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THE OUDH SEED-DEPÔTS.

By W. H. MORELAND, M.A., M.R.A.S., I.C.S., C.I.E.,

Director of Agriculture, U.P.

MANY if not most of the cultivators in the southern districts of Oudh are unable to carry an adequate stock of seed from harvest until the following seed-time. There is no lack of appreciation of the benefits to be derived from choosing seed from the best of the produce, and the practice is followed, as far as possible, in the case of the crops which cost little to seed an acre; but with crops, such as wheat, where the cost of seed is considerable, the people have not the financial resources that would enable them to hold their stock. In practice they hand over their whole crop of wheat to the grain-dealer to be credited to their account, and at seed-time they go to him for the loan of the necessary seed.

This part of the country produces in a favourable year more wheat than it consumes, as the bulk of the inhabitants have to be content with coarser food-grains. The grain-dealer naturally sells the best of the wheat that comes into his hands, and issues the balance for seed, so that a process of deterioration in the quality of the seed is steadily at work. It is probably due mainly to this fact that the wheat ordinarily grown in South Oudh gives a poor yield of inferior grain.

The question of providing facilities for the supply of sound seed in such tracts was raised by the Board of Revenue in 1898. Some of the larger landholders professed interest in the matter and offered subscriptions towards the capital required, as well as their assistance in distributing seed to the cultivators and in collecting their payments at harvest-time: an advance

was obtained from Government to supplement the landholders' subscriptions; and an experimental depôt was established to test the question whether good seed could be profitably distributed as a commercial operation. At the outset, it was hoped that if this question could be answered in the affirmative, the larger estates would follow the example set them and would organize the seed-supply of their cultivators.

The landholders soon lost interest in the operation, or perhaps it would be fairer to say that their interest, never very strong, proved insufficient to cope with the objections of their subordinates to the extra labour involved in distribution and collection. But this first phase of the undertaking lasted long enough to show that, whatever the landholders might think, the cultivators were keenly alive to the advantages of a system by which they could be sure of sound seed on fair credit terms. At the same time the Department was getting popular with the cultivators, so that when the landholders' interest waned, it was decided not to suspend operations but to deal direct with individual cultivators for the time being in the hope of gradually developing a system from which Government could eventually withdraw.

Dealing with individual cultivators had numerous drawbacks. There were too many petty accounts to keep: collection became very laborious, and the cultivators had to be introduced by the subordinates of the Land Records Department. This last necessity was objectionable both as diverting the staff from their duties and as tending to a system of fees for introduction. The first step in organization was to encourage cultivators to form groups which would take over substantial quantities of seed and be jointly responsible for the return of the produce. By last year sufficient experience had been gained of these groups to justify their recognition as the normal customers of the depôt, and consequently a differentiation of interest rates has been made in their favour which will probably eliminate the individual customer.

The next step forward, the conversion of these groups into co-operative societies, will be the work of the Registrar.

Recent high prices have made it inadvisable to press this development forward, and only a few societies have been actually formed ; but there is reason to think that many of the groups are ready, or will shortly be ready, to register themselves as societies, purchase a stock of seed with capital obtained through the Registrar at co-operative rates, and carry their stock from season to season. The chief anxiety of the groups appears at the present time to be the risk of loss in storage by theft, fire, insects, etc. This question has still to be worked out with the people, but as a temporary measure I have offered to store in the Government depôts the stock of the pioneer societies in return for a charge per maund calculated to cover storage-charges and insurance.

Should these societies develop in the way that is hoped, the Department will have nothing further to do with the supply of seed for their members, except to assist them from time to time in adding to their stock, or in taking up a new variety. The assistance will be confined to purchasing for them the best seed available at the cheapest rate, or advising them where and how to purchase. It will not be financial.

The original intention was to offer the people chosen seed of the local strains, and this course is still followed in the case of some kinds of grain where the local supply is fairly good. But in the case of wheat, which forms the bulk of the distribution, a change of policy was necessitated partly by the fact that it was impossible to get enough good wheat of the local strains, and partly because the people were tired of their own and asked for a different strain. The soft white wheat, known as Muzaffarnagar, had been tried in the locality with sufficient success to justify its offer, and it has been the principal grain supplied ; it has now become popular with the people as giving a considerably greater net return than the local strains. Oats have been introduced in one or two places where there was a demand for the crop, but the market is too limited for this crop to become very important ; and a variety of fine rice which commands very high prices in the market, appears to be becoming popular.

The terms offered were 25 per cent. for the crop; that is to say, a cultivator who takes a maund of seed undertakes to repay 50 seers of its produce after harvest. If he prefers as some do—to pay in cash, the cash rate is fixed beforehand at a slightly unfavourable figure from his point of view, as in order to maintain the stock it is desirable to get back as much grain as possible in kind. This rate of interest was fixed as the commonest prevailing rate in the locality, as it was desired not to appear to enter on the enterprise of reducing interest. As a matter of fact, the charge to the people has in some cases been reduced, because some dealers adjust their rates by the difference between prices at seed-time and at harvest, but reduction was not part of the scheme. At present a rebate of one-fifth the interest is being offered to groups provided they pay in their produce punctually in one lot: thus a group which has taken 10 maunds of seed need pay only 12 maunds instead of $12\frac{1}{2}$ maunds under the previous rule. This reduction is justified by the greater security, the saving of labour in collection, and the reduction of account work. On the other hand, from next year the rate to individuals will be raised to $37\frac{1}{2}$ per cent. in furtherance of the policy of encouraging the formation of groups.

The working of the depôt may be described as follows:—

The representatives of a group are now known to the agricultural staff and need no introduction, but individuals have to be introduced. In either case the issue is made on application with the minimum of formalities, and there is nothing more to do till harvest time. It is here that difficulties occur in collection from individuals. We have hardly had a single case of fraudulent refusal to pay, but debtors expect to be reminded, and this entails much work on the revenue-staff of the sub-division: work which will, I hope, be reduced to a minimum as the group system develops. As each lot of seed is returned, it has to be examined for fitness for re-issue, and then cleaned and bagged under the supervision of the agricultural staff. At first a seed-separator was used for cleaning, but hand-sieves have been found more suitable. The cleaned seed fit for re-issue is then stored

and the inferior seed and cleanings sold off for cash at a period when the market is favourable.

As regards storage, Khan Bahadur Muhammad Hadi, who has supervised operations since the start, has developed and adapted the indigenous methods on lines which he describes as follows : —

"Seed-grains may be stored either in pits (under ground) or in chambers (over ground) in a building (two-storied preferable) having but one entrance to the north or south. The most suitable shape for the pits or chambers is oblong, the dimensions, of course, depending on the amount of grain which has to be stored. The pits or chambers should be perfectly dry to begin with. The walls and the floor thereof should then be well coated with coal tar and allowed to dry. Before storing the seed, about half an ounce of sulphur should be burnt in each chamber and the door of the building should be closed while the sulphur is burning. Leaves of '*Mahua*' (Bassia latifolia) and '*Nim*' (Melia indica) should be collected beforehand and dried. A layer of *Mahua* leaves about 6 inches thick should first be spread on the floor and over this a thinner layer of *Nim* leaves. On the latter should be spread a six-inch layer of *bhusa* (the common wheat or barley straw). The grain should be *thoroughly* dried in the sun before storage and should be packed in bags in the *hot sun of June* (which is the best time for storing *rabi* seeds). Before the bags are stitched after being filled, two or three one-inch bits of naphthalene should be put in each bag. The bags should now be removed from the sun to the chamber and placed on the layers mentioned above. The upper surface of the bags should then be covered with a two-inch layer of *bhusa*, and on this layer should be placed a fresh layer of bags and so on till the chamber is full. A space of about one foot should be left all round the chamber inside to be closely filled with *bhusa* as each layer of bags is placed in it. The chamber should in this way be filled up to the top when a thick layer of *bhusa* should be spread and covered over with a piece of *tat* or some sort of matting. In the rainy season the bags should be examined once

a fortnight with an instrument well known to grain-dealers. It is called *parkhi* and is similar to the instrument used in Europe for examining cheese. Should any traces of an attack of weevils be found in any bag, the latter should be removed from the granary at once. The use of naphthalene minimizes injuries from the common granary pests but renders the seed unfit for eating purposes owing to the disagreeable odour which it imparts to the grain.

Kharif Seeds. Among the kharif seeds, rice does not require all this careful treatment, but *Urd*, *Mung* and *Juar* do.

Maize is specially liable to attack of weevils, and it should be *very thoroughly* dried before storage under the above method. The best way for keeping maize seed is to suspend the ripe cobs (they should be *dead* ripe) in a kitchen or some other room where smoke gets in regularly every day."

It may be added to the foregoing account that losses from weevils have on the whole been trifling.

It is found that in ordinary seasons the stock of grain increases as rejections and cleanings do not consume the whole of the interest received: but after a bad season it may become necessary to renew a considerable part of the stock by fresh imports, when charges for freight reduce the accumulated profit, while as prices are usually high when fresh purchases have to be made, the writing down of the new stock to normal values affects the balance-sheet very materially. The financial arrangements will be understood from the following balance-sheet made up on 31st August 1906: the depôt has a personal ledger account with the treasury:

Liabilities.	Rs.	A.	P.	*Assets.*	Rs.	A.	P.
Due to Government ...	14,000	0	0	Grain, bags & straw in stock or advanced ...	13,679	9	9
Reserve	2,000	0	0	Outstandings ...	2,536	1	11
Subscriptions ...	875	0	0	Dead stock ...	11	15	9
Profit	1,478	15	3	Cash ...	2,096	1	7
	18,353	15	3		18,353	15	3

Taking each item in turn, the sum *due to Government* represents the bulk of the working capital : it is technically an advance under Article 137 (*a*) of the Civil Account Code. The *reserve* represents a contribution made by the Government of India some years ago to enable the stock to be extended at a period of famine-prices ; but for this grant, the depôt, as a commercial institution, would have been bound to limit its operations till prices fell, while with the aid of the grant it was possible to purchase more seed and do substantial good. For accounts purposes the amount of the grant is still shown as a reserve fund, and part of it will probably disappear from the next balance-sheet, as the stock of seed has again been increased at a time of high prices. The *subscriptions* represent the original contributions of landholders, and the *profit* is the balancing item.

On the assets side, the *seed-grain* is valued at normal prices, the other *stock* at a low figure. The *outstandings* show the normal value of the grain due to the depôt at that date, while the *cash* represents the value of seed sold for cash as unfit for stock, etc. This has almost all been spent in adding to the stock of wheat. Contingent expenditure and wages are paid from the cash-balance.

It should be added that two district boards have established seed depôts on similar lines : they are worked by the staff of the department but financed by the district boards.

THE THIRD ANNUAL MEETING OF THE BOARD OF AGRICULTURE.

By E. J. BUTLER, M.B., F.L.S.,

Secretary to the Board.

THE expansion of Agricultural Departments in India, noted in the account of the second meeting of the Board of Agriculture (Agricultural Journal of India, Volume I, 1906, page 143), was still more evident at the third meeting which opened at Cawnpore on February the 18th, 1907, under the presidency of Mr. F. G. Sly, I.C.S., Officiating Inspector-General of Agriculture in India. Forty-six members attended as against thirty-five in the preceding year, the increase being more than accounted for by the presence of thirteen new officers appointed to the staffs of the Imperial and Provincial Departments of Agriculture during the year. Besides a very full muster of these Departments, the Board included the Inspector-General of the Civil Veterinary Department, the Director of the Botanical Survey, the Agricultural Chemist to the Government of Mysore, the Scientific Officer to the Indian Tea Association, and the Directors of Agriculture of Baroda and Kashmir. The Board had also the pleasure of welcoming as visitors Sir Edward Buck, K.C.S.I., and Major E. H. Atkinson, R.E., Principal, Thomason College, Rurki, both of whom made valuable contributions to its proceedings.

The two previous meetings were held at Pusa. The new departure, of meeting alternately at Pusa and at one or other of the Provincial Departments' head-quarters, proposed by the Board in 1906, has met with general approval. As one of the main objects of the Board is to give to agricultural officers throughout India an opportunity of meeting together to learn something of

each other's work and to discuss their problems from the different stand-points induced by local conditions, it is felt widely that the advantage which will accrue from seeing the actual working of the departments in different provinces fully justifies the change.

The annual meeting of the Board of Agriculture is an occasion on which a review can be made of the progress of State-aided improvement in Indian agriculture during the preceding year. Though this is not an admitted function of the Board, which in its official discussions applies itself rather to plans for the future, it is still an inherent necessity of any such meeting, since it is impossible to discuss the future, without reference to the past. The opportunity has, indeed, been taken by the President at the last two meetings to refer briefly to the results during the year of the action taken on the recommendations made by the preceding Board. The programmes of work submitted by the Departments of Agriculture also contain frequent references to current work and to new lines taken up during the year. It is, therefore, possible from this point of view to gain a general idea of the activities in agricultural matters of the State departments concerned.

In attempting to give a brief review of the salient features of the year's work, as they can be gleaned from the Proceedings of the Board of 1907,* it is necessary first to make some reference to the organization of the Agricultural Departments in India, and the expansion of their staffs which has taken place in 1906-07. A very complete account of these Departments, with detailed lists of their staffs as they stood at the beginning of 1906, will be found in an article in this Journal on "Departments of Agriculture in India" by Mr. F. G. Sly (Agricultural Journal of India, Volume I, 1906, page 1). The Imperial Department as it stood in the beginning of 1906 has undergone

* Proceedings of the Board of Agriculture in India, held at Cawnpore on the 18th February 1907, and following days. Calcutta, Office of the Superintendent of Government Printing, India. Price, Rupee 1, annas 2; or 1s. 6d.

no considerable change. Five new officers were, however, posted to Pusa in the period under review, to receive a course of training intended ultimately to prepare them for responsible posts in the Provinces. The addition of these officers—known as Supernumeraries—to the different branches of Agricultural Science represented at Pusa, has become an important feature in the organization of the Pusa Institute, and every section has been, or will shortly be, strengthened by one or more junior officers. As vacancies arise, these will be posted to the charge of sections in the provinces.

The Provincial Departments have made a decided advance towards the organization outlined in Mr. Sly's article already referred to. A separate Department of Agriculture, distinct from the Land Records Department with which agriculture was previously amalgamated, has come into being in nearly all the provinces, and in each case is in charge of a special officer of the Indian Civil Service as Director of Agriculture. Each Department has obtained, or will very shortly obtain, a nucleus staff consisting, in most cases, of a Principal of the provincial agricultural college, a chemist, a botanist and one or more expert agriculturists. Entomologists and mycologists will not at present be appointed to any province, the whole of the work of these sections being for the present centred at Pusa, with the assistance of native staffs in the Provincial Departments.

The recruitment of the very large native establishments required has naturally been much hampered by lack of suitable trained candidates, but this is inevitable pending the completion of the agricultural colleges; the supply from them of well trained men will eventually remove this difficulty. Besides the European staff of specialists mentioned, native assistants and subordinates are, therefore, being largely employed and will be graded into a regular service on rate of pay and prospects which will attract highly educated men who have been brought up among agricultural surroundings.

So much for the personnel. The material equipment has made an equally decided advance. The Agricultural Research

Institute at Pusa is approaching completion and it is anticipated that its laboratories will be occupied in the current year. In each province the site for the central provincial college and research station has been selected, and in most cases, considerable progress has been made in erecting the necessary buildings and laying out the land. Most of the provinces have been surveyed with a view to select suitable localities in which to found experimental farms, and the number of such farms in existence has largely increased. When completed, there will thus be besides the Imperial Research Institute at Pusa, eight provincial colleges and experiment stations, with full laboratory accommodation for scientific work, and a large number of experimental farms and demonstration plots in representative agricultural tracts throughout the country.

The degree of activity shown by the different departments naturally varies greatly in accordance with the staff available. In Burma, for instance, the Director was entirely without a scientific staff until nearly the end of the period under review. Several other provinces were but little better off. In Bombay, on the other hand, nearly the full staff was available. It is impossible to refer more than very briefly to a few of the directions in which the different departments have been active.

The work of the Agricultural Research Institute, Pusa, was outlined by a committee of the Board of 1906, who held that it should be directed, as far as possible, to solutions of the fundamental problems of tropical agriculture, the provincial departments undertaking more detailed or local work, of immediate application to local agriculture. Inevitable delay has occurred in inaugurating any large series of field experiments at Pusa, owing to the necessity of testing the soil of the different blocks. Uniform cropping for several seasons, so as to obtain a knowledge of their characters, has been the first requirement. When taken up in 1903, a large part of the present arable area was under jungle and all was in an unsatisfactory condition agriculturally. Hence, no field experiments proper have yet been commenced, and much time has been expended in mapping the farm into acre plots, the

yields of which have been separately weighed and recorded, so that a considerable amount of information as to the capabilities of the different fields has been acquired. Soil analyses of a very extensive nature have been made, and samples of all the blocks preserved for future comparison. It has, however, been possible to carry out a certain number of crop experiments in available portions of the farm, experiments in sugarcane cultivation, the testing of varieties, their period of maturing, behaviour to disease and so on, and the experimental cultivation of cotton and flax, being the chief of these. The ordinary work of laying out the farm has, of course, taken much time, but the necessary bunding, fencing, road making, providing irrigation and so on, are now nearly completed, and it may be expected that permanent field experiments can very soon be commenced. The details of these are not, however, yet definitely settled, but it is safe to say that an important part of the experiments will be permanent series, something on the lines made famous by the work carried on at Rothamsted in England, but with special reference to sub-tropical practices and conditions.

In chemistry the work has included the determination of available plant food in soils. This has been carried out largely in the pot-culture house, a well-equipped structure which has been erected for work of this nature. The results obtained up to date will shortly be published. The amount of nitrogen compounds in rain-water and dew has been determined, in work extending over a year in each case. The published results show that the quantities, contrary to what has often been suggested, are no greater than those similarly found in England. The subject of soil drainage has also been taken up, with the aid of four drain gauges erected for the purpose. These are solid blocks of soil, cut out and underpinned without any disturbance, and they provide a means of collecting and examining the drainage water through different thicknesses of a measured area of surface. Other investigations of the quantity and movements of soil moisture have been carried on, and it is expected that some interesting data will be available for publication shortly. Similarly, an apparatus for determining the

quantity and character of soil gases has been perfected, with a view to obtaining information on this little known subject. Investigations have also been carried out on the conditions which lead to an accumulation of the cyanogenetic glucoside, which gives rise to prussic acid in certain plants, such as sorghum (*Andropogon Sorghum*) and linseed, (*Linum usitatissimum*) so often fatal to cattle, and on the value of the recently introduced artificial manures, calcium cyanamide and calcium nitrate.

In botany the chief work has been investigations in plant breeding and plant improvement. The determination of the varieties of Indian wheat has been taken up, a very large collection of the Indian wheats having been grown at Pusa and their characters studied, the almost invariable mixtures being separated into their component types. Similar work with barley and tobacco is also in progress.

A commencement has been made in wheat breeding work, a number of successful crosses having been obtained. The results which have attended this class of work in other countries hold out considerable promise for similar work in India, where little breeding has previously been attempted. The collection and investigation of certain fibre plants has also been commenced. The first step is to collect material for growing under uniform conditions, in order to determine whether the varieties of any particular fibre plant are true to type, and to isolate and examine the types. The value of these types will then be determined. Hibiscus cannabinus (*Patsan*) has been selected for immediate investigation. Other work includes a series of permanent experiments on the culture of Indian fruits, and the study of the varieties and cultivation of cassava, with particular reference to the amount of starch and prussic acid-producing glucoside present, the Agricultural Chemist collaborating in the latter investigation.

In entomology and mycology the work has naturally been of a somewhat different character. Since no provision for these sections has, at present, been made in the provincial departments, the acquirement of information regarding Indian insect and fungus pests of cultivated crops has necessarily occupied a large

proportion of the time of the sections concerned. The accumulation of collections and their identification, and the giving of advice to cultivators and others regarding their pests, form an important part of their work.

In entomology a staff of native assistants has been trained and posted to different provinces. These men are employed in field observations of the more serious crop pests and in urging on the cultivators the adoption of simple remedial measures. Slow but real progress in this direction is recorded, aided by the publication of a volume on "Indian Insect Pests," which may be expected to promote the spread of more common-sense views as to the origin and nature of insect epidemics. An attempt has been made to discover insecticides fatal to insects, but not, in the quantities used, to cattle or other stock. This has been carried out in collaboration with Mr. R. S. Finlow. The value of *trap* crops in preventing insect epidemics, the influence of climatic conditions on their prevalence, and the practicability of utilizing beneficial insects as a means of checking pests, were also enquired into at Pusa. Large reference collections are being accumulated and identified with the aid of specialists in Europe and America. The special investigations included an enquiry into the prevalence in India of biting flies which may act as carriers of disease. This is a subject which has reached great importance in medical and veterinary science recently. Little is known of the species which occur in India, and a comprehensive survey of them may prove of great value in the discovery of the causation of certain human and animal diseases. A severe epidemic of the cotton boll-worm has recently occurred in the Punjab and Sind. To combat this a large campaign was undertaken in the Punjab, the chief means adopted being the re-introduction of the natural enemy of the boll-worm, a parasite which, there is reason to believe, was killed out by the severe cold of the winter of 1905-06, the burning of stalks and refuse of the cotton plant in the fields, after the completion of the cotton picking season, and the planting of *trap* crops of *bhinda (Hibiscus esculentus)*. The result was a distinct improvement in the crop in 1906-07.

In mycology the training of assistants for posting to the provinces has been started in a similar manner to that mentioned above for the entomological assistants. Little progress may, however, be expected from any efforts at present to teach cultivators to understand their fungus pests, for a considerable amount of education is required before the nature and effects of these obscure and minute parasites can be grasped. Attempts have, therefore, been made to indicate directions in which Government may take action in stamping out epidemic diseases and also to find disease-resisting varieties of crops subject to specific diseases. As an instance of the former, a large campaign has been started in the Godavari Delta to stamp out a very serious palm disease which threatens the extinction of palmyra and cocoanut palms in that area. This work is being carried out by the Madras Department with the necessary expert advice and assistance from Pusa. It is hoped, however, that in this case, material co-operation may eventually be secured from the ryots. The attempts to obtain a race of pigeon pea resistant to the wilt disease of this crop are promising well at Poona. At Pusa investigations of some of the chief diseases of sugarcane have been carried on, and a simple and efficient method of checking "red rot," the most serious disease of this crop, has been discovered. Research work has occupied much time, as a natural preliminary to the introduction of remedial measures in a country in which the crop diseases are largely uninvestigated at present. The collection and identification of Indian fungi is also a necessary preliminary to future work.

The work which is being carried out by the provincial departments, as submitted to the Board, is so extensive and varied that only a brief reference to its main features is possible here.

