036 per cent. He found that the formation of HCN at blood heat was exceedingly rapid—half the available HCN being often liberated in fifteen minutes—the maximum being attained in six hours. The hydrolysing enzyme is, however, easily destroyed by mixing the ground cake with boiling water, and the gruel, when properly prepared, is practically harmless.

In view of the generally expressed opinion that linseed cake as usually employed does not give rise to deleterious effects, it is worthwhile drawing attention to a suspected case of poisoning which has recently passed through my hands. Several cases of suspected poisoning of horses having occurred at the Saharanpur Remount Depôt, samples of the materials forming the ration were submitted for examination. Of these, suspicion attached to the linseed cake which was found to contain 0·023 per cent. HCN and a recommendation was made that the use of this foodstuff should cease. This was done and a report was subsequently received stating that no further cases of poisoning had occurred, and it would therefore seem very probable that this cake was the cause of the trouble.

The linseed cake in question had every appearance of being the local production of the country oil mill in which the temperature of extraction is comparatively low and consequently the hydrolysing enzyme was not destroyed, thus leading to the liberation of an excessive amount of HCN during digestion. In view

[1] Auld, S. T. M. *Jour. Southeast Agri. Col. Wye*, 1911, no. 20, pp. 289–326.

of these facts, it would therefore be advisable, when using country cake, to take such measures as will lead to the destruction of the enzyme before feeding to cattle. [W. H. HARRISON.]

*
* *

INDIAN SUGAR COMMITTEE.

THE Government of India, in the Revenue and Agriculture Department, issued the following Resolution on the 2nd October, 1919 :—

" Among the many questions which have been brought into prominence by the war, that of the possibility of organizing and developing the sugar industry in India stands high in importance. It is not a new question. It has been considered by the Board of Agriculture in India from time to time, and formed one of the main subjects of discussion at its last meeting at Poona in December 1917, when the necessity for a bureau of information on the industry was emphasized. A beginning in this direction has already been made; and Mr. Wynne Sayer of the Indian Agricultural Service was in February last placed on special duty to undertake the collection and co-ordination of all available information regarding the industry. But this is only a beginning and the Government of India realize that much remains to be done if any material expansion of the industry is to be looked for.

" 2. Regarding the desirability of such expansion there can be no doubt. The food value of sugar is high : the annual consumption has been increasing steadily for many years, and in India no less than elsewhere. Sugarcane is indigenous in India which until very recent years stood first of all countries in the world in its area under cane and its estimated yield of cane-sugar, and even now ranks second only to Cuba. Yet it is notorious that the yield both of cane and raw sugar per acre and the percentage of available sugar extracted from the cane are undesirably low. While, therefore, India should be in a position, as she was in the past, to produce a surplus of sugar for export, she has in fact had to supplement her own supplies by imports the tendency of which steadily to increase has only been checked by war conditions. The same conditions have also served to emphasize the disadvantages involved in relying upon external sources of supply. The world prices of sugar have risen enormously, with the result that, while imports between 1913–14 and 1917–18 fell in quantity from 900,000 to 500,000 tons approximately, they rose slightly in value from 14·96 to 15·32 crores. The beet-sugar industry has been disorganized over extensive areas in Europe and, if India cannot now look to herself to supply her own wants, she is faced with the alternative of either reducing her consumption of sugar, or paying increased amounts to obtain it.

"3. But if the desirability of extending the sugar industry in this country is obvious, the difficulties involved are hardly less so. Apart from the difficulties attending the cultivation and manufacture of cane-sugar in all countries, the Indian industry is confronted with problems which are either peculiar to India or exist there in a special degree. The systems of land tenure exhibit great variety and are complicated by the customary laws of inheritance and joint ownership. Again, the bulk of the sugar produced in India is consumed in its crude state as *gur* or *jaggery*; and this fact has an essential bearing on the prospects of a successful venture for the production of factory sugar in any particular locality. There are indications that the incentive of present prices of sugar is attracting considerable attention to India as a further source of supply; and that the necessary capital and business enterprise would be forthcoming if the whole question both in its agricultural and manufacturing aspects were thoroughly investigated, and the conditions essential to the establishment of an organized industry authoritatively defined. The Government of India are, therefore, of opinion that the time is opportune for the appointment of a representative Committee to investigate the problem in all its bearings and to advise whether a definite and co-ordinated line of policy can be laid down for the promotion of further development. They have accordingly, with the approval of His Majesty's Secretary of State, decided to appoint a Committee for this purpose during the coming cold weather, under the presidency of Mr. J. Mackenna, C.I.E., I.C.S., Agricultural Adviser to the Government of India, and with the following terms of reference :—

1. to examine the various sugarcane growing tracts of India with a view to determining the nature of the expansion possible in such tracts either by the development of a factory industry or by improvements in the existing indigenous methods ;
2. to examine the possibility of consolidating the areas under cane and of the extent to which this is limited by the existing systems of land tenure ;
3. to report on the work already done by the Sugar Expert with regard to the breeding and selection of improved varieties of cane, and to make suggestions as to the extent and direction in which this work can be further expanded ;
4. to examine the present methods of co-ordinating work on sugarcane adopted by the Agricultural Departments working in the various provinces and the efficiency of agricultural practice in vogue in India or recommended by the Agricultural Department ;
5. to examine the existing sugar factory industry in India and to advise in what localities and under what conditions a factory industry can be successfully established ;
6. to examine the economic and labour conditions now prevalent in the various districts where expansion of the sugar industry is likely and the question of improving railway facilities and other means of transport which may be required with a view to furthering the spread of the industry ;
7. to investigate the work that is being done in the introduction of improved small power plants and small power factories ;
8. to review the position of India with regard to the world's sugar supply and to formulate recommendations for the improvement of that position ;

9. to investigate the conditions under which refined and raw sugar and molasses are imported into India ;
10. to examine the effects of controlling such imports by a duty, and, where necessary, grading this duty so as to give preference to sugar grown in British dependencies ; and
11. to examine the present conditions governing the manufacture of rum under license from Government and the question of distributing such Government contracts.

The Committee is expected to assemble on October 26th. It will tour to such extent as may be necessary for the local examination of existing conditions, and it will examine witnesses with a view to the thorough consideration of all shades of informed opinion. The Government of India trust that Local Governments and Administrations and their officers will afford the Committee all facilities for the furtherance of its investigations, and will comply with any requests for information or advice which it may address to them.

"4. The Government of India are not yet in a position to announce the names of all those who will serve as members of the Committee ; but its composition and personnel, in so far as these have already been decided, will be as follows :—

1. Mr. J. Mackenna, C.I.E., I.C.S., Agricultural Adviser to the Government of India, *President*.
2. A member of the Indian Civil Service as Vice-President (to be nominated later).
3. The Hon'ble Mr. Lalubhai Samaldas, C.I.E., Bombay.
4. Sir Frank Carter, Kt., C.I.E., C.B.E., of Messrs. Turner, Morrison and Company, Calcutta.
5. Sirdar Jogendra Singh, Punjab.
6. Mr. J. W. Macdonald, of Messrs. Henry Tate and Sons, Ltd., Sugar Refiners.
7.} Two other experts to be obtained from England (will be
8.} announced later).
9. Mr. Wynne Sayer of the Indian Agricultural Service.

In addition to the above the Committee will co-opt Mr. A. B. Shakespear, C.I.E., of Messrs. Begg Sutherland and Company, Cawnpore, as a member for the period of its tour in the United Provinces, and it is proposed similarly to co-opt a representative of the industry in Southern India. Mr. A. E. Gilliat, I.C.S., will act as Secretary to the Committee."

Since the issue of this resolution the Government of India have appointed Mr. F. Noyce, I.C.S., as Vice-President, and Mr. B. J. Padshah, M.A., of Messrs. Tata, Sons and Company, as a member of the Committee in place of the Hon'ble Mr. Lalubhai Samaldas who was unable to accept the invitation, and have obtained the services of Mr. W. Craib, a planter with experience of Demerara and Cuba, as a member of it.

The Committee toured from the 26th October to the end of December, 1919, in the United Provinces, Bihar, the North-West Frontier Province and the Punjab.

From January to April 1920, the Committee will tour in Assam, Bengal, Burma, Madras, Deccan Hyderabad, and Bombay. The Central Provinces and Gwalior will also be visited, but this may not be done till after the 1920 monsoon arrives.

***

COLLOIDS AND CHEMICAL INDUSTRY.*

ANYONE familiar, even in the least degree, with the general nature of chemical industry, and the applications of chemical science to other sciences, cannot but be impressed with the importance which colloid chemistry has attained within recent years in these two directions. In order that the significance of this branch of chemistry, hitherto very largely neglected, particularly in its scientific aspect, may be more fully appreciated and recognized, a committee of the British Association was formed in 1917 to consider the problem.

