

the construction of any new railway is undertaken. One is strongly inclined to suspect that the synchronism of malignant malaria and the construction of high roads and railways noticed by various observers during two generations in different parts of India cannot be due to mere chance coincidence and that there is some intimate connection between them. And a little reflection will show what that connection may be. The main railway systems of Northern India traverse a vast expanse of thick alluvium. It is thus easy to imagine that the tremendous pressure exerted by the trains on high railway embankments would convert them into more or less impervious walls down to considerable depths. The effects of such walls would be to impede surface as well as sub-soil drainage, to increase humidity, to introduce marshy conditions where, as in parts of the North-western Province and the Punjab, they did not exist before, or aggravate them where, as in Bengal, they have always been present, and to convert the chains of "burrow pits" by the side of the embankments into so many breeding grounds of anopheles. It is true that railways chiefly in their own interests are provided with waterways ; but they are generally insufficient specially in a delta like that of Bengal. Besides, several of the main lines run more or less parallel to large rivers and the impervious underground walls of their embankments offer serious obstructions to the lateral percolation of the waters of these rivers, thus introducing or aggravating marshy conditions even in areas by the riverside which should otherwise be very healthy." Dr. Bentley also refers to the obstructions to the free flow of water tending to the diminution of water and the promotion of general stagnation caused both by river embankments and railway embankments, although he holds that the damage done by the river and railway embankments is not so much by causing areas to be water-logged as by contributing to the decay and death of rivers. He also points out that epidemic malaria has now appeared in parts of Eastern Bengal where railways have been constructed in recent years.

An expert committee to enquire into the sufficiency or otherwise of waterways in the railway and road embankments would thus seem to be highly desirable. Power should be taken by special legislation, if necessary, to provide adequate waterways and to fill up or enlarge all insanitary burrow pits and make them innocuous for mosquito breeding.

Minor Schemes—Success of Experiments.

Turning to minor measures for improving drainage and sanitary condition of particular localities and villages, it may be observed that not only are they within the scope of local enterprise, but judging from the splendid results achieved by intensive work in the vicinity of some of the jute mills and in the Mines Board of Health area in Asansol, and even in villages where there are any active anti-malarial and health societies, there cannot be any doubt that such work is fruitful of satisfactory results and succeeds in very greatly improving health and checking malaria in the limited area of their operations. In fact, having regard to the great expensiveness of the major schemes, the remoteness of their results and the doubt which has been thrown quite recently in Italy on their efficacy, it will certainly be wiser to concentrate attention on minor and local measures.

The remarkable improvement in the sanitary and hygienic conditions of the mill areas on both sides of the Hooghly cannot fail to attract attention. With the introduction of special sewerage system in the more prosperous mill areas there is bound to be still more marked progress. As an example of special anti-malarial work in jute mill areas, reference may be made to the excellent work by Dr. Norrie of the Angus Jute Mills at Bhadreswar which was inspected by me about four years ago.

A tract of country about $1\frac{1}{2}$ miles in area is being attended to. This covers not only the land belonging to the Angus Company, but includes land of private proprietors and a good portion of the compound of the Northbrook Mill. The chief anti-malarial work which is being done is to clear jungle and drain out all small *dobas* and puddles either by cutting out drains or by filling them up. This prevents the accumulation of water in small holes and ditches and destroys the breeding grounds of anopheline mosquitoes. Besides thus improving the ground, the water of every tank in this area is periodically examined with a view to detecting the presence of the larvae of anopheline mosquitoes and of destroying the larvae by spraying them with a mixture of kerosine and crude oil. I was interested to learn that the mosquito will breed in clear water as well as in dirty water and the larvae must be destroyed 48 hours before the period of hatching, otherwise the spraying may be too

late. Tea garden sprays are used, the cost of one being Rs. 75. The staff employed for this work consist of one Overseer drawing Rs. 45 per month, one Sardar cooly drawing Rs. 8-4 per week and 16 Gang coolies drawing Rs. 4-2 per week. As a result of the excellent work done by Dr. Norrie the incidence of malaria has been reduced by 66 per cent in the neighbourhood. I have little doubt that if the sphere of activities of Dr. Norrie be somewhat extended, and co-ordinated action on behalf of all the parties interested in the matter be taken, malaria will very soon be completely eradicated from this area.

Special mention must also be made of the excellent anti-malarial work of the Asansol Mines Boards of Health. The Board have a special staff for anti-malarial work, and the experience of the Board seems to indicate that great reliance may be placed on the value of careful drainage for driving malaria from any particular locality. The following instance quoted from the report of the Board will be of special interest. "In September, 1917, it was reported to the Chief Sanitary Officer that severe malaria existed in the village of Narfdi in Jamuria thana and that the disease had also for many years been epidemic there. On investigation the report was found to be correct, but it was observed that while the whole village was more or less malarious, the disease existed in an intensified form in the houses bordering on a low-lying marshy area of land immediately to the north of the village. Accordingly, in February, 1918, on the recommendation of the Chief Sanitary Officer, the Asansol Local Board made a grant-in-aid of Rs. 945 out of a total estimated cost of Rs. 1,200 to the Asansol Mines Board of Health for the purpose of carrying out the drainage of the area in question. The drainage scheme consisted:

- (1) In the construction of a "kutchra" main outfall drain of about 400 yards in length fed by smaller kutchra drains from all low-lying parts of the area.
- (2) In the construction of pucca overflow channels connected with the kutchra drains from two large neighbouring tanks, the overflow from which was chiefly responsible for the constantly water-logged condition of the area.
- (3) In filling up with spoil obtained from the drains

small depressions throughout the area which could be satisfactorily drained.

- (4) In the construction of three culverts to carry existing cart tracks over the drains.

The results of this simple and inexpensive scheme which has called for no additional expenditure for maintenance since its inception have been wholly satisfactory, as by it malaria has been completely eradicated from the village, and the villagers, many of whom were through ignorance, opposed to the scheme in 1918, are now after four years' experience unanimous in their appreciation of it.

The success of the experiments would seem to demonstrate two facts. Improved drainage resulting in the removal of water holes suitable for the propagation of the anopheline mosquitoes is as potent and perhaps more certain antidote for malaria as bonification, provided, there is a fairly thick and prosperous population as is the case in mining or jute mill areas. The second point is that to be really effective any anti-malarial campaign must be intensified in units of small areas.

Medical and Anti-infection Measures.

We will now say a few words about the medical measures necessary for the suppression of malaria and kala-azar, though, of course, it is not expected that we should deal at any length with the medical aspects of the treatment of the diseases. As regards malaria, it is fortunate that the vector had been discovered some years ago and measures have been taken in various parts of the world to minimise sources of malarial infection. In brief, we have to direct our efforts to the destruction and prevention as far as possible of the breeding of the malaria-carrying species of the anopheline mosquito. Of course, the other important source of infection is the malaria-infected human patient. The treatment and care of malaria patients is, therefore, perhaps, the most important medical measure for minimising malaria-infection.

For an authoritative statement of the situation we cannot do better than quote the late Prof. Battista Grassi who had the fullest opportunity of studying the campaign against malaria

carried on in Italy according to the latest methods and with the most successful results.

"In consequence of the discovery of the anopheles, which is carrier of malarial fever, the fight against this plague in Southern Europe has been based on the treatment of the germ-carrying man, on mechanical protection, on prophylaxis by means of quinine, and on minor drainage and reclamation.

- (1) The germ-carrying man, who is disinfected by quinine, alone or jointly with arsenic and iron, is no longer able to infect the anopheles. This way of anti-malarial fight is facilitated by the long period (from January to June almost) during which man is the sole carrier of the germs of malaria, because anopheles are rare; they sting very little and can hardly ever become capable of spreading infection when the temperature is low; all those of the previous year die at the beginning of spring and the new generations take up their abode preferably in cattle sheds. If, during this intra-epidemic period, all malaria sufferers could be cured, a fresh epidemic could not develop.
- (2) Mechanical protection by screen is a safeguard against stings, and consequently against new infections, while on the other hand, it prevents the anopheles from becoming infected by stinging malarial patients.
- (3) Small sanitation measures and drainage consisting in the destruction of watery breeding places of anopheles do away with small breeding centres of the latter (left over by large scale drainage or produced by negligence or faulty irrigation) by having recourse, for instance, to warping (colmata) or anti-larval measures (petroleum or Paris green).
- (4) The destruction of winged anopheles. This, during the winter, gives no appreciable results, but during the summer, on the

contrary, it is very successful, because in a very short time it is possible, for instance, in pigsties, to capture hundreds of anopheles among which the percentage of infected is almost the same as in the houses of malarial sufferers."

Difficulties of Adopting such Measures.

The Professor, however, is careful also to point out the drawbacks of each of the above methods. Aquatic destruction, he points out, meets with hindrance, because water which harbours anopheles is also wanted for irrigation. In Bengal, the kerosinization of tanks is often objected to on the score of its alleged baneful effects on the fish. The benefits of metal trellis work are only learnt after experience and would only be suitable in cities and towns

Quinine Distribution.

As regards treatment with quinine, it is pointed out that a number of patients have not sufficient faith in quinine, and as a prophylactic it is almost practically impossible to continue the treatment without interruption throughout the entire fever season. If this is so in Italy how much more difficult is the problem amongst the poor and uneducated people of rural areas of Bengal. It is curious that even amongst the medical profession there does not seem to be complete unanimity regarding the efficacy of quinine. Some authorities like Major S. P. James, M. D., I. M. S., hold that by administering large doses of quinine more or less in a haphazard manner, we may not only be placing the patient in such a condition that he is very liable to relapse, but may be increasing enormously the sources from which anopheline mosquitoes become infected. But the experience gained in Italy, Panama and other places and in our own jails, and amongst the planting community of the Dooars, leaves very little room for doubt about the value of quinine as a prophylactic and a febrifuge.

A more serious difficulty however is emphasised by Dr. Bentley in his monograph which consists in the utter inadequacy of the stock of quinine and cinchona available in Bengal, and the consequent inadequacy of the doses of the febrifuge administered to patients. According to Dr. Bentley out of the total of 10 millions of severely affected malarial patients in Bengal, only a few thousands receive adequate treatment in the larger hospitals, and under two millions receive treatment which is wholly inadequate as far as supply of quinine is concerned, and the vast majority have to go without treatment or be at the mercy of quacks. Having regard to the limited amount of quinine available and its comparative expensiveness, Dr. Bentley expresses the opinion that the eradication of malaria from Bengal by the use of quinine is under present conditions hardly a practical proposition. I am, however, inclined to place more value on Dr. Bentley's observation that the Government of a country which can secure a cheap and adequate supply of quinine and other cinchona alkaloids and ensure that each individual in the population learns both the value of the drug and how to use it, confers an inestimable blessing upon its people.

The work of quinine distribution and its administration should be carried on in urban areas by the executive officers of the municipality under the advice of the Health Officer or Sanitary Inspector, and in the rural areas by the Union Boards under the supervision of the Circle Officer and the District Health Officer. To combat an epidemic of malaria a regular census of the members of families attacked with malaria should be attempted and individual attention paid to each patient. The patients must be treated with proper doses of quinine and cinchona febrifuge which might be sold at cost price except to those too poor to pay who should get them free of charge, while it might be advisable to distribute gratis to all at the initial stages in order to popularise their use.

It is important, however, to avoid any show of compulsion in the matter and the tablets should not be administered to those who object to the treatment. The ideal aimed at should be that the quinine and cinchona tablets should be placed within the easy reach of all, in every village or town, and every attempt made to

popularise their use both as a preventive and as a curative, not only during the epidemic period but also during the intra-epidemic period. The services of all local doctors, village post-masters, *gurus* and teachers of village schools should be utilised for the distribution of quinine. Special attention should be paid to the administration of quinine to all boys reading in public schools both in the urban and rural areas. The District Boards should issue special instructions to all the head teachers of all primary and middle schools under their control, and the efforts of the District Board in this direction should be backed up by the Education department, which should instruct all inspecting officers to pay special attention to this matter and to see that suitable arrangements are made in all schools for the administration of quinine to the students twice a week during the fever season. For areas severely affected by malaria, intensive treatment would be necessary. Special malaria doctors will have to be appointed and special malaria dispensaries to be set up to meet local needs.

It is needless to point out that the primary need, however, is to provide existing dispensaries with a sufficient stock of quinine and other suitable drugs and the question of funds is thus the most important factor for consideration. As District Boards have now been instructed to set apart adequate sums from their augmentation grant for sanitary and anti-malarial work, it is hoped that a suitable sum should be set apart for the purchase of quinine which should be distributed to their dispensaries and also to the Union Boards according to their needs. Large quantities of quinine are also distributed by the Public Health Department of Government through the Civil Surgeons. During the last two years the provincial budget grant for the purpose has been greatly increased. To meet special cases special money grant from Government would also seem to be very necessary. Some system should be adopted which will avoid overlapping, and which will ensure distribution of quinine in areas where it is most needed. This can only be satisfactorily done if the existing District Sanitary Committee is reorganized to represent all interests, with the District Magistrate as the President, the Civil Surgeon as the Secretary, and the District Board Health Officer as the Assistant Secretary.

Medical treatment of Kala-azar.

As regards the medical treatment of kala-azar, the vector has not yet been finally accepted, and although it is suspected that a special kind of sand fly is more likely to be the vector of the disease than any other insect, yet this theory is not sufficiently advanced to justify the adoption of the measures for the destruction of this fly. We will, therefore, have to be content for the present with the treatment of the disease with a view to minimising the dangers of the transmission from man to man.

Normal anti-kala-azar work must, therefore, for the present be directed towards maintaining free treatment centres for the treatment of the masses, and the problem we have to face is, therefore, how we can open sufficient number of centres at suitable places, so as to bring the remedy within the reach of all the suffering population in the village. At these centres, treatment by antimony injection may now be considered to be the accepted medical remedy as the cures are reported to be over 90 per cent. Improved forms of the same treatment by Urea-Stibamine of Dr. Brahmachari and the German preparation—Von Heyden 471, though somewhat more expensive, are reported to be still more efficacious and free from any subsidiary injurious effect.

III

Available Agencies.

We may now turn to the agencies available for anti-malarial and kala-azar work. As already described in the previous chapter on Health, we may classify such agencies as follows:—

- (1) Governmental.
- (2) Local Bodies—District Boards and their offsprings—
Local and Union Boards.
- (3) Private and missionary enterprise—co-operative health associations.

Governmental Agency.

As regards Government, their policy, as we have seen, is direc-

ted to research and scientific work for the discovery of right methods; to the inauguration of a comprehensive scheme of sanitary and medical staff for rural areas, to giving such financial assistance as the budget allotments would permit to non-official organizations working either under central societies or under the guidance of village Union Boards, provided the village societies give evidence of actual useful work and provided also there is genuine effort at local self-help and self-reliance and the District Board and other local bodies discharge their legitimate share of responsibility. As regards malaria, we have already discussed the efforts which are being made conjointly by the Public Health and Irrigation departments to undertake feasible schemes of irrigation—bonification for the improvement of the health and agricultural prosperity of the people. In this connection we have pointed out that the pace has been painfully slow and should be greatly accelerated and far larger funds should be made available and a special department of expert engineers with knowledge of Egyptian and Italian methods created to cope with the vast problem of health and agricultural irrigation for Bengal. It is also true that, although efforts are being made to grow and manufacture quinine and cinchona at Government farms and the Bengal Government are buying more quinine than any other Provincial Government, yet the supply is still far short of the demand, and one of the most important directions for developing anti-malarial campaign of the province would undoubtedly be to greatly enhance the production and manufacture of cinchona and the placing of the whole scheme of quinine supply on a sound financial basis. In the last three budgets handsome sums have been allotted for anti-malarial work and during last year budget provision was made of Rs. 1,50,000 for free distribution of quinine and cinchona and Rs. 80,000 for assisting in the formation of village associations. Great stress is being rightly laid to the necessity of developing village associations—as otherwise the task of reaching medical aid to about 10,00,000 infected and 80,000 actually suffering patients, spread over an area of 75,000 sq. miles in 119,000 individual villages, would obviously be hopeless. But in connection with this ideal of the Public Health Department for 'human bonification' it would be well to confine

financial assistance to such organizations only which are able to furnish proof of actual work done and which have some guarantee of a continuity of programme. It is also a sound policy to encourage Union Boards to embark on health and rural work, and to establish health societies in the villages by the grant of suitable financial assistance.