Efforts towards the improvement of Indian cotton are receiving considerable attention. The attempt to acclimatize Egyptian cotton in Sind has attracted much notice, not only in India, but in the markets of the world. There is no need to refer

at length to this experiment, the details of which are probably familiar to most readers from the columns of the daily press. The success of its early stages is promising, but consideration must be given to overcome the habits and traditions of the cultivators, which deter them from the labour and care required in growing these cottons, and the ravages of the boll-worm, before any considerable supply can become available. Egyptian cotton is also being grown in the South Western Punjab. A classification of Indian cottons grown at Poona and an account of some of the tree cottons have been prepared by Professor Gammie, Economic Botanist, Bombay. In Bengal and elsewhere trials of these tree cottons have been carried out, without, as yet, any definite success. Several hybrid cottons have been produced in Bombay and the Central Provinces and are being tested. In the Punjab, fifteen hundred acres were sown with acclimatized American cotton in 1906, and a substantial increase is anticipated this year. In the United Provinces a medium stapled American cotton has been acclimatized and introduced on a small scale near Cawnpore. Cotton seed selection is in progress in most provinces, the superior seed being distributed to the ryots. In the Central Provinces three farms are devoted to this work.

Wheat experiments, particularly in the introduction of improved varieties, are in progress in the wheat-growing provinces. In the Punjab some of the varieties introduced at Lyallpur have found much favour. At Cawnpore and Orai wheat-breeding work is being carried on, search being made particularly for a rust resistant wheat for Bundelkhand. In Bombay similar work has been initiated. At Hoshangabad in the Central Provinces wheat is under special study, and in these Provinces demonstrations on the advantages of saltpetre as a manure for irrigated wheat are being given.

In sugarcane the farm at Samalkota has done much good work in introducing new varieties into the Godavari Delta. This farm is devoted chiefly to the study of this crop. At Manjri, near Poona, sugarcane is also the chief crop and the

work of the farm has exercised a wide influence on surrounding cultivation. In Assam attempts are being made to popularize sugarcane growing. The Agricultural Chemist to the Mysore Government has made an enquiry into the industry in that State, and indicated several directions in which improvement in manufacture can be carried out. The Hadi process of sugar making is being taken up by cane growers in the United Provinces.

The improved cultivation of paddy, introduction of new varieties and experiments in transplanting and manuring are being carried out at several farms in Bengal, at Raipur in the Central Provinces and at Rajshahi in Eastern Bengal. The efficiency of *rab* is being tested at Lonavla in Bombay.

Tobacco cultivation and curing are being studied at Nadiad in Bombay, Dindigal in Madras and Rangpur in Eastern Bengal. New varieties have been introduced into Cocanada and Koilpatti in Madras.

The improvement of potato cultivation in the Khasi hills is one of the chief aims of the Shillong farm where new varieties are introduced, spraying for disease demonstrated and manurial experiments tried. Disease resistant potatoes are being sought for at Dharwar in Bombay.

Special farms have been opened for the study of groundnut at Palur in Madras, pepper at Taliperamba in the same Presidency and Tasar silk at Chaibassa in Bengal. Groundnut is also being studied on some of the Bombay farms. At Kanara spice cultivation is especially under enquiry. The tropical Garden at Wahjain in Assam is devoted to spices, drugs and tropical fruits, while temperate vegetables and fruit are being acclimatized at Shillong. Rubber, fibres and a number of exotic and Indian economic plants are receiving attention at Ganeshkind Gardens in Bombay, where also there are experiments in fruit growing. A new economic garden for similar work has been opened at Bassein on the sea coast north of Bombay.

At most farms in all the provinces there are experiments in cultivation, manuring, seed-rate, introduction of varieties and

similar questions, with a large variety of crops, including most of the staple crops of the country.

Seed farms for the supply of good seed of cotton, wheat, jute and other crops have been opened in several provinces.

Of special enquiries mention should be made of the *reh* or alkali land investigations in Sind, the United Provinces, and the Punjab. Efforts at reclaiming alkali land by the application of gypsum, by drainage and by washing out the salts are in progress. In the United Provinces a survey has been made to locate sites where wells may profitably be constructed and a special well-boring staff entertained to conduct trial borings. In times of scarcity the assistance of Government for these minor irrigation works has been secured, according to a definite programme. A scheme for a similar survey has been prepared for the Punjab. Investigations of questions of soil nitrogen, determination of seepage in field irrigation channels, soil inoculation of leguminous crops and studies in insect and fungus pests are carried on at Cawnpore. Studies of root parasites, especially the sandal tree, and a survey of the wild peppers of the Presidency have been carried out by the Government Botanist, Madras. The co-operative system of seed distribution which has been devised in the United Provinces has been described at length in the present issue of this Journal.

Besides the general agricultural work of the departments mentioned above, several important crops have been made the subject of investigation by special officers appointed for the purpose. These are indigo, tea, jute and other fibres. The Indigo research station of the Behar Indigo Planters' Association receives a subsidy from the Bengal Government and is under the charge of the Imperial Bacteriologist who has been lent from Pusa for the purpose. The nature of indigo fermentation has been investigated and several improvements in manufacture carried out. The station has also been concerned in the extension of the Natal plant, which has revived the indigo industry, moribund under the competition of artificial or synthetic indigo. Recently a series of dying tests has been carried out which indicates a marked superiority of the natural over the

synthetic product. A large number of other investigations connected with seed raising, improvement in germination of Natal seed, cultivation, trials of varieties and other questions have been carried out.

The scientific department of the Indian Tea Association is under the charge of a special officer appointed by the Association and maintains an experiment station at Heleeaka in Assam. It receives subsidies from the Governments of India, Bengal and Eastern Bengal and Assam. During the period under review investigations have been carried on on the fermentation of tea, the causes which influence "quality," the characters of the tea soils of North Eastern India, several insect and fungus pests of tea (including the mosquito blight, red slug caterpillar, blister blight and red rust) and questions of manuring and cultivation. The value of the work of this department has received wide recognition from the tea industry.

Attached to the Eastern Bengal and Assam department is a special Fibre expert, whose work has been chiefly connected with jute. A survey has been made, as a result of an extensive tour, of the districts in India which appear to offer promise of success in jute cultivation. The extension of the area under jute is one of the first needs of the industry at present, as an increased demand has led to fraudulent watering on an extensive scale and the supply of inferior grades of fibre to the market. Experiments were carried out to determine the quantity of moisture naturally taken up by jute fibre under different conditions, in order to provide a basis for legislation should it be needed. Retting experiments were also carried out. Field experiments on the best season for sowing and thickness of planting are in progress and trials of a number of other fibres, possible substitutes for jute, have been made. Selection experiments with jute, designed to improve both the quality and yield of fibre, have been commenced and will form an important part of future work.

The consideration of the programmes of different departments, from which the above abstract has been made, occupied the first two sittings of the Board. The remaining three days

were devoted to the discussion of several matters of general interest to all the departments.

The chief of these was the improvement of the Indian sugar cane industry. The available statistics show that the consumption of sugar in India is increasing, while there is no corresponding growth in the area under cane in the country. It is everywhere recognized that, though India possesses canes, the quality of which is not surpassed in any country, still the yield of raw sugar per acre as a whole is lower than in any other sugar producing country. A scheme was prepared, after prolonged discussion, of the directions in which improvement can be attempted, and was adopted as a general guide to the departments of provinces in which the crop is of commercial importance. This scheme is contained in the published proceedings and need not be further referred to here.

Arising out of the grant of £10,000 made by the British Cotton Growing Association, the Government of India requested the advice of the Board regarding the best plan for assisting cultivators in disposing of small quantities of any new fine staple cotton introduced into cultivation. The Board recommended that the direct intervention of Government should be restricted to the earlier stages of any such introduction. In these early stages it may be advisable for Government to purchase the produce. Later on, when the area commences to expand, the assistance of private firms acting independently or as Government agents may usefully be sought. With still larger areas Government auctions, such as those held in Sind to dispose of the newly introduced Egyptian cotton, are recommended.

The question of legislation for the control of artificial fertilizers, brought before the Board of 1906, was again considered: the Board decided from the evidence collected in the meantime that the time is not ripe for the introduction of such legislation, though it is desirable to maintain a special watch over the developments which may occur in the future in this direction.

Sir Edward Buck gave addresses on two important questions which led to interesting discussions. The first of these was the utilization of river silts in India. The quantity and nature of

these silts is under investigation by the Imperial Department of Agriculture and by the Geological Survey. Their agricultural value was testified to by a number of members present, and the discussion elicited many facts of general interest in this connection. The Board agreed that it is a grave error not to utilize fertilizing silt wherever it may profitably be used, and recommended that silt investigations should be continued and extended, and that the co-operation of the Irrigation Department should be sought in the enquiry. The second matter brought up by Sir Edward Buck, was the employment of Agricultural Engineers in India. He instanced a number of important enquiries in which the services of trained engineers could profitably be utilized. The work which has already been done in such directions as well boring, lifting well water by power, checking erosion and carrying out minor irrigation work, though on a small scale, was appreciatively referred to by several members. As a result of these indications Major Atkinson, R.E., Principal of the Thomason College, Rurki, explained to the Board the technical qualifications required for such posts and the training necessary for the subordinate staffs. The Board recommended the question to the earnest consideration of local departments.

Of veterinary matters the chief considered was the provision of fodder in times of famine. A number of suggestions were made in this connection, and the Board recommended them for the consideration of the local departments.

The above summary of the matters considered at the Board of Agriculture of 1907, gives some indication of the work of the different departments and special officers. If it is remarkable rather for the amount of experimental and research work projected than as a record of improvements actually accomplished, this is partly accounted for by the fact that the Board occupies itself, as already said, more with the future than the past. It is also, however, in a large measure due to the recent birth of systematic agricultural enquiry in India, and it cannot, I think, be denied that the infant departments show remarkable signs of vigour and that their future careers are full of promise.

LOCUSTS IN INDIA.

H. M. LEFROY, M.A., F.E.S., F.Z.S.,

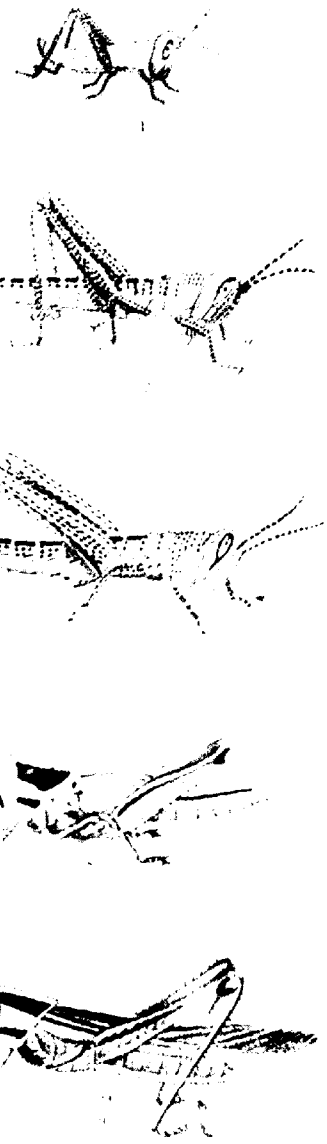
Imperial Entomologist, Pusa.

INDIA is the home of two locusts, which are periodically destructive to the crops and are familiar to agriculturists in the tracts through which they pass. These two species differ in habits and life-history and are checked by diverse methods. In order to facilitate their recognition, we reproduce coloured plates of these insects, and this short article is merely an amplification and explanation of the plates.

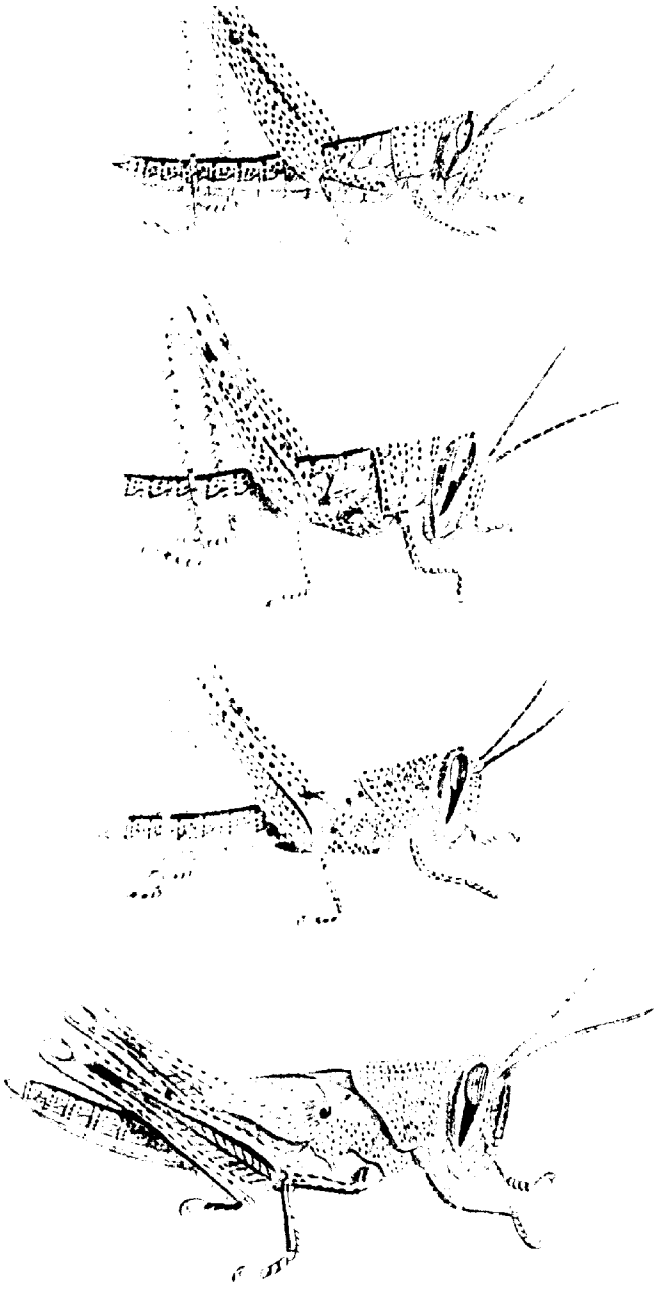
For many reasons it is important to be able to recognize a locust and make quite certain which one of the two kinds it is: knowing this, it is possible to predict what will happen, whether damage is to be anticipated, whether locusts are likely to lay eggs, and whether any precautions are possible. There are great gaps in our knowledge of locusts which we hope to fill if readers of the Journal will report every flight of locusts they see. For this, it is absolutely necessary to be able to identify the locusts with perfect certainty, and we hope that this will be possible by means of the plates.

A locust is a grasshopper which multiplies excessively, forms swarms and migrates, passing over long distances and settling here and there to feed. There are authentic records of only two insects in India which behave like this, but there is no reason why any of our common grasshoppers should not do so. If therefore the reader finds a swarm of locusts, the individuals of which do not agree with those represented here, we hope he will post specimens to Pusa with a short report. There have been reports of a green locust in Orissa, of curious locusts in Madras, of flights

PLATE XIV



THE BOMBAY LOCUST



THE BOMBAY LOCUST

of the Central Asian Locusts coming into India and so on, and it is desirable that these should be authenticated.

Plate XIX represents the North-West Locust.[1] This insect extends from Algeria through Northern Africa, into Cyprus, Arabia, Persia, through Baluchistan, into Sind, Kathiawar, Rajputana and the Punjab. From the last four areas it flies in vast swarms over Northern India, into the Western Himalayas, into the United Provinces, Behar, Bengal, and up the Assam Valley to the Eastern Himalayas. Calcutta is visited only occasionally, and is perhaps the Southern limit of its usual wanderings, although swarms have been recorded from the Godavari Delta), while Assam, which is also only occasionally visited, forms its eastern limit.

In the flying stage this locust occurs in two colours: when it first acquires wings it is pink with a purplish tinge (Plate XIX, Fig. 20); in this stage it flies actively and for great distances: later, when it is about to reproduce, it becomes yellow (Plate XIX, Fig. 21) and, since the females are burdened with eggs, it now flies more slowly and for shorter distances.

When a swarm of yellow locusts is seen, egg-laying may be expected, but, before this occurs, they will settle and mate. A characteristic of this locust is that it lays its eggs in sandy places in fairly dry loose soil: large numbers lay their eggs together in one spot, and one may find as much as a maund of eggs laid in a few suitable spots included in an area of a few acres. A single egg cluster contains about 100 eggs, and weighs about 11 grains: a seer of eggs totals about a lakh, and a maund about 40 lakhs.

Speaking generally, there are in India two broods of this insect yearly: eggs are laid, say, in February–March: they hatch in about six–seven weeks depending on temperature: the hoppers live for about six weeks and undergo six or seven moults: at the last moult the winged insect appears, and after some time flies away. It then lives for about three months, becoming yellow

[1] This is known to-day as *Locusta migratoria migratoria* (Linnaeus) (Systematic Entomology Ed.).

after about two months, as a rule: having mated and laid eggs, it dies.

The essential features of this locust are that it lives in all stages only six months, that its hoppers pack into swarms and move about, and that it is primarily a desert insect, an insect that lives and breeds in dry hot places and not in the moister parts of India where vegetation is abundant. In habits and colouring it is specially adapted to this life, and we might aptly term it the "desert locust" in distinction to the second Indian locust. The fact that the hoppers pack into swarms and move is sufficiently well marked to enable this locust to be immediately recognized in this stage: no one can mistake an army of these little dark coloured insects as they pour along the soil, and there need be no hesitation in identifying such a swarm as the North-West Locust. (Plate XVIII.)

The Bombay Locust* is so called as, in its capacity of a locust, it occurs chiefly on the Western Ghats and in neighbouring districts. Its last occurrence on a large scale was in 1903-04, and an account of its habits was published in 1906.† This locust is represented in Plates XVI, XVII. It will be seen that its colouring varies extremely, and this is the principal reason why it has been confused in the past. This locust is first seen in October, when swarms are found flying: at this time it has the colouring shown in Plate XVII. Normally the insect retains this colour until death. In almost any part of India that is sufficiently moist and wooded, it will be found singly, in small numbers, just like any ordinary grasshopper. In some years, as in 1903, it becomes abundant, assumes the instincts of a locust, gathers together in loose swarms and migrates: unfortunately we know little of this locust except from the 1903 outbreak: in that year these swarms concentrated on the Western Ghats, as they did in previous recorded outbreaks: the migration to the Ghats took place in November, and it was found that these locusts had

* At present known to Science as *Locusta succincta*, Linn., with some doubt. It is possibly undergoing revision at the present time.

† Memoirs of the Agricultural Department, Entomological Series, Vol. I, No. 1.

PLATE XVI

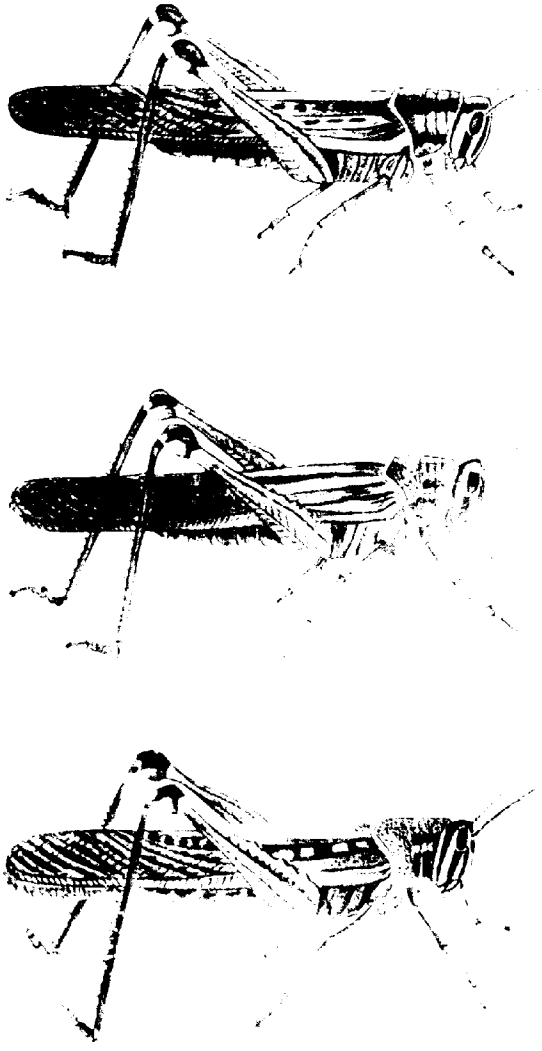
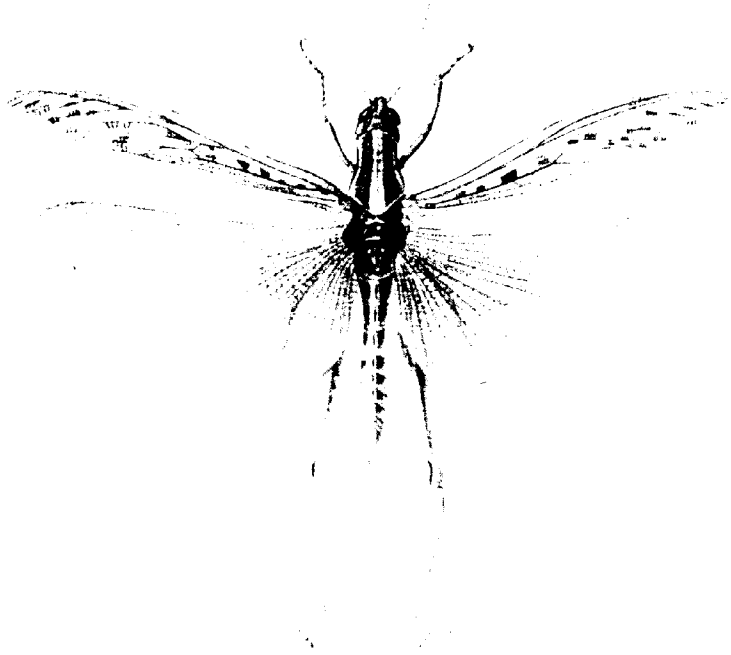


PLATE XVII



THE ROCKY MOUNTAIN LOCUST

become a vivid red, as shown in Plate XVI, Fig. 12 : we may call this the "Swarming Colour," and we surmise its object to be simply to facilitate swarming, the stragglers being able to see from a long distance and regain the swarm. From November to March, these locusts moved about the forests in great swarms, defoliating the trees : in March they commenced to move out, and they spread as far north as Ahmedabad and Udaipur, as far east as Nagpur, and south-east into Madras districts. The swarms then broke up, the locusts spread out singly and were widely distributed over a great area. In some the red colouring gave place to a "dry grass colour," the dull yellow brown of dry grass, but in the majority the red colouring remained more or less vividly until this second migration was over : in May the colouring of all changed to the dark colour shown in Plate XVI, Fig. 13, and when the rains came, egg-laying commenced. The colouring was then of extreme value, as the locust settling on the wet ground was very difficult to see. We call this the "wet ground colour" since it served the purpose of concealing the insect when settled on the wet soil. An egg-laying locust has many enemies, especially birds, and just as the North West Locust turns to the colour of sand, so this locust assumed the hues that best enabled it to remain unseen on the earth when laying eggs. Egg laying takes place after the first fall of rain in June : July, the eggs hatch in six to seven weeks to hoppers and the original locusts were by this time all dead. The hoppers were found to be green, did not pack into swarms, but remained singly in the long green grass just as ordinary grasshoppers do. In Plates XIV, XV we figure the hoppers in all stages. These figures were painted from specimens very carefully reared during the outbreak of 1903-04. Had not specimens been reared in cages and kept alive from stage to stage, it would have been impossible to tell which of all the hoppers caught were really of this locust. A great variety of insects were caught and sent in as being the hoppers of this insect. The senders could have avoided this confusion if coloured figures of the hoppers had been available at the time. These plates will enable

them to be immediately recognized when this locust occurs again. The hoppers moult as a rule seven times and then are winged, emerging in October.