Last year (*Nature*, March 28, 1918) attention was directed to the publication of the first report of this committee. The object

* Second Report of the British Association Committee on Colloid Chemistry and its General and Industrial Applications (1918). (Published for the Department of Scientific and Industrial Research by H. M. Stationery Office, 1919.) Price 1*s*. 6*d*. net.

which the committee has in view is to prepare in the form of sectional reports a summary of information respecting the present position of colloid chemistry and its various applications to other sciences, and especially to chemical industry. Each section is written by an authority on the subject treated. The first report dealt with the following technical subjects:—Tanning, dyeing, fermentation industries, rubber, starch, gums, albumin, gelatin, gluten, cements, nitro-cellulose explosives, and celluloid.

The committee has now issued its second report, which appears under the *ægis* of the Department of Scientific and Industrial Research. It may be obtained from H. M. Stationery Office or through any bookseller. The general arrangement adopted in the first report is adhered to in the present one. This consists of (1) classification according to the scientific colloid subject, and (2) classification according to the industrial process and general application of colloid science to other sciences. Under the first head the subjects treated are:—(i) Peptization and precipitation (W. D. Bancroft); (ii) emulsions (E. Hatschek); (iii) the Liesegang phenomenon (E. Hatschek); and (iv) electrical endosmose (T. R. Briggs). Under the second head are:—(i) Technical applications of electrical endosmose (T. R. Briggs); (ii) colloid chemistry in the textile industries (W. Harrison); (iii) colloids in agriculture (E. J. Russell); (iv) sewage purification (E. Ardern); (v) dairy chemistry (W. Clayton); (vi) colloid chemistry in physiology (W. M. Bayliss); and (vii) administration of colloids in disease (A. B. Searle).

It is only right to point out that the compilation of these sections represents a gratuitous contribution on the part of the compilers for the general benefit of all who may be engaged in pure or applied science or in industrial operations in which colloids play a part.

It is obvious, from the mere enumeration of the subject-headings, that a very valuable amount of material has been collected which, it is hoped, will serve the purpose of emphasizing the fundamental importance of colloid chemistry for operations and processes which, at first sight, might appear to be wholly distinct.

A number of sections remain to be dealt with, and it is hoped that these will be included in the third report which is now in preparation. [W. C. McC. Lewis in *Nature*, dated 7th August, 1919.]

***

REMOVAL OF RESIDUAL FIBRES FROM COTTON-SEED AND THEIR USES.

Mr. Ed. C. de Segundo, in the course of a lecture delivered at the British Scientific Products Exhibition on July 23rd, 1919, said :—

After the fibres of spinnable length have been removed from the seed-cotton by the action of the gin, and a further quantity recovered by saw-linting devices, it is found that upon about 95 per cent. of the cotton-seed produced, an appreciable quantity of cotton fibre still remains adherent to the seed. These short fibres have long been known to be suitable for many industrial purposes if only they could be recovered in a sufficiently clean condition at a sufficiently low cost. The difficulties in the way of accomplishing this mechanically on a commercial scale appeared to be insuperable for a number of years, and it is stated that hundreds of thousands of pounds were spent in fruitless attempts on both sides of the Atlantic. Such fibres were looked upon as a waste product until about seven years ago, when I was fortunate enough to work out a machine which successfully separated them out from the decorticated hulls of the cotton-seed produced under the American system of manufacturing cotton-seed oil. These machines have been at work in the United States commercially since the autumn of 1913, and a good many thousand tons of such fibre in the form of explosives were used by the Allies during the war. About five years ago I was led to attempt the solution of a somewhat similar problem involved in removing these residual fibres direct from the cotton-seed, and the machine which I shall have the pleasure of showing you in action at the conclusion of this lecture is the result of these efforts. This machine removes from the woolly varieties of cotton-seed such of the residual fibres as are not recoverable efficiently or economically by saw-linting or other existing devices, and delivers them in a form so free from the dirt and debris always present in the cotton-seed of commerce, that the highest grades of paper, artificial silk, vulcanized fibre and other commodities can be manufactured from the product of this machine which is termed "seed-lint" to distinguish it from the "hull-fibre" recovered by the other machine to which I referred above. Upwards of 10,000 tons of the residual fibres obtained by my machines in the United States from the hulls of cotton-seed have now been used in Great Britain, in France, and in the United States, for the manufacture of high-grade papers, of explosives, and of vulcanized fibre. "Seed-lint" is, of course, identical in its characteristics with "hull-fibre" but is superior in quality, being exactly the same material but removed from the seed *before* decortication. "Seed-lint" has been exhaustively investigated by the well-known firm of Cross and Bevan, Analytical Chemists, of London, who pronounce it to be "a new and superior product which, as regards chemical composition, approximates to that of raw long cotton. Messrs. Cross and Bevan also draw attention to the fact that "seed-lint" ful[illegible] the most exacting requirements for the production of cellulose acetate. Courtaulds, Limited, the well-known makers of artificial silk, have tested seed-lint for their special purposes, and have found it entirely suitable. Last year the Ministry of Munitions of War investigated the properties of seed-lint, and reported that they found it suitable for the manufacture of nitro-cellulose powders.

Apart from the industrial value of these residual cotton fibres the removal thereof from the seed concomitantly results in a considerable improvement in the seed for the purposes of the production of oil and feeding-cake and in a corresponding increase in the market value of the seed, a fact that has recently been confirmed by the investigations of the engineer and manager of an important seed-crushing mill in England. His figures show that, *on the basis of pre-war trading conditions,* the seed-crusher should realize an added advantage of as much as £2 10*s.* per ton by treating certain varieties of cotton-seed in this machine prior to crushing, as compared with the results obtained in his ordinary practice. Upon the basis of prices ruling to-day, the advantage would be much greater. This gentleman further points out *that even if the value of the residual fibres obtained be entirely neglected,* there still remains substantial additional profit to the seed crusher. To go into technical details concerning this machine would take us too far afield, and I must confine myself to such aspects of the subject as are likely to interest you from a general point of view. [*Journal of the Royal Society of Arts,* Vol. LXVII, No. 3480, August 1, 1919.]

***

MANIPULATION OF SHORT-FIBRED COTTON.

An interesting lecture on the above subject illustrated by diagrams and photographs of lay-outs and machinery, samples of priced Indian and Chinese cottons, various soft wastes and yarns, also blankets, towellings, and glass cloths chiefly made in Germany prior to the war and in the United States of America was given at "The Textile Institute," Manchester, on Friday, March 28th, 1919. The lecturer was Mr. L. A. Porritt, of Messrs. William Tatham, Ltd., Rochdale.

Mr. Porritt explained that by "short fibre" he meant the shorter grades of Indian, Chinese, and Asiatic cotton with a staple of $\frac{5}{8}$ inch and under. Short staple cotton is only suitable as a weft yarn, and the main object being to produce a full and round thread the "condenser" system is the one universally adopted. Plant suitable for treating 25,000 lb. per week would be a hopper bale opener, delivering by lattice to a hopper feeder coupled to a porcupine opener, this to feed into a Crighton opener or not according to the amount of dirt, then through dust trunks to exhaust opener with beater and cages, into a hopper feeder, delivering to single Buckley opener combined with single beater scutcher and lap machine. The loss between the bale and lap is about $7\frac{1}{2}$ per cent. to 15 per cent. The laps are double on 2 finisher scutcher lap machines. The delivery would be in laps for carding engines 48 inches to 50 inches wide, and by lattice delivery if for 60 inches to 70 inches wide, or if the cotton requires dyeing. On the

Continent the general custom is to use the wider widths. Carding is operated on the two card system, known as breaking and finishing. The carding engine is of the usual roller and clearer type which in order to get a woolly or oozy effect is the most suitable. The rollers are frequently 7 inches in diameter and the clearers $2\frac{1}{2}$ inches. The speed of the cylinders is 140 revolutions per minute, and so to prevent escape of dust and fly the cover over the "Fancy" receives special attention. A small clearer is placed between the cylinder and the doffer to prevent loss of fibre due to the quick speed of the cylinder. The undergrids are very stiff and can be accurately set. The finishing carding engine is similar, but has a leather type condenser. The set of engines in the mill described were 71 inches wide with 140 threads with four bobbins of 35 threads and 2 waste.