As regards kala-azar, special attention is being paid since 1919 to the fighting of this disease, and, in a sense, the whole available subordinate staff of the Public Health Department has been concentrated on this work. As we have seen, Dr. Sur was placed on special duty to make a survey of the incidence of the disease, and although the survey could not be completed, yet we have now a fairly accurate idea of the incidence of the disease in the different parts of the Province. As it would be impossible for Government to take upon itself the whole task of fighting this fell disease, as is being attempted in Assam where an intensive programme costing about 3½ lakhs annually has been laid down, we are in this Province following the policy of helping the people, and their representative local bodies to organize the medical and health associations necessary for fighting the disease. Special grants have been made in the last three budgets and in announcing the grant of a lakh-and-half last year, the officiating Director stated that in consultation with the District Boards it had been decided that the actual kala-azar work should be done by the local bodies by a special health establishment for which they will receive assistance from Government, whereas the work of supervision and organization would be taken up by the Government Health department. To enable the department to cope with the greatly increased work of supervision which the scheme will involve, a temporary staff of Inspectors has been appointed. It is pointed out that such an organization would possess the additional advantages of uniformity and local responsibility with ease of amalgamation with the coming district health establishments and also combination with village co-operative health societies. Regular dispensaries already established by District Boards and Union Boards and village dispensaries maintained by co-operative health societies would form convenient centres for kala-azar work also and would benefit in their popularity and usefulness. As soon as all the different separate organiza-

tions for different parts of public health work have been sufficiently developed, it may be possible to definitely combine them into one homogeneous local service available for all forms of public health activity. Detection of kala-azar cases in the villages would then be undertaken by the local health units. For the purpose of this scheme of kala-azar work, registered institutions like the Central Co-operative Anti-malarial Society and the Bengal Health Association, may be treated to be entitled to similar terms, if they agree to fulfil all the prescribed conditions on the proportionate basis of individual treatment centres. The District Boards and other private organizations are to receive a grant of Rs. 1,000 for nine months for a group of 3 treatment centres, provided the doctor received not less than Rs. 100 as his monthly pay. Every doctor would be required to visit the three treatment centres in rotation working two days at each. Regular records of the work done are to be maintained which should be open to inspection by Government officers. I am aware that in some circles this has been resented, but it is difficult to see how any association should claim assistance from public funds without submitting to inspection by Government officers.

In our last Divisional Conference the manner in which the offer of assistance by Government had been utilized by District Boards was a subject for discussion. But no definite information was forthcoming, and it was recommended that District Boards should send up their requisitions to the Director through their District Magistrates once a quarter, who in forwarding these requisitions would be able to give some general idea of the manner in which work was being done at the different centres. I attach great importance to District Officers and their subordinates, the Subdivisional Officers and Circle Officers, being closely associated with any scheme of rural medical and health work for which public money is expended—particularly if it be desired to develop simultaneously a network of co-operative village health societies to take part in the general campaign.

Local Bodies.

As regards local bodies, the various District Boards of the Presidency and Burdwan Divisions as also in the other Divisions of

the Province, have also shown commendable enthusiasm in undertaking schemes for fighting malaria and kala-azar. With the appointment of District Health Officers in 1921-22 and in pursuance of the Circular of Government requiring a portion of the augmentation grant being set apart for sanitary and anti-malarial work, they have all made an excellent start.

The District Board of Alipur set a splendid example by sanctioning in the year 1925 a sum of Rs. 200,000 for anti-malarial and kala-azar work. The same Board also sanctioned an annual subsidy of Rs. 5,000 to the Calcutta Anti-malarial Society for work in the Presidency Division. The scheme adopted by the Board is two-fold, curative as well as preventive. For the former, the Board had during last year opened 40 centres, with 2 or 3 sub-centres under each, in charge of a medical officer, besides the existing dispensary centres and 44 sub-centres under them, making a total of about 180 centres. The medical officer visits each centre twice a week at fixed hours to give injections to kala-azar patients and to treat malaria cases also. The work of the medical officers was supervised last year by three supervising officers, one appointed by the Board and two lent by Government, whose work in turn was supervised by the District Health Officer. The officers lent by the Health department have now been withdrawn, but the Board appointed a special Health Officer in connection with the scheme last year.

The District Health Officer, supervising doctors as well as the medical officers have been directed to persuade people to form societies and take up the work of clearing jungles, kerosenising tanks etc. The Sub Divisional Officers with the assistance of the Circle Officers and President-Panchayets are helping the Board in this work, and several societies have been formed, specially in Baraset and Diamond Harbour subdivisions. The Board got a grant of Rs. 7,500 from Government for kala-azar work during last year. The Board also allowed Rs. 12,500 during 1926-27 to the Union Boards and Union Committees for jungle-clearing and small drainage work, and accordingly there was much activity in some Union Boards in these directions.

The Board has a committee for the guidance of its medical activities of which the Director of Public Health is the President and the District Magistrate is the Vice-President. The Civil

Surgeon, Dr. U. N. Brahmachari, and Rai Bahadur G. C. Chatterjee are co-opted members, and some of the members of the District Board are also on this committee. The committee has been most helpful and has not only enabled a close supervision to be kept over the work done at the outlying centres and in laying down general lines of policy, but has also prevented any friction, as both the Civil Surgeon and the Health Officer are on the committee. This District Board has also recently sanctioned Rs. 38,765 for the Nowi-Sunthi scheme of the Government and taken up the question of resuscitating the Maraganga Channel.

The line of policy adopted in Nadia has been to maintain kala-azar centres and to do propaganda work inducing people to establish health societies and encourage them by suitable grants. It is reported that about 8000 kala-azar patients were treated in the several centres opened by the District Board. The District Board opened 10 centres with 20 sub-centres for kala-azar treatment between 15th September 1923 to 24th December 1926. 369 kala-azar and 4902 malaria patients have been treated in these centres. The difficulty in the way is to persuade a patient to undergo a full course of injections. The Sub-divisional Officers of Chuadanga and Kushtia had occasions to visit several kala-azar centres which appear to be doing work of considerable value. The Collector in his tour has occasionally met the subsidized local doctors and the members of the Co-operative Anti-malarial Societies. There is no Sanitary Board in this district, but steps are being taken to form such a Board.

All the District Board dispensaries of Jessore have been equipped with medicines and appliances for free treatment of kala-azar. Besides these dispensaries, kala-azar was treated at 4 special centres, the total number of patients treated for kala-azar was 4,429 in 1924. In 1925, 5 new centres for kala-azar work have been opened and it is proposed to open 6 more centres. There are 14 anti-malarial societies of which 3 have been registered up-to-date and 2 have applied for registration. A sum of Rs. 3,000 has been granted by Government to help the societies. The District Board proposes to divide the district area at present into 10 circles, each under the charge of a sub-assistant surgeon who will attend to medical work and during epidemics do

epidemic duties. To reinforce these workers 3 reserve hands will also be maintained. The District Board has applied to Government for a loan of a lakh of rupees for water-supply and medical and health work, and it is confidently hoped that much progress will be made in these directions in the immediate future. •

The policy adopted by the District Board of Khulna has been to stimulate local effort by formation of village health societies and gradually convert them into anti-malarial co-operative societies. At present there are 18 village health societies and 4 co-operative anti-malarial societies. In the year 1924, 2,669 patients were treated by the health societies. The co-operative institutions have been started only this year and within the short space of six months they raised by local subscriptions Rs. 3,914 and received grants from Government and the District Board to the extent of Rs. 4,170. The enthusiasm evinced by these societies is very encouraging. The District Board has constructed several drains for sanitary purposes. The amount spent during the last three years for the purpose came up to Rs. 5,163. The District Board has stationed sanitary officers at suitable centres, and are anxiously awaiting Government grant for starting rural public health organizations. It is reported that the presidents of Union Boards are being trained by the District Health Officer in the elementary principle of hygiene and sanitation and many such trained presidents are capable of applying those principles and even giving first medical aid in case of outbreak of epidemic. This year 47 kala-azar centres are being run by the District Board where malaria cases are also treated. The kala-azar centres of the District Board are being utilized for training local medical practitioners in giving injection.

Work similar to that detailed above has also been done in the districts of the Burdwan Division in all of which several societies have been formed for the eradication of kala-azar and malaria. Although I am not in direct touch with that division for some time, yet I cannot refrain from quoting the report of the Howrah District Board, which is typical of what use can be made of the Union Boards for health and medical work.

“With the creation of Union Boards throughout the entire area of the district, the problem of sanitary improvement in rural areas which was beset with insuperable difficulties appeared to lose

much of its complications as local agencies with power and organization were found to take up the sanitary questions in these areas. The Union Boards are being constantly asked to prevail upon the owners of the objectionable ponds, tanks, vegetation, insanitary ditches and jungles for clearance of the same, and in recalcitrant cases the Union Boards have been advised to wield their powers given under section 27 of the Village Self-Government Act. Some progress seems to have been achieved in this direction. A good many Union Boards have cleared jungles, and from reports received it appears that as many as 431 tanks have been cleared of rank vegetation. The District Board is also helping the Union Boards with three-fourth cost of minor drainage schemes undertaken by them. The Board is also helping the formation of anti-malarial societies the object of which is to clear jungles and tanks, to cut down or prune trees which are impediments to ventilation, to apply kerosine to the stagnant pools of water which are the breeding places of mosquitoes, to distribute quinine amongst the malaria-stricken people out of the stock given by the District Board, and to undertake other works tending to the improvement of village sanitation. Twenty such societies have up till now been organized in this district of which 5 have been registered. It is understood that 13 of the societies are in good working order and attempts are being made by the Health Officer to improve the other societies and also to add to their number. A monthly subsidy of Rs. 10 is being paid by the Board to each society as soon as it is registered. The anti-malarial society at Naikuli-Brahminpara has started a charitable dispensary on a co-operative basis and the Jodhgiri-Lakhanpur Society is going to start one shortly."

Mention must also be made, however brief, of the splendid work which is being done by Missionary Hospitals throughout the Presidency for relief of suffering and the cure of disease. The Missionary Hospital at Kalna in the Burdwan Division and the hospitals at Dayabari near Ranaghat in Nadia and Jeaganj in Murshidabad deserve special mention. More than a lakh of patients were treated at the Dayabari Hospital last year of whom more than 12 thousands were kala-azar patients who received injections. This is perhaps the best equipped and largest hospital outside Calcutta.

Village Health Associations.

While dealing with the activities of the local bodies reference has already been made to the formation of health associations, anti-malarial and otherwise, amongst the people themselves. Needless to point out that the organization of anti-malaria and kala-azar co-operative societies offer the most satisfactory solution of the problem in as much as an agency will then be available which will be based on the lasting foundations of self-help and co-operation and which will be capable of endless multiplication throughout the rural areas of Bengal. Each co-operative society will have to engage or subsidize its own doctor, draw up a scheme for improving its tanks and *dobas* and kerosenizing them and for distributing quinine to the members and their children. The use of mosquito curtains should be encouraged and special attention should be paid to the reserving of water for drinking purposes. The societies should also engage their own band of voluntary workers amongst whom the younger generation should be well represented.

One point of special interest to which I wish to draw particular attention is that from a purely medical point of view also economic work must go hand in hand with medical and sanitary work. For instance, if jungle is cleared from village sites this in itself will not help much to check malaria, unless the cleared site is brought under cultivation and helps to improve, in however slight a measure, the economic condition of the people and swells the density of the population of the locality. In this sphere of work mention must necessarily be made of the splendid work which is being done by the Central Co-operative Anti-malarial Society of Calcutta, to whose activities reference has already been made, under the devoted leadership and guidance of its founder, Rai G. C. Chatterji Bahadur. It is this Society which has led the way and demonstrated the value of co-operation and self-help amongst the people of the villages for fighting the scourge of malaria. From a report of this Society it would appear that the Society began its work with only 3 village societies in 1917 and their number last year was 453. The other almost equally important honorary organization is that of the Bengal Health Association which had 24 centres under it last year, the most important being

at Dogachia which gives relief to hundreds of sufferers. Rapid and satisfactory as the growth of such village organizations has been under the aegis of the central Calcutta organizations, yet it is needless to point out that as there is urgent need for many more such societies in the rural areas, and as ultimately each Bengal village should have an anti-malarial and anti-kala-azar association of its own, it is obvious that they cannot all be grouped under central associations at Calcutta. Although to begin with it will be an advantage to avail of the experience and the financial assistance of the Calcutta organizations, yet as the number of these organizations grows larger in a district the advantages of grouping them under the Union Boards will become more and more apparent. The formation of such anti-malarial co-operative societies was recommended in the Burdwan Conference of 1920-21, with the result that in 1921 numerous such associations were started in the Burdwan Division, about 20 being organized in Burdwan alone. Some of the societies, however, became moribund and the inspection of several such societies in different parts of Western Bengal confirms the opinion that they require constant supervision and encouragement. I may also remark that although the formation of anti-malarial societies must depend very largely on local enthusiasm and interest, yet in the beginning the assistance of the officers of the Co-operative department and of the General department, particularly of the Circle Officers, should be very helpful, while any money grants from Government and the District Boards are likely to greatly encourage this movement.

IV.

Anti-Malarial Work in Towns.

Although this monograph deals mainly with the affairs of rural areas, yet it is not out of place to point out here that the necessity for vigorous measures for fighting malaria and kala-azar in towns and municipalities is no less urgent. In fact, the comparatively advanced people of our towns and the municipal bodies in charge of such areas should set an example for the guidance of their less fortunate brethren living in isolated and far-away villages and hamlets. Yet there is a strange apathy in such matters even in such

large towns as Midnapore, Burdwan, Jessore and Murshidabad where the incidence of both diseases is as high as in any of the rural areas of Bengal. About three years ago concerted measures were adopted for fighting malaria in Burdwan town, and extracts from instructions which I then issued might prove useful to others who might contemplate similar action. I must refer in this connection to the splendid work which is being done in the small municipality of Birnagar in the Nadia District.

“The main thing as we all know is to try and destroy the anopheline mosquitoes. To do this we must try and get rid of as many of their likely breeding grounds as possible. These are, as we are told, weed-covered and dirty water puddles, edges of tanks where weeds have accumulated etc. Our task would, therefore, be either to fill up, drain out or to clean up as many of these as possible. For this purpose, the preventive powers vested in municipalities to compel owners of insanitary tanks and *dobas* to fill them up should be freely used. The area of the Burdwan Municipality is roughly about 8 sq. miles, but we will have to pay attention to the country in the immediate outskirts of the municipality also, so that roughly we might say that the area to be taken up for our campaign would be 10 sq. miles. I suggest that we should divide this area roughly into 10 blocks. It is rather lucky that we will have 10 blocks, because I understand that if each likely water receptacle is kerosenised once in 10 days, it is possible to prevent these receptacles from harbouring any malaria-bearing mosquitoes, as the larvae are supposed to take 10 days to pass to the stage when they are ready to fly away. For these 10 wards we had better have 5 sprays as suggested by Dr. Bentley. I understand each costs about Rs. 80 and we should indent for 5 at once. We should also take steps to train up gangs of coolies and sardars who will be entrusted with the work of kerosenising. I found that for an area of nearly 2 sq. miles in the Angus Mills at Bhadreswar Dr. Norrie was employing a staff consisting of one Overseer drawing Rs. 45 per month, one Sardar cooly drawing Rs. 8-4 per week and 16 Gang coolies drawing Rs. 4-2 per week. I do not know if this scale is not somewhat too liberal, but in any case, I think if we have two such gangs that ought to be sufficient for our purpose. Dr. Bentley said that he had found that some of the tea plantations were carrying on

anti-malarial work with much less expense. As far as I can see, however, for this part of our work we may have to set apart roughly about Rs. 5,000. It may be true that kerosenising need be kept up in full swing only for 5 months from June to October and it is only during these months that two gangs will have to be employed, yet I think we should not entirely neglect this department of the work during the remaining seasons of the year, but ought to keep up one gang at least for work throughout the year.