The essential features of this locust are:

(1) It is normally a grasshopper, but when excessively abundant behaves as a locust.

(2) It breeds normally in forest areas, and most abundantly in the forests of Kanara and Goa.

(3) Its total life is one year.

(4) Hoppers do not pack into swarms.

(5) The eggs are not laid in one place by a number of locusts but, as a rule, are scattered, each locust laying in any spot it finds suitable.

(6) The locust changes colour twice.

(7) Eggs are always laid in wet soil, not in dry earth or sand.

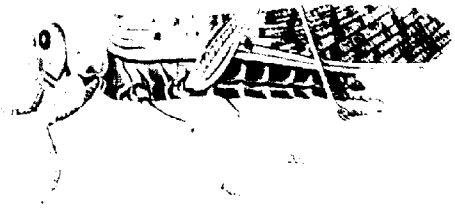
(8) Hoppers die in a dry atmosphere and can live only in very moist places.

The description given above shows how great is the distinction between these two insects and how important it is to be able to distinguish the habits and appearances of each. In the dry areas of Northern India, from Sind to the Punjab, in Kathiawar, and in Northern Rajputana, the North-West Locust alone occurs very commonly. The Bombay Locust may be found in forested areas, such as Kulu (and is doubtfully recorded as occurring there in vast swarms), but will not be found, as a rule, where the North-West Locust breeds.

From Ahmedabad southwards, through Gujarat, Central India, the Central Provinces and Berar, both locusts occur, and it is in these areas particularly that it is all-important to be able to distinguish which locust composes the swarm. There has been the greatest confusion in the past, and in 1903, when swarms of the Bombay Locust were flying south to the Ghats, swarms of the North-West Locust flew over from Kathiawar to Surat, crossing the path of the former, and passed on eastwards into India, giving rise to the belief that the locusts were moving east

THE NORTH WEST LOCUST.

PLATE XIX



THE NORTHWEST LOCUST

So far as the scanty records go, the locusts, south of a line drawn from Bombay to Calcutta, should be the Bombay Locust as a rule, but what the Locusts of Madras really are, does not seem to be certain. In Bengal and Assam, either locust might occur, but we believe that the Bombay Locust is not there known in swarms, but that the locusts are the North-West Locusts *which do not breed in so moist a climate*.

A great deal has been written about these two locusts, and we have indicated the salient points in the lives of each : but there are some points on which we are still ignorant. This is particularly the case with regard to the movements of these swarms of locusts, and unless far more full and accurate records can be obtained, we shall not be able to trace individual swarms across India. The peculiar migrations of the North-West Locust are still largely shrouded in mystery : when these locusts penetrate into the moist areas of Lower Bengal and Assam, what do they do ? Do they seek a hot dry area in which to lay eggs ? Do they turn back towards North West India, or do they push on in the vain hope of finding sandy deserts ? These and other questions remain unanswered to this day and much remains to be learnt.

The North West Locust is also the locust of other countries but, so far as we know, the Bombay Locust is not known to occur in swarms elsewhere than in India. The Central Asian Locust occurs in India, but we believe never in swarms. One of our commonest insects is the Black spotted Grasshopper, figured in Plate XX ; in 1903-04 this was constantly sent in as a locust ; there is no *definite authentic* case of this insect having been found in a swarm ; it has been found attached to swarms of the Bombay Locust, but no swarm composed of this grasshopper has been recorded. We figure it here because it is the insect most likely to be taken for a locust : it is the nearest in structure and appearance to the Bombay Locust of all our common grasshoppers, but it *never changes colour*, is common throughout the cultivated parts of India and normally feeds on cotton leaves.

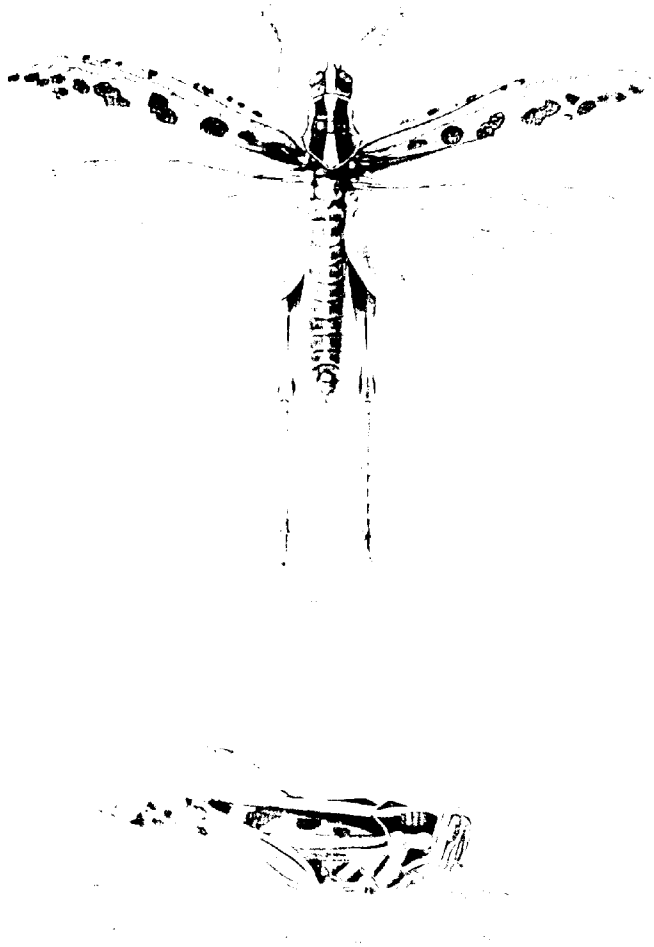
In all cases of a doubtful locust, compare the specimen with this plate: open the wings and note if the large delicate lower wing is yellow.

Unfortunately there is no single structural feature that separates a locust from a grasshopper, and the reader will find large insects that look like locusts, but do not agree in appearance with the insects portrayed here. Unless they are in swarms, they are not locusts: if they are in swarms, care is required to make sure that one gets the real insect composing the swarm. It is a surprising fact that grasshoppers often attach themselves to the fringe of a locust swarm, and it is very easy to assume that one of these insects, which one finds after a swarm has passed or which settles near a swarm, is the real article, when it is only a chance straggler or a hanger on.

We do not propose to say anything about remedies. To deal with locusts is not a matter for an individual, but a question of co-operation and effort on a large scale. The North West Locust is dealt with successfully by simple means in Northern India, and an account of the measures adopted against the Bombay Locust is on record.

We trust that any reader of the Journal who sees a swarm of locusts and finds that it is the Bombay Locust will help by reporting it *wherever he may be*: that anyone finding a swarm of the North-West Locust anywhere *outside the drier areas of the Punjab, Sind, Rajputana and Kathiawar* will report the fact and state the colour of the locust: and that anyone so lucky as to find a swarm of locusts not agreeing with those figured here will send as many as possible with full details: and finally, should anyone be so fortunate as only to *see* in a swarm of locusts that are green or any other colour than yellow, red or pink, he will render valuable assistance by reporting the matter by wire specifying the exact locality

PLATE XX



THE BLACK-SPOTTED GRASSHOPPER

STEAM THRASHING IN INDIA.

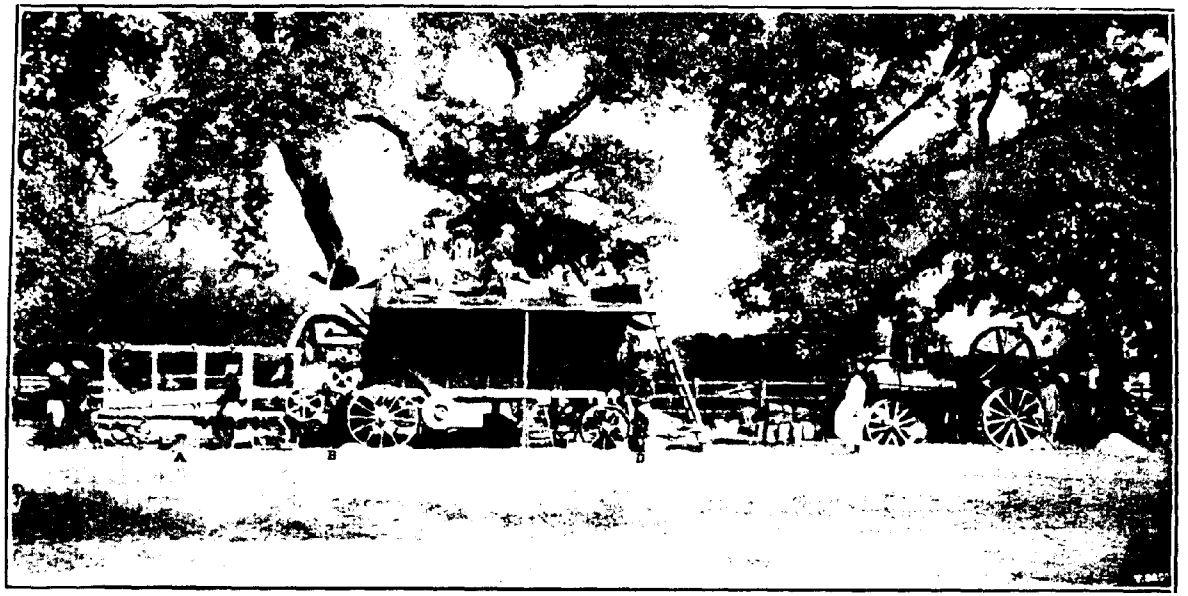
By E. SHEARER, M.A., B.SC.,

Imperial Agriculturist, Agricultural Research Institute, Pusa.

STEAM thrashers are not unknown in India, but hitherto their use has practically been confined to planters in Behar. At one time planters, whose factories lay along the banks of the Ganges, grew every cold weather stretches of wheat, sometimes several miles in extent, on the low lands flooded by the river and fertilized by deposits of river silt. Large areas of oats were also grown to satisfy the demand of the Commissariat Department and owners of horses generally. For thrashing such crops, grown on a large scale, steam thrashers were in very general use. The areas under wheat and oats, especially the former, have from various causes declined in recent years and thrashers are perhaps not now seen so often as formerly, but the fact that they have been used to so considerable an extent, in a district where labour is cheap and comparatively plentiful, would seem to indicate that there may be an opening for them in India in districts where large areas of cold weather grain crops are grown.

At Pusa there are usually about two hundred acres under cold weather cereals,—mostly oats grown to supply straw and grain to the work bullocks and the breeding herds which together aggregate about two hundred head of cattle. It was found impossible, in the short season available for thrashing, to deal with such a large quantity of crop by the ordinary country method of treading out by bullocks or by hand thrashing, and two years ago a large thrasher was purchased. As it was considered that some information about the working of this machine might

PLATE XXI.



A. J. I.

STEAM THRASHER AT WORK.

A. Sitting Reader with power at work. B. Running and chaffing apparatus. C. Self Feeder.
D. Cleaned grain delivered.

be of general interest, trials were arranged this year to test it against the country method of treading out by cattle.

The thrasher, which was supplied by Messrs. Marshall, Sons & Co., Ld., Gainsborough, has been specially designed for use in India. (Plate XXI.) It is built of seasoned teak and is mounted on large travelling wheels which enable it to be readily moved from place to place. With a thrashing drum three feet wide it requires a portable engine of five nominal horse power to drive it, but at Pusa an old eight-horse-power engine used for pumping is employed. The characteristic feature of the thrasher is a double roller straw chopping and bruising apparatus by which the straw, after leaving the thrashing drum, is converted into *bhusa*. In connection with this apparatus there is a separate attachment (supplied or not as desired) fixed in front of the machine which consists of a large sifting riddle, with a blower working underneath, designed to intercept any grain which may have passed over with the straw. The thrasher is fitted with a self-feeding arrangement consisting of endless canvas conveyors by which the corn is carried to a revolving barrel fitted with spikes which, with the assistance of oscillating forks fixed overhead, feeds it evenly into the thrashing drum. The grain is delivered into sacks cleaned and graded into three qualities, or all of one quality, as desired. Special drums can be supplied for thrashing other crops, such as paddy or rapeseed. The cost of the thrasher, landed at Calcutta, with the improvements above described, was about Rs. 4,500.

The crop used for the trials was oats, neither wheat nor barley being available in sufficient quantity. Unfortunately, the weather this season was far from favourable for thrashing. April in Behar is usually a hot rainless month with dry west winds prevailing and the humidity very low. Under these conditions, the grain is readily separated from the dry brittle straw and the latter under treading soon breaks up into *bhusa*. With a moist east wind, the grain is not readily separated and the straw becomes tough and breaks up with difficulty. Usually thrashing is postponed until the west winds have well set in. This year the

west winds were late in arriving and when they did come did not blow steadily but constantly alternated with moist east winds. The results of the trials, therefore, are not good for either of the methods tested, but they possess a certain comparative value. The trials extended over seven days. It was hoped to keep separate records for east and west winds, but in practice this was found to be impossible on account of the frequent changes.

The treading out by bullocks was done in the ordinary way and need not be described. (Plate XXII.) The total quantity of grain trodden out by three pairs of bullocks in seven days was thirty-seven and a half maunds. Taking the cost of bullocks at six annas per pair and the two men working in attendance at two and a half annas each this works out to an average cost of about four and a half annas per maund of grain. To this one anna per maund has to be added for winnowing, making the total cost five and a half annas per maund. This is rather a heavy charge for winnowing, but the wind was fitful and uncertain.

The unfavourable weather was more disadvantageous to the thrasher than to the country method of thrashing. With moist weather jamming was frequent, not in the thrashing drum but in the bruising rollers described above, and whenever this took place, the engine had to be stopped and the obstructing material removed, involving considerable loss of time. But changes of wind were more fruitful of trouble than even a steady east wind chiefly on account of their action on the leather belts by which the various parts of the thrasher are driven. With a dry wind these get slack, with a moist wind tight, involving in either case considerable loss of power and loss of time in making the necessary adjustments. Further, the alternate expansion and contraction imposed a heavy strain on the belts as a result of which they frequently broke. It might be worth while for makers of thrashers for India to consider whether it would not be possible to obviate this source of trouble by providing some substitute for belting such as endless chains of the bicycle pattern. The greater initial cost would, no doubt, be the chief obstacle. On the other hand, it must be remembered that if one belt out of the dozen

A. J. L.

TREADING OUT THE CORN.

or so used breaks, the thrasher must stop work until this is repaired or replaced. Breakages of other parts of the thrasher were few and insignificant, and were usually caused by some foreign substance entering along with the corn.

In the trials the normal working day for the thrasher may be taken as eight hours, but on account of stoppages for the reasons detailed above, it was actually reduced to an average of six and a quarter hours over the seven days. The total amount of cleaned grain delivered in this time was one thousand and ninety-seven maunds, giving an average of one hundred and fifty-seven maunds per day or twenty-five maunds per actual working hour. This is a very fair outturn, but low when compared with that of thirty-four maunds obtained in a measured hour when a good west wind was blowing. Coal and wood were used as fuel on different days. The consumption of the former averaged twelve maunds, of the latter twenty-four maunds per day. With coal selling at seven annas per maund and wood at twelve rupees per hundred maunds, this shows a distinct advantage in favour of the latter, but the difference is hardly appreciable on the total cost of working the thrasher, and with wood as fuel the risk of fire is considerably greater. The following abstract shows an average daily cost :—

	Rs.	A.	P.
1 Mistri @ Re. 1	1	0	0
1 Fireman @ Re. 0-3	0	3	0
1 Oilman @ Re. 0-3	0	3	0
6 Men drawing and carrying water for boiler @ Re. 0-2-6	0	15	0
6 Men forking and feeding @ Re. 0-3	1	2	0
2 Men keeping thrasher clear of chaff @ Re. 0-2-6 ...	0	5	0
2 Men removing covering, &c. @ Re. 0-2-6	0	5	0
2 Men attending grain bags @ Re. 0-2-6	0	5	0
12 Maunds coal @ Re. 0-7	5	4	0
3 seers lubricating oil @ Re. 0-5	0	15	0
Depreciation and repairs of thrasher @ 10 % on Rs. 4,500, 60 days per annum being taken as working period ...	7	8	0
Depreciation and repairs of Engine @ 5 % on Rs. 4,000, 100 days per annum being taken as working period (as it is also used for other work)	2	0	0
Belting @ Rs. 100 for season of 60 days	1	10	8
Interest on capital (Rs. 8,500) @ 10 % ...	14	2	8
TOTAL Rs.	35	14	4

This for one hundred and fifty-seven maunds gives an average cost of three annas eight pies per maund, or if the item for interest be omitted, two annas two pies per maund.

The straw bruising apparatus worked quite satisfactorily, producing *bhusa* in every way equal to that given by treading. Except for jamming in moist weather it gave no trouble and this was remedied by lighter feeding. The sifting riddle working in connection with this recovered quite an appreciable quantity of grain, especially in moist weather when thrashing is imperfect, and quite repays its cost. The self-feeder worked admirably and largely gets over the very great difficulty of training coolies to feed evenly and uniformly. It is probable that it increases the daily outturn by at least twenty-five per cent. The grain delivered was a nice clean sample, quite free from the dirt found in that removed from the thrashing floor.

One point in regard to the working of thrashers in hot dry weather requires special notice, and that is the considerable risk of fire. This may arise, either from overheated bearings or from a spark from the engine or even a hookah falling on to the dry straw. In several instances in Behar thrashers have been completely burned down in this way, and some planters for this reason will only have machines built on an iron framework. The risk of fire, however, is not very great if reasonable precautions are taken. At Pusa the practice is to stop the engine at the end of every hour and examine and oil all the bearings. The engine is set up in such a way that no sparks will blow towards the thrasher or the straw, smoking in the neighbourhood is strictly prohibited, and as a final precaution, a score or so of earthen pots or empty kerosine tins are always kept alongside filled with water.

Looking at the results described above, it is reasonable to consider that, in certain portions of India, such as the Punjab and the Central Provinces where large areas of wheat are grown, there may be a future for the steam thrasher. Its great initial cost would no doubt make it prohibitive on all but very large single holdings, but were it worked by a business firm on the peripatetic system familiar in many parts of England, there seems

to be no reason why it should not become popular and successful. It is rather an elaborate machine but a good native *mistri* will readily master its working and management. That at Pusa was imported in sections and completely set up by the *mistri* on the farm establishment, with no other assistance than that derived from an illustrated catalogue, and it has since been under his entire control. All the parts are standardized and numbered and easily obtained from the manufacturing firm, and with a small stock in hand of such spare parts as are likely to most frequently give way, no serious breakdown need be feared.

At Pusa the thrasher is employed for thrashing not only oats but also wheat, barley, paddy and *arhar* (*Cajanus indicus*). Next year it is intended to conduct similar trials with some or all of the latter crops.

THE MONTGOMERY AND SIND BREEDS OF CATTLE.

By J. MOLLISON, M.B.E.A.C.,

Inspector General of Agriculture in India,

AND

L. FRENCH, I.C.S.,

Offg. Director of Agriculture, Punjab.

THE Montgomery cows of the Punjab are superior as milk producers to those of any other Indian breed. The only others that rival them in milk production are *Hansi* cows and those bred in Lower Sind. The latter have many characteristics in common with Montgomery cattle. Both breeds are probably of common origin. Brief descriptions of each are given in this article.

The Montgomery cattle are locally known as the *Sahiwal* or *Teli* breed. The district has a very light rainfall with large upland stretches of waste land sparsely covered with poor scrub and grass. It is surprising that a superior breed of milk cattle should have been produced under these circumstances.

The best Montgomery cattle are bred in the tract known as the "Ganji Bar," which lies chiefly in the Dipalpur, Gugera and Montgomery Tahsils of the Montgomery district. The derivation of the word "Bar" is unknown, but its meaning is well understood in the Western Punjab. It signifies an upland tract or high plateau lying between two rivers and fringed on either side by riverain. "Ganji" means bald, and is appropriately applied to the tract on account of the general absence of

PLATE XXIII.

A 1 1

PUSA HERD OF MONTGOMERY CATTLE.

PLATE XXIV.

MONTGOMERY BULL. AMRITSAR.

SIRSA BULL, PUSA HERD.

vegetation. This characteristic impresses itself on those travelling by rail from Lahore to Multan, for the main line to Karachi traverses the heart of the "Ganji Bar."

Montgomery shares with Hissar (whence the *Hansi* breed comes) the reputation of being the most arid district of the Punjab. The "Bar" is comprised almost entirely of waste lands which are the property of the Crown. There are four distinct tracts of the "Bar" in the Montgomery district, and the highest of these is the "Ganji Bar." As might be expected, this is also the driest tract. Vegetation is scanty and where it exists of a stunted kind, considerable areas are thoroughly impregnated with alkaline salts.

The annual rainfall of the "Ganji Bar" is 10" or less. The depth to subsoil water is 60' or more. Well water is occasionally good, but just as frequently is brackish. The shade temperature varies from a maximum of 120° F. in May to a minimum of about 30° F. in December.

In seasons of favourable rainfall grass grows in fair abundance, except on the *usar* patches which grow nothing. On the best land there are stunted trees consisting chiefly of *Van* (Salvadora oleoides), *Jand* (Prosopis spicigera), *Karáli* (Capparis aphylla) and *Farash* (Tamarix orientalis). The best and most common grasses are *Chhimbar* (Elousine flagellifera), *Khabbal* or *Dáb* (Cynodon Dactylon), *Dhaman* (Pennisetum cenchroides) and *Pahrahan* (Andropogon annulatus).