Very short stapled cotton could only be prepared for 4's to 8's counts by the "tape" condenser. The bobbins are taken to the "condenser" mule. In this type of mule the creels for roving bobbins are replaced by horizontal surface drums about 9 inches diameter, which unwind the condenser bobbins. There are two lines of bottom fluted rollers 1 inch diameter and one top leather covered roller 1 inch diameter. The draft is between the spindle and the roller and is about 2 to 1 for clean material and less for lower quality. The "condenser" mules for counts 4's and above are fitted with a treble spindle speed to give increased production and superior quality. The first speed is 1,800 revolutions for 18 inches of draw, then 2,700 revolutions until the carriage is nearly at full stretch, and then 5,000 for twisting up. There is a motion to deliver $\frac{3}{4}$ inch to 1 inch of yarn before the carriage starts from the beam, in order to prevent the yarn being overstretched. When spindles 5 to 6 carriage makes about $4\frac{1}{2}$ draws per minute, for 7's to 8's under 4 draws. Production of 5's equals $4\frac{1}{2}$ lb.; 6's $3\frac{1}{2}$ lb.; 7's 3 lb.; and 8's $2\frac{3}{4}$ lb.

It is understood that the firm with which the lecturer is connected make a patent ring spinning frame for short cotton and waste. It is recommended where the material is comparatively clean. The threads pass from the condenser bobbin through a pair of delivery rollers, $1\frac{1}{4}$ inch fluted bottom and $2\frac{1}{2}$ inches top plain, on through a twisting tube to the drawing $1\frac{1}{4}$ inch front fluted and $1\frac{3}{4}$ inch back pressure covered with leather and lever weighted and on to the ring and bobbin. Draft between delivery and drawing rollers from $1\frac{1}{2}$ to 2. Drawing is assisted by twisting tube which imparts a false twist to the roving. Production on 10's counts about 3 lb. per spindle. [*The Indian Trade Journal*, dated 7th November, 1919.]

***

AGRICULTURAL EDUCATION IN THE CENTRAL PROVINCES.

THE following is taken from a notice in "The Agricultural and Co-operative Gazette," Nagpur, June 1919, by Mr. J. H. Ritchie, Deputy Director of Agriculture, Northern Circle, Central Provinces :—

It is notified for general information that an Agricultural School for the sons of malguzars and well-to-do tenants will be opened on the Powarkheda Farm near Hoshangabad on the 1st June, 1919. The course, the syllabus of which is given below, will be for two years and will be half practical and half theoretical. Boys must first have passed the Upper Primary Class before joining.

Buildings have been constructed and a hostel for 32 boys will accommodate the students. On the farm there is a Sarai, and fathers of boys can put up there if they wish to see what their sons are doing. The department will probably manage to hold demonstrations to popularize the principal improvements if a sufficient number of parents assemble at the same time. It is proposed to allow 25 boys to enter the first year, and, as far as possible, this number will be allotted equally amongst the five districts of the Nerbudda Division.

No fees are being charged except a hostel fee of Rs. 2-8 a month to cover incidental expenses, *e.g.*, servants, lighting, etc. The boys can make their own arrangements for cooking, but it would probably be preferable if they were to form a mess and have a cook who is being provided with all the necessary utensils.

Two teachers from the Education Department have been entertained after having received a training in agriculture at the Agricultural College in Nagpur. The Superintendent of the farm will also closely supervise their practical studies to ensure that the boys are being taught correctly.

The syllabus of study is given below :—

1. Reading—From special Agriculture Text-book being prepared.
2. Writing.
3. Arithmetic.—The best upper primary text-book to be used in conjunction with the text-book used at the Loni Agricultural School, Bombay Presidency. This subject will be taught with special reference to agricultural subjects.
4. Geography.—The best upper primary book to be used. Local geography and general physical geography.

First Year—

(1) Propagation of plants by means of seeds, cuttings, budding and layering.

(2) Seed—

(*a*) Plants and their use.
(*b*) Germination and its requirements.
(*c*) Germination percentage.
(*d*) Importance of good seed.

(3) Necessity of soils for plant life.
(4) Formation of soil in general.

(5) Roots—

(*a*) Growth.
(*b*) Effect of light.
(*c*) Use to plants.
(*d*) Kinds.

(6) Leaves—

(*a*) Different forms.
(*b*) Use to plants and their work.

(7) Insect life—

(a) Stages of life.
(b) Use of colour to insects.
(c) Their mode of feeding.
(d) Classification according to mouth parts.
(e) Rearing of insects to study the different stages.
(f) Information about crop pests in general and methods of destruction.
(g) Insecticides and use of sprayers.

Second Year—

(1) Insects of stored grain and cattle and how to destroy them.

(2) Plant life continued—

(1) Flowers—

(a) Parts and use.
(b) Use to plant in seed formation.

(2) Dispersion of seed.
(3) Struggle for existence.
(4) Life-history of some plants.
(5) General information about fungus life and some common diseases with controlling measures.
(6) Parasitic plants.

The Nature Study will be mostly or generally practical to velop observation.

5. Village life—

(1) Simple lessons on village sanitation.
(2) Principles of marketing.
(3) Advantages of co-operation.
(4) Rural credit.
(5) Village, Taluq and District administration.
(6) System of land revenue in force.
(7) Malguzari rights.
(8) Reading and understanding of Patwari maps.

6. Principles of agriculture—
   (1) Classification of soils.
   (2) Constituents of soils and their properties.
   (3) Physical properties of soils
   (4) Soil improvement.
   (5) Irrigation.
   (6) Manures.
   (7) Crops.
   (8) Vegetable growing.
   (9) Animal husbandry.
   (10) Milk.
7. Practical farm work.—Each boy will be allotted ½ acre of land for growing staple crops on the group system and a plot for vegetable and fruit growing on the individual system.
8. Elementary carpentry and smithing.
9. Fruit and flower gardening.
10. Elementary land-surveying and crop-cutting experiments.

From the above syllabus it will be seen that a fairly comprehensive study of agricultural practice is intended. There will be very little really scientific study, as most of the time will be devoted to the study of Nature out of doors to help and develop the observation faculties of the boys and to stimulate their interest by making careful records of what they have seen.

The department cannot offer any post to students who pass through this course, as it is intended that such boys should return to their father's land to improve his cultivation.

***

THE following account of the working of the **Federal Farm Loan Act of the United States** by the New York Correspondent of the "Economist" will be read with interest :—

The Act was passed on July 17, 1916, and provided for the creation of two classes of institutions, both designed to lend money at low rates of interest on improved farm properties. The first class of institutions is known as the Federal Land Banks, twelve of which were incorporated under the Act to operate in the twelve Federal Reserve Districts, which divide as nearly as possible into equal portions the whole area of the United States. These banks are limited to twelve in number, and their original capital was subscribed by purchase by the Treasury Department of the United States. After the organization was completed and the capital paid in, each bank proceeded to receive applications for farm loans based on 60 per cent. of the value of the land and 20 per cent. of the value of improvement on mortgages not exceeding a total of $10,000 on any one farm. When these mortgages had been approved by the Federal Farm Loan Board at Washington, the funds were advanced by the individual banks to the borrowers, and the mortgages thus secured were deposited as collateral for the Federal Farm Loan 4½ and 5 per cent. Bonds issued by the twelve banks and sold to the public, thus providing new fresh funds to continue the operation indefinitely. Federal Farm Loan 4½ and 5 per cent. Bonds, while issued by each of the twelve individual banks, are jointly and severally guaranteed by all of the other banks. The Bonds have a maturity of 20 years, are optional after five years, and are deemed and held to be instrumentalities of the Government of the United States, and as such are free of all taxation except Inheritance Taxes. The Government does not, however, directly or indirectly guarantee the payment of either interest or principal, although the Federal Farm Loan Board is a bureau of the Treasury Department. The Supreme Court of the United States, in holding that the Bonds were instrumentalities of the Government did not state what an instrumentality was, nor has the point ever been conclusively answered by any court. When the banks were able to sell 4½ per cent. Bonds profitably money was loaned to the farmers at 5½ per cent., but when the market conditions became such that it was necessary to increase the rate on the bonds to 5 per cent., then advances were made on mortgage at 6 per cent. The law provides that the banks can only charge the borrowing farmer 1 per cent. in excess of the cost of the money to the banks, and such banks may continue to loan until their outstanding Bonds secured by mortgages are equal to 20 times their capital stock, but since the provisions for capital increases are relatively simple, there is therefore no apparent end to the operation. The same Act provided for the creation of Joint Stock Land Banks without limit as to number, except that their scope of operation is limited to the State in which they are incorporated, and one contiguous State. Joint Stock Land Banks operate under Government charter and supervision, and lend money on identically the same terms as the twelve Federal Land Banks, except that they can take a mortgage of any size that the directors and Farm Loan Board approve. In addition to these differences, the capital stock of the Joint Stock Land Bank is privately owned, and their bonded debt limited to 15 times their capital stock, nor do these banks jointly and severally guarantee each other's debts, but are responsible simply for their own outstanding Bonds. Both systems have been a tremendous success, although the cry of class legislation has frequently been raised and efforts to nullify the tax exemption been repeatedly made. Mortgage loans of the Federal Farm Loan Banks amount to something over $160,000,000 while the Land Banks have loaned in the neighbourhood of $50,000,000. The former take care of the small borrower while the latter ordinarily get the business of the larger absentee landlords, who own and carry enormous properties in the North-West. As regards the Bonds themselves, both types have from the start proved extraordinarily attractive. The indirect liability of the United States Government, the tax exemption, the wonderful security provided by the collateral mortgages have all been factors of great appeal, and no public issue has been made without meeting an almost immediate response. The financing of the Federal Farm Loan Banks has always been handled by Alexander Brown and Sons, of Baltimore, while the Joint Stock Land Bank Bonds have almost from the beginning been placed by the Equitable Trust Company of New York.