The next question to decide is where the money is to come from and who are the persons to be entrusted with the work. The municipalities ought obviously to take the leading part in this work and should, therefore, make as big a grant as their funds will permit. I am sure you will also have no difficulty in inducing the chairman of the District Board to make a suitable grant for this scheme. He will be fully justified in doing so as the scheme if successful will improve not only the health of the town, but will have a very powerful influence in improving the health of the whole district as well. It is also a fact that in the course of their daily business a very large number of people from the rural areas come to the town daily and the scheme itself will embrace a portion of the non-municipal area. Besides these contributions from local bodies, I hope the people of the town will also make some contributions either in the shape of annual subscriptions or lump sum grants.

After providing for the funds you will have to think of the agency which will be employed in carrying out the campaign. I do not know what sort of an officer the Municipal Health Officer is, but I understand he has been to the War and I hope it will be possible to place him directly in charge of the work. No doubt the Civil Surgeon will give him advice, but he has so many other important duties to perform that I do not think he will be able to devote much time to this work. It will be a great advantage, however, if we could get some young doctors in private practice to take interest in the work and take charge of one or two wards. I also trust that you will have no difficulty in persuading all Government servants, specially the Deputy and Sub-Deputy Magistrates living in the town, to take an active interest in the scheme. But the most effective assistance is to be expected I think from the student community. The students of the Burdwan

Medical School will find in this work great scope for their special knowledge and youthful energy. In Santiniketan at Bolepur only the other day I saw small boys doing a lot of work for improving the sanitation of the village. So, I feel sure that if we can fire their imagination and rouse their enthusiasim, not only the medical students but the students of the colleges and schools are sure to give us great assistance. The thing is to find a leader who will have the time and ability to guide the young fellows.

In addition to the above outline of anti-malarial work, I think it will be necessary to keep statistics to show the effect of the measures adopted by taking spleen indices of children and other people in different centres. Maps and charts to show different *dobas* and tanks which are to be filled or cleaned or to be treated with kerosene should also be prepared. If the Health Officer has an office of his own in the municipal buildings he can make use of that for this scheme, but perhaps we want a hall where charts and diagrams could be hung up and where there would be room for occasional meetings etc."

Now to sum up :

- (1) The lead in this field of work should be given by Government who besides carrying on investigations for discovery of proper remedies etc. and laying down a definite line of policy, should also make adequate money grants to enable comprehensive measures to be adopted.
- (2) District Boards should make adequate allotments to the limit of their resources for this all-important work.
- (3) Large schemes of bonification should only be undertaken after full expert investigation and when their value as useful irrigation schemes for agricultural purposes is accepted beyond reasonable doubt.
- (4) Power should be taken by special legislation for the provision of adequate waterways in all railway embankments and for filling up all railway burrow pits.
- (5) The Provisions of Act VI should be fully utilized for the improvement of drainage and the

resuscitation of decaying rivulets and water channels.

- (6) Attention should be concentrated on minor schemes for improvement of drainage, clearance of jungles etc., and for bringing all jungle cleared sites under cultivation.
 - (7) Medical and curative work should go hand in hand with preventive and sanitary work
 - (8) The village self-governing institutions, the Union Boards, should be utilized as far as practicable to serve as nucleus for health work in villages. All voluntary and co-operative health associations should as far as practicable be grouped under Union Boards.
-

CHAPTER V.

RURAL WATER-SUPPLY.

I.

Sufficiency of Drinking Water—a Primary Need.

The problem of water-supply for drinking purposes is of great importance, because sufficiency of pure water is one of the primary needs of human existence, and nothing has such a direct and vital influence on the health and physical well-being of people in tropical countries as drinking water. Nothing impressed me more painfully in my tours in the interior of the Bankura, Midnapore and Burdwan districts than the want of drinking water in the majority of villages in these districts. In many places I found people actually drinking muddy water which is unfit even for the consumption of cattle. As the result of my experience in different parts of Bengal I am of opinion that there is no need which is more keenly felt in rural areas than the want of good drinking water, and I am also convinced that most diseases and epidemics can be traced to the use of polluted drinking water. The ordeal through which the people of rural areas have to pass in seasons of exceptional drought and the direct connection of water scarcity with epidemics of cholera and other diseases were brought into painful relief in the Birbhum district during the year 1924. In submitting my report on the cholera epidemic of that district I pointed out that all the sources of water-supply had either been exhausted or had dried up, leaving only a few mud-holes with impure greenish-looking water and even this "poisonous solution of foul organic impurity and a liquid misnamed water," as described by Dr. Bentley's Assistant, was threatening to disappear in most places.

Different Sources of Water-Supply.

The physical configurations vary considerably in the different districts of Bengal. Those of Western Bengal fall principally

under two heads;—firstly, those of the deltaic and alluvial tracts, and secondly, those of the undulating ridges of rocky and laterite soil, being continuations of the Chotanagpur plateau. Most parts of Birbhum, Bankura and the western parts of Midnapore, the Asansol subdivision of Burdwan, and a part of the Arambagh subdivision of the Hooghly district are of the latter class, whereas almost the whole of the Presidency Division as well as the district of Howrah, parts of Hooghly, and the Tamluk, Contai and Ghatal subdivisions of Midnapore are of deltaic and alluvial character. The scarcity of water as a rule is much more keenly felt in the laterite and rocky portions than in the deltaic and alluvial areas, chiefly because of the arid character of the soil, and its lack of natural moisture. Running streams, wells, tanks and, in some parts, embankments or bundhs form the sources of water-supply in these parts. Wells are used almost exclusively for drinking purposes, whereas tanks are used both for irrigation and drinking, although some tanks are in ordinary seasons kept reserved for drinking purposes. The water of bundhs and embankments are generally used for irrigation, but in cases of necessity also for drinking. Both tanks and wells can be suitably excavated in the undulating and rocky portions, and advantage can also be taken of the peculiar configuration of the country in these parts by putting up bundhs in a comparatively low-lying part, so that the water from the catchment area of the higher parts can be suitably stored. A large number of such bundhs are to be found in Bankura and the western portions of Midnapore, and there is a fair number in Birbhum also. In the deltaic portions in Western and Eastern Bengal it is comparatively easy to dig tanks, and tanks form the usual sources of water-supply of these areas. The water of rivers and rivulets is also largely used for drinking purposes, *e.g.* the Hooghly and its tributaries and the small hill streams of Bankura and Birbhum districts. But these latter streams become dried-up beds of sand for nearly nine months of the year, and temporary wells have to be dug in the beds in order to get to the water level and to find any supply of water.

The comparative adequacy or inadequacy of water-supply in a particular area depends on a variety of causes; the affluence of the people, the manner in which public-spirited zamindars have helped the raiyats to excavate tanks and set up bundhs and, much

more, in the way in which the existing wells, tanks and bundhs have been preserved and kept in a state of usefulness. For, the important point to remember is that water-supply is so inadequate not so much because sources of water-supply do not exist in sufficient numbers, but because in most cases they have been thoroughly neglected and are at present perfectly useless for drinking purposes. Another fact which explains the inadequacy of the supply of drinking water is that in most districts the same tanks are used not only for drinking purposes but also for purposes of irrigation, so that in a year of drought thoughtless and selfish people very often exhaust all the water of their tanks in irrigating their fields, without any thought of their own needs and the needs of the public as regards drinking water. This was the case in many parts of the Birbhum district in 1924, where water famine was mostly due to the tanks being run dry by their owners for saving their crops.

Causes of Deterioration.

As regards the causes which have brought about this unsatisfactory state of affairs, they must be traced chiefly to the desertion of rural areas by well-to-do people for economic reasons as also because of the growing unhealthiness of the villages. The spirit of religious and charitable benevolence which in the old days prompted zamindars and other well-to-do people to excavate tanks for public purposes has now practically passed away. In the place of such people owning and looking after their own tanks we have now as a rule a number of co-sharers and co-proprietors, some of whom are dead, most of whom are absentees, and joint action for the improvement of such tanks in most cases becomes practically impossible. The greed of impoverished land-owners who are glad to increase their *khamar* or raiyati lands by including the beds of dried-up or partially silted-up tanks is also another potent cause of the gradual disappearance of tanks. The Collector of Burdwan stated in his report that fewer tanks are excavated now-a-days because of the increased cost of labour, the high *salami* demanded by landlords for granting permission to dig tanks who previously encouraged such works of public utility by charging only a nominal fee in the case of khas lands and imposing no restrictions whatever

in the case of *mal* lands. The Collector of Midnapore pointed out that "the lack of public spirit generally and in particular the anxiety of the owners of tanks to retain the tanks exclusively for their own purposes, including the rearing of fish and bathing, are also important factors. The ignorance of the people who persist in fouling such tanks as exist also tends greatly to their deterioration."

II.

How to Effect Improvement.

The directions in which improvement can be effected in the existing state of water-supply would be, firstly, by improving existing sources, and, secondly, by creating new sources by the excavation and construction of suitable tanks and wells. Private sources of water-supply can only be utilised for public purposes by the leave of the persons owning and having proprietary rights over the property. It may be true that in almost all villages there are one or two tanks and also wells, which although belonging to private people are freely used by the public, but it is doubtful how far the public have acquired any legal right of user over such sources of water-supply. The different ways in which existing sources can be better utilised for public purposes would, therefore, be :—

- (1) By encouraging or compelling, under some provision of law, owners of such tanks or wells as are used by the public to clean, re-excavate and in other ways to improve them.
- (2) By helping private proprietors of tanks to re-excavate and improve tanks by giving financial assistance to them on their entering into a legal agreement to allow the public to use them.
- (3) By local bodies taking over private tanks either as a gift or under any special conditions and improving them.

The District Board of Midnapore adopted the policy of making grants to private owners to re-excavate their tanks on their undertaking to allow the public to use such tanks and agree-

ing to some other conditions. This policy has the advantage of comparative cheapness, as it would be possible to improve a far larger number of tanks in this way than if the Board has to find the whole cost of excavating a tank. But there is a risk of the interests of the public gradually falling into the background or being forgotten altogether, nor is there much security regarding the future upkeep and maintenance of the tanks.

As regards requiring private owners to improve their own tanks under sanction of law, or otherwise, in the draft Amendment Bill of the Local Self-Government Act it was proposed, that with a view to improving rural water-supply, power should be taken for District Boards to serve requisitions on the owners of private tanks and wells which are used by the public requiring such owners to improve or re-excavate such tanks or wells. Where the owner is unwilling to incur this expenditure, it was proposed that the District Board should be authorized to take possession of the well or tank and to undertake such improvement at its own cost, the expenses incurred remaining a charge upon the property. It was also proposed to vest Union Boards with similar powers to be exercised under the supervision of District Boards. It appears that the Conference of District Boards held in 1923 although it accepted the principles underlying the proposed measure was unable to come to a final decision, and that in the opinion of the Legal Remembrancer the proposal was found to be fraught with legal and practical difficulties. The chief difficulty which I can see is that even if the Board were to compel the owners to clean up a tank, they could hardly compel the owners to allow the public to use the tank, and therefore the advantage of such legislation would be very limited. In fact, in cases where the public use a tank by the tacit permission of the owners any legal compulsion may induce the owners to create difficulties where none exist at present. Nevertheless, I think it would be useful if District Boards and Union Boards were empowered to require private owners to clean up insanitary tanks. Even if the owners of these tanks could not be compelled to allow the public to use these tanks, yet the improvement of such tanks is bound to have a certain amount of beneficial effect. Power should also be given to local bodies to acquire tanks for sanitary purposes. The safest and most desirable line of advance would, however, seem to be for the District Board to

encourage private parties to make free gifts of tanks or suitable sites and for the District Board to improve and excavate tanks. This policy was pursued with much success by the District Boards of Rangpur and Dacca. Another way in which District Boards can help would be to encourage the formation of co-operative societies for the improvement of tanks. In the case of irrigation tanks this scheme has already met with great success in several districts, but there is scope for far wider development. And when a tank is excavated, may be primarily for irrigation, ordinarily there should be no bar to its being used for drinking purposes, provided the tank is kept fairly clean.

As regards new sources, the kind of work which will be most suitable to any particular locality will have to depend on local circumstances. In some parts wells are unsuitable and in most places there is not the same willingness to use the water of wells as that of much dirtier and insanitary tanks. But for our purpose obviously it will be better to encourage a larger use of wells, and the construction of suitable wells for drinking water should form the most important portion of our programme. Tube-wells no doubt would be ideal in many respects, but there are two important drawbacks—the first is that they are not suitable to every locality and money may be wasted in attempting to get tube-wells where either it is impossible to get good sub-soil water or only at depths which will make the cost prohibitive for practical purposes. The second difficulty is that in the case of iron tube-wells, pumps and other parts are liable to get out of order and unless they are constantly looked after and there is a competent *mistry* in charge, they will soon be quite useless in rural areas. There is no doubt, however, that much public interest has been aroused in connection with the tube-wells and much practical experience has already been gained. Tube-wells may now be sunk with greater confidence in areas where sub-soil water is easily available.

The Proper Policy to Follow.

Now in order to improve the existing sources of water-supply and to create new ones, it is obvious that satisfactory progress can only be made if there is a clear line of policy, and if there is

whole-hearted and effectual co-operation between the people, the local bodies, and the Government. It is true that hitherto the duty of improving rural water-supply has devolved primarily on the District and Local Boards, but unless on the one hand sufficient funds are placed at the disposal of the local bodies by Government, and on the other the people themselves who are to be benefited by these works evince a keen and practical desire of helping such schemes by suitable contributions of land, money and, if need be, of manual labour, it is clear that the vast problem of the adequate supply of water to the rural areas of Bengal cannot be satisfactorily solved. It is because these conditions have hitherto been so inadequately realised that progress has been so disappointing. Indeed, there are some who, like Dr. Bentley, hold that having regard to the vastness of the problem and the difficulty of creating any impression with the funds which District Boards and even Government can devote for this object, it would be wise to withhold expenditure altogether from public funds for rural water-supply. Such a view, however, would be opposed to the avowed policy of Government of encouraging District Boards to exert themselves to the limit of their resources to improve the water-supply of rural areas and to the provision of the Local Self-Government Act (sec. 88) which expressly empowers District Boards to undertake the improvement of the water-supply of rural areas. We should also remember that the present position is not so much that there are no sources of water-supply in rural areas, but that they are in a decadent and neglected condition and the people have to be encouraged and shown the way to improve them and maintain them in proper condition. Besides, however colossal the task, there is no question that even the addition of a few better sources of water-supply in a Union every year adds appreciably to the comfort and well-being of the people from whom the public works cess and road cess are realised. Lastly, an abandonment of the present policy of Government which has for its main objective the encouragement of the people of rural areas to help themselves in the matter of water-supply by small monetary doles and the throwing of the whole responsibility on the people of the villages themselves, is sure to lead to stagnation and inaction in this matter, and nobody will deplore such a result more than Dr. Bentley himself, for the

provision of pure drinking water is admittedly the very first and almost the most important step in rural sanitary reform.