In circumstances such as those above described, agricultural life has been less profitable than pastoral, and the Mohammedan denizens of these arid upland tracts have hitherto made a living entirely from their herds of *Sahiwal* cattle and occasional flocks of sheep and goats. They have led a purely nomadic life. It is significant that the best professional breeders of cattle in all parts of India lead wandering lives and rarely settle to the hard routine work of arable cultivation.

In the high tract between the Ravi and the Sutlej there are a few cattle camping grounds more or less permanent in character. These usually consist of a circle of sheds placed

conveniently near a deep and narrow well from which with great labour drinking water is obtained. The herds of cattle graze in the vicinity from the commencement of the rains until the end of February. The grazing then usually becomes insufficient and the pasturage on the banks of the rivers has to be utilized. But occasionally the cattle are able to remain in the "Bar" until the next rainy season approaches. The natural grazing is supplemented by *bhoosa*, which is now easily obtainable, on account of extended canal irrigation. Formerly in seasons of exceptional drought the nomad cattle owners had to take their herds great distances to obtain sufficient grazing. The grasses of the "Ganji Bar" are said locally to be "taqatwala" *i.e.*, "strength giving" and are considered far superior to the grasses which grow on riverain lands.

Montgomery cows being good milkers have been sent freely to many parts of India and have been even exported from India. A vast extension of canal irrigation has taken place in the neighbouring districts across the Ravi river, and many good cows have been taken or sold by their owners into the new Chenab Canal Colony. A steady and rising demand for them is also maintained by the professional milk dealers of Lahore, Multan and Amritsar, and in consequence a scarcity in supply is already being experienced. A herd is maintained at Pusa to test the milking quality of this breed and to supply the European and Native establishments with milk. (Plate XXIII.)

These cattle are apparently easily acclimatized to conditions which differ greatly from those of the Montgomery district. At Pusa, the young male stock are readily saleable and have been found active and generally useful for ordinary agricultural work in Behar, though in the Punjab they have no great reputation as plough cattle.

Representative specimens of the Pusa herd are illustrated in this article, and measurements are given for each animal represented. (Plates XXIV—XXVI.)

Montgomery cattle are small, shapely and short-legged with fine clean cut heads, fairly short horns, small alert ears

PLATE XXV.

MONTGOMERY COW, (SOORMI.)

No. 21, PUSA HERD.

[illegible]

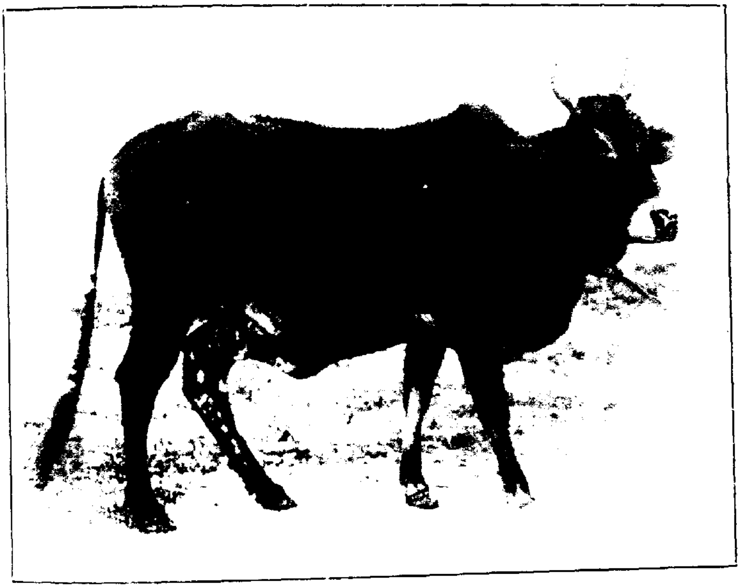
Measurements.

[illegible]	Height behind hump.	Girth.	Length from [illegible]	Length of [illegible]	Width of [illegible]	Length of [illegible]	Length of horn [illegible]	Circumference of horn at base.	Width of forehead. (Greatest, measuring from the base of each horn.)	Length of face from poll to muzzle.	Length of canon.	Girth of canon.	Height at croup.
[illegible]	3—10½"	5—4½"	3 7	1 4½	1 4½	10¼	9	7	8	1—7½	7½"	6½	4—1½"

PLATE XXVI.

MONTGOMERY COW, K[illegible]

N[illegible] P[illegible] H[illegible]



thin necks, fine leg bones, small feet and exceptionally long thin tails. The back is generally highest at the croup. The skin is thin and the coat fine. The colours vary, but most are dark red, pure white or grey. Spotted cattle are, however, fairly common. Average cows giving 16 lbs. of milk daily, are worth 50 or 60 rupees each. A first class cow is worth Rs. 100 or more. The very best cows yield about 30 lbs. of milk per day when in full profit. The udder is large, well shaped, with fairly large regularly placed teats. Prior to the extension of the Chenab Canal, through the neighbouring "Sandal Bar," good cows were locally worth only Rs. 30 or Rs. 35 each.

The breeding of Montgomery cattle is likely to suffer unless special precautions are taken to maintain the purity of the breed, because the extraordinary prosperity of the Chenab Colony across the Ravi, has diverted the attention of the Nomadic "Bar" tribes to the profits derivable from agriculture when assisted by canal irrigation. It is also to be remembered that the whole of the "Bar" tracts of the Montgomery district are destined within the next few years to receive irrigation from the projected Lower Bari-Doab Canal. Formerly selection was carefully practised in breeding. Only the best bulls were kept. Rivalry amongst owners forbade their parting with their best stock except to blood relations. The superiority of the breed is largely due to these causes.

Sind Cattle. There is similarity in type between Montgomery cattle and those bred in Lower Sind. The latter are found between Hyderabad and Karachi. The owners are nearly all Mohammedans and do not usually cultivate land. They move their cattle from one jungle pasture to another as occasion requires. Hay in quantity is stored by most cattle owners. When in milk, the cows get in addition to grass or hay, concentrated food consisting of cotton seed, oilcake, bran or pulse meal. The owners are particular in selecting their bulls.

Sind cattle show considerable variety in type and colour. Many good Sindi cattle are spotted in colour. The majority are red, a deep rich red with occasional white markings, a white mark

on the face, white ankles or a white udder being very common. These cattle are of medium size. The frame is long, deep, massive and is supported on short well-set legs. The shank is round and coarse and the feet large and soft. The long level quarters, deep muscular thighs, wide loins and large paunch are characteristics usually found in good milk cattle. The heavy head, thick short neck and ponderous dewlap are, however, points not usually found in superior milk cattle. The horns are generally coarse, rather long and blunt-pointed. The ears are fairly long and somewhat pendulous. The eyes have a sleepy placid appearance indicating the docile temperament for which the breed is noted.

Good cows in Sind are worth about Rs. 60 each. The best cows give about 20 lbs. of milk per day. A pair of good strong work bullocks can be bought at Rs. 60 to 80. They are usually too slow for light quick road work and not big enough for heavy slow cartage.

The two illustrations with measurements represent typical specimens of a bull and cow. (Plates XXVII XXVIII.)

PLATE XXVII.

SIND BULL.

KENNEY FARM HERD.

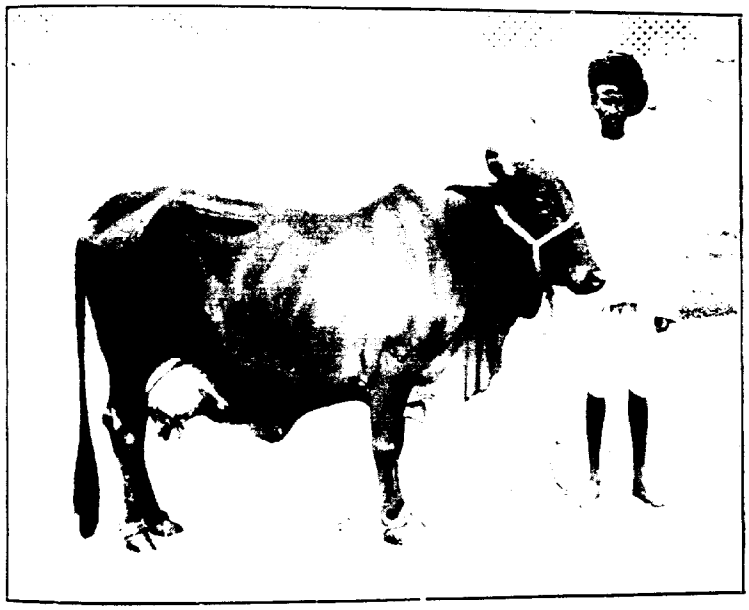
A. A. J.

Measurements.

1–2	Height, vertical from ...
5	Girth, ...
8	Length, ...
9	...
1–4	...
1	...
3	...
11	...
10	...
1–7	Length of face from ...
6	Length of tail, ...
7	Girth of tail, ...

PLATE XXVIII.

SIND COW.



PROPOSED GRASS-LAND EXPERIMENTS IN INDIA.

By J. MOLLISON, M.R.A.C.,

Inspector-General of Agriculture in India.

MANURIAL and other experiments on grass-lands in England have yielded valuable and very definite results. Such experiments are worth trying in India, where good pasture lands exist, or where they can be established.

The military dairy farm grass-lands in various Indian cantonments have been greatly improved by the trenching of night-soil and city-refuse in a systematic and entirely sanitary manner, and by the establishment on the improved land of good varieties of indigenous grasses.

There can be no question that we have in India very superior and very inferior grasses in the pastures of every district of moderate or light rainfall. Professor Middleton, who is now the Practical Adviser to the Board of Agriculture in England, identified in Gujarat, whilst employed in the Baroda State, over a hundred varieties of grasses. This work of identification and the work of estimating the feeding value of numerous grasses has not yet been seriously undertaken in India. The work is important, and will claim early attention. We know, however, that many of the grasses which commonly grow are inferior in value, and that leguminous herbage, which has generally high feeding value, is extremely sparse.

The quality and character of herbage on any class of soil depends greatly on natural conditions. In fighting the last famine in Gujarat and in trying to keep a few of the far-famed Gujarati cattle alive, I came very definitely to the conclusion that the rank grass which grew in districts of ordinarily heavy

rainfall was poor in nutritious stuff when cut in the ordinary way when dead ripe. On the other hand, I found that the grass obtained from districts of moderate rainfall had very considerable feeding value even when overripe.

It is probable that the natural climatic conditions in the plains of India may preclude the possibility of improving natural pastures, as the soil and climate determine largely the character of natural and cultivated vegetation. I found in Kashmir, lucerne and every ordinary kind of clover growing wild, but it would be difficult, if not impossible, to establish such vegetation in the plains of India.

In attempting to improve the better descriptions of our grass-lands, the first steps should be (*a*) to improve the character of the soil, if possible, as in military cantonments: (*b*) to introduce by sowing such indigenous grasses as have superior feeding value and are of vigorous habit of growth: (*c*) to stimulate by sowing seed and otherwise the growth and spread of useful indigenous leguminous herbage: (*d*) to test on improved land the effects of various manures on the quality and outturn of produce.

In England, at various Experimental Stations, it has been definitely proved that the quality and character of natural pasture can be fundamentally changed by the application of particular manures.

Basic slag and other cheap phosphatic manures have given astounding results on poor clay land pastures in England. The price of these and other artificial manures in India is, at present, so high and the need for economy in agriculture is so great, that it is uncertain whether such costly artificial manures should be tested. The production of such manures in this country may be anticipated as the agricultural and trade resources are developed. I, therefore, advocate the experimental use on a small scale of such manures.

India is extremely rich in oilcakes. It has been proved that castor cake and non-edible cakes got from natural forest products, such as the seeds of *Karanj* (Pongamia glabra) and *Neem* (Melia Azadirachta) are very valuable manures. These non-edible

oilcakes have really less manurial value than such edible cakes as groundnut, rape seed, niger seed, safflower, etc. At the present stage of agricultural advancement in India, such edible cakes can be economically used as manure, because when fed to cattle the dung is largely used as fuel and the urine largely runs to waste. Very little, therefore, of manurial value is returned to the land.

Edible as well as non-edible cakes should, therefore, be used in experiments. For these purposes, selections should be made from the kinds of cake which are locally the cheapest.

Oilcakes produced in the country *ghani* act very quickly, whereas those produced in hydraulic press mills from seed treated by superheated steam act very slowly. This superiority is due to the fact that the nitrogenous portion of the seed becomes coagulated by heat and therefore can only be utilized in the soils slowly for plant nutrition.

At Pusa we keep a breeding herd of cattle and a flock of sheep, and it is important to determine whether our pasture lands can be improved by the means indicated above. Mr. E. Shearer, Imperial Agriculturist, Pusa, has framed a scheme of manurial and other experiments which will be carried out at Pusa.

The manurial scheme is tabulated below :—

Manurial Scheme for Pasture Experiments.

No.	Plots :	Remarks.
1	No manure.	To be applied once : thereafter at the end of 3 years or other date to be subsequently fixed to be followed by 10 tons farm yard manure repeated every fifth year.
2	Superphosphate 150 lbs. Phosphoric acid per acre.	
3	Basic slag 150 lbs. Phosphoric acid per acre.	
5	Superphosphate 100 lbs. Phosphoric acid per acre. Superphosphate 100 lbs. Phosphoric acid Kanit 50 lbs. Potash. } per acre.	
6	Rape cake 1 ton per acre.	To be applied every fifth year.
7	Castor cake 1 ton per acre.	
8	Ammonium Sulphate 50 lbs. Nitrogen per acre.	To be applied every year.
9	Nitrate of Soda 50 lbs. Nitrogen per acre.	
10	Superphosphate 33⅓ lbs. Phosphoric acid per acre.	
11	Superphosphate 33⅓ lbs. Phosphoric acid per acre. Kanit 25 lbs. of Potash per acre.	
12	Superphosphate 33⅓ lbs. of Phosphoric acid per acre. Ammonium Sulphate 50 lbs. of Nitrogen per acre.	
13	Superphosphate 33⅓ lbs. Phosphoric acid per acre. Ammonium Sulphate 50 lbs. Nitrogen per acre. Kanit 25 lbs. Potash per acre.	
14	Farm Yard manure 3 tons per acre.	

The extent of *even* land available in the pasture land at Pusa is limited and the proposed experimental plots are, therefore, smaller than is desirable. The area in one block will be divided into fourteen plots each of 1 acre. One-fourth of each plot will be fenced off and cut annually as hay, the remaining three-fourths will be grazed by cattle and simply kept under observation.

I should like to see this scheme of experiments arranged for in other parts of India, particularly on Government Cattle Breeding and Dairy Farms. It should be modified to suit local conditions, etc. If possible, the plots should be larger than those at Pusa.

As bearing on the improvement of pasture by actually sowing seed, Mr. Shearer says: "The Indian leguminous plants in pastures are not nearly so numerous nor so valuable for their soil improving and feeding qualities as those found in England, but fortunately they are not altogether absent. In Behar one legume in particular which would seem to correspond very closely with trefoil or yellow clover (Medicago lupulina) is found where there are no rough jungle grasses like *Rarí* (Saccharum spontaneum) and *Dabbi* (Imperata arundinacea). Yellow and white melilot are also found as weeds in the cultivated fields in the cold weather, and there are other leguminous weeds which may or may not be valuable in pasture land. There are found growing naturally at Pusa at least four good grasses. *Dubb* (Cynodon Dactylon), *Apang* (Andropogon annulatus), *Sáie* (Paspalum Royleanum) and *Jobh* (Ophiurus sp.).

CATTLE MANURE.

By D. CLOUSTON, M.A., B.Sc.,

Deputy Director of Agriculture, Central Provinces.

It is a recognized principle in manuring that the composition of the manure should be regulated by (1) the deficiencies of the soil, and (2) the particular requirements of the crop. The poverty of a soil is nearly always due to a lack of one or more of the three most essential plant foods, nitrogen, phosphoric acid and potash. Black cotton soil is especially deficient in nitrogen.

One of the more important problems investigated at the Nagpur Experimental Farm in the Central Provinces deals with the most profitable nitrogenous manure for a cereal crop on black cotton soil. Such manures may be roughly divided into two classes :—(1) bulky manures, such as cattle-dung ; and (2) artificial manures, such as saltpetre. These two are taken as examples, because they are locally obtainable and are representatives, the first of slow-acting manures, the second of quick-acting chemical manures.

In western countries farm yard manure is considered the chief available manure. This indispensable and time-honoured product of the farm was never valued in Europe and America more highly than at the present day. Artificial fertilizers have come more and more into use as cultivation has become more intensive, but the farmers of the West use them only to supple-

ment, not to replace natural manure. In cattle manure, intelligent farmers in any country should recognize a cheap product of the farm that is always available in arable cultivation, which will produce good crops, gradually enrich the soil and improve its physical texture.

In the Central Provinces and Berar, much of the cattle-dung is only used as fuel. In some districts even that part of it which, in the rainy season, cannot be dried for fuel, is thrown out as so much rubbish, or sold at a mere nominal figure to the more enterprising cultivators. The price in Raipur is two to four annas per cart-load: in other districts it seldom exceeds four annas. The wastage of manure in India has generally been discussed by Scientific Agriculturists in a compromising spirit. Excuses for the cultivator were freely offered. One apologist expressed the opinion that the ashes of the dung and the supposed large amount of nitrogen obtained in the rainfall as nitric acid together make up for the loss that the dung suffers in burning. Another writer recognized the great difficulty experienced by the cultivators in obtaining other fuel, and suggested that the black cotton soil of the Central Provinces is productive enough without manure. Such theories are only true in part. Careful investigation and fuller knowledge of local conditions have shown that there is error in both. It has long since been proved that in the process of burning, over 97 per cent. of the nitrogen of cattle-dung is dissipated, and that the manurial value of the ash is much less than that of the dung from which it was derived. It has been proved too, that the rain of tropical countries in general does not supply the soil with a greater amount of nitrogen than the rain of temperate climates, the average total for tropical countries being only 3·54 lbs. per acre annually. It is fairly certain that the fertility of the black soils in the Central Provinces will continue to decline, unless cattle-dung is more generously used as manure. Other sources of fuel supply would be better exploited, if the valuable properties of well-made cattle manure were fully recognized. The results per acre obtained at the Nagpur Farm by the use of saltpetre, cattle-dung and the ashes of cattle-dung

as manures for irrigated and dry wheat respectively are given below :—

Irrigated Series.

Manure Applied.	Average in lbs. of Grain.				Average increase due to Manure.		Water rate and cost of Manure.	Profit (+), Loss (−).
	5 Years 1899–94.	5 Years 1895–00.	5 Years 1901–06.	15 Years 1892–06.	Lbs. of grain.	Value of Increase.		
						Rs. a. p.	Rs. a. p.	Rs. a. p.
Saltpetre 240 lbs. ...	931	826	1,278	1,012	517	19 14 0	18 10 0	+ 1 4 0
Cattle-dung 160 mds. ...	717	915	1,500	1,044	549	21 2 0	8 0 0	+ 13 2 0
Ashes of 160 mds. of cattle dung ...	584	618	820	677	182	7 0 0	8 0 0	− 1 0 0
No manure ...	486	371	627	495	...	...	2 0 0	...

Unirrigated Series.

Manure Applied.	Average in lbs. of Grain.					Average increase due to Manure.		Cost of Manure.	Profit (+), Loss (−).
	5 Years 1892–96.	5 Years 1896–01.	5 Years 1901–06.	5 Years 1892–06.	Lbs. of grain.	Value of the increase.			
						Rs. a. p.		Rs. a. p.	Rs. a. p.
Saltpetre 240 lbs. ...	1,133	751	514	817	803	323	12 7 0	16 10 0	− 4 3 0
Cattle-dung 160 mds. ...	913	627	365	1,012	729	249	9 9 0	6 0 0	+ 3 9 0
Ashes of 160 mds. of cattle-dung ...	949	576	359	724	652	172	6 9 0	6 0 0	+ 0 9 0
No manure ...	790	418	197	507	480	...		...	...

The first statement shows that cattle-dung for irrigated wheat is more profitable than saltpetre and has greater residual effect. The manurial value of the ashes of cattle-dung is shown to be considerable in comparison with no manure. The ashes appear to be almost exactly equal in value to $\frac{1}{3}$rd the dung from which they were derived. Two-thirds of the value of cattle-dung are therefore lost when it is used as fuel. This means a loss of Rs. 14 per 160 maunds. It is very questionable whether the fuel cakes made from this quantity of dung would be worth this sum. In the second statement the dry crop results are irregular. The explanation is that without irrigation the effect of season is often greater in determining rabi outturn than the effect of manure. Without

water bulky and slow-acting manures lose, to a great extent, their effectiveness: for though the plant food is there, it cannot be taken up by the crop save in a state of solution in water. The bulky manure when applied to dry land may even do harm by attracting white-ants which cause much damage in the Central Provinces. In seasons of favourable rainfall, the superiority of cattle manure over saltpetre for dry crop wheat has been amply proved on the Nagpur Farm. Percentage increases of wheat from comparative irrigated plots in dry and wet seasons are shown below. The plots were irrigated twice each year and manured as shown in the statement :—

Manure per acre.	Percentage increase.	
	For seven dry years.	For eight wet years.
Saltpetre 240 lbs.	114 ×	97 ×
Cattle-dung 160 maunds ...	126	95
Unmanured ...		

If full advantage is to be taken of cattle-dung as a manure for unirrigated land, it should always be applied to *kharif* crops. Where *kharif* crops are the only ones grown, or where they are included in the rotation in vogue, this can be done. The rotations practised in the Central Provinces and Berar nearly always include a *kharif* crop, so that there would be no difficulty in applying the manure at the beginning of the rains. By the combined effect of the rains and tillage operations the manure is thoroughly incorporated into the soil, and full advantage is taken of it by the *kharif* crop grown: the residue is very beneficial for the *rabi* crop that follows on the same soil. The most profitable results will be obtained from the use of cattle-dung if it be applied to the same soil only after intervals of two or three years. An experiment with cotton and *Juar-Tur* grown as a two-years' rotation at the Nagpur Farm has so far given results which tend to prove this. The plots were manured in the

year in which cotton was grown. The outturns are given in lbs. per acre:—

Manure.	1902-03.			1903-04.			1904-05.			1905-06.		
	Crop.	Lint.	Seed.	Crop.	Grain.	Fodder.	Crop.	Lint.	Seed.	Crop.	Grain.	Fodder.
Saltpetre (40 lbs. N. per acre)	Cotton	386	650	Juar	770	2,075	Cotton	255	570	Juar	690	2,311
				Tur..	250	445				Tur..	125	200
Cattle-dung (60 lbs. N. per acre)	"	450	760	Juar	955	2,625	"	350	715	Juar	901	3,500
				Tur..	440	855				Tur..	235	280
Unmanured	"	237	419	Juar	500	2,050	"	150	295	Juar	719	2,448
				Tur..	155	755				Tur..	200	276

If owing to particular agricultural conditions *rabi* crops are the principal ones grown, as in parts of the Nurbudda Division in the north of these Provinces, where wheat, gram, til and linseed are the staple crops, the question naturally arises how this manure can be most profitably applied under these conditions. This question has also been investigated, and it has been found that for unirrigated *rabi* crops June is the best time, but for irrigated *rabi* crops the applications made in August give better results.

