

the foundation of the Pusa Research Institute about the beginning of the present century, great developments in the scientific exploitation of Indian agriculture have taken place. Much credit is due to Lord Curzon, who, aided, it is now curious to recall, by the munificent bequest of an American (Mr. Phipps), founded a department which it is no exaggeration to say has added thousands, and will add millions, to the wealth of the country. India undoubtedly presented a fine field for the modern plant breeder. If we consider the immense variety of her plant products, their value either as food or in the arts and industries, and then observe that, owing to the absence of any skilled seed production industry, there is an uncounted number of identifiable races within each distinctive variety of economic plant, we can form some conception of the possibilities which even selection presents: superadding hybridisation, it is difficult to assign any limits to the field that is opening out.

It would be impossible in the ordinary limits of space to give a detailed account of what has already been achieved, but some indication may be given of proved successes in relation to the more important economic plants.

Mention may first be made of Wheat, of which upwards of 30 million acres are grown, and which was naturally one of the first crops to receive attention. Both selection and hybridisation have been brought into action, and several new varieties are now firmly established. In the United Provinces in 1917 alone "Pusa No. 12" occupied 100,000 acres, and was extensively grown in the Punjab as well. This wheat gives a cultivator an *increased yield of 25 per cent.* over the varieties formerly grown by him, as well as nearly one shilling per quarter more on the market, owing to its improved quality. Another and later production of Pusa has on occasions given a yield of nearly fifty-five bushels per acre, which for India is an unheard-of figure, and may be compared with thirty-two bushels, the British average yield of wheat. In the Punjab another new variety occupied 97,000 acres, and it is estimated that the growers of this wheat were presented with an additional income of nearly 15,000*l.* In the Central Provinces improved varieties, returning to the cultivators considerably increased profits, occupied 200,000 acres.

Remarkable progress is also being made in the production of improved varieties of Rice, the most important cereal crop in India. A variety known as "Indrasail," isolated by pure lime selection, occupied 20,000 acres in Bengal. In the Central Provinces it has been necessary to establish thirty seed farms for the production of other new varieties. Turning to non-food products, we find that extraordinary advances have been made in regard to cotton (of which 20 million acres are grown in India). In Surat an improved cotton has been produced giving a premium value of 13 per cent.; in Sind new varieties are giving a premium of 23 per cent. In the Central Provinces a new introduc-

tion is estimated to occupy no less than 800,000 acres, and to have brought the cultivators increased profits of nearly 900,000*l.* After this we may pass over such relatively inconsiderable figures as 215,000 acres under a new variety in the Punjab, but, for its human interest, mention may be made of one incident in a campaign directed to the eradication from a certain district of an inferior indigenous variety. It is a good example of the methods adopted to impress the Oriental imagination. "In the Tinnevely district the department had to resort to drastic action for the control of seed in the case of some ninety acres of *pulichai* [the inferior cotton] . . . the seed from this cotton was publicly burnt . . . before a large gathering of ryots."

In the improvement of Jute (of which India exports annually products worth 40,000,000*l.*) some notable advances have been made. It is expected that in the present year more than 30,000 acres will be sown with a new selected variety as a result of the distribution by the department of 500,000 packets of seed. In this connection a valuable scientific discovery may be mentioned. The pernicious weed, water hyacinth, which infests the waterways of Bengal, has been found to have a high potash content, and is consequently a valuable manure for jute, the use of which not only directly stimulates yield, but also protects the plant against a *Rhizoctonia* disease which attacks it.

It will be readily admitted that this tale of economic progress is astonishing. No mention has been made of the purely scientific results achieved, and they are very considerable. The workers no doubt feel well rewarded by the satisfaction with which they must regard the additions to knowledge which they have made, but they may also feel some pride in the remarkable economic advances which their labours have brought about, especially in regard to the food-producing plants.

THE VALUE OF INSECTIVOROUS BIRDS.

THROUGHOUT the country at the present time farmers, fruit-growers, allotment-holders, and owners of gardens are faced with a plague of insects such as has not been experienced in the United Kingdom for many years past. True it is that we have had more or less local outbreaks of the winter moth, the cabbage butterfly, apple and plum aphids, wireworms, leather jackets, and numerous other pests of great severity, but not, in the present writer's opinion, to such a general extent as at the present time.

The reason for this very serious state of affairs is not difficult to discover, and although the truth may not be palatable, it is, nevertheless, true that it is largely due to neglect and to an absence of a State Department with a thoroughly practical and scientific staff. It would be futile and unprofitable to dwell upon either of these two causes. Rather let us turn to another phase of the matter not altogether foreign to the subject, viz. the value

of our insectivorous birds in controlling insect life.