There are several reasons which explain why till quite lately District Boards were not able to make any material advance in improving or augmenting the supply of water. The most important, naturally, was the need of funds. Before the making over of the Public Work Cess to District Boards in 1913-14, even with the 25 p. c. augmentation grant the majority of the Boards were in a very greatly embarrassed financial position. The bulk of the money was required for roads and communications of the district, and what was left over had to be shared between medical and educational institutions, sanitation and water-supply coming in for a very small share of the Board's resources. Matters, however, have improved since the decision of Government to make over the public works cess, but even now the income of most District Boards is not sufficient to grapple seriously with the problem of rural water-supply. Another difficulty was that besides District and Local Boards, there were no other local rural organizations whose assistance could be counted upon either for financial contribution or for the execution of these works and their proper maintenance and future management. The Village Self-Government Act of 1919 with its scheme of Union Boards has removed that want. What is wanted now is that the Union Boards should be utilised to the fullest possible extent in solving the problem of rural water-supply and it is this view which has also been accepted by Government in their most recent circulars on the subject. Another important reason has been the want of any definite policy of District Boards in this matter. Nor can it be said that beyond passing occasional resolutions on the omissions of the District Boards in this matter and requiring them to have a village to village census made of their water requirements, Government laid down any strict line of policy for the guidance of the Boards or gave them any special encouragement in this matter by suitable money grants. Lastly, the stimulus of intelligent and helpful public opinion was also absent. Fortunately, all these retarding influences are now on the wane. The recent definite instructions of Government requiring District Boards to spend 33 p.c. of their Public Works Cess and the whole of their augmentation grant on sanitation and water-supply have had the most salutary results. The Government have

also encouraged District Boards to take loans on reasonable rates of interest for carrying out their programme of water-supply. When I was in charge of the Burdwan Division, the District Board of Birbhum with its usual enterprise was the first to take advantage about the year 1921 of this offer and a loan of Rs. 50,000 taken by the Board from Government was most usefully utilised in extending sources of water-supply in the most needy parts of the district. Similar action has recently been taken by the District Boards of Khulna and Jessore.

Present Policy of Government.

In the year 1924-25, Government wisely decided to take another important step in furtherance of their policy of encouraging local effort and intimated their intention of making grants aggregating Rs. 2,50,000 per annum during the succeeding five years for stimulating local effort in supplying pure drinking water in rural areas. The importance of this decision lies in the fact that it marks a new line of policy, indicating that Government propose to take some share of the financial burden with the object principally of encouraging local bodies and the people of the villages to discharge their duties adequately in this matter. The wisdom of this policy of Government is amply demonstrated by the results which have obtained in the five districts of the Presidency Division, for instance, which received grants of Rs. 20,000 in 1924-25, and Rs. 75,000 in the year 1925-26 and again in 1926-27. The Commissioner distributed the grant almost equally among the districts, i.e. Rs. 15,000 to each district. Schemes were prepared by the District Magistrates in consultation with the District Boards and the Subdivisional Officers and in most of the districts the District Board in addition to carrying out its own water-supply programme supplemented the Government grant by an equal amount, and the local people contributed a like sum. In 1925-26 alone the district authorities were thus able to construct 6 tanks and 81 tube-wells in the 24-Parganas, 71 wells in Nadia, 3 tanks and 66 wells in Murshidabad, 4 tanks and 39 wells in Jessore and 18 tanks in Khulna. The projects for 1926-27 were prepared with greater care in the light of the experience gained in the previous year,

and it is expected that better progress has been made in the course of the year which has just closed.

As regards the co-operation of the people, the advice of Government that allotment should be made only as a stimulus to local self-help, deserves special attention. As Chairman of the District Board I made it a rule, both in Rangpur and Dacca, in cases of applications for excavation of tanks, that the applicants should bear a portion of the initial cost and make over the land free to the District Board, the tank thus becoming the property of the District Board. It is gratifying to learn that Union Boards in many districts are trying to raise money by taxation and otherwise to supplement the District Board grant for water-supply, and the response of the people has been most gratifying.

As regards the exact proportion in which the cost can be equitably divided between Government, local bodies and the persons to be benefited by the schemes, this would, I think, have to depend a great deal on the circumstances of the locality concerned and the financial solvency of the local bodies. If in any case the people of the locality are not able to find their share of the contribution in money, they ought to be able to contribute free labour, specially as tank and well excavation takes place during the slack season of the agricultural year. I do not think, however, that any useful purpose will be served by laying down any hard and fast rule. The available Government grant for water-supply should be distributed according to Divisions, on the basis of the area, the pecuniary circumstances of the population and the cost of construction of tanks and wells. After the divisional grant is made, the best course would be to leave the Commissioner to divide the grant amongst the several districts in consultation with the District Magistrates and Chairmen of the several District Boards. I have no doubt that the Commissioner in distributing these grants to the different districts will look to the needs of the district concerned, the financial resources of the District Board and the extent to which District Boards are prepared to utilise their available resources in this matter. No doubt, it would be useful to lay down a general standard, as it will help people to understand under what conditions they can expect assistance of the District Boards and of Government in this matter. But in

practice there is bound to be large deviations and these matters might well be left to the discretion of the local officers.

As regards the agency for the distribution of these grants, it is a matter for congratulation that this water-supply grant is being distributed through the District Officer, as it enables him to guide the activities of local bodies and the people in removing this primary need of the people. As I have elsewhere pointed out, the position of the District Officer has been very seriously affected by his dissociation from the administration of the District Board, and the more the opportunities are found for the distribution of special grants through the District Officer the better, for not only would that go some way in stabilising the position of the District Officer, but it would also ensure the most efficient and economical expenditure of the grant itself. The District Magistrate commands the confidence and respect of the people of his district to an extent which no other agency in the district does, and he has the advantage of having his Subdivisional Officers and Circle Officers to help him to draw up schemes and supervise their execution. The District Magistrate is also in the best position to encourage Union Boards to take upon themselves the responsibility, if not for finding the major portion of the money, for the execution of these works by their own members and officers and for their maintenance and upkeep after completion.

III.

Future Maintenance.

For, it is obvious that great emphasis must be laid on the paramount importance of the proper maintenance of these works. Equal attention must be paid to the protection of the works against damage and pollution as to their future upkeep. As regards the first, it should be made the rule that as soon as a tank is excavated its banks should be enclosed suitably, and as soon as a well is sunk it should also be provided with a suitable enclosure. These works should vest in the Union Board which should maintain a register for them. There should be a column in the register for entering the remarks of inspecting officers. A sign-board should be put up at each work declaring it to be reserved for drinking

water and warning the public against damaging or polluting it. It should be the duty of the village chawkidar to take care of the public tanks and wells in his *mahalla* and to promptly report to the Union Board any cases of pollution and damage. The local body should unsparingly prosecute the offenders in such cases.

The question of future upkeep of tanks and wells is somewhat more complicated. If the policy and programme adopted recently is carried to its logical conclusion, the number of tanks and wells in the area of a Union will soon be very large and the charges for frequent repairs of tube-wells, quinquennial repairs of masonry wells, and septennial re-excavation of tanks will be beyond the ordinary means of the Union Board. It will perhaps be necessary to levy a water cess like the water-rate in municipalities. It is to be hoped that with the spread of mass education, the villagers will soon realise the importance of the supply of pure drinking water and will agree to tax themselves for this purpose. As the Village Self-Government Act does not specifically provide for the imposition of a water-rate adequate provision should be made for this. An amendment of sections 27 and 37 of the Act might be necessary.

To sum up

- (1) The responsibility for adequate supply of drinking water in villages should now vest primarily in Union Boards and the people of the villages concerned.
 - (2) They should, however, continue to receive every assistance, financial and otherwise, from Government and the District Boards concerned.
 - (3) The proper maintenance and upkeep of all sources of water-supply in the village, should receive as much attention as the construction of new works.
 - (4) A small water-rate for rural areas, to be levied by the Union Boards under an amended provision of the Village Self-Government Act, will be very desirable.
-

CHAPTER VI.

AGRICULTURE.

I.

Importance of the Agricultural Industry.

It would seem almost superfluous to dilate on the importance of the agricultural industry in the economic scheme of India. Even in Europe it is still the most important industry, whether measured by the value of its products or by the number of persons employed in it. Its importance came into special prominence during the recent world war, and as a result, Great Britain and most of the European countries are giving more and more attention to-day to the development of their agricultural resources. In India more than 72 per cent. of the entire population is dependent on agriculture, while in Bengal agriculture is the direct means of support of no less than 77·3 per cent. of the total population. Moreover, the majority of others who depend on industries, such as the manufacture of jute, are also indirectly dependent on this basic industry for the supply of their raw materials. At the last census ordinary cultivators in Bengal numbered 9,274,927 workers and 21,268,653 dependents, so that the total number supported by agriculture was found to be 40,543,580 out of a total population of 47,592,462. It is the form of industry which is perhaps the most suited to the health of the people and the climatic conditions of the country. Moreover, there is a remarkable parallelism between agricultural prosperity and health conditions, and the decline of agriculture in any part of the country has been invariably followed by the prevalence of disease. From this point of view alone agriculture should be entitled to the greatest respect in India. And undoubtedly the form of industry in which improvements will bear the most immediate and abundant fruit in India is agriculture. It is necessary, however, to lay emphasis on one important consideration. Although the importance of this basic industry and necessity of the concentration of all our available resources to the development

of agriculture cannot be overestimated, yet we should not lose sight of the fact that India, if she wishes to take her rightful place amongst the rich and progressive countries of the world, must develop her mining and manufacturing industries as well. A substantial advance in the manufacturing industries, however, will depend on the development of the material resources of the mass of the people. As we have just said, the surest and quickest way of improving the economic and material condition of the people and securing an advance towards a higher standard of living lies through agriculture. With the level of individual wealth and intelligence so low as it is to-day we cannot hope to see the energies of any substantial portion of the population to be diverted to the successful exploitation of manufacturing industries. The development of the agricultural industry, therefore, holds the key to the economic progress of the country in every sphere.

Scope for Improvement.

It will not serve any useful purpose to enter into a discussion of either the comparative prosperity of the agricultural industry to-day and in the pre-British period, or to compare the efficiency of the Indian agriculturist with that of his brethren in other parts of the world. Nobody doubts, however, that there is vast scope for the improvement of Indian agriculture as found to-day, both in extensive and intensive directions. Roughly speaking, only about 222,825,000 acres, i.e., 36 per cent. of the total area of British India, is under cultivation, whereas the area of culturable waste other than fallow and of current fallow is no less than 27 per cent., or in other words, only 57 per cent. of the total culturable area is now under cultivation, and it would thus be possible by the expenditure of labour and capital, particularly in the direction of extending irrigation facilities, to almost double the extension of cultivation in India. In Bengal, during 1922-23 the current fallows amounted to 4,669,962 acres, whereas culturable waste other than fallow amounted to 6,166,648 acres, or in other words, there were available altogether 10,836,610 acres for extension of cultivation.

Similarly as regards yield, the produce of the Indian fields

compares very unfavourably with those of other countries. Taking some of the principal crops we are told that whereas the yield per acre of rice in Japan is 3232 lbs., in Egypt 2610, in India it is only 1336 lbs. Similarly, while an acre yields 1861 lbs of wheat in the United Kingdom, 1318 in Japan, and 1496 in Egypt, the yield in India is only 617 lbs. There is also no room for doubt that with the application of proper manure and an improvement in the methods of tillage, it is possible to very greatly increase the productive capacity of our soil. As results of experiments carried on in various parts of India, it can be safely asserted that the productive capacity of our fields can easily be doubled. Howard points out that by the combination of a more efficient plant with more improved methods of agriculture the yield of sugar cane, for instance, which is ordinarily 33 mds. of sugar to the acre in the United Provinces, can be increased three-fold and 100 mds. of country sugar obtained from an acre. If the total annual value of the agricultural produce of Bengal is calculated roughly at 150 crores, and if by the aid of science and the application of capital cultivation could be extended, more efficient plants introduced and the productive capacity of the soil enhanced, so that the agricultural produce could be increased by even half as much, we can imagine what an enormous advance in the wealth of the country that will mean.

The Present Position of the Agricultural Industry.

The normal area sown in Bengal as shown in the report of 1925-26 as 25,823,300 acres. The principal crops of the Province may conveniently be divided according to the two great agricultural seasons into the *kharif* or monsoon crops, and the *rabi* or winter season crops. From another point of view the crops may be divided into two groups—the food crops, the cereals and pulses which feed the people, and the money crops by which mainly the cultivator pays the rent and purchases the necessaries of life. In Bengal, the monsoon or the wet season crops and, to a less extent, the food crops are by far the most important. The normal area under paddy is shown in the same report to be 24,570,500 acres, while the area under jute was 2,310,300 acres. Bengal

stands first amongst the rice-producing provinces of India, the area under rice in Bengal being equal to that of Madras and Burma combined. On an average, 17,000,000 mds. of rice are exported from the Province. Jute is practically a monopoly of Bengal, though small quantities are also grown in North Behar and Assam. The best jute is grown in a narrow strip of the country on both sides of the Brahmaputra in Eastern Bengal, the excellence of jute in this tract is attributable to the well-drained and fertile soil and the abundance of clear water for retting the jute. Last year 17,317,797 mds. of raw jute and 11,724,692 mds. of gunny bags were exported from the province. The normal for oil-seeds is 1486,8000, for sugar only 264,600, for cotton 52,200 and for wheat 162,000 acres.

Cattle power is almost universally used both for ploughing and taking the produce of the field to the market. The implements used are mostly of wood, though the ploughs are usually tipped with iron points, and iron ploughs are also coming into use very rapidly. The levelling beam is almost universally used in preference to the harrow and the roller. Hand implements consist of various sizes of hoes, the best known of which are the *kodali* and *khurpi*. On the whole, the cultivation and tillage are suited to the physique of the people and the cattle power available, although it cannot be denied there is considerable room for improvement.

The cultivation of the soil is at present carried on by three classes of people. Of these the vast majority are practical owners of the land which they cultivate, although they have to pay some rent to their landlords. There are small patches of *khamar* lands in the *khas* possession of the landlords themselves which are cultivated by hired labourers. In a few cases, again, gentlemen farmers have sprung up who cultivate their own farms through the help of hired labour. The other class of cultivators are the *bhagidar* or *adhidar*, who cultivate other people's lands and receive a share of the produce, generally half. They have no rights to the land and are really a class of labourers who are paid wages in kind. As stated above the vast majority of the cultivators are persons who practically own the land although they have to pay rent. The rent varies from Rs. 2/- on an average for ordinary crops to Rs. 10/- for special crops as betel groves. The cultivators generally do most of the work of cultivation themselves, although the more prosperous

amongst them engage labourers to help them to sow their fields and reap their harvests. It was found in the last census that there is one hired labourer on the land to every five who cultivate the land themselves. These cultivators are practically the owners of the land, and have what is technically known as occupancy rights. They cannot be ejected except for non-payment of rent and for rendering their lands unfit for cultivation, and their rent can be enhanced only under certain conditions and for definite reasons. Their position, therefore, approximates to some extent to that of the "peasant proprietors" of Switzerland and France, and thus the incentive to improve their holdings, which a knowledge of ownership imparts, is not altogether lacking amongst them. But unfortunately in the majority of cases their holdings are so small and their resources so limited that they are not in a position to carry out any improvements, or, in fact, to keep their lands from deteriorating in fertility. Not only is the Bengal peasant's holding comparatively small, but his fields have a comparatively much smaller outturn. Add to this the uncertainty of the rainfall and the vicissitudes of the season, a normal crop in Bengal is only from 10 to 12 annas of the full crop and there is a complete or partial failure of crops every fourth year. A deterioration in the sanitary and health conditions is also visible in most parts of rural Bengal. All the above circumstances account for the low level of prosperity amongst the majority of our cultivators, their indebtedness, and the absence of any resisting power amongst them, caused by the absence of any reserves.