The black cotton soil of the Central Provinces must have deteriorated in fertility. It has received deficient supplies of manure for centuries. It has stood the strain well, but can only be renovated by judicious applications of well-rotted cattle manure. The problem to be solved is how far the present supply can be made to meet requirements. The number of dung-producing animals being known and also the area under crop, the amount of manure available per acre can be found. In the Central Provinces and Berar there are 10,661,042 cattle, including buffaloes. On an average each one of these will produce $2\frac{1}{2}$ tons (70 maunds) of dung annually, this being the weight at the time of application. In an experiment tried this year at the Nagpur Farm, a working bullock was found to give 3·6 tons or 101 maunds annually, when the stall droppings and the very small quantity of litter used were collected. At Cawnpore a mixed herd of cows and young animals were found to yield at the rate of

$2\frac{1}{2}$ tons annually. The ryot should, therefore, have at least $2\frac{1}{2}$ tons of cattle manure per head of stock every year. The 10,661,042 cattle of the Provinces should therefore give annually 26,652,605 tons of well-rotted dung, which would be sufficient to manure the whole area under cultivation at the rate of $2\frac{1}{2}$ tons once in three years. If this were universally carried out by the cultivators, it may be safely stated that their net farming profits would be enormously increased, even though some expenditure had to be made in the purchase of wood for fuel.

The total amount of manure available could be very much increased if steps were taken to utilize the dung of horses, sheep and goats, night-soil, leaves, crop-refuse, road scrapings, animal urine and all other decomposing and putrescible material that is always obtainable on a farm. Even then the cultivator would find the supply inadequate to meet the requirements of intensive cultivation, but, in the near future, it is hoped that the present market prices of artificial fertilizers will be reduced to a price at which he can profitably utilize them. A light manuring with cattle-dung, supplemented by a small amount of a quick-acting nitrogenous fertilizer, would suit the requirements of black cotton soil—the one to renovate a soil depleted of its source of nitrogen, *viz.*, humus, the other to give the crop a good start in its early stage.

Analyses of fresh Indian cattle-dung show that it is normally rich in nitrogen. Rotted Indian cattle manure contains a comparatively low percentage of moisture often not more than 35 per cent., while that made in Great Britain generally contains 70—75 per cent., and for that reason the percentage of nitrogen is very much higher in the former than in the latter. Samples from the Nagpur Farm generally show from 1 to 1·3 per cent. of nitrogen, which is double the amount found in ordinary English cattle manure. That which is commonly made by the ryot of these Provinces, however, is of the poorest description owing to the faulty methods of conservation practised.

The value of cattle manure depends (1) on the kind of animals producing it; (2) the quality of the food they consume;

and (3) the method of conservation. The quantity of nitrogen, potash and phosphoric acid voided in the manure of adult animals that are neither gaining nor decreasing in weight will be nearly the same as that contained in the food consumed. The manure from working bullocks should therefore be rich. The manure from growing animals that are converting part of the albuminoids and ash constituents of their food into animal tissue is poorer, as is also that of cows that are supplying milk or that are in calf. Forty per cent. of the cattle of these provinces are of the former class, that is to say, they are adult working animals that retain little, if any, of the nitrogenous or ash constituents of their food in their bodies.

When a large amount of concentrated food, rich in nitrogen, is consumed by the cattle on the farm, it follows that their solid and liquid excrements are proportionately rich in nitrogen. In the Central Provinces and Berar, a very considerable quantity of cotton seed, linseed and other highly nitrogenous foodstuffs are consumed on the farms, being given chiefly to the working bullocks, so that the nitrogen of the food should almost all reach the soil again in the manure.

The method of storing cattle-dung in these Provinces is a very primitive one. That part of it which is to be kept for manure is ordinarily thrown together in loose heaps at some distance outside the village. No account is taken of the evanescent nature of its most useful constituents, of the ammonia which passes off into the air, or of its salts of nitrogen, potash and phosphoric acid which are leached out of it by the rains: consequently only the more stable and insoluble part of it ever reaches the cultivator's field. The following three principles should be adhered to in its conservation :—(1) The urine as well as the more solid excreta should be preserved; (2) the manure should be stored in pits and always kept moist, but should never be allowed to get over-soaked; (3) the manure should be well-rotted before it is applied to the land.

The two systems of conservation of urine which appear to be most suitable for the agricultural conditions of these

provinces are what may be called the open-drain and dry-earth systems. The former is now being carried out at the Experimental Farms. The cattle-shed is provided with a stone floor and a 'V'-shaped gutter, one foot wide and four inches deep. The floor has a gentle slope so as to carry the urine down to the gutter, which in turn carries it the whole length of the stalls to a masonry pit outside the shed. This pit is provided with a concrete floor to prevent the loss of liquid manure by drainage. As much litter as is available is made use of. The floors of the stalls are kept swept and clean by washing them down daily. The urine, supplemented by the added water keeps the manure moist at all seasons. A roof is erected over the manure pit to protect the manure from the scorching sun and drenching rains. This method of conserving manure should meet the approval of the landowners, who cultivate their own fields and who can afford the initial cost of making the stone floor, gutter and pit.

The dry-earth system is the one which is most likely to be adopted by the poor ryots, as it is a simple method which involves no initial expenditure and requires no other bedding than the dry earth used. Like the open-drain system, it is based on sound scientific principles. Dry earth is spread in the stalls to a depth of six inches, and is kept in position by a plank of wood of the same depth, supported by bamboo pegs. The earth absorbs the urine and retains its most valuable ingredients. After three or four weeks the urine-earth is conveyed to the pit and a fresh supply added to the stalls.

By removing the excreta daily the stalls are kept clean. Should the earth get baked, the surface is slightly scarified by means of a rake, so as to make it pervious to the liquid manure. The earthen pit, in which the dry excreta and urine-earth are stored, is protected by a roof of thatch. An open drain carries off the water that falls from this roof. If the manure gets too dry, certain holes in the roof are uncovered and some rain-water admitted thereby. In the dry season the manure should be kept moist by hand-watering.

A manure pit should not exceed five feet in depth. Its cubic content will depend on the number and size of the farm stock. One cubic yard of dung in India weighs about half a ton, and a pit for a mixed herd should, therefore, provide for five cubic yards per head. On the Government Farms, where working bullocks only are kept, six cubic yards or what is sufficient to hold three tons of manure per animal is provided for. The pit should be in close proximity to the shed, and provided with an open drain to prevent surface water from flowing into it.

It can be claimed for these two systems of conserving manure that by them both the solid and liquid excrements are saved. The urine or liquid excrement contains the greater part of the most valuable constituent, nitrogen. The nitrogen of the urine is, moreover, in a very soluble form; its effect on a crop is to give it a good start, while the more durable but less soluble solid excreta gives out its plant food slowly. Being stored under shelter and kept moist, fermentation is quick and thorough, especially when the urine is allowed to run into the pit as by the open-drain system. At the end of the year, rich, well-decomposed manure is obtained, which in a very short time becomes thoroughly intermixed with the soil to which it is applied. Such manure is complete in itself, and is specially suited for the black cotton soil of the Central Provinces and Berar.

Cattle manure made in this way is what is wanted to renovate soils impoverished by the methods of farming that have been followed in these Provinces for many centuries.

THE PREVENTION OF FODDER FAMINES IN THE CHITALDRUG DISTRICT IN MYSORE.

By E. RAMASWAMI IYER, B.A.,

District Forest Officer, Chitaldrug, Mysore.

CHITALDRUG is the most arid district of the Mysore State, its geographical position being such that it does not receive the full benefit of either the south-west or receding monsoon. Past history shows that on an average every third year gives a poor harvest, accompanied by scarcity of fodder and water. About once in three years the district is blessed with a bountiful harvest and then the grass and grazing is much in excess of immediate requirements. The district should be always prepared for a scant year. The following measures for the safe storage of fodder, are suggested with a view to prevent serious loss of cattle in seasons of drought.

In years of plenty, every ryot should contribute in proportion to the size of his holding a certain quantity of hay to a village communal stack. This quantity should be sufficient to carry his cattle through customary periods of drought, making an allowance of 10 lbs. per day for each animal. This hay should be securely stored in stacks near the village. The stack yard should be fenced. Each hay stack should be built on a platform of brush-wood or such like material, so that dampness is prevented from rising from the soil and loss from white ants minimized. The stacks should be properly built by experienced cultivators and properly thatched, otherwise much loss will be caused by rain. The safe custody of the stacks should be entrusted to the village watchman under the control of the Village Council (*Panchayat*). The headman (*Patel*) should keep a regular account of the grass

contributed by each individual and of out-goings. These accounts should be checked at the annual examination of the village records (*Jamábandi*). The stored hay should not be touched until a year of fodder scarcity is declared by the Deputy Commissioner, when under the supervision of the Amildar each ryot should receive the quantity contributed by him. In the unlikely case of the stock accumulating in excess of possible requirements, the surplus should be sold for the benefit of those concerned. The practical working difficulties will certainly not be greater than the somewhat analogous plan of Village Co-operative Credit Societies.

The communal grazing lands, assigned to villages in this district, are extensive, but the ryots do not concern themselves with their improvement. Cattle usually graze over the whole area throughout the year, with many harmful results. Grazing is allowed early in the rains, so that the sprouting grass has no chance to grow properly. Clay soil is, during heavy rains, injuriously trampled, and lighter soil is so broken up that much of it is carried away into the neighbouring tanks or elsewhere. This erosion is increased by the removal of trees and shrubs. Even the stumps and roots are dug out for making charcoal. In consequence, these pasture lands are generally deteriorating. This deterioration of pasture lands is most evident near the larger villages. It is desirable to check this deterioration and to arrange for communal conservancy in a practical way.

The grass land of each village should be equally divided into two blocks. Each block should be ordinarily open each year alternately for grazing and for grass cutting. The portion reserved for hay will afford a certain amount of grazing in the fair season from January to July.

The State Forests of Chitaldrug district yield in many places considerable quantities of grass fit for making superior hay. Such portions of the forests should be utilized as 'Forest Fodder Farms.' They should be protected from unauthorized grazing, if necessary, by fencing or otherwise. The grass should be cut in the months of November and December, and stored securely in

stacks. In order to arrive at definite conclusions regarding the probable advantages of storing hay, a beginning should be made on an experimental scale and the work should be extended as experience may direct. Experience might show that baled hay could be more economically preserved from year to year than grass stacked in the ordinary way.

Trees which once existed on village grass lands have disappeared or are fast disappearing in consequence of heavy lopping. The destruction will soon be complete owing to increasing population and cultivation. Useful trees should be planted and protected, as they are essential to preserve moisture in the soil, protect the grass, offer shelter to cattle against sun and rain, and provide fruit for man, also leaf fodder for sheep and goats.

The people of the Chitaldrug district are chiefly agriculturists. Seasons of distress are of frequent occurrence. It is, therefore, imperative to prevent, if possible, fodder famines on the lines above suggested.

THE CULTIVATION OF PARA RUBBER IN NORTH-EAST INDIA.

By Dr. H. H. MANN, D.Sc.,

Scientific Officer to the Indian Tea Association.

Numerous attempts have been made both on the Government Rubber Plantation at Tezpur, Assam, and by Tea Planters in several districts of the Assam Valley, during the past few years, to grow the *Para* rubber (*Hevea brasiliensis*), the culture of which has been such a success in Ceylon and in the Malay States. The results were unsuccessful. Some of the experiments are still being continued, but there is little confidence in the ultimate establishment of a *Para* rubber industry in the Brahmaputra Valley.

Of course these results are not necessarily applicable to other parts of North-East India, and in fact, evidence is to hand that in the upper part of the Valley of the Surma and its tributaries—in other words, in Cachar,—*Para* rubber can be successfully cultivated, that during its early stages it grows nearly as fast as in Ceylon, and that after ten years or so it produces rubber which compares in point of quality and yield with that in other districts recognized as favourable for the purpose.

These remarks are made as the result of the tapping of some ten trees which were planted in the Dhulai Tea Estate, Hailakandi, Cachar, in 1897, and which have grown without special attention among the tea ever since. They are healthy, and their size can be judged by the following figures for the

girth, three feet from the ground, at the end of 1905 and 1906 respectively :—

Number of Tree.	Number of Trunks.	1905.	1906.
1	2	1′ 10½″ & 1′ 7″	2′ 1″ & 1′ 10″
2	1	2′ 9″	2′ 9″
3	1	2′ 8″	2′ 8″
4	1	1′ 10″	2′ 2″
5	1	2′ 1″	2′ 7″
6	2	2′ 2½″ & 1′ 8″	2′ 5″ & 2′ 0″
7	2	1′ 3½″ & 2′ 0″	1′ 6″ & 2′ 2″
8	2	1′ 9″ & 1′ 6″	2′ 2″ & 1′ 7″
9	1	1′ 10″	2′ 2″
10	1	2′ 5½″	3′

During the season 1906-07, these ten trees were all tapped, either by the complete spiral or the herring-bone system, with the Bowman-Northway tapping knife, and alternate use of the spurwheel. Rubber was freely yielded by all the trees, and the total amount obtained was ten pounds of dry rubber or one pound per tree. They were under tapping from December to March, when the quantity of rubber obtained became too small to make it worth while continuing. On re-opening the cuts early in April, however, rubber again ran fairly freely. These figures, of course, give no evidence as to how much rubber could have been obtained earlier in the plant's life, say, at six or seven years old when trees in Ceylon are ready to tap, but they do indicate that in South Cachar on rich flat but well-drained land there is no difficulty in growing *Para* rubber and getting a fair yield from it.

The trees were healthy, were flowering vigorously and produced seed.

I am indebted for these figures and notes to Mr. W. Stiefelhagen, the Manager of the Tea Garden, in which the trees are planted.

Several planters in the same district have recently planted *Para* rubber on land recently cleared. The young trees are so far quite healthy where the position is sheltered from the sun in the hottest part of the day. I am permitted by Mr. W. K.

Green, the Manager of the West Jalinga Tea Estate, to quote the following figures to show the growth of the young plants :—

(1) *Rubber stumps received from Ceylon and planted in April* 1905. (Average of sixteen plants).

Date.	Height.			Girth 1 foot from Ground.			Girth 3 feet from Ground.		
	Average.	Highest.	Lowest.	Average.	Highest.	Lowest.	Average.	Highest.	Lowest.
	Feet.	Feet.	Feet.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
Nov. 28, 1905	3·4	5·4	1·4	1·6	2·0	0·4			
Sept. 30, 1906	10·0	13·0	5·7	3·7	5·6	2·5	2·5	3·5	1·5
April 23, 1907	11·9	14·5	7·0	4·6	6·3	3·2	3·4	4·5	2·0

(2) *Rubber seeds received September* 1904 : *trees planted July* 1905. (Average of sixteen plants).

Date.	Height.			Girth 1 foot from Ground.			Girth 3 feet from Ground.		
	Average.	Highest.	Lowest.	Average.	Highest.	Lowest.	Average.	Highest.	Lowest.
	Feet.	Feet.	Feet.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
Nov. 24, 1905	3·8	5·3	2·2	2·0	2·5	0·6	...	...	...
Sept. 30, 1906	10·0	12·2	6·3	3·7	4·6	2·7	3·2	3·6	2·1
April 23, 1907	13·0	14·0	9·5	5·6	8·0	4·5	4·3	6·0	3·5

(The figures for April 23rd, 1907, are only for eleven plants, as the others had been damaged by deer, and the figures for three feet above the ground are only for those with single stems.)

(3) *Rubber seeds received September* 1905 : *trees planted June—July* 1906. (Average of twenty plants).

Date.	Height.			Girth 1 foot from Ground.			Girth 3 feet from Ground.		
	Average.	Highest.	Lowest.	Average.	Highest.	Lowest.	Average.	Highest.	Lowest.
	Feet.	Feet.	Feet.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
April 23, 1907	5·5	7·0	1·0	2·2	2·7	1·5	1·7	2·5	1·5

The figures above tabulated indicate a possibility that *Para* rubber will probably succeed in Cachar. The figures are, however, only preliminary and much more information will have to be gathered before it can be definitely decided whether this district can compete with those districts in which rubber is already profitably established.

THE TAPPING OF ASSAM RUBBER (FICUS ELASTICA).

By Dr. H. H. MANN, D.Sc.,

Scientific Officer to the Indian Tea Association.

The methods hitherto in vogue in India for the tapping of Assam rubber have been extremely crude and wasteful of bark. The system used on the Government plantation at Tezpur (Assam) leads to a loss of four per cent. of the bark at each tapping, an amount which appears extraordinary when compared with that lost under the improved methods now employed in tapping other kinds of rubber trees in Ceylon and elsewhere. I am able now to describe a method which has been tried and used with success by Mr. W. Stiefelhagen in Cachar, and which leads to little loss of bark, and to rapid healing of the injuries caused by the tapping.

Instead of attacking the bark with a V-shaped gouge, as has been the custom at Tezpur, or with a scraping knife of any kind, Mr. Stiefelhagen employs an ordinary carpenter's chisel, $\frac{1}{2}$-inch to $\frac{3}{4}$-inch wide, and drives this into the bark vertically in a series of cuts, each the width of the chisel, across the direction of the branch being tapped. At least half an inch must be left between each incision. The rows of incisions are made about six inches apart up the stems and large branches of the tree, and strips of tea lead are pinned to the stems underneath each row, in such a way that the latex running down into the channels thus made, drops into a cup fixed at the end of each channel of tea lead. By this means, tapping through the cold weather from November to March, about two-thirds of the latex finds its way into the cups, while one-third coagulates on the cuts.

It will be easily seen that the injury done to the tree by this method of tapping is very small indeed compared with that usually adopted. It is easy to apply, and a man becomes very expert in a few days. I, myself, tried to carry it out during a recent visit, and found there was no difficulty, after a little practice, in judging how far in to drive the chisel without materially injuring the cambium layer. The yields obtained were very good, as compared with those given on the Government plantation, and are set out below.

Eight trees, planted in 1882, were tapped in 1905-06 and gave an average of six pounds of rubber per tree, which, including all grades, obtained an average price of three shillings and ninepence per pound in London. The yield of each individual tree was not kept. In 1906-07 *the same* trees were tapped again, and gave (individual trees) as follows :-

Number of tree.	Weight of rubber.	Number of tree.	Weight of rubber.
	lbs.		lbs.
1.	10	5.	5½
2.	3½	6.	4½
3.	4	7.	4
4	6½	8	2½

The average yield was therefore five pounds per tree, and the amount given by individual trees varied from 10lbs. to 2½lbs. The cuts made in the previous year were healed and would hardly have been noticed.

Four younger trees were also tapped by the same method in 1905-06 and 1906-07. These were planted in 1889-90, and were hence sixteen and seventeen years old respectively in the two years. The yield was not carefully kept in 1905-06, but it amounted to about 2 pounds of rubber per tree. In 1906-07, the four trees gave respectively 2¼, 3¼, 1¼ and 2½ pounds of rubber, or an average of 2¼ pounds per tree. These trees were apparently by no means exhausted, as on making a series of new incisions in one of them early in April 1907, the latex flowed very freely, and a considerable further yield could have been obtained.

It has usually been stated that Assam rubber trees can only be tapped once in two or even three years. Though the figures at present given are by no means sufficient, yet they suggest that this inability to bear frequent tapping may be due to the excessive injury to the bark caused by the older methods of carrying out the operation. Certainly there is no sign as yet of the trees now being considered materially losing yield through tapping in two successive seasons.

The individual trees vary enormously, as will be seen, in the amount of rubber which they give, and not only this but the latex is much more fluid and hence more easily worked from some trees than from others. Whether this is a peculiarity of the tree or due to slight variations in the conditions of growth is at present uncertain. In the meantime, it is wise to take all cuttings for new extensions of Assam rubber from the trees giving the best yield and the most fluid latex. It is curious to find that, in every case, more latex is given by the large branches of the trees than by the main stem.

The method of treatment of the rubber obtained is different from that adopted on the Government plantation. That which coagulates on the cuts, amounting to about one-third of the whole is, of course, the best and requires no further treatment. The remainder is mixed with a 2 per cent. solution of formalin, and poured into clean half bamboos (bamboos split longitudinally), laid parallel to one another, and the whole covered from the direct rays of the sun. Within a day the whole of the rubber is coagulated, and can be removed. The long strips are then allowed to dry before rolling together into balls. Many other materials have been tried instead of formalin for mixing with the latex, but none have answered the purpose so well, and given rubber equally free from stickiness.

I cannot think that this method of tapping and treating Assam rubber is by any means the final word on the subject. It is, however, a distinct step in advance on those hitherto in use in India, and would seem well worth following up by those who have the opportunity of doing so.

THE FOOD OF THE MYNAH.

By C. W. MASON,

Supernumerary Entomologist, Pusa.

As in England so many birds prove invaluable to the farmer, so in India we may expect birds to be equally invaluable to the Indian agriculturist. That some birds eat insects, and among them some of the worst pests, is a matter of everyday observation : but it is not known definitely what birds eat what insects ; investigations are being carried out at Pusa with regard to this point, both from field observations, and from an examination of the food in the birds, the results of which should prove of great interest and value.

This note deals with the mynah (*Acridotheres tristis*). The mynah's food is very varied, consisting of fruits, seeds and insects. It is partial to the common wild figs, and with them devours the fig parasite and its parasite. The large fleshy flowers of the tree cotton are largely eaten. Of seeds, grass forms by far the greatest bulk, but wild hemp is also largely eaten. Its insect food is very varied, in fact the mynah would seem almost a general insect feeder ; but some of the commonest insects, no doubt being distasteful or protected by scent, are not touched by the mynah.

The mynah has one point in common with other birds, namely, an individual preference on the part of each bird for certain forms of insect food. With the Mynah on several occasions, as also with the Hoopoo (*Upupa indica*) and the common Hawk-Cuckoo (*Hierococcyx varius*), I have found, of two or three birds shot feeding together, that one contained completely different food to any of the others. These birds had been

observed together, and feeding for some little time. In each case with the individual mynah, its food consisted wholly of Surface caterpillars (*Noctuid larvæ*), and no sign or trace of other food. It seems that if a bird eats these caterpillars, they form the whole, or very nearly so, of its food.

From the list of insects given below, it would seem that the mynah does most insect hunting on the ground: nearly all the insects in the list occur on the ground, among grass and weeds as well as in the crops, much more than on trees.