POSITION OF SEED IN COTTON.

MR. G. L. KOTTUR writes in the "Poona Agricultural College Magazine" (July 1919) :—

The writer was studying the causes of stunting in cotton when he happened to read "Natural History of Plants" by Kerner wherein the subject of the position of seed is treated in a very impressive manner. Kerner says that there are 7 kinds of cotyledons and in the seventh they require to be withdrawn from the seed-coat during germination. In this particular case, he says, the position of the seed is important. He cites the instance of the big and flat cucurbit seeds, and points out that the most favourable condition is obtained when the axis of the hypocotyl and radicle lie parallel to the surface of the ground. He further adds that when seeds of this sort are sown they usually assume this position.

Cotton, we know, withdraws its cotyledons from the seed-coat during germination and as such the author thought that the position of seed had some influence on stunting. He therefore began experiments on the subject, but before his observations were complete a paper was read by Rao Saheb M. L. Kulkarni at the Fifth Indian Science Congress in which the "tip up[1]" position was described as the most advantageous in cotton. The author however continued his experiments and the results which he obtained are given here.

One hundred seeds of the same weight were taken from a pure strain of cotton and sown in pots in three different positions : (1) Apex up, (2) Apex down, (3) Apex side. All the seeds were sown at the same depth, *viz.*, 1 inch, and the condition of the pots was kept uniform throughout. The following table shows the percentage of germination :—

Pot No.	Position of seed	No. of seed sown	GERMINATION			Total	COTYLEDONS	
			4th day	5th day	6th day		With coat on	Without coat
1	Apex up ..	100	4	90	0	94	1	93
2	Apex down ...	100	2	88	1	91	3	88
3	Apex side ...	100	6	90	2	98	0	98

[1] *Agric. Journ. of India*, Special Indian Science Congress Number, 1918.

A small percentage of these seedlings brought the seed-coat above the surface of the ground in the first two instances, the highest percentage being 3·3 in the case of apex down position. This shows that position has very little to do with the bringing off of the seed-coat. The radicle first elongates and fixes the seedling to the ground. The hypocotyl then grows but in the opposite direction, and a pressure is thus exerted on the seed-coat. If at this stage the seed-coat is firmly held in its position whatever the latter may be, the cotyledons are easily withdrawn leaving the coat in the ground. But if the seed-coat is not firmly cemented to the ground it comes like a cap above the surface. In loose soils and in shallow sowings the coat is not firmly fixed and a large number of seedlings bring the coat on their cotyledons in the case of all positions.

All the seedlings in the three pots were allowed to grow for about a fortnight and no difference in vigour was seen in favour of any position. The seedlings which had come up with the seed-coat, threw off the coat immediately and grew equally vigorous.

Later on another experiment was undertaken to ascertain the yields. In this experiment also, the seeds of one pure strain of the same weight were dibbled one inch deep on an even piece of land in the field. 112 seeds were thus sown 24 inches by 18 inches in each position. The following statement gives the result obtained:—

Serial number	Seed position	Number of seeds sown	Number of seeds germinated on					Number of seedlings obtained		Total	Percentage of germination
			5th day	6th day	7th day	8th day	9th day	Without coat	With coat		
1	Apex up ...	112	4	86	2	1	0	85	8	93	83·04
2	,, down ...	112	0	93	0	0	1	78	16	94	84·82
3	,, side ...	112	0	99	0	0	0	83	16	99	88·39

The plants on the three plots were examined in the seedling stage and also later on, but it was not possible to detect any difference in them. The following statement shows the yields obtained from these :—

Serial number	Seed position	Plants whose cotyledons had come up without the seed-coat			Plants whose cotyledons had come up with seed-coat			Total		
		No. of plants	Yield of kapas in tolas	Per plant yield in tolas	No. of planst	Yield of kapas in tolas	Per plant yield in tolas	Plants	Yield of kapas in tolas	Per plant yield in tolas
1	Apex up ...	85	176	2·07	8	19½	2·44	93	195½	2·10
2	,, down ...	78	165	2·11	16	33	2·06	94	198	2·11
3	,, side ...	83	173	2·09	16	35½	2·21	99	208½	2·11

The results of these experiments conducted with all possible care indicate that there is very little advantage to be gained by the position of seed in the case of cotton. There is no position which has an appreciable influence on the germination of the seed, vigour of seedlings or the yield of the individual plants.

***

AGRICULTURAL PESTS AND DISEASES ACT IN COIMBATORE DISTRICT.

The following note has been issued by the Madras Publicity Bureau :—

A note has already been published explaining why the Pests Act has been put into force in the Coimbatore District. The public may be interested to hear something of the result of the application of the Act. The particular object aimed at was the eradication of all Cambodia cotton by the beginning of August, so that the boll-worm moth, emerging from the diseased bolls, might during the next month find no fresh cotton plants wherein to lay her eggs. As no bollworm moth has been known to live for more than 34 days, this was calculated to effect an enormous mortality in bollworm circles.

The Act has been enforced with the smallest possible friction and so far from ryots being at all averse to the idea of pulling up a crop still capable of bearing something, they have raised no objections, and in places have actually welcomed the step. It is as if they realized that it was bad farming to leave the crop in the ground, for the Coimbatore Gounden is an observant individual and a shrewd farmer, but that without the little bit of necessary compulsion they could not bring themselves to do what they realised they ought to. There have been so far as we can learn no proceedings taken under the Act and no opposition except in one tract where less than a hundred petitions are pending. This is a very satisfactory state of things and reflects great credit on all concerned, on the officers who had to see the Ordinance carried out, and on the ryots who in many cases suffered pecuniary loss. This latter has as a matter of fact not been much in any case: any man who had a field of Cambodia cotton in bearing must have already gathered a very heavy and profitable crop, and could quite well afford to lose the few and diseased bolls still remaining on the plant. The staff, from all accounts, interpreted the Act leniently, and since the sudden demand for labour was impossible to meet in some tracts, a few days' grace was permitted where asked for. The interpretation of the regulation and the explanation of its necessity and its bearing in the future crop of cotton were the work of the Agricultural Department subordinates, and right well they have done it. It seems odd to see a Brahmin assistant demonstrating to an interested crowd of Goundens, Naicks, or Gollas, the bollworm's habits and the damage it does.

A point the importance of which even our up-to-date Agricultural Department failed apparently to realize, was the great benefit which comes from grazing the field before pulling it out. The local ryot was acute enough to see that he saved both ways: he fed his cattle or his sheep, or at any rate got the dung from some one else's animals during the process, and at the same time he insured a much more certain destruction to the boll worm. Any one who has seen a field of cotton, after a herd of sheep and goats have finished with it, a bare ground with a few bare sticks on it, and never a sign of a boll or a leaf, and realizes what the digestive powers of a goat are, must realize that here we have the most potent instrument for bollworm destruction that could be devised.

WORLD'S FOOD CROP.

THE following information has been issued by the International Agricultural Institute at Rome:—The yield of wheat in Spain, Scotland, Italy, Canada, the United States, India, Japan, and Tunis is estimated at 929,525,000 cwt. or 5·6 per cent. below the 1918 crop, and 1·1 per cent. below the average yield of the five years 1913–17. The estimated production of rye for Italy, Canada, and the United States is given as 48,274,000 cwt. or 7·1 per cent. below last year's production, but 67·3 per cent. above the average crop for the years 1913–17. The barley crop for Scotland, Italy, Canada, the United States, Japan, and Tunis is estimated at 159,397,000 cwt. or 15·1 per cent. below last year's production, and 4·1 per cent. above the average production of the years 1913–17. The estimated production of oats in Scotland, Italy, Canada, the United States, Japan, and Tunis is 491,933,000 cwt. or 18·4 per cent. below the 1918 yield, and 7·2 per cent. below the average yield of the five years 1913–17. The maize crop in Italy, Canada, and the United States is estimated at 1,473,592,000 cwt. or 10·2 per cent. above the 1918 production, and 3 per cent. above the average yield of the years 1913–17.