Fortunately, however, some improvement is visible in the condition of our agriculturists. There cannot be any question that the price of agricultural commodities has greatly increased during the last decade, particularly since the world war. The price of paddy which used to be on an average about Rs. 2/8/- per maund has now risen to Rs. 4/8/-, and in the case of jute there has been a still more remarkable rise. Even not taking into account the phenomenal prices (Rs. 25 per maund and upwards) which jute commanded for some time in 1926, it may be safely said that the level of the price of jute has risen from about Rs. 4/- or Rs. 5/- to Rs. 10/- a maund. The rise in the value of agricultural crops has been reflected in a steady increase in the wages of agricultural labour, which has risen from an average of annas

6 to 8 to an average of annas 12 or Re. 1 per day. Unfortunately, there has not been any permanent advance in the material prosperity of the agricultural classes proportionate to the rise in the value of the agricultural produce. This has no doubt been partially due to the improvidence, thoughtlessness, and want of education amongst the agriculturists. It has also been due to the fact that on account of the want of proper organization of the agricultural industry the producers themselves have not been able to get as much of the share of the profits as they might have, and a disproportionately heavy share has been appropriated by middle-men who intervene between the producers and the manufacturers. To improve the material condition of the agriculturist first of all his efficiency as a producer must be enhanced. He must produce better crops and more crops from his fields. Even admitting that the Indian agriculturist has inherited a knowledge of tillage and husbandry which according to experts like Voelcker are sufficient for the practical needs of his vocation, yet there cannot be any doubt that the outturn of his fields is comparatively very poor and modern appliances and up-to-date methods are likely to add greatly to his income. The improvement of irrigation facilities is also likely to bring the most immediate relief by making the cultivator more independent of the vicissitudes of the season than he is at present. It is also obvious that it would be a great advantage if the average cultivator had a little more land to cultivate than he has now. Constant subdivision, due no doubt to the gradual increase in the number of those who have to depend on land for their livelihood, is tending to decrease holdings to a size which makes its cultivation more and more unremunerative. A deflection of some portion of the heavy burden which land has now to bear is urgently called for, and this end can best be achieved if some other rural industries, such as hand-loom weaving and specially dairy farming, are opened up for the villagers of Bengal. Not only will such cottage industries find occupation for a portion of the population which has now to depend on agriculture, but those depending on agriculture will also be able to supplement their income by pursuing such subsidiary industries in their leisure hours. A check on too rapid a growth of the agricultural population would also seem to be most desirable. Above all the industry must be organized so that the producers will be able to keep a

larger share of the profits. With this brief account of the present position of the agricultural industry we may now proceed to describe the directions in which improvements are possible, and examine the means by which our object can be gained.

II.

Factors of Agricultural Progress.

We may follow the classical analysis of the elements necessary for the production of agricultural wealth into land, labour, and capital. From another point of view we may classify these factors under the two heads of *physical and human conditions*.

In speaking of land, therefore, we might deal with all the physical concomitants necessary for the production of agricultural wealth. These may roughly be described to be :—

1. The soil,
2. The seed,
3. Suitable moisture, and soil-aeration.

We must have fertile soil, good seed and sufficient moisture and soil aeration to secure a good harvest. The natural fertility of the Indian soil is wonderful. Other physical advantages of ample sunlight and bountiful rainfall have made it possible for the same fields to yield ungrudgingly crops year after year for centuries past, without rest and with comparatively little help from man. But with the growth of population and the decay of the indigenous industries of the country a steadily increasing burden is being thrown on the soil. No adequate measures have, in the meanwhile, been taken to replenish the exhausted natural resources of the soil, while the prevailing poverty and ignorance of the agricultural classes makes difficult the adoption of advanced scientific methods of tillage. While in Europe more is being paid back to the soil than is being taken out of it in crops and thus the soil is being continuously enriched, in India there is a steady deterioration of the soil owing to the lack of manure and the uninterrupted cultivation of exhausting crops. The inevitable result is that a decline of the agricultural industry is visible in most parts of Western Bengal, and for some time there was a steady decline in the cultivated area in the Burdwan Division.

How to improve fertility of the soil.

We must consider first such proposals which aim at the improvement of the fertility of the soil. The use of sufficient and proper kinds of manure is almost the only practical method, except perhaps improved aeration, of improving the fertility of our soil. But it is necessary first of all to know exactly what kind of manure would be most suitable to a particular soil, and in what quantities they should be used. The ideal would be to have a complete census taken of the soil in every locality so as to discover what constituents of plant life the soil has in abundance and in what constituents there is a deficiency. But it would be obviously unnecessary to wait for the completion of the scientific survey of the soils of the province before taking vigorous measures to prevent their further deterioration and for the increase of their fertility. The agriculturists themselves have a fair idea of the manures required for their fields, and it would be in the direction of increasing the practical knowledge of the agriculturists about the manurial requirements of their fields that most of the propaganda and educative work of our district and village farms will have to be directed. The inorganic part of the soil, as we know, supplies three plant food elements—phosphoric acid, potash and lime, and the organic part of the soil supplies the fourth plant food element, nitrogen. The organic part is also a medium for the development of soil bacteria and it produces suitable physical condition of porosity, aeration and drainage which fit the soil for the growth of plants. Cultivators usually supply potash to the soil by applying wood ashes and nitrogen by cow-dung, oil cakes etc. The manures used, however, are generally most insufficient and the most regrettable feature of the present situation is the continuous loss of nitrogen, the most valuable soil nutriment, that is continuously going on. First of all there is the loss caused by the burning of cow-dung for fuel instead of being used as manure. It may be true that the agriculturists of Bengal may not be so wasteful in this respect as their brothers in Behar or the Central Province, but there is no question that there is a great deal of waste even in Bengal in this direction. There is urgent need to teach the raiyats the importance of husbanding every grain of animal manure which may be available to them. It would be much cheaper for them in

the long run to buy fuel and to use their cow-dung for their fields. Further, we have the sad spectacle of India exporting on an average about a million tons of manures, chiefly in the form of oil seeds, animal products, bones etc., while her own fields are being continuously impoverished. Nor is the loss made up by the importation of nitrogenous fertilisers. Most of the Sulphate of Ammonia from the coal fields is not used in India but is exported to Java and the Strait Settlements and crude Saltpeter although manufactured in India is not applied to the land by the cultivators to any great extent. It has been suggested that the export of nitrogenous fertilisers from India should be stopped by legislation, but it is obvious that such a measure by itself will not help the agriculturists, unless a comprehensive scheme of nitrogen conservation and development and its supply on easy terms to the cultivators is worked out by the Government with such help from land owners and associations of the cultivators which might be organized for the purpose.

The obvious line of advance would be to teach the Indian cultivator the value of conserving the dung of his cattle in suitable manure pits and to follow the methods practised by his brothers for 40 centuries in China of utilising organic residues, both plant and animal ashes, crop residues, leaves and composting these materials with earth and cow-dung. One of the most important agencies in nitrogen fixation is the leguminous crop, such as cow peas sunn-hemp, *rahar* etc., whose root-nodule organisms work up the free nitrogen gas of the air into complex substances which the plant can use and which are partly left behind for succeeding crops. Fortunately, the value of these crops both for green manuring and as a rotation crop is already well-known to the raiyat in most parts of Bengal, but more propaganda work in this direction would seem to be desirable. The vital importance of improving the condition of the cattle of the raiyat to ensure better cultivation would be mentioned later on, but reference should be made here of the direct benefit to the cultivator from better-fed cattle in the increase of cow-dung which could be used as manure. The above methods besides being cheap and within the means of the ordinary cultivator would also seem to be sufficient for his most immediate needs, because, for paddy, the principal crop of Bengal, cow-dung and green manuring would seem to be the most suitable

manures, while for jute oil-cake and cow-dung are the most efficient.

The establishment of small power mills for pressing mustard oil in rural areas with a view to making the oil cakes freely available to the rural population is commendable from every point of view. Experiments should also proceed with the object of making Water-Hyacinth available as green manure for jute. As regards the use of artificial manures it is satisfactory that the Chillan Nitrate Committee through their agents, Messrs. Shaw Wallace & Co., are taking practical steps for popularising their use and I have promised every assistance to them and propose to put them in touch with the principal District Boards of this division

Mr. Lupton in his illuminating book "Happy India" has been at great pains to show what small use is made of the abundant natural advantages of the country, and indicates the means by which the fertility of the soil could be enhanced and the prosperity and happiness of the people secured. He advocates very strongly that Government should offer to the cultivators manures at first free of charge to be recouped ultimately from the net profits of the cultivator. Any action in this direction will have to be taken through the Agricultural department, nor can there be any doubt that the Agricultural Department should take up this matter in earnest, and work out schemes for the fertilization of the soil by the use of sufficient quantity of necessary manures. Having regard, however, to the vastness of the task, the only practical way of tackling the problem with any hope of success would be to formulate a scheme which would have the object of stimulating a spirit of co-operation and self-reliance amongst the cultivators, by which the people would be able to help themselves under the guidance and with the assistance of the officers of the Agricultural and General departments of Government. The necessity of a net-work of seed and manure depots owned by agricultural associations and other agencies throughout the rural area thus becomes obvious. These agricultural and other co-operative associations should be interwoven with the Union Boards, and a definite programme of manuration of the soil should be drawn up and placed before

these Boards. The District Board should make substantial grants to the Union Boards for this purpose which should be supplemented by handsome grants from Government. There should be a central manure depot in each Union Board which will supply the requirements of each rural agricultural association. At first the use of manure should be encouraged by free supplies for propaganda and educational purposes, but gradually the scheme should be run on business lines.

Better Tillage.

Along with proper manuring of the soil careful and proper tillage is essential to obtain the best results. The aim of tillage is to secure proper ventilation of the soil by increasing its supply of oxygen and nitrogen from the atmosphere and by getting the best work out of the nitrogenous organisms already existing in the soil. By constant and timely ploughing of the soil it is helped to assimilate the manurial substances that might be put into it, and by being exposed to sun and air its proper ventilation is secured and it obtains the maximum supply of oxygen and nitrogen from the atmosphere. Sir Gangaram, who may be considered to be the most successful practical agriculturist in India, and with whom I had the honour of sitting on the Agricultural Commission, told me that he attached greater importance to the proper ploughing of the soil than to any other artificial means for securing its maximum fertility. Most of his fields are ploughed 5 times over and 7 ploughings before sowing is not uncommon on his estate.

Howard points to the process of nitrogen fixation that goes on in tropical soils by *Azotobacter* and other soil organisms, a process which however requires constant aeration and is stimulated by numerous ploughings. In Rohilkand, for instance, we find that the sugar cane crop does not seem to have undergone any diminution of yield for centuries past, although no manure is used. He also points out that the destruction of Nitrate in the soil by incipient water-logging during the monsoon is an important source of loss of nitrogen to Indian agriculture. This can be largely avoided by improv-

ing the grading of the fields and by providing a suitable system of surface drainage. Special attention has to be paid to this source of loss if artificial irrigation is resorted to an extent which causes water-logging.

The Bengal peasant has a very good idea of the value of proper tillage of the soil, but he is greatly handicapped by the poor quality of his cattle. Not only are his cattle weak and therefore unable to draw deep ploughs, but he is very often not able to use his cattle as often as he would like to, because of their physical weakness and also because of their insufficiency. The improvement of the cattle of Bengal is, therefore, probably the most important practical measure necessary for the improvement of methods of cultivation.

Improvement of seed, seed farms and seed stores.

We now pass on to the consideration of the improvement of seed. As has been well said, seed is the rock on which the house of agriculture must be built. "The plant," as Howard says, "is the real centre of the subject. Improvements of the soil are in a sense subsidiary and are undertaken with the sole object of increasing the activities of crops and getting more work done by the plant." The introduction of improved varieties of crops and the provision of the most suitable and efficient seed is the first step in the up-lift of rural India, particularly as in using better seeds the cultivator is not put to any substantial increased expense. The majority of the agriculturists cannot select the seed themselves, nor are professional seedsmen available as in the European countries for the supply of suitable kinds of seed for their fields. The efforts of the Agricultural Department have, therefore, been directed to the improvement of the seed of the suitable crops of the province, such as jute, paddy and sugarcane. In the several Government farms of the province experiments have been made and steps taken to improve these seeds by cross-breeding, hybridization and other means, and when the results have been considered satisfactory, special kinds of paddy seeds like Indrasal, Dudhsar and Nagra of the Aman variety and Kataktara of the

Aus variety, suitable jute seeds like the Bombay Kakai and the Chinsurah Green and the Tanna and Coimbatore (C. 213) variety of sugarcane have been placed before the agriculturists. The Department has not yet been able to produce paddy strains suitable for all types of land in the province, but it is confidently hoped that types will be evolved suitable for every class of land from the earliest Aus to the latest Aman. By the efforts of the Agricultural Department the seeds already evolved have now been widely popularised in many parts of the province, with the result that the yield of these crops has been visibly increased and the cultivators have made comparatively larger profits. For instance, even in such an unfavourable year as 1923-24 demonstrations from various stations in Rajshahi showed that the outturn per acre of Indrasal paddy was 21 maunds 30 seers against 16 maunds 1 seer of the local Gazi variety of paddy, while Chinsurah Green yielded 23 maunds 13 seers of jute against 20 maunds 34 seers of local varieties and Yellow Tanna yielded 65 maunds and 20 seers *gur* against 33 maunds and 3 seers from local cane.

For the whole of India it has been estimated that in the comparatively short space of 18 years over 5 million acres have been brought under improved varieties of crops originally isolated or evolved by officers of the Agricultural Department, and thus the annual net value of the agricultural crops of the country has been enhanced by over 5 crores of rupees. For Bengal it has been estimated that in 1924 on account of the improved varieties of jute seeds the cultivators made an increased income of nearly 80 lakhs of rupees. If gradually the whole of the jute area in Bengal could be planted with departmental seed it has been calculated that the cultivators would reap an increased income of $4\frac{1}{2}$ crores of rupees. If the increased yield of fibre is not wanted the actual demand could be met from a smaller area and the land thus set free could be utilised for food crops. Similarly for paddy, it has been calculated that if the normal yield could be increased by something like 3 maunds per acre, the total increase of income to the cultivators from paddy alone would amount roughly to 9 crores or approximately Rs. 2 per head of the population. It should not be forgotten, however, that the figures on the basis of which the above calculations have been made are derived from the results of experiments

carried on in farms and selected areas, where not only improved seeds have been used but better methods of cultivation and proper and sufficient manures have also been employed. So it is essential that with the use of better seeds the cultivators must be taught to pay equal attention to better methods of tillage and the use of proper and sufficient quantities of manure. In fact, if his fields are to yield heavier crops the drain on the natural resources of the soil will be greater and the greater will be the need for replenishing the exhausted resources of the soil. Nevertheless, it is incontrovertible that the use of better seeds would under the present conditions undoubtedly be the first as well as the most important step in the uplift of the rural classes, because the immediate and comparatively inexpensive gain of income and the consequent enhancement of his resources could then be utilised for effecting improvements in the methods of crop cultivation now in vogue. Better seeds produce not only more crops but a better quality of crops.