The following are the lists of insects found in the mynah:—

I. Acrididæ. (Grasshoppers.)
   1. *Chrotogonus*, several species.
   2. *Oedaleus*, several species.
   3. *Tryxalis*, several species.

II. Formicidæ. (Ants.)
   1. *Camponotus compressus*.
   2. *Myrmecocystus setipes*.
   3. An unidentified species.

III. Curculionidæ. (Weevils.)
   1. *Myllocerus maculosus*, the white weevil.
   2. *Paramecops* sp.
   And two unidentified.

IV. Other Coleoptera.
   1. Various elytra only. (Not identified.)

V. Lepidoptera.
   1. Noctuid larvæ. Surface caterpillars.
   2. Noctuid moths, too damaged to identify.

Probably all insects in the above orders and families would be taken, provided they were not too large, or had danger colours, and could be got at. Spiders are largely eaten.

The mynah has not been found to damage any crops at Pusa from January to May. Only three wheat grains have been found in the numbers of birds examined. It was reported to have damaged Juar (Sorghum) last December.

The mynah much resembles the English starling in habits, it works arable and grass-land in the same way, though not so methodically. It commonly occurs in flocks up to 60 or so, sometimes more, but usually about 10 or 20 are seen together.

Nesting occurs in holes in trees, sometimes on the branches and in holes in walls and thatched roofs. The young are fed largely on various lepidopterous larvæ, more so than on any other food. If in any district the mynah was causing damage so as to be regarded a nuisance, the young should be destroyed just before they can fly; they are fed on insects (larvæ), and so up to that time are doing good rather than harm, as is the case with the English house sparrow.

If mynahs are damaging small plots of crops only, they can be scared off easily.

We should be very glad of assistance in this enquiry from observers of birds in India; collectors of bird skins could especially render great help, as a correct identification of the birds is as essential as a correct identification of the insects upon which they feed. We shall be glad to identify the crop contents and gizzard contents sent in to Pusa as far as possible. It is proposed to identify the insect food of all birds, rare or common, not only those found in or round crops, but also exclusively jungle birds. Birds living entirely in the jungle may prove as valuable as those on arable and grass-land, feeding on the insect pests of crops after migration to jungle plants. We can keep a certain check on insects on the crops, but when these insects continually come in from the jungle, the value of the check is partially lost, and to attack a pest when migrated to the jungle would seem hopeless. In this respect jungle birds may prove of great value.

On application being made to Pusa, tubes, etc., for keeping and sending in the food contents (or crops and gizzards) to us, will be supplied with full directions.

THE PESTS OF INTRODUCED COTTONS.

By H. M. LEFROY, M.A., F.E.S., F.Z.S.,

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Exotic cottons grown in India are liable, at first, to suffer to an abnormal extent from insect pests; when acclimatized, they suffer less; special precautions are always necessary. This note deals only with the pests which are likely to prevent the establishment and acclimatization of exotic varieties and of indigenous varieties transferred for experimental purposes from one district of India to another.

The Cotton Leaf Hopper is the worst pest. This small green insect sucks the juice of the leaves by cutting through the outer membranes. This attack on the leaf tissues probably gives entrance to diseased conditions which cause curling and withering of the leaves. There is no easy remedy against the leaf hopper. In the first stages of attack, the insect should be checked by liberal spraying with Crude Oil Emulsion,* a strength of 1 in 50 of water should be used.

Cotton Aphis.—Weak cottons are particularly affected by the cotton aphis; as a rule, the natural enemies of this pest keep it in check, but it is often advisable to spray with Crude Oil Emulsion diluted as above described.

Boll-worms attack all cottons. In Sind and the Punjab Egyptian and American varieties have under ordinary seasonal conditions suffered more than local kinds.

Bhindi (*Hibiscus esculentus*) is a good trap crop where it can be successfully grown near to or among cotton, provided the

* For formulæ of this see Leaflet on Crude Oil Emulsion and also "Indian Insect Pests."

green pods are regularly removed. Boll-worm often seriously affects the cotton bolls which first form. Such, when seen to be affected, should be removed and burnt. This will materially check the spread of the pest.

The Leaf Roller is the only other pest which specially attacks exotic cottons. The attack is limited to a short season and begins in the three weeks which follow the commencement of the rains. It can be easily seen by the rolled leaves and can be checked by hand-picking and burning if the work is thoroughly done.

Stem-Borer.—Two special pests attack perennial Tree Cottons. The stem-borer is a small weevil whose grub bores to the base of the stem and causes a characteristic swelling there. At Pusa, a reliable preventive was found in growing annual indigenous cotton, such as Broach Deshi, between the rows of the perennial varieties. The Deshi plants were pulled up and burnt as soon as they were seen to be affected. The stem-borer is only known to occur in Behar and Madras, but may appear anywhere.

The other special pest of Perennial Cottons is common in South India and Bombay. It is a weevil whose grub bores down the twigs and small branches. The withered branches are easily seen, and the only remedy is to cut these out periodically and burn them.

To prevent recurring damage to tree and annual cottons by insect pests, it is desirable to adopt the following general precautions :

(*a*) Perennial cottons should be rested from vegetative activity for several months during the hot weather each year. The trees or bushes should be pruned at this time, and all decayed branches, leaves and bolls should be removed and burnt ; finally, the whole soil between the trees should be hand-dug or otherwise freely opened up by careful cultivation in the hot weather.

(*b*) Annual cottons should be grown in rotation and should not occupy the same land oftener than every second year. The plants cease to produce some time in the cold weather or at

latest at the beginning of the hot weather. As soon as gathering is completed and, especially, if the crop has been much affected with boll-worm and other pests, the stalks and all litter on the soil surface should be gathered and burnt.

(*c*) Flower buds and bolls, which appear in annual or perennial cottons at the wrong season and worthless bolls produced in the regular season, should be removed and burnt. Such serve to provide food for injurious insects during certain stages of their history. It is most desirable to deprive injurious insects of their ordinary food for defined periods.

(*d*) When cotton is introduced into a new locality the introduced seed should be fumigated.

(*e*) If a pest appears in a locality and multiplies abundantly, its parasite should be introduced. By this means serious damage by boll-worm in the Punjab has been greatly reduced. The work has recently been extended to Sind. Similar work can be further extended by communicating with the Imperial Entomologist.

NOTES.

SERICULTURE IN KASHMIR, BALUCHISTAN AND QUETTA. The Silk Association of Great Britain and Ireland, in Report No. 22, 1906, briefly refers to Sericulture in Kashmir, Baluchistan and Quetta. The more salient points are noted below.

The raw silk produced in Kashmir in 1905 yielded a profit of £28,139 or 58½ on invested capital. In 1906 a record crop of cocoons was produced, and with advanced prices it is expected that the profits will exceed those of the previous year. Kashmir raw silk chiefly $\frac{2}{11}$ deniers meets with a very ready sale at Lyons. The extension of mulberry cultivation is carefully attended to by the State. The number of rearers in Kashmir is yearly increasing. This successful industry now gives employment to nearly 70,000 persons.

Major H. L. Showers, C.I.E., Political Agent in Kalat, commenced experiments in Sericulture in the Mastung Valley in Baluchistan, obtaining some silkworm-eggs from the Kashmir Durbar and also from the South of France. These experiments have given satisfactory results. Expert opinion on the raw silk was favourable. This silk was sold in London at 13*s.* 3*d.* and 13*s.* 4*d.* per lb. The Mastung Valley is the home of the mulberry and the local tribesmen have been quick to see the advantages of cocoon-rearing. The silk industry promises, therefore, to get a permanent footing in Baluchistan.

Some silkworm-eggs were supplied by the Kashmir Durbar for experiments in Quetta. The cocoons obtained from these eggs were reeled in Kashmir filatures. The raw silk and a sample of piece goods woven from this silk were found to be of excellent quality.

It is probable that Sericulture will be arranged for in the Punjab on the lines pursued in Kashmir and Baluchistan.—(EDITOR.)

* * *

AN EXPERIMENT IN ASSAM TO PREVENT BY MEANS OF CRUDE OIL EMULSION THE INJURIOUS EFFECTS OF PARASITES ON WORK CATTLE.—Mr. D. L. Stewart, the Manager of the Assam Zemindary Company, imported work cattle from Tirhoot in November last. The necessity for this importation arose because the local breed does not supply the present local demands and because the opening up of the Assam Valley for the cultivation of rice, other cereals, jute, etc., will require a large importation of work cattle. These can be bought advantageously in Tirhoot. Even with the added transport charges they are cheaper than local Assam cattle because they are stronger and are capable of doing much more work.

The cattle imported by Mr. Stewart became infested with biting flies, lice, ticks, bugs and leeches by grazing in the harvested paddy fields and grass jungles or from the litter which was necessarily used in the stables. The bullocks lost condition rapidly and were mere wrecks in a month.

Mr. H. Maxwell Lefroy, Imperial Entomologist, on being consulted, suggested washing or spraying the cattle with Crude Oil Emulsion. This was done and was found to be a complete success. The leeches did not attach themselves to the cattle whilst at pasture except occasionally inside the nostrils. Flies did not settle on the cattle—the ticks and bugs fell off dead. Lice and fleas were more difficult to deal with. They had to be brushed out when the coat dried after spraying. A broom-corn brush, commonly called a "dandy" brush and ordinarily in use for grooming horses, was found most useful. The spraying and grooming to be quite effective had to be repeated once a week. The effect on the skin and hair of the cattle has been excellent.

Leeches affect local cattle as well as the imported cattle and have to be picked off every evening when the cattle return from

grazing. Mr. Stewart tested the effect of Crude Oil Emulsion diluted to the ordinary strength on leeches by applying a sprinkling to a number which were purposely collected. They died at once.

Mr. Stewart says that work cattle in Assam, both imported and indigenous, suffer greatly from sores, the irritating cause being particular flies. The sores are situated beneath the side of the hump and above the point of the shoulder blade. Doubtless, the action of the neck yoke at work, aggravated by the persistent attentions of these flies, keeps the sores open until they eventually become hard lumps with deep sore cracks. Mr. Stewart found that the sores were effectively cured by softening with vaseline and washing out with diluted Crude Oil Emulsion applied rather more frequently than was necessary for the rest of the body. The sores soon healed up naturally chiefly because the flies were kept away. Mr. Stewart thinks that this treatment would be of great advantage to the ordinary Assam cultivator if brought to his notice and placed within his reach and also for the bullocks, some of them with ghastly sores, which work on the transport service, such as from Gauhati to Shillong.

Mr. Stewart further says that the cheapest and most economical way to spray an animal is to use a stiff brush or broom made of thatching grass. The stalks should be so tied in a bundle that the blades or leaves of the grass all lie evenly together. The blades should now be doubled back over the stalks and bound with the stalks for a length of six inches to form the handle of the broom. The blades should then be cut through at a point where they were doubled back. This gives a small broom with six inches of handle and six or eight inches of stiff brush. It has been found very effective in shaking the emulsion all over the animal. After sprinkling, the coat should be well rubbed, in every part with a wisp of straw.

One-half pint of Crude Oil Emulsion rubbed up in a kerosine oil tin of water gives the correct strength of mixture.

Fairly large bullocks at Pusa were found to require each approximately the following amounts according to the method :

Mr. Stewart's grass brush	.. 1 pint
A sprayer	.. 1¾
Rubbed with a cloth	... 1½

with Mr. Stewart's method, and at half a pint of emulsion per 1-gallon tin of water, a gallon drum of emulsion would make 320 gallons of mixture, enough for approximately 48 bullocks to be treated once a week for a year. The yearly cost for one bullock works out at about four annas, the drum of emulsion costing Rs. 6-8 in Calcutta, Rs. 9-8 in Bombay.—(Editor.)

* *

Well-sinking Experiments in Bhavanagar.—Experiments in boring wells on the Japanese system were commenced in 1905 in the Bhavanagar State, Kathiawar, Bombay Presidency. In all five trials borings were made with the assistance of a Japanese expert well-sinker who had his implements made locally. It was found that the boring implement stuck at a certain depth and could not be taken out. The depth reached in one case was 110 feet. The boring was abandoned in each trial before water was found. It is reported that failure was at least partly due to the difficulty of making the Japanese expert and the labourers understand each other. The total cost of the borings amounted to Rs. 5,516-10-11. The expenditure involved was therefore considerable, and probably better and cheaper results could have been obtained by ordinary boring appliances.—(Editor.)

* *

Preliminary Experiments with Jute in the Madras Presidency. In accordance with the recommendations of the Board of Agriculture, experiments with Bengal jute (Corchorus) were made during 1905 at the Samalkota Station in the Madras Presidency with a view to test the suitability of the Godavari Delta for the crop. This first trial was not successful. As the result of experience, better arrangements for another trial were made in 1906. The results in 1906 were so encouraging that

more extensive experiments have been arranged for in the delta and other areas. The enquiry will form a definite feature in the Programme of work of the Madras Agricultural Department.

The fibre obtained from the jute averaged 7 feet in length and was valued by Messrs. Ralli Brothers, Calcutta, at Rs. 10 5-0 per maund of 80lbs. The value of outturn was Rs. 80 per acre. It is expected that much better yields will be obtained as the local officers gain experience in determining how far the Bengal methods of cultivation should be modified to suit local conditions in Madras. (EDITOR.)

* * *

GROUNDNUT EXPERIMENTS AT THE CUTTACK EXPERIMENT STATION.—Leaflet No. 2 of 1907, published by the Bengal Department of Agriculture, describes the results of the experiments with groundnut (*Arachis hypogæa*) during the past two seasons at the Cuttack Experiment Station. It also describes the methods of cultivation, treatment of the crop, mode and time of harvesting, etc. The trials were made on poor sandy soil, which is unsuitable for most other crops. The results were satisfactory. The yield obtained was 20 maunds per acre in 1905 and 16 maunds in 1906. Aman paddy or jute land is not suitable for groundnut. The crop will grow well on friable sandy loam soils if cultivated and manured sufficiently. (EDITOR.)

* * *

CHLORIS VIRGATA AND CHLORIS GAYANA.—In 1904, the Director of the Botanic Gardens, Sydney, brought to the notice of the Government of India, some of the advantages of the variety of grass *Chloris virgata* sw., known as Rhodes grass, which had been introduced with success into New South Wales from South Africa. The grass was said to be suitable for cold soils with light rainfall. A small quantity of seed of this grass and of *Chloris Gayana* was obtained in 1906 from the Minister of Agriculture, Pietermaritzburg, Natal. Both kinds were tried at Pusa. The seed was sown early in September on land which was well prepared and in good condition. Each kind was allowed

to seed and was cut at the middle of November. Chloris virgata yielded 480lbs. of seed and 1,006lbs. of hay per acre, while the yield of Chloris Gayana was 1,452lbs. seed and 2,178lbs. hay. The plants stood respectively 2½ft. and 2ft. high. [Seven species of Chloris are described in Prain's "Bengal Plants," and Chloris virgata is said to be found in most of the provinces.] The seed now in stock is intended for more extensive trials at Pusa and for distribution to a small extent in order that the economic value of these grasses for grazing and for hay may be more definitely determined under varying conditions of soil and climate, etc.—(E. Shearer.)

***

Destruction of Rats by Ratin.—The attention of several officers in the Department of Agriculture in India has recently been drawn to a preparation known as "Ratin" for the destruction of rats and mice. This preparation is made by the "Ratin" Company, Ltd., of Copenhagen. It is said to be of a bacterial nature and may be obtained in liquid or solid form. It is highly recommended by the German Minister of Agriculture. Special tests have been carried out in the bacteriological laboratories and on a number of farms, by the Chamber of Agriculture for the Province of Saxony. The results are reported to have been highly satisfactory. The substance is said to be quite harmless to domestic animals.

In view of the enormous damage which in some districts is periodically done by rats to Indian crops, this preparation is well worth a trial. It is understood that "Ratin" is being tested in the laboratory and in the field by the Civil Veterinary Department. The London Office of the Company is at 17, Gracechurch Street, E. C.—(C. Bergtheil.)

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Soil Inoculation for Indigo.—Experiments on the inoculation of Behar soils with cultures of the indigo nodule bacteria prepared according to the method of Dr. Moore of the United States Department of Agriculture have shown that absolutely

no benefit is to be derived from the application. Both the Sumatrana and Java varieties of indigo were tested and a variety of methods of application tried, but in every case the result was *nil*. The explanation is clear that Behar soils are sufficiently well provided with the necessary organisms, and that these organisms are in as active a condition as can be obtained by artificial culture. (C. BERGTHEIL.)

* * *

AN INSECT ATTACKING THE GRAPE VINE. One of the few known insect enemies of the grape in India is a small beetle (*Sebaluata strigicollis* Mots), of a dull nearly black colour with bright bronzy reflections. This beetle is familiar to grape-growers in Western and Southern India: it destroys the tender shoots and buds, working a considerable amount of havoc in the pruned vines. (Plate XXIX—Figs. 5 and 6, the latter the natural size). Mr. P. S. Kanetkar, Superintendent, Empress Gardens, Poona, has sent the following description of the method used by cultivators to check this pest. The figures are from his drawings, and we have added an enlarged figure of the beetle and its outline natural size:—

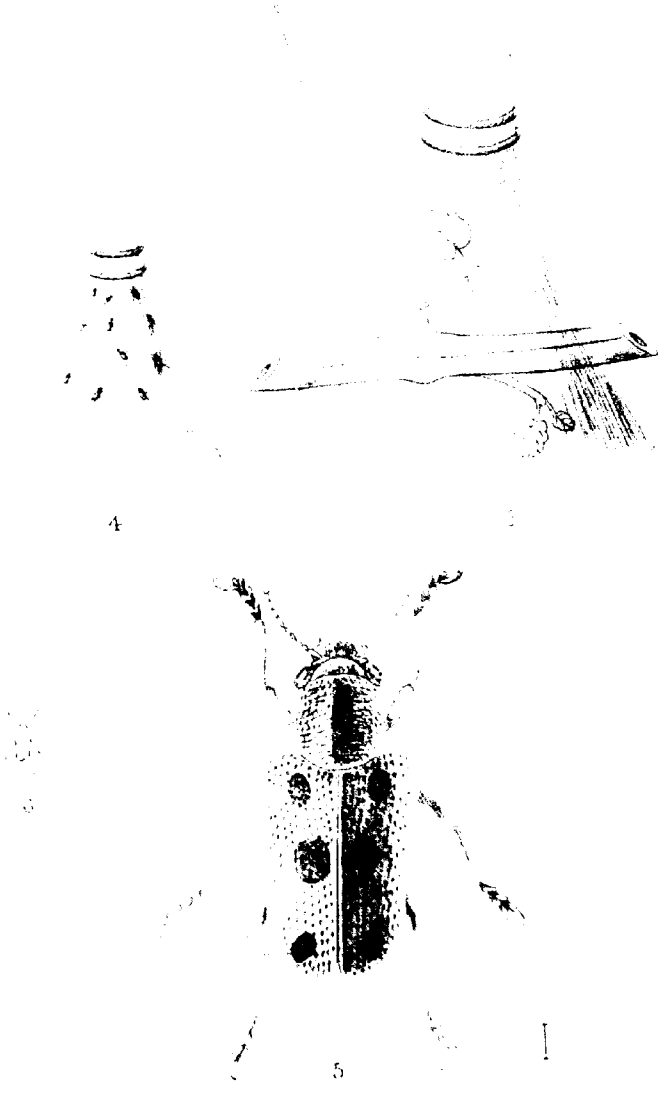
"Contrivance made by vine growers at Nasik to catch insects on grape vines."

"Dry sheaths of the plantain (Fig. 1) are torn into shreds and made into little bundles about 6 to 9 inches long. One end of the bundle is tied firm while the other is kept loose. It is thus made into the form of a tassel (Fig. 2). Such tassels are placed on the pruned ends (Fig. 3) of the vines in the evening as the buds begin to swell and shoot forth. The insects after roaming about by day find a snug resort during the cold nights in these tassels (Fig. 4). In the morning, however, they find themselves in a bag or basket being shaken into it from their resort by the cultivator."—(H. M. LEFROY.)

* * *

THE GROUNDNUT LEAF-MINER.—The most injurious insect enemy of the groundnut in India is the leaf-miner (*Anacampsis acrteria* Meyr), known in South India as the "Surul puchi." This crop pest is appearing on groundnut wherever grown in the

PLATE XXIX.



A. J. L.

1, 2, 3, 4. Contrivance to catch Insects on Grape Vines.
5, 6. Scelodonta strigicollis.

Madras Presidency. The cultivation of groundnut is extensive in some districts of Madras and is spreading.

The leaf-miner is a very small caterpillar which hatches from a tiny egg laid on the leaf: on hatching, it eats into the tissue of the leaf and mines within, causing an irregular blotch which turns brown: the affected leaf withers and falls off if badly attacked: the full grown larva emerges, webs the leaf up or joins two leaflets together with silk and pupates there in a light silken cocoon. A very small dark moth then emerges and lays eggs. The whole life cycle is about one month, and the broods succeed one another throughout the year.

The pest is most easily recognized by its work, a badly affected field turning brown as if fire had passed through and burnt the plants. In bad seasons the losses are said to be very heavy. This pest must gain a wider range, as groundnut cultivation is extended, unless special precautions are taken. Groundnut is so profitable that taking good and bad years together, the cultivator can afford to neglect the pest. Profits would be considerably larger if the pest was checked at an early stage. Usually the cultivator makes little or no effort to protect his crop. This leaf-miner has not yet been identified north of Bellary. Groundnut was grown for the first time at the Hagari Farm in Bellary in 1906-07, and the pest was found on the first crop.

This pest is now under investigation in Madras and a full account will be issued in due course. This enquiry will possibly lead to recommendations regarding efficient practical remedies. Meantime I advise that (*a*) the appearance of the insect in new places should be keenly looked for, (*b*) such appearance should be promptly reported to me in order that vigorous methods may be quickly adopted to prevent the pest spreading in a new district.

In districts where the pest is already established, serious damage can be prevented by continual care in removing affected leaves and burning them and by the use of trap crops and trap lights. A trap crop may be successfully used when local conditions have been fully studied. The moth comes readily at night to the light and can be captured in abundance. It is as yet doubtful

how far the suggested means will check the pest when firmly established. They will be useful when it first appears.

The pest is not bad in every season and is checked by a Hymenopterous parasite; but should the insect be introduced to a new locality without its parasite, the effects may be serious. In South Arcot (Madras) one of the difficulties consists in the fact that there is always groundnut growing, either irrigated or rain fed; consequently there is no season when the pest has no food plant and it multiplies throughout the year.—(H. M. Lefroy.)