PERSONAL NOTES, APPOINTMENTS AND TRANSFERS, MEETINGS AND CONFERENCES, ETC.

We regret to record the death of Mr. D. Meadows, Civil Veterinary Department, Punjab, who was drowned in a *Jheel* while out for shooting.

WOODHOUSE-SOUTHERN MEMORIAL FUND.

	Rs.
Donations received up to the 31st August, 1919, and acknowledged in the *Agricultural Journal of India*, Vol. XIV, Pt. V, October, 1919.	1,950
Donations received during the period from 1st September to 30th November, 1919 :—	
Miss B. Wright (S)	12
Alfred Wright, Esq. (S)	50
A. C. Dobbs, Esq.	100
R. C. Wood, Esq.	100
H. C. Sampson, Esq.	100
L. C. Coleman, Esq.	100
R. S. Finlow, Esq.	50
D. Chalmers, Esq., I.C.S.	40
J. H. Ritchie, Esq.	20
F. J. Plymen, Esq. (W)	20
G. P. Hector, Esq. (W)	20
Total	Rs. 2,562

MR. J. C. B. DRAKE, O.B.E., I.C.S. (Bihar & Orissa), has been appointed Under Secretary to the Government of India, Department of Revenue and Agriculture, *vice* Mr. P. P. M. C. Plowden, I.C.S., whose services have been replaced at the disposal of the Government of the United Provinces.

***

MR. A. HOWARD, C.I.E., M.A., and Mrs. Gabrielle L. C. Howard, M.A., Imperial Economic Botanists, have been granted combined leave for 11 months.

***

Mr. A. P. JAMESON, B.Sc., who has been appointed by the Secretary of State for India as Protozoologist at Pusa, joined his duties on the 17th October, 1919.

***

MR. R. CECIL WOOD, M.A., Offg. Director of Agriculture, Madras, has been granted combined leave for 18 months from or after 15th March, 1920.

***

MR. F. T. T. NEWLAND has been confirmed in his appointment of Government Agricultural Engineer, Madras.

***

ON return from military service, Mr. E. Ballard, B.A., F.E.S., has resumed the duties of Government Entomologist, Madras.

***

MR. A. WILSON, M.A., B.Sc., Deputy Director of Agriculture, Cinchona, Madras, has been granted privilege leave for six months with effect from the date of relief. Mr. E. Collins, Superintendent of the Naduvattam, Cinchona Estate, will act for Mr. Wilson in addition to his own duties.

***

M. R. RY. M. V. RAGHAVALU NAYUDU has been appointed to act as Deputy Director of Agriculture, Live Stock, Madras, until further orders.

MR. E. J. BRUEN has been appointed Deputy Director of Agriculture for Animal Breeding, Bombay, with effect from the 16th September, 1919.

***

THE SECRETARY OF STATE has sanctioned the proposal to appoint Mr. V. A. Tamhane, M.Sc., L.Ag., to the post of Soil Physicist, Bombay, in the Indian Agricultural Service, after he goes through the requisite training in England.

***

MR. A. D. MCGREGOR, M.R.C.V.S., Offg. Superintendent, C.V.D., Bengal, has been confirmed in the Civil Veterinary Department.

***

MR. G. C. SHERRARD, B.A., Deputy Director of Agriculture, Bihar and Orissa, has been granted combined leave for one year.

***

MR. H. M. LEAKE, M.A., Economic Botanist to Government and Principal, Agricultural College, Cawnpore, has been appointed, on return from leave, to officiate as Director of Agriculture, United Provinces, *vice* the Hon'ble Mr. H. R. C. Hailey, C.I.E., I.C.S., granted privilege leave for six months.

***

MR. H. E. ANNETT, B.Sc., F.I.C., Agricultural Chemist to the Government of Bengal, on special duty in the United Provinces, has been granted combined leave for 17 months and 19 days, from the 12th April, 1919, exclusive of the period of his deputation in England for a period of six weeks.

***

MR. J. N. SEN, M.A., F.C.S., Supernumerary Agricultural Chemist, on special duty under the Government of the United Provinces, was on privilege leave for one month from the 19th November, 1919.

Mr. T. Rennie, M.R.C.V.S., Second Superintendent, Civil Veterinary Department, Burma, has been granted combined leave for ten months.

***

Mr. E. Sewell, M.R.C.V.S., who has been appointed to the Indian Civil Veterinary Department, has been posted as Professor of Sanitary Science in the Punjab Veterinary College.

***

On return from leave, Mr. H. E. Cross, M.R.C.V.S., assumed charge of the office of Camel Specialist, Sohawa, on 27th October, 1919.

***

Mr. G. Evans, C.I.E., M.A., Deputy Director of Agriculture, Central Provinces, is on combined leave for eight months from the 5th July, 1919.

***

Mr. C. P. Mayadas, M.A., B.Sc., Assistant Director of Agriculture, Northern Circle, Central Provinces, has been transferred in the same capacity to the Western Circle from the 15th October, 1919.

Reviews

A Manual for Co-operative Societies in the Bombay Presidency.—By R. B. EWBANK, I.C.S.

THE author of this book is the Registrar of Co-operative Societies in the Bombay Presidency, and he is not one of those that darken counsel by words without knowledge. His purpose, he tells us, is to place the accumulated experience of his department, in a simple form, at the disposal of the public. This purpose he has attained; and, after having searched Mr. H. W. Wolff's "Co-operation in India," and after having searched in vain, for definite guidance conveyed in clear English, it is with great relief that one turns to a book which is written by an expert who has not had the amazing temerity to write about a country, or rather a collection of countries, which he has never even seen. Mr. Ewbank has a great deal to say about Co-operation in the Bombay Presidency. And what he says is generally well expressed and always to the point, though never marred by that contention for the last word which is the bane of human relations. A man's opinions are not more important than the spirit and temper with which they possess him, and our author is clearly not one of those who are always insisting on better bread than can be made of wheat. In his fourth and fifth chapters Mr. Ewbank gives some valuable hints on the organization of agricultural credit societies. Regarding the number of members permissible in a credit society Mr. Wolff treats us to a lengthy discourse "about it and about," and, at the close, "we go out by that same door wherein we went." Mr. Ewbank gets to the root of the matter in a sentence. "Many societies in this Presidency have lost their unity and become inefficient from the fact that they have allowed their membership to become unwieldy." Again, in his sixth chapter, our author tells us, in clear language, what the radical difference is between co-operative credit in the town and its country cousin. "An urban or limited society," he says, "is intended to meet conditions for which a rural or unlimited society is unsuitable. In country villages the members are usually thoroughly acquainted with each other's character, means, and behaviour, and know exactly how much money a particular person requires and how far he can be trusted. They are, therefore, not unwilling to accept joint and unlimited liability for each other. This joint and unlimited liability forms the basis of the credit of the society and enables it to raise funds from outside lenders. In a town, circumstances are different. Members of different classes or professions cannot all be acquainted with each other; they are usually artisans or traders who own very little land or real property and, therefore, have no very substantial property to offer. They want funds for their own business but do not want to be troubled with their neighbours' affairs. It would be unreasonable to expect such persons to submit to joint and unlimited liability."

In his ninth chapter, Mr. Ewbank explains the functions of "Guaranteeing Unions," from Mr. Wolff's adverse criticisms of which we venture to demur in the uplifted spirit of the Trodden Worm. "Guaranteeing Unions" are, in reality, nothing more than groups of societies, the members of which supervise each other and are responsible for each other's borrowings. It is upon the development of "Guaranteeing Unions" that the expansion of rural co-operative credit depends in India; for there are so few members of societies who are able to read and write that the promoter of rural economy must use an organization which is well calculated to get the greatest amount of public benefit from them. "A Union will sweep away delays," declares the Bombay Registrar. If it does, it will be a startling novelty in India, a country in which there is not much that is *jaldi* except the word.