The cultivators are not slow in appreciating the advantages of sowing better seeds. As already stated considerable progress has been made in this province in the introduction of more efficient varieties of seeds. In one subdivision, Kishoreganj alone, for instance, there are now 10,000 acres of Tanna cane and there are further large areas in the Hooghly and Rajshahi districts, while it is spreading at a less rate in all parts of the Province. The heavy yielding races of paddies mentioned above are now grown over an area of more than 150,000 acres throughout the Province. Nearly 3,000 maunds of departmental jute-seeds were sold during the last season. Taking the demand for the Chinsurah Green variety of jute seed it is found that even in Western Bengal in a district like Nadia where jute is by no means one of the main crops, the demand is growing by leaps and bounds, for whereas the demand was 15 maunds in 1921, in 1925 the demand was 150 maunds, and in 1926 it was reported that even if 3,000 maunds of this seed could be supplied they would be quickly taken up by the agriculturists. It is clear, therefore, that the agriculturists have appreciated the benefits of good seed, and what is necessary now is to draw up a definite programme for the growing of sufficient quantities of the better races of seed and their universal introduction throughout the agricultural areas. Seed farms and seed stores should, therefore, be established not only at the headquarters of subdivisions,

but near each Union Board office, and by degrees in all important villages where there are agricultural or other co-operative associations. The great advantage of local production and storage of improved qualities of seed is that seed would thus always be available at the proper time. If seed has to be imported from a great distance and if the agriculturists have to depend on supply from the Agricultural Department, more often than not the seeds arrive too late and failure and disappointment are the results. In the case of paddy seeds the cost of transport also becomes a heavy charge. Another great advantage of making local arrangements for the supply of seed is that the supply of good seed can be automatically increased year after year, as paddy multiplies itself about 20 times. It is true that a certain amount of technical knowledge is necessary for the selection and storage of the right kind of seed, so that only pure and properly ripe seeds will be stored, but this will not require much training and the cultivators would soon be able to help themselves in this matter. As regards jute seed, it might be necessary to arrange for the exchange of seed grown in different areas to prevent a deterioration of the strain.

The agencies which might be looked upon for assistance in this connection are the same as in the case of manure depots. The District Board, Alipore has set an example in this direction, and a grant of Rs. 20,000 was made in 1926 for the supply of departmental seeds and the establishment of seed stores. The result has been that seed stores have been established at suitable centres, and departmental seeds supplied to the cultivators at cost price. The District Boards of Jessore and Khulna are also taking action on the same lines. The co-operative associations of Khulna are arranging to start small seed farms to serve each Co-operative Union under the Central Bank. The energetic District Officer of Nadia with the assistance of the Deputy Director is organizing elaborate measures for the supply of good seed to the cultivators. A number of private farms, the Mullick Farm at Ranaghat, Harbarudi Farm at Chuadanga, the Ballavpur Farm at Meherpur and the Nakasipara Farm at Nadia sadar, have arranged to grow Chinsurah Green jute seed for local distribution. The newly started Chuadanga Agricultural Association which has 4000 members has opened a seed store at Chuadanga, and it is also proposed to start a seed farm for which a site has already been

selected. A representative Committee has been appointed at Kushtia to establish a seed and manure store at the headquarters of the subdivision. At Rangpur a policy of establishing seed stores with the joint assistance of the District Board and the Agricultural Associations of the people was initiated some years ago, and during the time I was there 3 seed-stores had been established at Gaibandha at Burirhat and Lalmanirhat, and steps were being taken to establish many more at convenient centres. An arrangement was also made to grow seeds on the land of private cultivators and store a portion of these in the village store for distribution in the locality. At Dacca too we succeeded in establishing a number of seed stores.

A programme should be drawn up by the Agricultural Department for the establishment of seed stores and seed farms for each district. These farms and stores should also serve as depots for the distribution of manures and fertilizers. As far as possible advantage should be taken of the existence of Union Boards and other self-governing village institutions for the establishment of these farms. Advantage should at the same time be taken of agricultural associations and other co-operative associations for the establishment of farms in important villages. Special attention might be paid by Collectors to Court of Wards Estates and Khas Mahals. Private zamindars should be encouraged to join in the district scheme for the distribution of better varieties of seed to their tenants. For some years special Government contributions in furtherance of the above objects will be most helpful. The Government grant should be distributed through District Officers, the District Boards and Union Boards getting a contribution in proportion to the amount which they will be prepared to spend themselves.

For the management of these village farms and manure and seed depots, a large number of Demonstrators will be required and the appointment of a suitable number of Demonstrators by the Agricultural Department is a pressing need. How local bodies can also help the Agricultural Department in providing this extensive staff will be discussed later. Union Board Secretaries and other Village Officers could be trained in the District Farms and utilized for this purpose. At Rangpur and at Chinsurah Union Board Secretaries received training in batches at the Government

farms and were most useful for agricultural work in their villages. This practice should receive the sanction of Government and be adopted in all districts.

Along with our efforts for the introduction of better classes of seeds for our principal crops attempts should simultaneously be made for the introduction of new crops and second crops in fields which now grow only one crop. Of new crops cotton in the higher lands would seem to offer a hopeful opening. The Agricultural Department is engaged in evolving a species of cotton which will be suitable for cultivation in this Province, and results of considerable value have been obtained, and it is understood early maturing races have been discovered. There would also seem to be scope for further increase of the cultivation of suitable types of Pusa wheat. I have seen wheat doing extremely well in parts of the Murshidabad district. When I was in Burdwan ground nut at one time promised to be a very promising crop for the uplands of Bankura and Birbhum. As regards second crops, the cultivator has to depend a great deal on facilities of irrigation. With an extension of a system of well, tank, and canal irrigation it ought to be possible to greatly extend the scope of the production of a second crop in most fields. The cultivation of suitable fodder ~~as~~ as a second crop on fields already under cultivation and also on fallow land would appear to have great possibilities in this province, and would meet the crying need of supplying sufficient and nourishing food for its starving cattle—a point to which we shall refer again. But all this will, of course, also require much heavier manuring if the soil is to preserve its natural fertility, and if more crops than one are to be grown, a scientific system of the rotation of crops will also have to be observed. But although there are difficulties in the way, it is certain that if our cultivators are to learn intensive cultivation on the lines of other progressive countries, they will have to turn their attention to the introduction of new crops on lands which are now lying fallow and the extraction of a second crop from fields which now yield only one crop in the year.

IRRIGATION AND DRAINAGE.

Importance and Scope in Bengal.

We now pass on to the consideration of the steps which would be necessary to regulate proper moisture for the germination of seed and the maturing of the crop through all the stages till it is harvested. It would hardly be necessary to point out that for crop production it is the root development which is the most important factor, and for this purpose it is the subsoil moisture more than the surface water to which attention has to be paid, although the depth and quantity of subsoil water is undoubtedly chiefly dependent on the quantity of surface water available in the locality.

There would appear to be a complete unanimity of opinion amongst experts regarding the supreme value of proper regulation of surface water in Bengal by execution of suitable irrigation and drainage projects, both for the economic development of the province and for the improvement of its health and control of its greatest enemy, malaria. In his evidence before the Agricultural Commission, the present Director, Mr. Finlow, stated that irrigation may prove to be the crucial factor in deciding whether Bengal shall make an appreciably larger advance in agricultural prosperity than would otherwise be the case. In the opinion of Sir Arthur Cotton, "upon the regulation of water of a country depends incomparably more than upon anything else the well-being of it, and this is specially the case in all tropical and other countries which have well-defined periodical rains." As we have already seen Dr. Bentley considers suitable irrigation measures as the most important scientific remedy that can be devised for fighting malaria and improving the prosperity of the people. Irrigation, he says, will increase soil fertility by silt deposit and improve drainage, thus encouraging cultivation of the land, increasing the food supply of the people, and promoting the prosperity of the country as a whole. Although experts thus seem to be united regarding the value of irrigation projects for Bengal the belief is not uncommon that owing to abundant rainfall in Bengal, irrigation is not such a crying necessity. This popular belief receives some support

from the speeches of the late Lord Curzon to the effect that irrigation was not an important problem for Bengal. But Lord Curzon was perhaps referring to measures for famine prevention. Another consideration which might have prevented a proper examination of the needs of Bengal in this matter is the existence of the Permanent Settlement in Bengal by which the revenue of the State from land is permanently fixed, and the State is debarred from claiming any portion of the increased income of the cultivators which suitable irrigation schemes may help to produce. As regards the theory that the copiousness of rainfall in Bengal makes irrigation schemes unnecessary, we might again refer to the views of Mr. Finlow on the subject. Irrigation, he says, is of critical importance for the paddy crop in Western Bengal in two years out of five, and even in Bengal as a whole the yield of cleaned grain is often cut short by a million tons or more for the want of suitable post-monsoon showers from the beginning of October onwards. The two years, 1922-23 and 1923-24, are striking contrasts in this respect. The year 1922-23 was an ideal one for paddy and the crop one of the biggest ever reaped, but for the want of a few post monsoon showers the produce of 1923-24 fell short of the yield of 1922-23 by 1,500,000 tons valued at Rs. 75 lakhs. Such is the loss of the cultivators, says the Director of Agriculture, which could be made good by irrigation. As a former District officer I can myself bear testimony to widespread failure of crops not only in Western Bengal but in other parts of the province, due to the cessation of rainfall at the critical time when crops were maturing and when one or two more showers would have sufficed to secure an abundant harvest. What is necessary is that not only should there be a sufficient rainfall but it should be seasonable and well distributed, conditions which are not always realised. As regards the areas in Bengal where irrigation would be necessary, Mr. Finlow observes that in most portions of the Burdwan and the Presidency Divisions monsoon irrigation is a necessity, whereas in many parts of Eastern Bengal and North Bengal, viz., Bogra, Rajshahi, Malda there is little doubt that irrigation in the cold weather and specially in the early hot weather would enormously facilitate cultivation and would in most years ensure bumper crops. But taking

Bengal as a whole it is Western Bengal where the need for irrigation and drainage is most acute. Dr. Bentley points out that the comparative paucity of rainfall in West Bengal, the construction of the Damodar embankments, and the neglect and decay of the indigenous system of tank irrigation have all combined to bring about a decay of the agricultural prosperity and the health of this part of Bengal, which was at one time one of the most flourishing areas in India. He quotes figures to show that there has been a progressive diminution of the net cropped area in these parts which is just over half of what it used to be before, and only 5 p. c. of this area is twice cropped on account of the deficiency of the supply of subsoil moisture. The level of the subsoil water has steadily declined to an average of 26 ft. below the surface and in some parts to 60 ft., and so it would require 104 inches of water to raise the subsoil water level sufficiently for the purposes of winter rice cultivation, whereas the rainfall is only about 50 inches. Suitable irrigation schemes are, therefore, an indispensable necessity for these parts.

Similarly in the Presidency Division, the decay and silting-up of the old rivers and water channels have seriously interfered with the drainage and sanitation of the areas served by these rivers and have resulted in a serious deterioration of the health and simultaneously of the agricultural prosperity of the central districts of the Division, particularly of Jessore, Nadia and Murshidabad. An expert examination of the feasibility of schemes for the reclamation and improvement of the decaying river systems and water channels of the Presidency Division and the adoption of suitable measures for improvement of drainage are matters of great importance.

Large Schemes.

The regulation of the surface water of Bengal would have to be directed mainly in the directions of the improvement of irrigation and the provision of suitable facilities for drainage. The first set of schemes would have to provide for the storage of sufficient quantities of silt-laden water that pass through

the Province during the rains for the proper flushing of the country and for irrigation of the fields with the assistance of canals and distributaries. In this connection, however, the importance of the regulation of the run-off rain water and the provision of surface drainage should not be overlooked. For, as Howard points out, it is clearly of greater advantage to make the best use of the rainfall which costs nothing before going to the expense of leading river water to the fields for the purpose of making up any shortage of moisture. The regulation of surface drainage in the deltaic plains of Bengal would necessitate the adoption of measures which will control the passing of the rain water over the fields to some extent by keeping the water for sufficiently long time to enable it to soak into the fields and also to prevent the scouring of the fields by the run-off water by which the most fertilizing elements in the soil are washed down into the sea. The only practical means by which this can be done would be by the erection of suitable cross dams and embankments, specially in regions where there is any marked difference in the level and where the scour by unchecked rain water is likely to be more injurious. In fact the *aids* of the cultivators' fields now serve this purpose to a great extent. The second set of measures in Bengal for the regulation of proper surface drainage will be of a more negative character and consist mainly in the removal of such river embankments and railway and road embankments as stop the proper drainage of the country and lead to the rapid silting-up of the rivers and to the destruction of nature's drains. Experts like Bentley and Addams-Williams are agreed that a great deal of harm has already been done, principally in West Bengal, by the erection of premature river embankments and railway and road embankments with an insufficient provision for drainage and the passing of surface rain water.

The main object of drainage schemes, however, is to provide suitable egress and outfall of water during the monsoon and to prevent water-logging in any particular area and the destruction of crops by submergence during inundation etc. Dr. Bentley is opposed to any schemes of drainage proper as it denudes the country of a much needed supply of water. But although a sufficient supply of water may be a necessity,

an excess of water by destroying the permeability and porosity of the soil has been proved to be an evil even from an agricultural point of view. Those who have any experience of the disastrous effects on life and property caused by floods in areas like Famluk and parts of Contai, where the country is like a saucer without any natural egress for the water, will have little doubt regarding the necessity of properly devised drainage projects for these parts. Well considered drainage projects which will also provide for a sufficient supply of water when needed should not only bring under cultivation large areas which are now lying waste, but also improve the health of the people. Facility for drainage would also include schemes for the resuscitation of silted-up and decayed rivers with the object of restoring life and the power of accumulated water to flow out through lower levels into the sea. Both aspects have already been dealt with at some length in connection with the feasibility of large measures of bonification in the previous chapter on Malaria. It has been pointed out that the sources of supply of water for Bengal are almost limitless. What is necessary is to devise sound engineering schemes for storing and distributing the water at the proper season and in a manner which will not have any ulterior harmful effects on the health of the people or the agricultural fertility of the soil. For not only as already pointed out do irrigation schemes which do not properly safe-guard against undue water-logging of the country result in the deterioration of the health of the people, but excessive use of water results in the formation of alkali deposits, and in this way, as pointed out by Howard, thousands of acres of land have been transformed into useless alkali land in the Deccan and in the locality round Amritsar. Excessive use of water and water-logging have a tendency of slowly lowering the producing power of land. Dr. Bentley is of opinion that these evils can be avoided in Bengal by providing for flush or inundation irrigation during the monsoon and not having perennial irrigation as in the Punjab. The important point seems to be, however, that precaution should be taken to prevent first such structural defects in the schemes of canals and reservoirs which will lead to leakage and water-logging and which might destroy the permeability and porosity of the soil, and secondly, excessive and wasteful use of the water after the construction of the canals. This should not

be a very difficult achievement, for as observed by Sir William Willcocks, "the science of dams, weirs and regulators has received such development during recent years that there can be no problem so difficult that it cannot be solved by experience and originality."

If comprehensive irrigation schemes are to be devised for Bengal, there would obviously be two separate zones for the operation of these schemes, the first to serve the deltas of the Damodar and the Rupnarain and the second the deltas of the Ganges and the Brahmaputra. The commencement of the construction of the Damodar canal has already been referred to. For two successive years the Burdwan Conference pressed for this scheme. It is to be hoped attention will now be concentrated on what is perhaps the first major irrigation scheme undertaken in Bengal and that it will be completed within the scheduled time. I have also in a previous section referred to the scheme for a Damodar Reservoir. For the Gangetic delta I have suggested a barrage above Jangipur by the construction of an anicut. The feasibility of this suggestion, however, will depend on expert examination by trained engineers.