* *

The Potato Moth.—An enquiry is in progress in the Bombay Presidency into the prevalence and distribution of a pest of the potato plant. This pest is the notorious Potato moth (*Phthorimæa operculella*, formerly known as *Lita solanella*); it occurs in Southern Europe, Algeria and Australia and is known to be a seriously destructive insect. There is reason to believe that this pest was introduced to India with European seed potatoes some years ago. It lives in the potato tubers and is readily carried long distances in them. The moth is a small brownish insect, a little over half an inch across the expanded wings. It can only easily be recognized by comparison with a full technical description.

It is possible that certain measures may prevent the spread of the pest from the districts in which it is now prevalent. Cultivators in any part of India should, however, be very cautious in importing seed potatoes because this pest has done immense damage in other parts of the globe.

The object of present enquiries is to ascertain exactly in which districts of India the pest occurs and whether it can be eradicated. It may or may not be confined to particular districts in Western India. If it is not now present in other potato-growing districts in India, it will probably make its appearance if seed potatoes are imported without proper precautions. Fumigation and other treatment, on lines which will be minutely described by me on application, should be adopted.

If this pest appears in any new locality, immediate information should be sent to me. It is probable that remedial measures can be recommended.

This pest has been investigated by Entomologists in Europe and Australia, and we extract the following information from the account given by French in "Hand-book of Destructive Insects of Victoria," Part II.

The eggs are laid by the moth on the young shoots of the plant; the caterpillars, as soon as they hatch, eat into the root-stock and descend until they reach a tuber, in which they live, making galleries through it in all directions. When full grown, the caterpillar closes the gallery with silk and turns to the chrysalis from which the moth emerges. When the tubers are not near the surface and are properly covered, the caterpillar does not attack them but confines itself to the root-stocks and stems of the plant at and near the surface of the soil.

In addition to attacking the potato plant while growing, the pest attacks the tubers after they are dug and is thus able to pass from one crop season to the next in the stored seed potatoes.

It is not at present possible to investigate all the areas where potatoes are grown, and we draw attention to the insect in order to give timely notice to those particularly interested.—(H. M. LEFROY.)

THE BOLL-WORM PARASITE. In consequence of the results obtained last year in re-establishing the boll-worm parasite in the Punjab, boxes of parasites have been sent to Sind and again to the Punjab. In all 100 boxes have been sent to each area and these should be sufficient to thoroughly establish the parasite and restore nature's remedy against this pest. The action which has been taken will, it is hoped, help in producing normal or very much improved conditions in the Punjab and that the Sind crop will be much less damaged than it was last year. The useful effect of the parasite, as it becomes more fully established, will of course be progressive.—(H. M. LEFROY.)

INDIGO SEED SELECTION.—The improvement of processes in manufacturing indigo has received a great deal of attention by specialists and others for many years. Little has yet, however, been done to improve the plant by selection. The Behar Planters' Association have recently appointed an Economic Botanist. He will have great scope for useful work in systematic field selection and in watching the results of cross-fertilization. The superiority of the Java variety under very varying conditions of soil and climate is now very generally recognized. There is little doubt that its cultivation could, with advantage, be greatly extended in India. Mr. Bergtheil in his Report of the Indigo Research Station, Sirsah, 1906-07, however, states that the Sumatrana plant can be grown in Behar on certain classes of soil which are unsuitable for the Java variety. The ordinary field crops grown from Sumatrana or Java seed produce plants of great variety of type. The first step towards real improvement is to isolate type specimens and subsequently determine the economic value of each. As the economic value of a pure type depends upon leaf percentage and indigotin content, it is clear that the field work of an Economic Botanist should be in close touch with chemical laboratory investigations. The importance of an enquiry of this sort and the value of ultimate results to the indigo grower cannot be questioned. Mr. Bergtheil, in referring to the urgent need of selection work on the Sumatrana plant, states that a preliminary step has been taken by growing and examining the different sub-varieties isolated by Mr Leake in 1903. The following results were obtained :—

Variety.	Percentage leaf analysed of 3 m/s.	Percentage indigotin in 35.5 c.c.
Multan	51·3	·825
Sukkur-Sind	45·8	·757
Hissar	54·9	·75
Rohtak	50·5	·742
Dharwar (?)	46·6	·742
Meerut (?)	46·7	·725
Delhi	48·3	·705
Muzaffargarh	49·6	·697
Dera Gazi Khan	47·6	·66

The Laboratory investigation indicated that the Multan type was the most desirable to establish, but in the field this type was less vigorous in growth than any of the whole series. The best plants were grown from Delhi and Meerut seed. Hissar and Rohtak plants were of poor growth and showed a tendency to early flowering, which is an undoubted disadvantage. It is considerations such as those above referred to and the practical experience gained by close observation which will influence an Economic Botanist in his selections. His work will not benefit the indigo planter until the seed of type-plants, produces first on experimental plots and then on larger demonstration areas plants which are absolutely true to variety. Meantime the Behar Indigo Planters' Association have established seed farms. A note issued recently by the Sirsoah Committee shows that the first crop of Java seed realized Rs. 10 per maund which, owing to an unfavourable season, was less than the cost of production. For sowings in 1908, members of the Association will be charged Rs. 15 per maund. The Committee points out that they have gained experience in the methods of seed cultivation and have been able to sow the Association seed farms with selected seed. The indigo planters should appreciate this work, but the term *selected seed* as used is only comparative and in a sense inaccurate. There is no indigo seed obtainable in India on a commercial scale which can produce a crop with all the plants true to variety, and therefore such seed should not be accurately described as "Selected."—(EDITOR.)

* * *

GREEN MANURING.—Green manuring is practised in many parts of India, but there seems to be room for extension especially in those regions where the rainfall is sufficient for growing a cold weather as well as a rains crop. Last rains at Pusa a field of about 40 acres, which had just been broken in from jungle and which was in very poor condition, was sown with *Sanai* (*Crotolaria Juncea*) which was ploughed in early in September. This was followed by oats as a cold weather crop, no other manure being applied. The crop yielded an average

of 25 maunds of grain per acre, and this notwithstanding that no rain fell from some weeks before the crop was sown until after it was in ear. Green manuring is not expensive—it is considerably cheaper than a rains fallow—and it is easy. The chief precaution to observe is to plough the crop well in and to consolidate the surface afterwards to prevent loss of moisture. (E. SHEARER.)

* * *

ANTHRAX.—In connection with enquiries made by the English Board of Agriculture into the outbreaks of anthrax amongst animals in Great Britain, it was suggested that infection was possibly introduced by oilcake or oilseeds imported from India. The suspicion was induced because certain affected animals had been given Bombay cotton cake as part of the daily ration. In order to investigate the matter, the Secretary of State, advised by the English Board of Agriculture, asked the Government of India to institute enquiries. The information collected in India goes to show that in threshing oilseeds under the feet of bullocks there is risk of contamination to a certain extent. The oilseeds exported from India are, when expressed for oil in European countries, first ground into coarse particles. The 'meats' thus produced are then subjected to a high temperature by superheated steam in order to open the oil cells and allow free extraction of oil. It is believed that such heat will destroy any possible source of anthrax infection.

The feeding of Indian oilseeds as such to cattle in Europe may be a source of infection, but it is hard to understand why Indian agricultural produce should be viewed with special suspicion. In any case cotton seed cake made in England from Indian cotton seed is a most unlikely source of infection.—(EDITOR.)

* * *

THIRD AGRICULTURAL SHOW AT ONGOLE (MADRAS). The Third Annual Agricultural Show was opened on the 27th February last, and extended over three days. The Show was an unqualified success, and keen interest in it was evidently taken

by the native gentlemen who constitute part of the local committee.

Ongole is considered a suitable centre for an annual show as it is in the centre of a good cattle breeding tract and is also on the railway. The reports connected with this year's show indicate in decided terms—(*a*) that the Ongole breed of cattle has more than a local reputation; (*b*) that there is a demand for these cattle from other parts of India and from abroad; (*c*) that to satisfy these demands in future years, strenuous efforts should be made to maintain the purity, and, if possible, to improve the breed.

The commercial results of the show in the cattle section were encouraging. Cattle to the value of Rs. 15,000 were sold. The report gives, however, a note of warning to breeders because the sales would have been much greater but for the high prices demanded. There is a limit to prices obtainable. At the same time owners should be congratulated on keeping their best cattle, even if tempting offers are made. The breed will deteriorate if the best breeding cattle *are exported* from the district. The measurements of the bulls, which carried off the 1st and 2nd prizes, are uncommon for Indian cattle. Each bull was well over five feet in height behind the hump and well over seven feet in girth.

1,023 animals were exhibited. In comparison with former shows, cows and heifers were better represented than work bullocks and bulls. There were increased entries in the classes for buffaloes and sheep. The sheep had good fleeces.

Prizes were offered for animals fed solely on prickly pear, but although the usefulness of this fodder has been proved in famine times, it is a doubtful policy to encourage feeding cattle on such stuff ordinarily. The specimens of cattle which were shown did not indicate that prickly pear contained much nutriment. Cattle breeders would be well advised to give more attention to storing nutritious fodder in time of plenty and thus obviate the necessity of using poor substitutes when the pinch of famine comes.

Some other features of the show are specially noteworthy, *viz.*, (*a*) the delivery of lectures on agricultural subjects; (*b*) demonstrations showing the practical utility of particular agricultural implements; (*c*) the exhibition of blankets and carpets made from the wool of Madras sheep.

It is suggested that if local sheep breeders would show some enterprise in breeding sheep with white wool of good quality, a local industry in blanket and carpet making might achieve commercial importance. White wool can, of course, be dyed to any desired colour.—(EDITOR.)

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REFINED SUGAR.—Dr. Lehmann, the Agricultural Chemist to the Government of Mysore, sent to the Inspector-General of Agriculture in India a sample of light-coloured clean sugar of good grain with the following note: "At Cawnpore this year we saw the Hadi process of sugar-making. I was surprised at the light colour of the refined sugar. We were told that that could not be produced if lime were used. I strongly advocate liming to neutrality. That is condemned by nearly everyone in India because it is said to give such a very dark sugar. I should like to undermine that general impression. I am sending you a little sample of sugar made here this year. The juice was limed to slight alkalinity (that is, very slightly overlimed). Red litmus turned faintly blue when put into the limed juice. The juice was boiled down in an ordinary iron country sugar pan and centrifugalled in a small laboratory centrifugal machine intended for all sorts of conditions of work." —(EDITOR.)

LITERATURE.

THE FIBRE ALOE. BY M. HAUTEFEUILLE. (Article in the Bulletin Economique of Indo-China, July 1906, No. 54.)

IN 1904 M. Hautefeuille was commissioned by the French Government to investigate the question of introducing the Fibre Aloe on a commercial scale into French Indo-China. During the investigation M. Hautefeuille visited British India, in order to see for himself the existing plantations. His conclusions, containing some useful general information about this plant, are given in an article published in the Bulletin Economique of Indo-China.

The author describes his visits to the agave plantations in India. He criticizes very sharply the attempts to extract fibre profitably from agaves planted along the railways. He considers that the industry cannot be profitable unless regular plantations are formed in compact blocks.

There exist in India, according to the author, only two plantations of importance. One is that of Dr. Süter, at Powai, near Bombay, and the other at Daurachecrra, in Assam, under the management of Mr. James Hunter. The author's criticisms of the Powai plantation are full of interest. The samples of fibre, which he had seen in Europe from this plantation, were of a very high quality. They were reported to be extracted from *Agave americana*. M. Hautefeuille wished, therefore, to see whether this species really did produce fibre of such merit. He found that the plants at Powai were of several species. Some were certainly sisal agaves, and the author holds that it is not certain that *Agave americana* produced the superior samples of fibre above referred to. Speaking of the plantation generally, he considers that there should be more uniformity in the soil,

the situation, the cultivation, and the species of agaves cultivated. The climate with a very dry period followed by a very wet one is trying to the plants, especially those growing in the valley bottoms: the soil is in places thin and light with a rocky subsoil and in other places of a clay consistency: some plants are grown under shade, others in the open: the plants vary in age, and the produce does not keep the extracting machine running regularly.

Of the plantation at Dauracherra, M. Hautefeuille is able to speak more highly in regard to its management, but he considers that the climate of Assam is not quite suitable for profitable work. The agaves in growth compared unfavourably with those in the plantations of Yucatan. He noted the splendid development of some 12 years old fourcroyas, which require a far more humid climate than the true agave, and he thinks it probable that the cultivation of *Fourcroya gigantea* might be more profitable than that of *Agave sisalana* in Assam.

A visit was paid to Tirhoot, where Mr. Hill and Mr. Coventry had each, side by side, plantations of agave and ramie. Though the appearance of the country at the time was one of extreme drought, yet there was in reality no lack of moisture. The plantations of agave were not looking healthy.

The author believes that in no part of India does *Agave americana* produce fibre of better quality than that of *Agave sisalana*, and he further states that when Dr. Suter, in the *Journal d' Agriculture Tropicale* of January 1902, affirmed this superiority, contrary to the assertions of Professor Warburg, of Berlin, the value of the opinion was unreliable, because it was based on wrong nomenclature of species.

M. Hautefeuille states that he saw no really thriving agave plantations in any part of India. He believes that existing plantations have been established under unfavourable conditions of soil, climate, etc. He suggests that the *Agave rigida* might be successfully tried in the rocky elevations of Southern Peninsular India and in certain waste portions of the Punjab and Rajputana. He considers that the cultivation is difficult and requires for suc-

cess special knowledge. He, accordingly, indicates the lines on which an experimental plantation should proceed. He deals with the essential characteristics of climate and soil and the choice of variety. He then goes on to discuss fully the methods of cultivation and extraction which should be adopted, and in conclusion he gives us the economic side of the question, going somewhat fully into details of outturn, cost of working and value of product. The author lays stress on the fact that there is the greatest difference between growing moderately healthy plants under special conditions and growing plants on a large scale for profitable fibre production. The quality of the fibre, the rate of growth of each plant and the period of existence, are not factors which are considered when planting for ornamental purposes. The agave is moreover very particular in its wants: indeed, in Yucatan, the cultivators will name a soil at first sight as being a "Chelem" soil or "Sarci" soil, these being the particular varieties of agave which for each soil are suitable. The varieties of real economic importance for India are mentioned. The whole paper may be recommended to any one interested in agave cultivation in India.—(R. C. Wood.)

INDIAN INSECT PESTS. By H. M. LEFROY, M.A., F.E.S., F.Z.S., *Imperial Entomologist, Pusa.* (Printed at the Govt. Central Press, Calcutta, 1906. Pp. 300 and 365 Illustrations. Price, Re. 1-8 or two shillings.)

AMONG the recent publications of the Agricultural Department in India is a volume entitled "Indian Insect Pests" by H. Maxwell Lefroy, Imperial Entomologist. This work is divided into four parts. In the first part, a brief summary is given of familiar facts relating to insects and insect life. Part II deals with the origin of insect pests, preventives and remedies. These two parts are written in plain words in a connected manner, and introduce the reader to the salient facts of Entomology as applied to Agriculture. Technical terms are not used. The substance of these chapters applies not only to India but universally. Part III discusses the more important pests of the

staple crops of India, omitting tea, coffee, rubber and such other crops yielding economic products as are more important to European planters than to ordinary agriculturists. The author has, in fact, dealt with the injurious insects which affect in greatest degree the material prosperity of the Agriculture of India. The illustrations which are given will aid the reader to recognize important injurious insects in the field. Simple remedies are recommended. The information which is given about the life-history and habits, should enable any intelligent person to check the ravages of the more destructive species. Part IV deals with insects attacking grain and cattle: exhaustive treatment is not aimed at, but only such information is given as should be familiar to every agriculturist. Beneficial insects are also discussed. The more common kinds are illustrated. In Appendix A, the author gives tables of weights and measures and information about preparing insecticides and simple appliances, etc. In Appendix B, the methods in use for collecting, pinning and setting insects, are described, with a short account of the best methods of study and observation. This is intended for those who may wish to study insect pests, or are interested in insect life generally.

Mr. Lefroy's book contains 300 pages and over 350 illustrations. It is bound in cloth and is sold at Re. 1-8 (two shillings) by booksellers in India and Europe. It is the only work which deals with the Economic Entomology of any portion of the tropics of the East, and in a practical way with pests attacking, in the tropical East, such important crops as cotton, rice, sugarcane, maize, pulses, groundnut, oilseeds and fruit. It should be in the hands of every enterprising agriculturist in India and the East. It is printed and published by the Government Central Press, Calcutta.—(Editor.)

* * *

The use of Prickly Pear as Cattle Fodder. (Bulletin No. 1. Issued by the Central Agricultural Committee, Madras, and printed by the Superintendent, Government Press, Madras. Price, 3 pies.)

The Madras Department of Agriculture has published, in Bulletin form, a summary of experiments carried out in the past.

with a view to ascertain the value of Prickly Pear as Cattle Fodder. Most of the work done in India has been carried out in the Madras and Bombay Presidencies with very conflicting results. Systematic investigation, on a sufficiently large scale, is necessary, in order to arrive at definite conclusions. Different breeds of cattle should be dealt with, also various methods of preparing this fodder for consumption. It is necessary to settle the question whether this plant can be satisfactorily fed to all Indian breeds of cattle as a supplement to other food stuffs in time of famine. The question has certainly not yet been settled by such information as is now on record. (T. F. Main.)

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The Improvement of Sugarcane by Selection and Hybridization. By Sir Daniel Morris, K.C.M.G., &c. and F. A. Stockdale, B.A. (West Indian Bulletin, Vol. VII. No. 4. 1906. Pp. 346. Price, 6 pence.)

The West Indian Bulletin, Vol. VII. No. 4 of 1906, gives an instructive account of work done by the Imperial Department of Agriculture, West Indies, in the improvement of Sugarcane by Selection and Hybridization. The paper has been prepared by Sir Daniel Morris and Mr. T. A. Stockdale. The writers admit that the great expectations, once held regarding seedling canes, have not been fulfilled. They, however, mention numerous examples of success. There is no doubt canes of definitely known parentage have been produced which have high economic value as regards (*a*) disease resistance, (*b*) heavy weight of cane, and (*c*) high sucrose yield.

The pamphlet consists of two sections. The first gives a historical summary of the development of the method of hybridizing sugarcane. The second describes work of this class done in the chief cane-growing countries. Before 1887-88, it was generally believed that sugarcane produced no fertile seed. About that time the researches of Soltwedel, in Java, and Harrison and Bovell, in Barbados, showed that sugarcane, at times, did bear fertile seed. This discovery led to systematic work in the West Indies, and British Guiana is raising improved races of seedling

canes. Practical difficulties in the work of cross-fertilization arose because of the very large number of very minute flowers on each inflorescence.

In 1894, it was discovered that some canes did not bear fertile pollen, but produced flowers which were otherwise normal. Seedlings obtained from the pollenization of such flowers were necessarily the result of cross-fertilization.

In 1904, Lewton Brain demonstrated how flowers could be emasculated while still very young. This operation requires considerable skill. It has to be done in the field on a high platform, because a good crop of cane is usually 8 feet or more in height, and under a dissecting microscope. It is easy to cross-fertilize the emasculated flowers, and in recent years thousands of seedlings have been raised annually in many cane-producing countries.

Mr. Barber's work in trying to produce new varieties of cane in Madras is referred to, and it is suggested that the burning dry air in India is unsuitable to the successful raising of seedling canes, and that therefore the cultivation of selected "sports" is a more likely means of obtaining in India improved varieties. The term "sport" is applied to a single cane which differs in colour and generally in other characters from the other canes which are produced from the same root system. This variation is a comparatively common feature in the fields of cultivated cane in India and in other countries. (T. F MAIN.)

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A NOTE ON THE DUKI FIG-TREE BORER OF BALUCHISTAN (BACTOCERA RUBUS). By E. P. STEBBING, F.L.S., F.Z.S., F.E.S., *Imperial Forest Zoologist to the Government of India* (Forest Bulletin No. 10 of 1907. Pp. 7 and Plates 2. Price, annas 7 or 9*d*.)

THE Imperial Department of Forestry in India has published in Bulletin No. 10, a Note by Mr. E. P. Stebbing, on the Duki Fig-tree Borer of Baluchistan (*Bactocera rubus*). It appears that this borer was first noticed attacking fig-trees in 1905 by Mr. Turner, the Extra Assistant Commissioner of Duki. It was

at first thought that the insect was identical with the willow tree borer, but Mr. Stebbing, with the co-operation of Major Kemball, Political Agent, Loralai Agency, Baluchistan, has proved this supposition to be erroneous, and has identified the insect as being the one above-named. It has been ascertained that few trees are fatally injured by this insect, but this is probably due to the fact that the insects are not yet very numerous. The whole of the life-history has not yet been worked out, but Mr. Stebbing is able to suggest a few precautionary and remedial measures, which, if carefully carried out, are hoped to be sufficient to keep the insect in complete check. Mr Stebbing is of opinion that this insect exists throughout Baluchistan.—(T. F. Main.)

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Tobacco Breeding. By A. D. Shamel and W. W. Cobey. (United States Department of Agriculture, Bureau of Plant Industry, Bulletin No. 96, pp. 71, plates 10 and figs. 14.)

Bulletin No. 96 of the Bureau of Plant Industry, recently published by the United States Department of Agriculture, describes in detail the exhaustive work which is being carried out by Messrs. A. D. Shamel and W. W. Cobey on Improved Methods of Tobacco Cultivation. These two scientists are carrying out a most searching enquiry into all possible means of improving the tobacco plant. One striking fact brought to light by these investigations is that a change of seed on a large scale is extremely bad practice. A particular variety may, by change of environment, not only lose valuable characters but acquire undesirable qualities. The Bulletin discusses minutely the *Control* which it is possible to exercise over such characters as the number of suckers and leaves produced on a plant, the shape, size, venation, aroma and burning qualities of the leaf, resistance to disease, early maturity, etc. Methods of testing the burning quality of the leaf are fully described. Systems of keeping records for use in the field and for permanent reference are minutely explained. The Bulletin concludes with a description of several valuable new varieties of tobacco which have been obtained by cross-fertilization.

The authors, however, have no high appreciation of the value of cross-fertilization in improving a variety within itself, the first effect being to break up a type. Useful hints on the selection of seed are given. The Bulletin is well illustrated with 10 plates and 14 figures. (T. F. MAIN.)

* * *

SCIENCE IN SUGAR PRODUCTION. AN INTRODUCTION TO THE METHODS OF CHEMICAL CONTROL. BY T. H. P. HERIOT. (Published by Norman Rodger, Altrincham, England, 1907. Pp. 108.)

THE object of this book is to bring the methods of science within easy reach of the practical sugar-maker. This endeavour is amply fulfilled. The author gives in simple language a true account of the chemical processes which take place during the manufacture of sugar. The book deals with more than the scientific side of the subject. Much useful information of a practical nature is given. Methods of effecting economy in fuel and generally throughout the whole sugar factory are described. In an Appendix a list is given of the apparatus necessary for the various methods described in the text. This book should be in daily use in every sugar factory that does not employ a chemist. —(T. F. MAIN.)