Through the interesting chapters provided on District Central Banks, Provincial Banks, Stores, Cattle Insurance, and other forms of co-operative effort we need not accompany Mr. Ewbank in this brief review. They are full of great thoughts from the heart, and, as expressed by a practical enthusiast, they go round by the head. In thirteen years the number of societies in the Bombay Presidency has increased from 12 to 1,650, membership from 219 to 156,805, and working capital from a few thousands of rupees to Rs. 1,62,89,000. For eight years Mr. Ewbank has guided the movement in his province, and if Registrars are to be known by their fruits, then, indeed, it is clear that the Bombay Presidency has been fortunate in securing the devoted services of the author of this book. [H. R. C.]

***

The Journal of Indian Botany, Vol. I, No. 1.—Edited by P. F. FYSON, B.A., F.L.S., Presidency College, Madras. [Printed and published by the Methodist Publishing House, Madras.] Price per annum, Rs. 10.

THIS is the first journal of its kind that has appeared in India. It is designed to be a means of publishing botanical work done in India. Up to date there has been very little opportunity for publishing articles on pure botanical matters. "The Journal of the Bombay Natural History Society" has often given such articles a home in its pages, but the need has been felt, for some time, for a magazine devoted entirely to botany.

The publications of the Agricultural and Forest Departments deal with botany as applied to these special subjects. The magazine under review deals with "pure" botany, meaning botany as a branch of knowledge, quite apart from its utilitarian aspects.

On this account it is of interest chiefly to professional botanists, and to botanical students. The number of persons in both these classes in India is now considerable, and it is hoped that they will support this new venture, which is to them a source of great benefit.

The present number is a modest blue-covered book of 32 pages, containing four original articles and a great number of notices of books and papers. These original articles compare well in matter and style with those published in the newer botanical journals in Britain and America. The illustrations are well done, and intending contributors can see for themselves that their drawings will be properly reproduced.

Subscriptions should be sent to the Editor, Professor Fyson, Presidency College, Madras, by any manner found convenient. [W. B.]

***

First Report of the Bombay Central Co-operative Institute for the period ending the 31st March, 1919.

THE institute has recently been started, and has for its objects, among others, the development of the co-operative movement in all possible directions, the organization of junior and senior classes for educating the secretaries and other workers of co-operative societies, and the publication of periodicals, leaflets and books on the subject of co-operation in English as well as in the vernaculars of the presidency.

The report covers a period of six months only. Much of the time was necessarily spent on spade work and, in this, the workers appear to have made satisfactory progress. The institute has a large field of work before it and conducted as it is under the guidance of an experienced co-operator, Mr. R. B. Ewbank, I.C.S., it ought to fulfil its functions.

Thirty night schools in villages in which illiteracy hampers the progress of co-operation have already been opened, and it is expected to open ten more schools of the type. It is very gratifying to note that the promoter of this promising scheme—Sir Vithaldas D. Thakersey—has undertaken to pay the cost amounting to Rs. 60,000 and to continue to finance the scheme should it prove a success. [EDITOR.]

***

The Preliminary Report on the Water Power Resources in India.—By Mr. J. W. MEARES, M.I.C.E., Chief Engineer, Hydro Electric Survey. [Superintendent of Government Printing, Calcutta.]

THE report consists of 7 chapters, illustrated with excellent plates and maps, and 14 appendices containing the information hitherto collected regarding the rivers and other possible sources of electric power in India and Burma.

The opening chapter contains a very clear exposition of the methods by which power can be developed from streams and reservoirs, and corrects the popular misconception that a natural waterfall like that in the Cauvery or at Niagara is necessary. The importance to India of combined schemes of irrigation and power is also clearly brought out. Further on, "Weather and Water," "Localities and Surveys," "Power and its Uses," are dealt with. Then follows a chapter on State control, charges for water power and leases and agreements. Chapter six summarizes our present knowledge of the water power already developed, under development, and examined with a view to development. A general description is given of the conditions in each province as an introduction to the "Lists of Sites" in the Appendices.

The final chapter puts forward a constructive programme for the further work of the survey in its various aspects, and calls attention to specially favourable sites for survey and perhaps development.

So far as the preliminary investigation has gone—and it is admittedly incomplete—India's industries now absorb a matter of over a million horse power, of which only some 285,000 is supplied by electricity from steam, oil or water. The water power so far actually in sight amounts to $1\frac{3}{4}$ million horse power, but this excludes practically all the great rivers at present uninvestigated. Thus it is stated that the minimum flow of the seven great rivers eastward from the Indus is capable of giving no less than 3 million horse power for every thousand feet of their fall from the Himalayas, while similar considerations apply to rivers in other parts. Some doubt, however, is expressed as to the estimate of seven million horse power in the Irrawaddy and Chindwin rivers, given in the Report of the Conjoint Board of Scientific Societies.

While Bombay is in an especially favourable position in respect to water power, Bengal at present depends on its coal fields, though it has the honour of owning the first hydro-electric station in India at Darjeeling. In this neighbourhood, the report shows that great power is available from the Teesta, the Jaldaka and other rivers of Bengal and Bihar. What is now wanted is a capitalist to develop these potential sources of wealth.

The first edition of 2,000 has been practically taken up for official use and a second impression has already been ordered.

NEW BOOKS

ON AGRICULTURE AND ALLIED SUBJECTS

1. A Large State Farm: A Business and Educational Undertaking, by Lt.-Col. A. G. Weigall and Castell Wrey. Pp. xiii+82. (London: John Murray.) Price, 2*s*. 6*d*. net.
2. The Flower and the Bee: Plant Life and Pollination, by J. H. Lovell. Pp. xvii+286. (London: Constable & Co., Ltd.) Price, 10*s*. 6*d*. net.
3. The Farmer and the New Day, by K. L. Butterfield. Pp. ix+311. (London: Macmillan & Co., Ltd.) Price, 8*s*. 6*d*. net.
4. The Fauna of British India, including Ceylon and Burma. Coleoptera, Chrysomelidæ (Hispinæ and Cassidinæ), by Prof. S. Maulik. Pp. xi+439. (London: Taylor & Francis.)
5. The Cactaceæ: Descriptions and Illustrations of Plants of the Cactus Family, by N. L. Britton and J. N. Rose. Vol. I. (Washington: The Carnegie Institution.)
6. Problems of Fertilization, by Prof. F. R. Lillie. (University of Chicago Science Series.) Pp. xii+278. (London: Cambridge University Press.) Price, 1·75 dollars.
7. A Source-book of Biological Nature-study, by E. R. Downing. (University of Chicago Nature-study Series.) Pp. xxi+503. (London: Cambridge University Press.) Price, 3 dollars.
8. Mining and Manufacture of Fertilizing Materials and their Relation to Soils, by S. E. Lloyd. Pp. vi+153. (London: Crosby Lockwood & Son.) Price, 9*s*. net.
9. Mathematics for Collegiate Students of Agriculture and General Science, by Profs. A. M. Kenyon and W. V. Lovitt. Revised edition. Pp. xii+337. (London: Macmillan & Co., Ltd.) Price, 10*s*. 6*d*. net.

10. First Advice to Would-be Farmers, by E. E. Green. Pp. 190. (London: "Country Life" Offices.) Price, 5*s*. net.
11. Note-book of Agricultural Facts and Figures for Farmers and Farm Students, by P. McConnell. Pp. 538. (London: Crosby Lockwood.) Price, 15*s*. net.
12. The Silk Industry and Trade: A Study in the Economic Organization of the Export Trade of Kashmir and Indian Silk, with Special Reference to their Utilization in the British and French Markets, by Ratan C. Rawlley. Pp. xvi+172. (London: P. S. King & Son.) Price, 10*s*. 6*d*. net.
13. Birds Beneficial to Agriculture: Economic Series No. 9 British Museum (Natural History), by F. W. Frohawk. Pp. vi+47. [London: British Museum (Natural History).] Price, 2*s*.
14. The Planting, Cultivation, and Expression of Coconuts, Kernels, Cacao, and Edible Vegetable Oils and Seeds of Commerce. A Practical Handbook for Planters, Financiers, Scientists and others, by H. Osman Newland. (Griffin's Technological Handbooks.) Pp. vi+111+xi plates. (London: Charles Griffin & Co.)
15. Heredity, by Prof. J. Arthur Thomson. Third edition. (The Progressive Science Series.) Pp. xvi+627. (London: John Murray.) Price, 10*s*. net.
16. Catalysis in Theory and Practice, by Dr. E. K. Rideal and Prof. H. S. Taylor. Pp. xv+496. (London: Macmillan & Co.) Price, 17*s*. net.
17. Insect Artizans and their Work, by Edward Step. (Hutchinson's Nature Library.) Pp. x+318. (London: Hutchinson & Co., n. d.) Price, 7*s*. 6*d*. net.
18. Insect Pests and Plant Diseases in the Vegetable and Fruit Garden, by F. Martin Duncan. Pp. 95+xii plates. (London: Constable & Co.) Price, 3*s*. 6*d*. net.
19. The Condensed Chemical Dictionary, compiled and edited by the Editorial Staff of the Chemical Engineering Catalogue. Pp. 525. (New York: The Chemical Catalogue Co., Inc.) Price, 5 dollars.