The appointment of an Irrigation Commission for Bengal and entertainment of a special staff of engineers with experience of irrigation work in Egypt and other parts of India is a recommendation to which I attach great importance. In this connection it might be pointed out that the activities of the present Irrigation Department of Bengal appear to be mainly directed in the improvement and maintenance of water communication, and irrigation and drainage properly so called only occupy a minor position in its programme. Accordingly out of a total budget expenditure of 12 lakhs, in 1926 only 3 lakhs were appropriated for irrigation and drainage and of this the major portion was taken up for the maintenance of the Midnapore and Eden Canals. A very notable and hopeful departure, however, in the policy of the department was initiated last year by its adoption of the Damodar Canal scheme. For the present day needs of Bengal such schemes are far more urgent than the launching of ambitious schemes, like the proposed Grand Canal scheme, for improving the river communications of the province, specially as the future of this scheme seems to be somewhat uncertain both from financial and engineering points of view. Finally, I would

strongly recommend that the two sides of the department—communication and irrigation proper—should be completely separated and the department of Irrigation brought in close touch with the department of Agriculture.

Smaller Schemes.

I have now spoken of large schemes which can be carried out successfully only by the agency of Government through its department of Irrigation in consultation with such other departments which might be directly concerned in such schemes, e. g. the departments of Agriculture and Public Health. Necessarily such schemes would require a great deal of preliminary investigation and some time must elapse before they can materialise. In the meanwhile, there is vast scope for extending irrigation facilities and improving local drainage by the execution of minor schemes. It is obvious that in this field not great progress can be made without an awakening of a spirit of self-help and self-reliance amongst the people themselves. Local bodies, zamindars and co-operative societies of persons likely to be benefited by such schemes would be suitable agencies for carrying out minor schemes both for drainage and irrigation. It is a matter of great satisfaction, thanks to the devotion and energy of such District Officers as Mr. G. S. Dutt, I.C.S. (when he was the Collector of Bankura) and Mr. J. R. Blackwood I.C.S. (when he was the Collector of Birbhum) and the active co-operation of such leaders of the people as Rai Bahadur A. C. Banerji, M.L.C. etc., and the stimulating and educative influence of the district and divisional conferences in the Burdwan Division, there was most remarkable progress in carrying out successful irrigation schemes by the agency of co-operative irrigation societies, throughout the division, and notably in the districts of Birbhum and Bankura. The efforts of local officers were no doubt also adequately supported by the departments of Government concerned, viz., Co-operative and Irrigation Departments. The Irrigation schemes undertaken by these societies fall under three heads :

- (1) Excavation and re-excavation of tanks;

- (2) Erection of irrigation embankments for the storage of water flowing from higher catchment areas; and
- (3) Construction of masonry weirs across small perennial streams and storing water for irrigation purposes.

Naturally much greater progress has been made in connection with the first two classes, whereas progress has been somewhat slow in the case of masonry weirs on account of the newness of the work and the difficulty of discovering the most suitable types. The Amjora weir in the Taldanga thana of Bankura was washed away in 1924 on account of engineering defects in the construction of the embankment and it is again being replaced ; while the Salband weir in the Sonamuki thana has not yet been completed, although it was commenced in 1922, and the scheme has been several times revised by the Irrigation Engineers. Delay has also occurred in preparing the final plan and estimate of the Kukra Jhora and Rukim khal schemes. But inspite of these checks which have caused some disappointment amongst the members of the societies there has been steady and continuous progress. Last year there were 268 such societies with a membership of 10,368 and working capital of Rs. 1,90,124. Of these societies 142 are in Bankura, 116 in Birbhum 3 in Burdwan, 1 in Midnapore, 4 in Hooghly, 1 in Faridpur and 1 in Bogra. Of the 142 societies in Bankura, 113 are in the sadar subdivision with a total irrigable area of 35,007 bighas, while 116 societies of Birbhum have an irrigable area of 15,502 bighas. My experience in connection with the establishment of these societies and the execution of the projects suggests the necessity of closer co-operation between the Co-operative and Irrigation departments than what seems to exist at present. And this can only be secured in my opinion by placing local officers of both departments under the control of the District Officer. I speak from personal experience when I say that without the driving power and organizing capacity of the District Officer this movement could not have originated and taken root in the manner it has either in Bankura or Birbhum. It may also be necessary to provide by legislation for the acquisition of land, tanks and suitable catchment areas for the working of these co-operative societies. I know in many cases the District

Officers had to exert their personal influence to persuade selfish land-owners having proprietary interests in tanks to come to reasonable terms with their tenants about the distribution of water and their rights of catching fish. Government has given every facility to the people and in addition to a special District Irrigation Officer for Bankura another such officer has been appointed for Birbhum. It is to be hoped that the excellent start now made will be kept up and the irrigation facilities of those parts of the Burdwan Division where the physical configuration of the country makes the storage of water in large embankments specially suitable will be fully developed. Already tracts of country like the Taldangra thana of the Bankura District which was a prey to successive visitations of famine and scarcity are being turned into smiling rice fields where abundant crops are being harvested year after year, and if the present rate of progress is maintained, it is not too much to hope that Bankura and Birbhum which have hitherto been two of the poorest districts in Bengal will gradually take their place amongst the richest and most prosperous.

Besides co-operative societies the only other instrument by which these minor schemes can be brought into operation is the Bengal Sanitary and Agricultural Drainage Act (VI of 1920). Although specially designed to help the people to carry through speedily and with minimum difficulty minor schemes of drainage and irrigation, yet very little advantage has up to now been taken of this enactment. The question of still further simplifying the procedure laid down in the Act and of the rules framed under the Act is now under the consideration of Government. The principal difficulty seems to lie in the preliminary stage of the preparation of the schemes, because in the absence of any guarantee that any particular scheme is likely to be passed by the Irrigation and Agriculture Departments as a desirable and a feasible scheme, private parties are naturally chary of coming forward with contributions for the preparation of the preliminary estimate. It would be highly desirable, I think, to appoint a technical agency for the preparation of all feasible and desirable schemes of minor irrigation and drainage for each division, the cost of the preparation of the schemes being borne jointly by the Government and the local bodies concerned. After the schemes are ready, there should be

suitable propaganda to place them before the public, when they could be taken up either by co-operative societies or under the provisions of Act VI of 1920, and it is only when the schemes are actually taken up for execution that the people likely to be benefited by the scheme should be called upon to contribute towards its cost. As an encouragement to the public a portion of the cost should be borne by the Government and the District Boards, and it will be a great advantage if Government were to lay down a general line of policy with regard to the financial assistance which Government would be prepared to give in different classes of schemes which might be undertaken under the Act. Another difficulty about which complaints have been made both by Collectors and the public is the amount of unnecessary interference by technical departments of Government with local enterprise. In the case of larger schemes affecting the life of current streams etc., Government could not obviously divest itself of responsibility of safeguarding the interests of the public, but in smaller schemes with purely local interests there is obviously room for much greater elasticity in the rules and the delegation of power and responsibility to local authorities.

According to latest expert opinion there appears to be great scope for carefully planned schemes of tube-well irrigation. The system known as the strainer tube-well is a device by which the water present in deep seated layers of sand can be raised to the surface by a pump driven by an oil-engine. These installations are often 200 ft. in depth and are capable of commanding from 200 to 400 acres. The system is providing a very suitable form of irrigation for permeable soil and such schemes are sure to be taken up by the co-operative irrigation societies if their feasibility and value can be demonstrated in Bengal by the Irrigation and Agricultural departments.

In the conferences both in the Burdwan Division and in the Presidency Division great importance was attached to the desirability of the execution of minor schemes by District Boards and other local bodies. The release of the income of ferries by Government to District Boards to enable them to take more active part in undertaking such schemes was recommended and it is a matter for congratulation that the recommendation has been accepted and orders on the subject have just issued. The establishment of a

joint Board on which the Government and the District Boards would be suitably represented, either for each division or for the province as a whole, was also suggested.

Great importance was attached to the creation of public opinion in favour of recognition of the supreme importance of irrigation and drainage for the economic welfare and improvement of the health of the people of the province. It is true that the larger schemes will involve the expenditure of large sums of money, and that both the capital outlay and recurrent expenditure will be heavy. But these works are all likely to prove remunerative in the end, and in any case as the bulk of the revenue of the country is derived from land and as the future of the country is so vitally dependant on the welfare of the masses, there is no public object for which expenditure on a large scale will be so amply justified. The extension of irrigation facilities is gradually transforming the deserts of the Punjab into smiling gardens, and it will be a strange irony of fate if Bengal which from the earliest times has been described as the garden of India, and which has supplied the bulk of the revenue from the earlier days of British rule for the improvement of other parts of India, should now be left to decay and languish in neglect. During 1923-24 the total area under irrigation in British India was about 26.5 million acres, while in Bengal the total did not aggregate to more than about 22,000 acres.

The evils of subdivision and fragmentation of holdings.

We may now pass to another important consideration which though directly connected with land is also concerned with labour and capital, and may, therefore, serve as a link between the physical and the human factors of agricultural wealth mentioned above. I refer to the smallness of agricultural holdings in India and the serious obstacle which this circumstance presents in the path of agricultural progress. The census of India in 1921 shows that the cultivated area per cultivator in Bengal is 3.12 acres, the average for India being about 6 acres. Mr. Thomson in the Bengal Census says that for each agricultural worker there are in Bengal only 2.215 acres of land. But there is one important con-

sideration to be remembered about these figures. The average for all classes of cultivators does not bring into sufficient prominence the fact that the majority of cultivators have much smaller holdings, and the average is pushed up because of the large holdings possessed by a comparatively few prosperous cultivators. Detailed census of the size of holdings in Bengal has not been taken, but I think it can be safely stated that fully 50 per cent. of the Bengal cultivators do not own more than 3 bighas of land, while 25 per cent. of the more well-to-do classes own holdings on an average of about 8 bighas, and it is only the remaining 25 per cent. of the prosperous cultivators whose holdings average about 20 bighas. So, it is the smaller cultivators with 2 or 3 bighas of land about whose welfare we are primarily concerned. A too small holding is uneconomical in two different ways. It does not fully employ the available energies of the agricultural workers and it does not give any scope for the employment of labour-saving appliances. The size of average holdings in Europe is much larger, being about 20 acres, but even in European countries like Holland, Belgium and France small holdings are not infrequent. Excessive fragmentation adds to the difficulties of subdivision. Not to speak of the difficulty of the utilization of the labour-saving appliances and the cost of supervision etc., the direct loss caused by a number of unnecessary *ails* must be quite substantial when the total area in possession of the average cultivator is in itself so small. It may be true that after all a very small percentage of agriculturists is really in a position to invest in labour-saving appliances and up-to-date machinery, but even for such primary needs as the improvement of irrigation facilities, a compact holding will have a distinct advantage over a holding lying in fragments separated by other people's lands.

Various measures have been recommended for remedying this evil of the subdivision of holdings, but it must be obvious that this evil is only another name for the poverty of the masses, and no remedial measures are likely to be of any avail unless they are aimed at the improvement of the moral and material condition of the *raiyat*. Legislation to restrict subdivision of holdings would be worse than useless. There is no doubt scope for improvement if the co-operative principle can be introduced and if the cultivators by mutual agreement can exchange fragments of hold-

ings with a view to securing greater compactness. In Punjab the co-operative movement has tackled the problem with remarkable success and a large number of societies have been formed in the province with the object of consolidating holdings. In three years 133 consolidation societies have been formed with 500 members, and 35,000 scattered parcels of land have been consolidated into 4,500. The area thus re-stripped up to the end of the year 1925 was about 50,000 acres. Instructions have been issued to make experiments in this direction in selected properties under the Court of Wards and in Khas Mahals. I do not anticipate however, that any striking results will be obtained in Bengal, where the land tenure system encourages such excessive sub-infeudation of holdings. The evils of small holdings may also be minimised if agriculturists could form themselves into co-operative societies for purposes of purchasing costly appliances, artificial manures and for the construction of irrigation projects. The spread of education amongst the agriculturists, specially in the direction of better methods of tillage and husbandry, a rise in their standard of comfort followed by the adoption of moral restraints against over-population, are, therefore, the directions in which our efforts should be mainly concentrated. The revival of the old village industries which might give occupation to a certain number of people now depending upon agriculture will also be a great relief.

The evils of the Barga system.

Mention may be made of another evil to which my attention was drawn in the Hooghly district by Rai Bahadur Bijoy Narayan Kundu of Itachona. The Rai Bahadur pointed out that in his quarter bonafide agriculturists were fast disappearing and people were anxious to get their lands cultivated by squatters under the *bhag* system. As a result of this evil practice the lands through sheer neglect are steadily deteriorating. The owners of these lands are very glad to get from them whatever they can while they carry on some other profession, chiefly clerking, and do not spend anything at all in manuring or improving the land. Obviously, it is not the interest of the *bhagidar* who is on the land by sufferance only, to do anything to improve the land. The Rai Bahadur is in favour of

drastic legislation to make the actual cultivator the real owner of the land. This may not be feasible, but steps might be taken to discourage those who cannot afford to or do not desire to cultivate their own fields and to induce them to sell out their lands, so that a more earnest race of agriculturists may take their place.

LABOUR.

MASS EDUCATION AND AGRICULTURAL EDUCATION.

Need for extension of education.

Proceeding to consider the factor of labour in relation to the agricultural industry, the necessity of mass education with the object of increasing the efficiency of the labourer, raising his standard of living, and making him responsive to the influence of new ideas becomes obvious. An examination of this aspect of the question, however, involves the consideration of two separate though closely related topics, viz., the present condition of mass education and the necessity for reform ; and secondly, the manner in which the education to be imparted can be so directed as to be most fruitful in advancing the cause of agricultural progress in the country. As regards the present state of mass education in Bengal, there is complete unanimity of opinion that quantitatively it is miserably inadequate and qualitatively it is thoroughly bad and inefficient. The whole educational system of the country in fact has been assailed within recent years on the ground of its not keeping in touch with the social and economic requirements of the country and not producing boys and men who satisfy its present day needs. Into the broader aspects of this question we need hardly enter here. Turning to elementary mass education, the outstanding features we find to be the appalling illiteracy of the people, the paucity of suitable schools in rural areas, the smallness of the attendance in the village schools and the lamentable lack of equipment of the teachers themselves.

It would appear from the census of 1921 that only 9·1 per cent of the population of Bengal was shown as literate, a term which it might be observed falls far short of "educated", and in

1924 only 12·5 per cent. of the children of school-going age were attending school, the percentage of boys being 20 and that for girls being 4·9. It has been ascertained that between 37 and 45 per cent. of the children who go to the primary school leave the school before they have learnt to read, and thus relapse into illiteracy, causing great waste of energy and misuse of even the paltry resources we possess for imparting elementary education. I have before me the expert opinion of the Directors of Education of Bengal and of Assam from which it would appear that in the opinion of both these officers there is absolutely no hope of any satisfactory reform under the present conditions. "With things as they are to-day", says Mr. Oaten, "it is not possible to do much by mere manipulation of curriculum. The existing voluntary one-teacher village school of 30-40 children with classes dwindling as each higher class is reached, can have no future. The inadequacy of rural primary education system or rather lack of system has been detrimental to agriculture as it has been detrimental to other rural activities—no more and no less—simply because it is inadequate and that it is not so much a change in the system as the creation of a system which is needed." I think Mr. Oaten goes to the root of the whole problem in Bengal when he says "but to-day a preliminary requisite of any improvement in rural education is adequate finance, on the basis of which a reasonable system of rural primary education both on the administrative and pedagogic side might be built up."

Government Scheme for Free Primary Education.