* * *

THE VARIATION IN THE COMPOSITION OF MILK. BY PROF. A LAUDER, D.SC., *Edinburgh & East of Scotland College of Agriculture*. (Bulletin XI. Pp. 52.)

THE pamphlet describes an investigation of the above subject conducted with two herds of cows in Scotland. The subject is of interest to producers and consumers of milk in India, and the pamphlet is therefore reviewed. In Great Britain, after a searching enquiry, the Board of Agriculture adopted a definite standard of richness of milk, *viz.*:—fat 3·00 per cent. total solids 11·5 per cent. It is pretty generally believed that the milk of individual cows and the mixed milk of a small number of cows, is liable to vary considerably from this standard.

Richmond gives the following as the average composition of 31,120 samples of milk from the South of England during 1905:

	Fat %	Total Solids %
Morning Milk	... 3·54	12·53
Evening Milk	... 3·91	12·86

The variation in composition of milk is due to a number of causes which may be divided into two classes, *viz.*, 'Constant' and 'Irregular.' 'Constant' causes of variation are:—

(*a*) Breed.
(*b*) Period of lactation.
(*c*) Effect of the season of the year.
(*d*) Effect due to situation and climate.

'Irregular' causes, which tend to produce sudden variations in the composition of the milk, are:-

(*a*) Sexual excitement.
(*b*) Sudden changes in the weather.
(*c*) Effect of milking at very unequal intervals.

In experiments carried out since the Board of Agriculture fixed the standard composition for milk, Gilchrist, Bryner-Jones and Collins at the Armstrong College, Newcastle-on-Tyne, and Crowther, at Leeds University, have shown that in a number of cases the mixed milk of a whole herd, particularly in the morning, contained less than the standard percentage of butter-fat. Dr. Lauder's investigations were intended (*a*) to test these results; (*b*) to determine whether the fat content of the morning and evening milk is largely due to unequal intervals between the times of milking; (*c*) to confirm the view that with properly nourished animals, it is impossible, by feeding, to do more than effect a temporary improvement in the quality of the milk.

The results obtained show that the average quality of the milk obtained from a herd of cows varies considerably at different times of the year. The fat content was well above the standard, till about the middle of January when a gradual falling-off began:

the milk, especially that of deep milking cows, remaining rather poor in quality till June. The analytical results are as follows :

	Morning Fat.	Evening Fat.
Average for whole year	3·15	3·91
,, January to April	2·85	3·58%

These figures show that the evening milk was considerably richer in butter-fat than the morning milk. The cows were regularly milked at 6-30 A.M. and 4 P.M.

During August 1906 the milking was done at 5-30 A.M. and 5-30 P.M., thus making equal intervals of 12 hours. The following figures show the composition of the milk obtained :

	Morning 5-30 A.M.		Evening 5-30 P.M.	
	Fat %	Total Solids	Fat %	Total Solids
Average	3·67	12·92	3·70	12·42

Thus by making the intervals between milkings equal, the composition of the morning and evening milks becomes practically identical. These results are in agreement with those obtained by other observers.

In the experiments to observe the effect of feeding in the composition of milk, a portion of the herd received, in addition to the common ration, two pounds of crushed oats and two pounds of linseed cake daily. The averages of the results obtained are given below :—

	Average of cows to which increased ration was given.		Average of rest of cows in herd.	
	Fat %		Fat	
	Morning.	Evening.	Morning.	Evening.
Before change ...	3·03	3·68	3·74	4·18
After change ...	2·81	3·49	3·48	4·05
Difference (—) ...	·22	·17	·26	·13

The experiments were carried out in January and February when, as shown by both sets of figures, the quality of the milk was falling off. The results, which are supported by those obtained by Gilchrist and Bryner-Jones and by other observers

indicate that, with cows already in good condition, increased feeding does not tend to produce any marked improvement in the quality of the milk.

In India the ordinary percentage of butter-fat in cows' milk is much higher than in that of European breeds excepting perhaps the very best of Channel Island Cattle, but variations in quality occur in India under varying circumstances more or less precisely in the same way as in Europe.

Attention is drawn in the report to the value of systematic chemical analysis of milk as a means of selection in forming a herd of dairy cattle. By selecting the good milkers and breeding from these, not only the yield but the quality of the milk of a herd may be gradually improved.—(R. S. FINLOW.)

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THE FERMENTATION OF TEA, PART II. By DR. HAROLD H. MANN, D.SC. (*Published by the Indian Tea Association, Calcutta*, 1907.)

THIS pamphlet forms a further valuable addition to the author's previous publications on the same subject. During the past six years, Dr. Mann has been more or less continuously studying the fermentation of tea, and within this time we have had no less than five publications from his pen dealing with the matter in its various aspects.

In the present issue, the subject is taken up from the point at which it was left in The Fermentation of Tea, Part I, published in April 1906, and reviewed in our issue of July 1906. The enquiry is now extended to the question of flavour in tea, and some interesting and valuable observations are made on the necessity of plentiful aeration of fermenting-rooms and on the optimum conditions of "firing." It has always been held that the flavour of tea is due to an essential oil contained in the leaf cells. This oil, which is apparently a body of doubtful chemical composition, is said to be contained in very small quantities in the leaf: according to Dr. Mann, "so small indeed that any

measurement of the amount of the oil, by weighing it directly, is absolutely impossible." Under these circumstances, Dr. Mann has devised an indirect method for determining its quantity in a given sample of tea-leaf, on which he bases all his observations on the effect of varying conditions during the fermentation process on the development of the oil. The method, as described, does not seem altogether beyond criticism from a chemical standpoint, but the results obtained by its application to several samples of tea seem to coincide remarkably closely with trade valuations.

The first point, brought out by an application of this method to the study of the process of manufacture, is that a very small proportion of the essential oil is developed during withering, but that immediately the walls of the leaf-cells are broken down by rolling, a rapid formation of oil takes place and speedily reaches a maximum. The rate of formation decreases during fermentation, and is generally complete after three hours from the beginning of the rolling process.

This suggests one of two things: either that the oil is developed by a process of enzyme fermentation which cannot take place until the cell-walls are broken down and the interacting bodies brought into contact, or that the method of analysis is at fault, and that less oil is found in the unrolled leaf solely because in this condition the unbroken cell-walls prevent the whole being carried over by distillation. The latter seems the more probable explanation. The observation that no appreciable increase in rate of formation of the oil takes place with a rise in the temperature at which the fermentation is conducted, seems also to argue against its being formed during the manufacturing process and in favour of the apparent increase after rolling being due to the method of determination. Against this, we have the fact that an increase in the quantity of oil apparently does take place after rolling, though at a comparatively slow rate.

It is found that an increase of the period of fermentation, beyond about three hours, leads to a decrease in the flavour-giving constituent, and this gives Dr. Mann an opportunity to preach again his excellent sermon on the necessity for absolute

cleanliness during tea manufacture. It is clearly shown by experiments, in which antiseptics are used, that this loss of flavour is due to bacterial action and, since the use of antiseptics is clearly inadmissible in manufacture, the necessity for the only other alternative to reduce bacterial action to a minimum, absolute cleanliness, is clearly indicated. In following this observation of the decrease of flavour giving constituents after three hours fermentation to its further logical application, a practical difficulty arises. In a former publication Dr. Mann has shown that, in order to obtain a leaf capable of giving a liquor of the best pungency and character, four or five hours' fermentation at a temperature of 75 – 84 F. is required. He now shows that anything beyond three hours leads to loss of flavour. Can these two requirements be reconciled? In Dr. Mann's opinion the answer is in the negative, and each planter must face the position and make up his mind if it will be more to his advantage to make for "pungency," etc., at the expense of flavour, or for flavour at the expense of pungency, etc. To put it in the author's words, "if flavour is the primary consideration, the fermentation should be as short as possible, consistent with producing a respectable 'liquor'; if 'liquor' is the more important, the fermentation should be as long as possible (up to 4½ hours at any rate), consistent with retaining the most flavour possible."

Some interesting observations are made on the subject of the aeration of fermenting-rooms. Figures are given showing that on an average, 4½ lbs. of fermenting tea-leaf exhausts the oxygen from one cubic foot of air, and the conclusion is drawn that it is necessary to provide for a constant supply of fresh air in the fermenting-room. It is pointed out, however, that any air so supplied must be saturated with moisture, so as to avoid any risk of premature drying of the leaf, and the valuable practical suggestion is made that a constant supply of fresh air should be blown into the room over wet cloth or *khuskhus*.

The last subject discussed is that of "firing." In his previous report, Dr. Mann has shown the importance of rapid firing by tracing the great losses of soluble matter and tannin which result

if anything like "stewing" of the leaf takes place. He now shows that, from the point of view of flavour, rapid firing is equally desirable, since there is a marked deterioration if the leaf is kept at an elevated temperature in a moist condition. Rapid firing can be attained in two ways:—(*a*) by working at a high temperature; (*b*) by having a strong induced draught. The former method is shown to be inadmissible when flavour is a prime consideration, and the use of machines with strong draughts, or of a large number of machines, so that firing takes place rapidly at a comparatively low temperature, is recommended.—(C. BERGTHEIL.)

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REPORT ON EXPERIMENTS IN PUMPING WITH OIL-ENGINES AND CENTRIFUGAL PUMPS IN 1905-06. BY ALFRED CHATTERTON.

(Printed by the Superintendent, Government Press, Madras, 1907. Pp. 26, Figs. 8.)

MR. CHATTERTON, Director of Industrial and Technical Enquiries in Madras, has published a report for 1905-06 of his experiments in pumping water with oil-engines and centrifugal pumps. The report is illustrated with many instructive diagrams, and gives valuable information based on the results of elaborate experiments. It embodies information in regard to (1) the actual cost of raising water under different conditions; (2) the amount of irrigation water required under varying conditions as regards crop, soil and rainfall; (3) the advantage of employing small oil-engines and pumps for the irrigation of intensive cultivation such as that of garden crops on small areas; (4) the quantity of water available for lift irrigation throughout the year from various sources of supply, such as wells, open rivers, tanks and natural lakes; (5) the distribution of underground water in various parts of the Presidency and practical means of making larger use of it than at present; (6) the efficiency of different oil-engines and centrifugal pumps, the practical method and the precautions to be taken in using them; and (7) the general arrangement of installations.

The report, like Mr. Chatterton's work in general, is thorough, and cannot be briefly summarized without the omission of points of great practical value. It necessarily appeals more to those who have some technical knowledge of an engineer's work than to the ordinary reader. An educated capitalist can utilize the report to his advantage; an ordinary cultivator would gain very little advantage from even a free and easy vernacular translation without numerous explanations in very simple language.

In various parts of India *intensive* cultivation is practised with extraordinary success. For such cultivation in many places, expensive well irrigation is used with great advantage for such crops as sugarcane, tobacco, ginger, turmeric, and many more which it is unnecessary to particularize. These crops are regularly rotated and are taken in rapid succession. The land is continuously occupied, and well irrigation by bullocks and the ordinary leather bag water-lift costs well over Rs. 100 per acre per annum. If there is a sufficient spring of water in a well in ordinary seasons to justify the use of an oil-engine and pump, Mr. Chatterton's figures clearly indicate that there will be great economy in their use. Any intelligent reader can determine from the report the conditions under which oil-engine and centrifugal pump can be economically used for the purposes of irrigation. Mr. Chatterton points out that experience has shown that it is not necessary to employ expensive men to drive these engines. They work fairly satisfactorily in the hands of Native drivers on wages of Rs. 10 to 15 per month, provided the drivers implicitly carry out the instructions given to them and carefully attend to lubrication and the tightening of nuts and bolts that may accidentally become slack.

For estimating the cost of pumping water under good working conditions, Mr. Chatterton takes an installation consisting of a $7\frac{1}{2}$ H.-P. oil-engine and a 4" pump with a maximum lift of 25 ft. This plant will raise 18,000 gallons of water per hour, provided there is sufficient water available for 12 hours' running per day. Including charges for installation, interest, depreciation, mainten-

ance and repairs, the working expenses are estimated as follows :—

		Per day.
1.	Liquid fuel, 9 gallons @ 3 as. per gallon	... Re. 1-11-0
2.	Driver @ Rs. 15 per mensem ...	... „ 0- 8-0
3.	Lamp and lubricating oil, waste and stores	... „ 0- 8-0
4.	Interest and depreciation 10 per cent.	... „ 1- 4-0
5.	Maintenance and repairs 5 per cent.	
	Total ...	Rs. 3-15-0

This gives a total cost of working of Rs. 3-15-0 or Rs. 4 per day. The cost increases as the number of days in the year, during which the engine is not worked, increases. Assuming that the engine works for only 200 days in the year, the daily cost of working comes to Rs. 5-10-0.

I have repeatedly tested the amount of water which is ordinarily lifted per hour by means of the ordinary leather bag worked by bullocks. If the depth of water is about 25 feet, the amount discharged does not usually exceed 1,800 gallons per hour or $\frac{1}{10}$th of Mr. Chatterton's figures. The daily cost of manual and bullock-power at ordinary hiring rates comes to 12 annas or about the one-sixth of Mr. Chatterton's maximum estimate.—(EDITOR.)

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WELL-WATERS FROM THE HADHRAMAUT, ARABIA. By DAVID HOOPER, F.C.S. (Journal of the Asiatic Society, Bengal.)

MR. HOOPER, Curator, Industrial Section, Indian Museum, Calcutta, has contributed to the Journal of the Asiatic Society, Bengal, an interesting article on the value of well-waters containing mineral salts in the Hadhramaut Valley of South Arabia. This valley, which extends over 100 miles parallel to the coast, collects under its sand the water of the high Arabia tableland. These subterranean stores form valuable sources of water-supply in the springs, streams, aqueducts and wells of the valley, and being rich in mineral salts give fertility to the lands irrigated from them. Mr. F. Noel-Paton, Director-General of Commercial Intelligence, during a visit to South Arabia a few years ago, was struck with the fertilizing property of the mineral water of

Hadhramaut and specially with the fine crops of tobacco grown in that region. Cultivation depends upon irrigation, for there is practically no rainfall. Last year Mr. Noel-Paton procured samples for chemical analyses. These have been analysed by Mr. Hooper and contained the following constituents per 100,000 parts :—

	Total Solids.	Lime.	Magnesia.	Potash.	Soda.	Iron.	Chlorine.	Sul. Acid.	Nitr. Acid.
Harith	415·5	96·88	9·55	20·60	59·21	2·8	46·5	143·3	·19
Ferath	383·8	94·96	9·72	18·92	54·39	2·0	30·9	146·2	traces.
Sida	409·6	87·50	11·10	17·37	58·83	2·5	35·5	151·1	·11

Mr. Hooper thinks the fertilizing properties are probably due to the presence of potash and lime salts and the action of the sulphates in liberating the alkaline constituents from the soil. In this respect the composition of the water differs widely from that of waters of wells in the Bombay and Madras Presidencies which are suitable for tobacco cultivation. The nitrates, which these waters contain, have a high fertilizing effect for tobacco. There are salt or brackish wells in numerous other parts of India. The waters of these have, in some cases, great manurial value, whilst in others the brackishness has injurious effects on nearly all crops. The brackishness deserves searching chemical investigation particularly in reference to the profitable use of the water for tobacco cultivation.—(Editor.)

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Notes on Rubber Cultivation : with special reference to Portuguese India. By Lieutenant-Colonel J. A. Wyllie, F.R.G.S., I.A., and Octaviano Guilherne Ferreira, M.R.A.S. (Published by Higginbotham & Co., Madras. Pp. 131 and 16 Plates. Price, Rs. 4-8.)

This volume, at once a résumé of results so far achieved in rubber cultivation in India and a practical guide to Planters, based on wide personal experience, is commended to all who are interested in this industry. The principal plantation rubber trees are dealt with at considerable length and the relative merits of each discussed, while full instructions are given for planting,

The estimates of expenditure and returns on outlay of capital give promise of a rosy future for rubber planters, and the authors are not inclined to agree with those who fear overproduction in the near future. It must be remembered, however, that rubber planting is still an infant industry, and much must be learned before one can forecast its future with any degree of certainty. Thus Ceara rubber (*Manihot glaziovii*), which at first gave but little promise of success, is now finding favour with a good many planters even in Ceylon, and there is little doubt that Ceara can be grown over a very wide range of country. Even the range of Para (*Hevea brazilliensis*) is likely to be considerably more extended than was at one time thought possible of a tree whose natural habitat is the tropical and marshy Amazon valley. The possibilities of many of the rubber vines also are but imperfectly understood. On the other hand, cheapening of the processes of production is bound to come with advance of knowledge, and again the demand for rubber is sure to respond enormously to any fall in price. Perhaps, in the present state of our knowledge, all we can say with safety is that unless natural conditions place a limit to rubber planting, cultivation will extend until only an average rate of profit is earned on all but the most favoured tracts.

The publishers are to be congratulated on the general get-up of the volume, paper, printing and illustrations being alike good.—(E. SHEARER.)

* * *

FIRST BOOK ON AGRICULTURE. By C. BENSON, M.R.A.C., *Late Deputy Director of Agriculture, Madras.* (Published by Messrs. Macmillan & Co., Ld., London, 1906. Pp. 166.)

THIS small volume, which has translations into both Tamil and Telegu, has been written for use in primary schools, especially in Southern India. Mr. Benson's intimate knowledge of the agricultural conditions of the Madras Presidency has particularly qualified him for such a task, and he has here combined an exposition of the elementary principles of agriculture with their local application in a very successful manner. The book is written in

a simple and homely style, suited to the reader whom the author has in view, but we have no doubt it will appeal still more to adults, among whom it ought to have a wide circulation. The apposite sayings from the vernacular which head each chapter should, as Mr. Benson hopes, "produce a homely effect on the minds of the parents of the pupils in rural schools," and should do much to engage their interest. We commend the book to all who are interested in Indian agriculture. (E. SHEARER.)

CHEMISTRY OF THE PROTEIDS. By DR. GUSTAV MANN. (Published by Messrs. Macmillan & Co., Ltd., 1906. Pp. xviii + 606. Price 15*s.*)

THE subject of proteid chemistry is one which has of late years become more and more prominent, and we are indebted to Dr. Mann for co-ordinating the literature of this vast and scattered subject.

This work may well find its way to every chemist's bookshelf, for, not only does the author give a clear and concise description of much of the pure chemistry, such as Emil Fischer's work on the mono-amino acids and other decomposition products of albumen, but he also gives what is of almost equal value to the earnest student, a very full series of references to the original papers.

The nomenclature of the subject has always been one of the great difficulties in the way of its study: and Dr. Mann, on more than one occasion, falls into the error of using confusing terms. Notwithstanding this deficiency, however, the book is eminently one for use, and will be well worthy of a place in every scientific library.—(J. H. BARNES.)

RUBBER CULTIVATION IN THE BRITISH EMPIRE. By H. WRIGHT. (Published by Messrs. Maclaren and Sons, London. Pp. 100, 2 Photos. Price 2*s.* 6*d.*).

THIS booklet contains an account of a lecture delivered before the Society of Arts and deals briefly with the present position and prospects of rubber cultivation in the tropical portions of

the Empire. The high prices obtained for both wild and plantation rubber in recent years have led to the planting of considerable areas in the Malay States, Ceylon and Java, chiefly with Para rubber (*Hevea braziliensis*). The trees on some of these estates have been tapped and excellent rubber has been produced, but most of the area planted up in these regions still consists of young trees. In spite of the extremely optimistic views of the author on the future of the plantation rubber industry and the large profits to be made by extending the area in the East, a perusal of this pamphlet and of some of the recent literature suggests the possibility that the rubber boom is not likely to last and that before very long, the new plantations will produce sufficient rubber to lower the price considerably. It is well to remember the history of the cinchona, tea, coffee and sugar industries, when high prices rapidly led to overproduction and a great fall in prices. There is further the possibility of producing artificial rubber or rubber substitutes at a low price with results similar to those brought about by the manufacture of artificial indigo. Except in some portions of Burma and Southern India, like Travancore, there is not much prospect of the successful cultivation of Para rubber in India, and before any extension of the present plantations in these regions can be advocated, it will be well for planters and Government officers to watch the results of those already in existence. The prospects of Assam rubber (*Ficus elastica*) in Eastern India have been discussed by Dr. Mann in a recent paper in this Journal (Vol. I, Part IV). It appears that Assam rubber is not likely to be of much importance in this country, and it is perhaps not too much to say that India is unlikely to become an important producer of plantation rubber. Some wild rubber is exported every year from Assam and Burma, but the amount is inconsiderable. (A. HOWARD.)

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SECOND REPORT ON SUGAR MILLS AT BENIPORE FACTORY. By PERCY JONES. (Published by the Behar Planters' Association.)

THE Behar Planters' Association have published a 2nd Report on the experiments in Rab-making at Benipore

(Tirhoot) in 1906-07. At the suggestion of Mr. Percy Jones, Government supplied two *Rab*-making appliances (*Bel*). The term "Rab" means crude sugar in a semi-liquid form. In this form the sugar crystals can readily be separated from the treacle by a Centrifugal machine. The Agricultural Department, United Provinces, lent the services of a qualified Inspector and two boiler-men to erect the appliances and to demonstrate proper working methods to the local men. Mr. Percy Jones reports that he has thus succeeded in making *Rab* of uniform quality, and superior to that ordinarily made in his district. He purchased cane in the field on terms which were satisfactory to the grower and the refiner. The experience gained during the last two seasons has demonstrated that the improved methods of *Rab*-making will be of advantage to such cultivators as can afford to grow cane but cannot afford to set up expensive cane mills and refining appliances. During the last season the Benipore Mill worked under certain unusual disadvantages which are fully described in the report. The margin of profit was, therefore, small. The experiments clearly indicated the necessity for a high speed hand Centrifugal machine. This will be obtained. The experiments which will be carried out during the next sugarcane harvest will be on a commercial scale and Mr. Percy Jones offers a cordial invitation to all concerned to come and watch results. These experiments are intended to show the practical advantages of a cheap installation which will deal with detached areas of cane, each of moderate size, and be capable of turning out refined sugar and molasses, which latter can be boiled down again into saleable *gur*. The interests of the ordinary cultivator are chiefly concerned.—(EDITOR.)

NOTICE.

THESE Memoirs, dealing with scientific subjects relating to Agriculture, will appear from time to time as material is available. They will be published in separate series, such as Chemistry, Botany, Entomology and the like. All contributions should be sent to the Editor, the Inspector-General of Agriculture, Nagpur, Central Provinces, India. Contributors will be given, free of charge, fifty copies of their contributions.

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