20. Applied Economic Botany based upon actual Agricultural Gardening Projects, by Dr. M. T. Cook. Pp. xviii+261. (Philadelphia and London: J. B. Lippincott.) Price, 7*s*. 6*d*. net.

THE following publications have been issued by the Imperial Department of Agriculture in India since our last issue:—

Memoirs.

1. Absorption of Lime by Soils, by F. J. Warth, M.Sc., B.Sc., and Maung Po Saw. (Chemical Series, Vol. V, No. 6.) Price, R. 1-2 or 2*s*.
2. A *Pythium* Disease of Ginger, Tobacco and Papaya, by L. S. Subramaniam. (Botanical Series, Vol. X, No. 4.) Price, Rs. 1-8 or 2*s*. 6*d*.

Bulletins.

1. A Contribution to Our Knowledge of South Indian Coccidæ, by T. V. Ramakrishna Ayyar, B.A., F.E.S., F.Z.S. (Bulletin No. 87.) Price, As. 14 or 1*s*. 3*d*.
2. Second Hundred Notes on Indian Insects. (Bulletin No. 89.) Price, R. 1-4 or 2*s*.
3. A Malarial Parasite in the Blood of a Buffalo, by A. L. Sheather, B.Sc., M.R.C.V.S. (Bulletin No. 90.) Price, As. 6 or 7*d*.

Reports.

1. Proceedings of the First Meeting of Agricultural Chemists and Bacteriologists held at Pusa on 24th February, 1919, and the following days. Price, R. 1 or 1*s*. 6*d*.
2. Scientific Reports of the Agricultural Research Institute, Pusa (including the Report of the Imperial Cotton Specialist), for the year 1918–19. Price, R. 1-4 or 2*s*.
3. Annual Report of the Imperial Bacteriological Laboratory, Muktesar, for the year ending the 31st March, 1919. Price As. 4 or 5*d*.

Miscellaneous.

1. Guide to Agricultural Section, Pusa.

PUBLICATIONS OF THE IMPERIAL DEPARTMENT OF AGRICULTURE IN INDIA

TO BE HAD FROM

THE OFFICE OF THE AGRICULTURAL ADVISER TO THE GOVERNMENT OF INDIA, PUSA, BIHAR, *and from the following Agents* :—

(1) THACKER, SPINK & CO., CALCUTTA.
(2) W. NEWMAN & CO., CALCUTTA.
(3) RAI M. C. SARKAR BAHADUR & SONS, CALCUTTA.
(4) HIGGINBOTHAMS, LTD., MADRAS.
(5) THOMPSON & CO., MADRAS.
(6) D. B. TARAPOREVALA, SONS & CO., BOMBAY.
(7) THACKER & CO., LTD., BOMBAY.
(8) SUNDER PANDURANG, BOMBAY.
(9) RAI SAHIB M. GULAB SINGH & SONS, LAHORE.
(10) MANAGER, EDUCATIONAL BOOK DEPOT, NAGPUR.

A complete list of the publications of the Imperial Department of Agriculture in India can be obtained on application from the Agricultural Adviser to the Government of India, Pusa, Bihar, or from any of the above-mentioned Agents.

These publications are :—

1. The *Agricultural Journal of India*. A Journal dealing with subjects connected with agricultural economics, field and garden crops, economic plants and fruits, soils, manures, methods of cultivation, irrigation, climatic conditions, insect pests, fungus diseases, co-operative credit, agricultural cattle, farm implements, and other agricultural matters in India. Illustrations, including coloured plates, form a prominent feature of the Journal. It is edited by the Agricultural Adviser to the Government of India, and is issued once every two months or six times a year. *Annual Subscription*, Rs. 6 or 9*s*. 6*d*., including postage. Single copy, R. 1-8 or 2*s*.
2. Scientific Reports of the Agricultural Research Institute, Pusa (including the Report of the Imperial Cotton Specialist).
3. Annual Report on the Progress of Agriculture in India.
4. Proceedings of the Board of Agriculture in India.
5. Proceedings of Sectional Meetings of the Board of Agriculture.
6. Memoirs of the Imperial Department of Agriculture in India :
   (a) Botanical Series.
   (b) Chemical Series.
   (c) Entomological Series.
   (d) Bacteriological Series.
   (e) Veterinary Series.
7. Bulletins issued by the Agricultural Research Institute, Pusa.
8. Books.

The following are the publications of the last two years :—

Scientific Reports of the Agricultural Research Institute and College, Pusa (including the Report of the Imperial Cotton Specialist), for the year 1917-18. Price, R. 1-4 or 2*s*.

AGRICULTURAL PUBLICATIONS.—(*Concld.*)

Scientific Reports of the Agricultural Research Institute, Pusa (including the Report of the Imperial Cotton Specialist), for the year 1918-19. Price, R. 1-4 or 2*s.*

Report on the Progress of Agriculture in India for the year 1916-17. Price, As. 12 or 1*s.* 1*d.*

Report on the Progress of Agriculture in India for the year 1917-18. Price, R. 1-8 or 2*s.* 3*d.*

Proceedings of the Board of Agriculture in India, held at Poona on the 10th December, 1917, and following days (with Appendices). Price, As. 13 or 1*s.* 3*d.*

Proceedings of the Second Meeting of Mycological Workers in India, held at Pusa on the 20th February, 1919, and following days. Price, As. 11 or 1*s.*

Proceedings of the First Meeting of Agricultural Chemists and Bacteriologists, held at Pusa on 24th February, 1919, and the following days. Price, R. 1 or 1*s.* 6*d.*

Proceedings of the First Meeting of Veterinary Officers in India, held at Lahore on the 24th March, 1919, and following days (with Appendices). Price, As. 8 or 9*d.*

MEMOIRS OF THE DEPARTMENT OF AGRICULTURE IN INDIA

BOTANICAL SERIES

Vol. IX, No. IV. Studies in Indian Sugarcanes, No. 3. The Classification of Indian Canes with special reference to the Saretha and Sunnabile Groups, by C. A. BARBER, SC.D. Price, Rs. 2-4 or 3*s.*

Vol. IX, No. V. *Phytophthora Meadii* n. sp. on *Hevea brasiliensis*, by W. MCRAE, M.A., B.SC., F.L.S. Price, R. 1-4 or 2*s.*

Vol. X, No. I. The Rice Worm (*Tylenchus angustus*) and its Control, by E. J. BUTLER, M.B., F.L.S. Price, R. 1-4 or 2*s.*

Vol. X, No. II. Studies in Indian Sugarcanes, No. 4. Tillering or Underground Branching, by C. A. BARBER, C.I.E., SC.D., F.L.S. Price, Rs. 4-4 or 7*s.*

Vol. X, No. III. Studies in Indian Sugarcanes, No. 5. On testing the suitability of sugarcane varieties for different localities, by a system of measurements. Periodicity in the growth of the sugarcane, by C. A. BARBER, C.I.E., SC.D., F.L.S. Price, R. 1-12 or 3*s.*

Vol. X, No. IV. A *Pythium* Disease of Ginger, Tobacco and Papaya, by L. S. Subramaniam. Price, R. 1-8 or 2*s.* 6*d.*

Vol. X, No. V. Studies in the Pollination of Indian Crops, 1, by A. HOWARD, GABRIELLE L. C. HOWARD, and ABDUR RAHMAN KHAN. (*In the press.*)

CHEMICAL SERIES

Vol. V, No. II. "Heart Damage" in Baled Jute, by R. S. FINLOW, B.SC., F.I.C., F.C.S. Price, R. 1 or 1*s.* 6*d.*

Vol. V, No. III. Experiments on the Improvement of the Date Palm Sugar Industry in Bengal, by HAROLD E. ANNETT, B.SC., F.I.C.; GOSTA BEHARI PAL, M.SC.; and INDU BHUSHAN CHATTERJEE, L.Ag. Price, R. 1 or 1*s.* 6*d.*

Vol. V, No. IV. Cholam (*A. Sorghum*) as a Substitute for Barley in Malting Operations, by B. VISWANATH, T. LAKSHMANA ROW, B.A., and P. A. RAGHUNATHASWAMI AYYANGAR, Dip. Ag. Price, As. 12 or 1*s.*

Vol. V, No. V. The Phosphate Requirements of some Lower Burma Paddy Soils, by F. J. WARTH, M.SC., B.SC., and Maung Po Shin. Price, R. 1-12 or 3*s.* 3*d.*

Vol. V, No. VI. Absorption of Lime by Soils, by F. J. WARTH, M.SC., B.SC., and MAUNG PO SAW. Price, R. 1-2 or 2*s.*

ENTOMOLOGICAL SERIES

Vol. V. No. V. The Rice Leaf-hoppers (*Nephotettix bipunctatus*, Fabr. and *Nephotettix apicalis*, Motsch.), by C. S. MISRA, B.A. (*In the press.*)

Vol. V. No. VI. *Lantana* Insects in India. Being the Report of an Inquiry into the Efficiency of Indigenous Insect Pests as a Check on the Spread of *Lantana* in India, by Y. RAMACHANDRA RAO, M.A., F.E.S. (*In the press.*)

BACTERIOLOGICAL SERIES

Vol. I, No. VII. A Bacterial Disease of Wheat in the Punjab, by C. M. HUTCHINSON, B.A. Price, As. 12 or 1*s*.