Whilst no one possessing a knowledge of the food habits of wild birds will for a moment contend that any species will ever exterminate any species of injurious insect, it is equally clear that if present in sufficient numbers our insectivorous birds do materially help to maintain the balance of Nature, and so prevent certain species of insects from becoming so numerous as to assume the dimensions of a plague. There is now ample evidence to prove this, both in our own country and elsewhere.

Unfortunately, in this country, the species of wild birds that are truly insectivorous in their habits are not plentiful. During the past few years two causes have materially tended to bring about a great reduction in their numbers, viz. the severity of the winters of 1916-17 and 1917-18, particularly the former, and the misguided enthusiasm of certain individuals who, in and out of season, claim protection for practically every species of wild bird. This latter cause, in our opinion, has been as fully disastrous as the severity of our climate. When a certain section of the educated public shuts its eyes to the enormous depredations that a comparatively few injurious species of wild birds commit, and is so prejudiced as to misrepresent facts, one result is inevitable, viz. those who are the sufferers and losers wrongly take matters into their own hands and proclaim a ruthless war on all species of wild birds. This is what has taken and is taking place in the country at the present time, much to the detriment of the agriculturist, fruit-grower, etc. Moreover, this is likely to continue so long as the biased view of uniform protection is advocated, with the result that year by year we shall see great plagues of caterpillars making their appearance and devastating the countryside. Crops will be lost, the supply of our home-grown food materially lessened, and the numbers of our insect-eating wild birds must continue to grow less.

The outlook is not a cheerful one, and it is fraught with exceedingly grave possibilities, much graver and more far-reaching than most people realise.

With the first cause we are, at present, unable to deal, although it is exercising the minds of many as to the best manner in which to counteract or checkmate this misguided and pernicious zeal. For the second, however, we believe there is a remedy, if not wholly, at least in part, viz. the enlightenment of the agricultural community as to the part these birds play in the economy of Nature; and this is the immediate object we have in view. For we believe that if, without bias or prejudice, the facts are truthfully and carefully laid before those interested, this terrible destruction will be arrested to an appreciable extent.

The thoughtful reader will no doubt inquire, "Do not the Wild Birds' Protection Acts afford complete protection to these species of birds and an effective means of preservation?" Our answer is "No." To a very large extent the Act of 1880 and its four

supplementary Acts are practically dead letters. From 1880 to the present time they have all proved largely ineffective.

The actual number of species of insectivorous wild birds we have in this country is comparatively small, and many visit us for only a brief season of the year. Of the few that remain throughout the year a heavy toll has been taken. Let us consider briefly the nature of the food and the feeding habits of some of these.

The fieldfare, water ouzel, wheatear, whinchat, stonechat, redstart, and robin are all above suspicion. The warblers and wrens (excepting the whitethroat and blackcap) belong to a like category, as also the hedge accentor, dipper, tits, wagtails, pipits, flycatchers, swallow, martins, and tree creeper. Of the finches we must except the greenfinch, chaffinch, house sparrow, and bullfinch the two latter being wholly injurious. So far as their food habits are known, none of the buntings are injurious. In some districts the corn bunting is rather plentiful and has been accused of damaging grain and ricks, but much more careful investigation is necessary before condemning it. All the larks do far more good than harm, whilst the swift, nightjar, woodpeckers, wryneck, kingfisher, cuckoo, and owls are all most beneficial. Thus, of the 280 species of British birds, excepting those aquatic or littoral in their habits and the game birds, we have somewhat fewer than a hundred insectivorous species, many of which are quite rare. Surely it is to the interest of the agriculturist and fruit-grower to do all in their power to help to protect and increase these beneficial species, which constitute a really important factor in crop production.

Some during the whole of the year, and others during the period they are in this country, are feeding almost entirely upon insects and the seeds of weeds. It is difficult to estimate the enormous bulk of food that they consume, but we can form some idea when it is stated that a bird about the size of a skylark consumes about 6 lb. of food per year, so that 10,000 birds would require about 27 tons of food in a year, of which fully half or more consists of insects and caterpillars.

Taking a miscellaneous lot of insects and caterpillars from the stomachs of ten skylarks, we find that in the different individuals, according to the particular species of insects eaten, 174, 160, 162, 162, 177, 182, 156, 138, 154, and 156 weigh exactly one ounce, or an average of 162, so that 10,000 birds would consume 78,382,080 insects in a year, whilst every 1000 birds would account for nearly 8,000,000, and each bird an average of 8000 per year. In all probability our smaller species of insect-eating birds consume a number of insects far in excess of these figures.