It is a matter of great satisfaction that a comprehensive scheme for the introduction of universal primary education into Bengal, in successive stages, has at last been carefully worked out by the present Education Secretary, and the decision of Government on the subject has been published in their resolution No. 3222 Education of the 25th September 1926. The whole scheme is based on a proposal to raise about two crores or rupees by an additional cess of 5 pice in the rupee of the annual value of lands to be levied and collected in the same manner as the present road cess and public work cess. A vital part of the scheme is the creation of a

District Primary Education Authority in each District for the supervision and administration of the new scheme. There can not be any question that the Government resolution sets up a high ideal, and there would be obvious advantage in dealing with the problem on a comprehensive and adequate scale. Unfortunately, the ideal has very often to be subordinated to present conditions and available resources, and it is doubtful whether the levy of such a tax, whose incidence will be heavier than that of the existing public works and road cesses put together, would receive that spontaneous support from the public which is so essential for the success of any such scheme, specially if it be not found possible to supplement this local cess by large subventions from the Provincial revenue. To my mind the root cause of the unfortunate condition of mass education, as of most other departments dealing with the moral and material advancement of the people, is the financial embarrassment of the Province. With a revenue income of only about two rupees per head of the population as against six and seven rupees per head of the other two major provinces of India, Bengal cannot possibly satisfactorily discharge any of her numerous duties towards the people. We find that the budget allotment of Bengal for primary education in the year 1926-27 was only 24 lakhs 15 thousands against a crore and 27 lakhs in Bombay and a crore in Madras, although Bengal was spending the same percentage of her revenue, viz., 12 per cent. on education as a whole as the other provinces. Re-adjustment of the financial resources of the province is in our opinion an essential preliminary to any far-reaching schemes of reform. There is another important consideration which should not be forgotten in dealing with this question and that is the organic inter-connection of the different spheres of rural welfare. It will not be wise to devote all available surplus resources of the province on primary education alone, when the demands of rural health and of economic and agricultural progress are also equally insistent. I am convinced that the poor attendance of children in the rural schools is due as much to the poverty of their parents as to their ignorance, and a more masterful cause than either is the prevalence of malaria and other fevers in rural areas for nearly half the year. Certain amount of additional local taxation will no doubt be necessary for work in all these directions, but I think it will be wiser to proceed cautiously and

by degrees, and at first only one additional tax for general rural development work of an anna in the rupee, equalling the present road cess and public work cess, might be imposed. In any case, as even under the scheme of Government some delay will be inevitable in making the preliminary survey of our requirements, finding the staff etc., it would be best to make a beginning with one Central School of an improved type at the headquarters of each Union Board or Union Committee, which will provide for 150 students with about 4 teachers as recommended by Mr. Michael West of Dacca. Older boys of the surrounding hamlets will walk to the Central School, while smaller children in the infant classes will receive instructions in feeder schools containing only the two lowest classes.

The Union farm to which I have referred should be utilised for giving practical agricultural training to the boys of the Central school and manual work at the farm on alternate mornings should be compulsory for all boys. For this purpose the boys should be divided into two batches. There should also be an industrial class attached to the school, where survey, carpentry, smithy work and some useful and profitable cottage industries will be taught. The attendance of half of the boys alternately at this class every morning should be made compulsory. Scouting should be made compulsory in the top classes. Similarly, there should be a Central school for girls for each Union. The School may be at the headquarters of the Union, or the best existing Girls' school in the Union might be chosen for the purpose. The curricula should be specially framed to suit girls. House-keeping, hygiene, baby clinics, cooking etc. should form a part of the curriculum. Physical exercise and drill should also be made compulsory. The cost of establishing such model Central schools at the headquarters of each Union will be comparatively moderate and could be met from a portion of the general rural improvement tax supplemented by a grant from the Provincial revenue. There will also be fundamental advantage in linking up our new scheme for mass education with the Union Board and the scheme of village self-government which we are attempting to develop, and I doubt much whether any centralised authority of the nature indicated in the Government resolution will be as efficient and suited for the purpose of administering mass education in the villages as the Circle

system and its component units, the Union Boards, under the guidance of the Circle Officers and Subdivisional Officers and ultimately of the District Magistrate.

Type of Agricultural education to be adopted.

As regards the second question of how to suit mass education for the needs of the agricultural classes whether this can best be done by having separate agricultural schools of different grades or by giving an agricultural bias to the education at present being given in the primary, middle and high schools, I think the prevailing opinion is in favour of adopting the Punjab system which leaves primary schools alone, but seeks to add some agricultural instruction in the middle vernacular school curricula without attempting to start middle agricultural schools of any special type. It is reported that this system is proving very successful in the 43 middle schools in the Punjab where it has been introduced. In holding up the Punjab system for adoption in Bengal we should not, however, forget that conditions are somewhat different in the two provinces, in as much as in the Punjab agriculture is a lucrative and attractive occupation which is growing in popularity chiefly on account of powerful stimulus given by canal irrigation, whereas in Bengal it is unfortunately in a decadent and depressed condition. The great advantage of the Punjab system in the opinion of the present Director of Agriculture is that it will make the boys learn in the ordinary course of their school career, just as they learn geography and mathematics, that there is such a thing as improved agriculture also and that agriculture is not a degrading profession. This in itself, the Director hopes, will lead to a demand for further training at higher agricultural institutions. But in Bengal we must be prepared to face the fact that there is hardly any real demand at the present time for agricultural education either in the lower and middle schools or in the higher schools and colleges. It is not likely, therefore, that much progress will be made and we shall attract many students to our agricultural classes, unless simultaneously with the introduction of agricultural instruction in some of our schools vigorous efforts were made to demonstrate to the people that agriculture is a paying profession.

Of course, it will always be possible to attract a certain number of students by reserving some Government appointments of Sub-Deputy Collectors and Court of Wards Managers etc. for those who succeed in obtaining diplomas from the proposed Dacca Agricultural Institute, and similarly by appointing Agricultural Demonstrators and other subordinate officers from students who leave the secondary Agricultural School at Dacca. But the surest way of making agriculture an attractive course in our educational institutions would be to demonstrate the possibility of agriculture affording an honourable and lucrative occupation to the youth of the country. So, while I am in favour of the introduction of agricultural instruction in a certain number of selected middle schools ; while I support the establishment of a secondary agricultural school at Dacca and possibly another secondary school for Western Bengal by a revival of the moribund school at Chinsurah ; while I shall welcome an institution for higher agricultural education at Dacca on the lines of the proposed Dacca Agricultural Institute ; and would also advocate, as suggested by Sir P. C. Mitter, the introduction of agricultural instruction in some of the existing private colleges where there are special facilities, e.g. in the Rangpur College, the Daulatpur College and in the Bankura Mission College. I am nevertheless very strongly of opinion that some scheme should be evolved for the establishment of a certain number of Vocational Agricultural Schools where instruction in agriculture will go on hand in hand with the pursuit of agriculture as a profession in a farm to be run on commercial lines. In my original memorandum on Agriculture I annexed a scheme for such a school with details of syllabus etc., but it seems unnecessary at this stage to labour the details of such a scheme. I am glad, however, to find that Sir P. C. Mitter is also in favour of this type of schools and has outlined an attractive syllabus. The important points to remember are :—

- (1) That instruction will be given in a farm, which will be run on co-operative lines, and where the students will be able to begin to earn some money ;
- (2) that not much literary qualification should be necessary for entering the school, but general education up to the Matriculation standard should be sufficient ;

- (3) that manual labour would be compulsory, as a matter of fact, the farm will be run mainly by the labour of the students ;
- (4) that along with agriculture proper some allied agricultural industries like dairy-farming, pisciculture or sericulture should also be taught ;
- (5) that there should be elementary instruction in engineering only to the extent which will enable the students to handle and keep in repairs any labour-saving appliances and machinery and to put up necessary buildings and structures.

My scheme being placed before the Calcutta Corporation, the University of Calcutta, the District Board of Alipore, and other public bodies received universal support. Two main difficulties were, however, pointed out against the realisation of the hope that students leaving such an institution will be able to set up as successful practical agriculturists. If the initial cost of starting a moderate farm of even 100 bighas comes up to say Rs. 5,000/-, where is the capital to come from ? Co-operation should ordinarily solve this difficulty, for it is not expected that each individual student, leaving the school, will start a farm of his own, but a band of young men can jointly start a mixed farm on co-operative principles. The Registrar of the Co-operative Societies, Bengal wrote to say that his department and the societies under his department will be prepared to give substantial assistance to students of the institution proposing to start a farm on co-operative lines. Some assistance might also be forthcoming from District Boards and also from the Agricultural Department of Government. The second difficulty pointed out is about securing land. Where is the land required for these farms to come from ? Apprehension has even been expressed by responsible critics that if young men were to take up farming they will oust bonafide cultivators from their legitimate occupation. But surely even under present conditions culturable lands at very cheap rates are available in the uplands of Midnapore, Bankura, Birbhum and also in Burdwan, Jessore, Murshidabad and Nadia. Only the other day I was given an offer of a farm of 200 acres at almost a nominal price of Rs. 10/- a bigha in the Nadia District. Land is perhaps more scarce in Eastern Bengal, but the extension of irrigation facilities will

everywhere make much more land available for agriculture. Another important point to remember is that the adoption of agriculture by the educated classes will afford the most powerful and direct stimulus to intensive cultivation that can be devised, with the result that far less land will be required to yield the produce that is now being obtained, or, in other words, the land now under cultivation will find occupation for a greatly increased number. Sir P. C. Mitter lays stress on the importance of encouraging small land-owners, zamindars' *gomasthas* and *naibs* and other residents of rural areas who have interest in lands to take to improved methods of agriculture in their own farms and homesteads, so that they may lead the way for agricultural progress in their villages. I am very doubtful, however, whether this class of people will be open to the influence of new ideas and will take to new methods in a hurry, and I think our efforts should be concentrated in encouraging the educated youths of the higher classes to take to agriculture which, in my opinion, would be the surest way of bringing about rapid improvements in the methods of agriculture and for raising the outlook of the agricultural industry altogether.

How to educate agriculturists and increase their efficiency.

Lastly, I must refer to the most important question—how far will our efforts in the direction of imparting agricultural education on the lines indicated above reach such agriculturists who are now actually cultivating the soil and transform them into more efficient producers of agricultural wealth? Perhaps not more than 15 p. c. of the agriculturists go to school and of these only about 2 p. c. of those who receive any education take to agriculture as their profession. Even if there should be an immediate and rapid extension of primary education among the masses and agricultural education becomes far more popular than it is at present, I am certain that these influences will take a very long time to reach those who are actually engaged in agriculture at the present time. To help them to improve their knowledge of agricultural practice and to induce them to take to better methods of cultivation, the only practical method which I can suggest is to establish small

agricultural farms extensively throughout rural areas, and to make a start by establishing a farm at the headquarters of each Union Board or Union Committee as the case may be. Arrangements will have to be made for imparting practical instruction in up-to-date agricultural methods, such as the selection of seed, use of proper manures, use of labour-saving appliances, care of cattle etc. by demonstration and by such other attractive methods as will appeal to them most readily. The farm should also be a centre for propaganda work for the area within its influence, and arrangements will have to be made for the distribution of illustrated leaflets and for holding of cinema shows at fairs and *hats*, in which agricultural films as well as films of general interest might be shown. I have already referred to the great success of the Demonstration Train scheme organized by the E. B. Ry. last year and have strongly recommended the extension of this experiment and also of the organization of Demonstration Steamers on the same lines as the Demonstration Train. Continuation class for adults may also be taken up in connection with the central Union School to which I have referred above.

Labour-saving Appliances.

The use of labour-saving appliances and up-to-date machinery would of course also need to be mentioned in connection with labour. But at the present stage of the industry we should confine our attention only to the cheaper appliances, because the bulk of the agriculturists are really too poor to find the capital necessary for the purchase of the costly appliances. If they are of the nature of a grain-winnower or a crushing machinery which are necessary at only a particular stage of the industry, the agriculturists can combine and hire the machinery jointly. And in the case of certain other machinery like deep ploughs, the advisability of deep ploughing has to be first definitely ascertained before we can recommend such a machinery for adoption in any particular area. The capacity of the available cattle and the facilities for replacing broken parts and of carrying out necessary repairs are important considerations which should not be lost sight of. As pointed out by

Mr. Mackenna, the improvement of the local materials which the cultivator can himself make and repair and which his cattle can draw seems to be the more hopeful line of improvement. However, if we are able to establish Union farms, each farm should have a stock of suitable ploughs, harrows and irrigation appliances for sale. Intending purchasers may also be encouraged to buy these implements on the instalment system. But it is in the comparatively larger farms of gentlemen farmers that there will be scope for the use of up-to-date machinery like motor-tractors, steam-pumps etc., and it is with the object of enabling intending agriculturists of the higher classes to use these implements and keep them in repairs that they should receive some training in elementary engineering.

Cattle Power.

It is easy to realise the importance of cattle power in connection with the agricultural industry in India where, besides human labour, bullocks are probably the only form of power used for driving the plough and carrying the produce to the market. Mechanical contrivances and power-driven implements are rarely used and horses are also seldom, if ever, used for agricultural purposes. It has been truly said that if we want better crops, heavier crops, and more crops, we must improve the bullock power, the quality and efficiency of the bullock, and if we want the population to be healthy—specially in West Bengal where fish is not so easily available—we must improve and expand the sources of milk-supply. Yet, important as live-stock is to agriculture and to the health of the general community, the question of preservation and improvement of cattle seems to receive very little attention. Repeated famines, wide-spread diseases of cattle, the export of good quality cattle of all kinds, and to some extent, the slaughter of prime cows and calves for beef, all tend to the deterioration of cattle. The statistics taken for the whole of India show that the available plough cattle is hardly sufficient for the work that is expected of them, there being only about 66 cattle per 100 acres of sown area, and 61 cattle per 100 of the population for the whole of India. Even out of these there is a large number of useless and

decrepit cattle, so that the percentage of active cattle would be only about 50 for 100 acres. The net area under cultivation in Bengal in 1923-24 was 22,805,700 acres. In the same year there were 82,05,171 bullocks. According to these figures for 100 acres there were 36 bullocks, but some of the animals might be used exclusively for carts. The outstanding feature of the situation in Bengal, however, is not so much the shortage of cattle as their miserably weak and inefficient condition. Sir P. C. Roy stated before the Agricultural Commission that in his recent tours in connection with flood relief he found the cattle of North Bengal diminutive in size, shrivelled in limbs and reduced to skeleton. To use such bullocks for ploughing, Mr. Andrews thinks, is a positive cruelty to animals. The unsatisfactory condition of the indigenous cattle and the rapid deterioration of the imported cattle may be due to some extent to the damp and insalubrious climate of Bengal, but there is little doubt that the chief cause of the emaciation of the cattle of Bengal is due to the prevailing inattention regarding the feeding and care of cattle. The cattle are left in most cases to pick up what scanty food and nourishment they can from the rapidly contracting pasture grounds and the stubble in the fields after harvest. Stall feeding except in the case of the well-to-do cultivators is very scantily resorted to and in most cases the only stall food is chopped straw which has very little nutriment for the animals. The cattle of East Bengal are perhaps somewhat better looked after than in West Bengal chiefly because the cultivators there are somewhat more prosperous. An improvement in the general standard of the care and tending of cattle is urgently called for. For, it is obvious that in order either to materially increase the productive capacity of the soil or to bring virgin land under cultivation, our efforts must be primarily directed to the improvement of cattle.

The improvement of cattle can be effected by better breeding and better feeding. In the matter of breeding Government are assisting by evolving in their farms at Rangpur and Dacca the best type of buli and draught and milch cattle required for the Province. The foundation is the best type of country cows available which were at first crossed in the Rangpur farm by up-country bulls of the Hansi breed, but Tharparkar bulls have now been substituted. At Rangpur there are two herds and the mini-