VETERINARY SERIES

Vol. II, No. VIII. *Kumri*: Combined Diffuse Sclerosis and Central Poliomyelitis of Horses, by G. H. K. MACALISTER, M.A., M.D., D.P.H. Price, R. 1-8 or 2*s*. 6*d*.

Vol. III, No. I. The Vitality of the Rinderpest Virus outside the Animal Body under Natural Conditions, by A. W. SHILSTON, M.R.C.V.S. Price, As. 12 or 1*s*.

BULLETINS ISSUED BY THE AGRICULTURAL RESEARCH INSTITUTE, PUSA

No. 76. Experiments with Emulsions for Protecting Camels against the Attacks of Blood-sucking Flies, by H. E. CROSS, M.R.C.V.S., D.V.H., A.Sc. Price, As. 2 or 3*d*.

No. 77. Some Camel-feeding Experiments, by H. E. CROSS, M.R.C.V.S., D.V.H., A.Sc. Price, As. 2 or 3*d*.

No. 78. Smuts of Jowar (*Sorghum*) in the Bombay Presidency, by G. S. KULKARNI, L.Ag. Price, As. 4 or 5*d*.

No. 79. Prussic Acid in Burma Beans, by F. J. WARTH, B.Sc., M.Sc.; and Ko Ko GYI. Price, As. 2 or 3*d*.

No. 80. Are Camels Susceptible to Black Quarter, Hæmorrhagic Septicæmia and Rinderpest? by H. E. CROSS, M.R.C.V.S., D.V.H., A.Sc. Price, As. 4 or 5*d*.

No. 81. The Value of Phosphatic Manures in India and the Possibility of their Manufacture on a Larger Scale. Being evidence submitted to the Committee appointed to discuss this question (Subject IX) at the Meeting of the Board of Agriculture, Poona, 1917. Edited, with an Introduction, by W. A. DAVIS, B.Sc., A.C.G.I. Price, As. 4 or 5*d*.

No. 82. The Improvement of the Indigenous Methods of *Gur* and Sugar making in the United Provinces, by WILLIAM HULME and R. P. SANGHI. Price, As. 8 or 9*d*.

No. 83. Progress of the Sugarcane Industry in India during the Years 1916 and 1917. Being Notes submitted to the Meeting of the Board of Agriculture in India, Poona, 1917. Edited, with an Introduction, by C. A. BARBER, C.I.E., Sc.D., F.L.S. Price, As. 5 or 6*d*.

No. 84. The Best Means of Rapidly Increasing the Outturns of Food Crops by Methods within the Power of the Agricultural Department. Being Notes submitted to the Meeting of the Board of Agriculture in India, Poona, 1917. Edited, with an Introduction, by J. MACKENNA, C.I.E., I.C.S. Price, As. 4 or 5*d*.

No. 85. Soil Drainage, by R. G. ALLAN, M.A. Price, As. 4 or 5*d*.

No. 86. A New Nematode causing Parasitic Gastritis in Calves, by A. L. SHEATHER, B.Sc., M.R.C.V.S. Price, As. 4 or 5*d*.

No. 87. A Contribution to our Knowledge of South Indian Coccidæ, by T. V. RAMAKRISHNA AYYAR, B.A., F.E.S., F.Z.S. Price, As. 14 or 1*s*. 6*d*.

No. 88. Cawnpore-American Cotton: An Account of Experiments in its Improvement by Pure Line Selection and of Field Trials, 1913-1917, by B. C. BURT, B.Sc., and NIZAMUDDIN HAIDER. Price, As. 10 or 1*s*.

No. 89. Second Hundred Notes on Indian Insects. Price, R. 1-4 or 2*s*.

No. 90. A Malarial Parasite in the Blood of a Buffalo, by A. L. SHEATHER, B.Sc., M.R.C.V.S. Price, As. 6 or 7*d*.

No. 91. Notes on Practical Salt Land Reclamation, by G. S. HENDERSON, N.D.A., N.D.D. (*In the press.*)

No. 92. Syngamus laryngeus in Cattle and Buffaloes in India, by A. LESLIE SHEATHER, B.Sc., M.R.C.V.S., and A. W. SHILSTON, M.R.C.V.S. (*In the press.*)

No. 93. The Orange: The Trial of Stocks at Peshawar, by W. ROBERTSON BROWN. (*In the press.*)

BULLETINS ISSUED BY THE AGRICULTURAL RESEARCH INSTITUTE, PUSA—(*Concld.*)

No. 94. A Preliminary Note on the Behaviour in North India of the first batch of Sugarcane Seedlings raised at the Sugarcane-breeding Station, Coimbatore, by T. S. VENKATARAMAN, B.A. (*In the press.*)

INDIGO PUBLICATIONS

No. 1. A Study of the Indigo Soils of Bihar. The Urgent Necessity for Immediate Phosphate Manuring if Crops are to be Maintained, by W. A. DAVIS, B.SC., A.C.G.I. Price, R. 1-4 or 2*s.*

No. 2. Present Position and Future Prospects of the Natural Indigo Industry, by W. A. DAVIS, B.SC., A.C.G.I. Price, As. 10 or 1*s.*

No. 3. The Loss of Indigo caused by Bad Settling and the means of obviating this: The use of Dhak Gum—its Effect on Yield and Quality, by W. A. DAVIS, B.SC., A.C.G.I. Price, As. 4 or 5*d.*

No. 4. The Future Prospects of the Natural Indigo Industry: The Effect of Superphosphate Manuring on the Yield and Quality of the Indigo Plant, by W. A. DAVIS, B.SC., A.C.G.I. Price, As. 4 or 5*d.*

No. 5. An Improved Method of preparing Indican from Indigo-yielding Plants, by BHAILAL M. AMIN, B.A. Price, As. 2 or 3*d.*

No. 6. The Effect of Manuring with Superphosphate and Sannai on the Yield of Crops on Indigo Planters' Estates in Bihar—especially of Rabi Crops in the Season 1918-1919, by W. A. DAVIS, B.SC., A.C.G.I. (*In the press.*)

BOOKS

"Indian Insect Pests," by H. MAXWELL-LEFROY, M.A., F.E.S., F.Z.S. Price, R. 1-8 or 2*s.* (*Out of print.*)

"Indian Insect Life," by H. MAXWELL-LEFROY, M.A., F.E.S., F.Z.S.; and F. M. HOWLETT, B.A. 786 pp. Price, Rs. 20 or 30*s.* (*Out of print.*)

Wheat in India," by ALBERT HOWARD, M.A., A.R.C.S., F.L.S.; and GABRIELLE L. C. HOWARD, M.A. 288 pp. Price, Rs. 5 or 7*s.* 6*d.*

"A Description of the Imperial Bacteriological Laboratory, Muktesar: Its Work and Products," by Major J. D. E. HOLMES, M.A., D.SC., M.R.C.V.S. Price, As. 8 or 9*d.*

"Agriculture in India," by JAMES MACKENNA, M.A., I.C.S. Price, As. 4 or 5*d.*

"Some Diseases of Cattle in India. A handbook for stock-owners." Price, As. 8 or 9*d.*

"The Importance of Bacterial Action in Indigo Manufacture," by C. M. HUTCHINSON, B.A. Price, As. 2 or 3*d.*

"Report of the Proceedings of the Second Entomological Meeting, held at Pusa on the 5th-12th February 1917." Price, Rs. 3.

Report of the Indian Cotton Committee. Vol. I, Report; Vol. II, Maps and plans. Price, R. 1 per volume. (Superintendent: Government Printing, India, Calcutta.)