Bird counts, such as have been carried out in the United States of America, do not exist in this country, so we cannot state even approximately the number of insect-eating birds we have in the United Kingdom, but assuming that there are 32,000,000 acres of land under cultivation and that we have a pair of birds to every four acres,

these 16,000,000 would consume annually 135,411,328,000 insects. Such figures require some thinking about before we can realise or form any true conception of the vast quantities that are included in such measures. It is impossible fully to realise the millions of insects and caterpillars that birds destroy just at the season of the greatest agricultural activity.

Wherever insectivorous birds have been destroyed there has followed an increase or plague of injurious insects. Scores of cases are on record, such as the destruction of woodpeckers and tits in the forests of Saxony and Brandenburg prior to the year 1798, in France in 1859-60, in Nebraska between 1865-77, and in Russian Siberia in 1893-94.

An anonymous writer stated a short time ago: "Some of the very greatest friends that our nation has are being destroyed without mercy. If the British Navy were threatened with destruction, a great cry would rise from the people, but only whispers are heard now and then about the slow destruction of a defensive force upon which most of our prosperity depends."

Surely we shall not appeal in vain to the various agricultural and horticultural organisations of this country to bring the weight of their influence to bear on a matter so vital to the country's interests. If the cultivation of the land has to prove profitable, it can do so only by preserving and utilising every factor that is favourable to crop production, and so long as economic entomology and ornithology remain neglected or only of academic interest in the United Kingdom, it behoves us to awaken and to take heed where we stand, or for some years to come our land will groan with the cry of desolation, due to our apathy and the ignorance and neglect of the ways and habits of our insectivorous birds, and the wanton destruction of what has ever been Nature's means of adjusting the complications of animal life, which man in his ignorance is seeking to pervert.

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INDIAN INDUSTRIAL PROGRESS.

TWO publications¹ have recently been received which would indicate that decided progress is now being made in industry in India, owing to the stress involved under war conditions. The Indian Munitions Board undertook its formal duties as a Department of the Government of India in April, 1917, its primary function being the utilisation to the utmost extent of Indian resources in materials of all kinds required for the prosecution of the war.

When considered from a broad aspect, the munitions for a modern army cover practically all the wants of a civil community, with the addition of the special weapons, the armies' munitions, etc., which are employed by the soldier or sailor in actual fighting operations. With the enormous

armies which are now used in warfare, the scale of operations is such that the wants of these fighting men necessarily compete with the requirements of civil life; hence the necessity for departments which will be able to cover the whole aspect of the economic and other life of a country. India has hitherto been mainly an agricultural country, but with the operations of war preventing supplies reaching India from England and other countries, it has become essential that many manufactured articles, which were formerly solely imported into India, must now, or, at all events, so long as the war lasts, be largely manufactured in India itself.

It is probably not too much to say that, owing to the influence of the war, India has already made progress which would otherwise have occupied almost a generation, and the Report on the Indian Munitions Board now available shows that its activities have been manifold.

The Indian Munitions Board was fortunate in being able to secure as its President Sir Thomas Holland, who was formerly for some years Director of the Geological Survey of India, and happened to be in India as head of an Industrial Commission which was engaged in developing India's industrial resources. The Board consists of the President, Sir Thomas Holland, assisted and advised by four members; and it is attached to the headquarters of the Government of India. At headquarters the work is divided into a number of well-defined branches, each branch being under the administration of a Controller. There are also provincial organisations in the different parts of India, and nine Controllers of the principal provinces, provided with proper deputies and assistants, have been appointed.

The provincial Controllers are responsible for utilising local industries which are not within the sphere of the special branches at headquarters. The organisation, therefore, appears to be fairly complete. The subjects dealt with under the control and supervision of Government are very varied, but the main object of these changes appears to be the utilisation of all indigenous materials and their exploitation so far as possible. As indicating the diverse activities now being carried on by the Indian Munitions Board, it may be mentioned that such special subjects as the following are now being worked at:— Timber supplies and resources, hides, tanning, and leather, the chemical and metallurgical industries of India, the potash salts in India suitable for chemical manufactures, manufacture of organic chemicals, essential oils, and perfumes, glycerine manufacture, wood distillation, indigenous dyes, etc. It would hence appear that great developments may be expected in future in the industries of India.

In connection also with the Indian Munitions Board, a conference was called by it for the consideration of the reorganisation of chemical research in India, the meeting being held at Lahore on January 8 last. This was attended by the majority of qualified and skilled chemists in

¹ "Indian Munitions Board Handbook" and "Proceedings of a Conference for the Consideration of the Organisation of Chemical Research in India, held at Lahore, January 8, 1918." (Simla: Government Monotype Press.)