The Control of Insect Pests by Means of Parasites.

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IN recent years agriculture in its broadest sense has received a powerful stimulus throughout the British Empire owing to the tremendous growth of the demand for vegetable and animal products of all sorts, especially in the more densely populated countries. In consequence, more and more attention has been directed to the insect and other pests of crops and domestic animals, and some recognition of the vast damage they do is becoming general. One result of this is that entomology, as an applied science, has attained a status and importance that would not have been thought possible a generation ago.

The almost world-wide attention that has been directed of recent years to problems of insect pests has naturally led to the investigation of new methods of controlling them. Though considerable strides on the chemical and physical side have been made in advancing our knowledge of insecticides and of apparatus for using them (even aeroplanes having been adapted for this purpose), it is now fairly widely recognised that such methods are seldom more than palliatives and necessarily involve an annually recurrent expenditure. Indeed, it is not too much to say that the damage done by insects, when the cost of keeping down their numbers is added to it, materially increases the cost to the consumer of nearly everything he eats and much of vegetable and animal origin that he wears or uses in other ways. Artificial control measures have the further disadvantage that most of them are unsuitable for use by the uneducated native populations, who are yearly producing more and more of the crops of cotton and other tropical products that are exported to other countries.

One of the primary causes of an insect becoming sufficiently numerous to reach the status of a pest is the action of man himself, who, in the processes of agriculture, destroys the equilibrium that exists under natural conditions between insects and their various enemies. A pest with a somewhat different origin, and one often most difficult to deal with, is an insect that has been accidentally or thoughtlessly introduced into a new country where the climatic conditions may be specially favourable to it and the natural enemies that kept down its numbers in its native country do not exist. That this should have already occurred in the temperate regions of the New World and of the southern hemisphere is not surprising, and some of the worst pests in Canada, South Africa, Australia, and New Zealand are in fact of European origin and not indigenous in those countries. Many examples of this might be cited, but one with which most people are probably familiar is that of the Codling Moth, which infests apples. This insect, though not of any great importance in England, and seldom found in numbers except in neglected orchards, is a major pest in all the more temperate parts of the British Empire. Elaborate spraying operations have to be carried out against it, and these materially enhance the cost of imported

apples, while the fact that the best insecticide used for it contains arsenic has caused much loss and confusion to the trade in imported apples owing to the risk of arsenical residues being found on them.

Though every country now has a more or less elaborate code of quarantine laws directed to keeping out insect pests, they can never be an absolute safeguard, and it is too much to expect that what has happened in temperate climates will not repeat itself in tropical ones with the ever-increasing exchange of tropical products that is now going on. Indeed, the history of recent years shows that this is already happening, as can be seen by the spread, within the last ten years, of the dreaded Pink Bollworm of cotton into the New World.

Realisation of all this has led the modern entomologist to try to take a leaf out of the book of Nature, and to see whether what may be called artificial methods of insect control cannot at least be supplemented, and perhaps in some cases superseded, by utilising parasitic insects or other enemies to reduce the numbers of a given pest. Though this method obviously has great limitations and must be applied with great circumspection, it has the outstanding advantage that, if successful, its results are permanent, and that the expense it involves is limited to the original cost of the preliminary investigation and of the breeding, exportation, and establishment in its new home of the parasite concerned. It is not, however, suggested that this method can be expected to eliminate altogether the necessity for artificial control measures except in rare cases, since a parasite in the nature of things does not normally exterminate its host (a procedure that would involve its own extinction), but merely reduces its numbers to such an extent that a major pest may become one of minor importance.

It is obvious that great care must be exercised in the carrying out of such a scheme, and certain cardinal principles are involved. Perhaps the chief of these is that in the majority of cases the parasite selected for introduction must be a highly specialised one that is unlikely to affect the balance of Nature in its new home by attacking anything but its intended host or a species nearly allied to it. It is also important to discover the most effective parasite of the many that commonly attack a given host. Harm may be done by the importation of several parasites, all of which compete for existence in the same host. Though there is some doubt on the point, it has been stated that in Hawaii, where some of the pioneer work of this character has been carried on, when several parasites of the Mediterranean fruit-fly were simultaneously introduced into those islands, they ultimately proved less effective owing to the numbers of the most efficient species being reduced by competition with the others. Similarly, the utmost care has to be taken to eliminate all hyper-parasites, that is to

say, parasites of the parasite itself, for these may practically cancel its effect on the host, and it must be borne in mind that once such minute insects are established in a new country their eradication is impossible. Moreover, a parasite that is only moderately effective in its native country may become vastly more so in a new one if its hyper-parasites are absent. It will therefore be obvious that the successful accomplishment of a scheme of this character involves much careful and often lengthy investigations sometimes extending over several years, and that satisfactory results cannot be guaranteed in advance.

The Government of the United States has devoted large sums in recent years to establishing laboratories where work of this kind may be carried out, and early in the present year it passed an Act that appropriated no less than 10,000,000 dollars for work on the European Corn-borer, an

introduced moth that is doing a vast amount of damage to maize, and the parasites of which are being bred in France for export to North America.

In order that a start may be made on these lines in the British Empire, the Empire Marketing Board has recently provided the Imperial Bureau of Entomology with funds to maintain a laboratory at Farnham Royal. Work has just begun there, but it is not to be expected that any important results can be attained before next year at the earliest, though it is probable that, as a small beginning, a Braconid parasite of the blow-flies that cause serious losses amongst sheep may be sent in the autumn to Australia, New Zealand, and the Falkland Islands. Several investigations have, however, been begun or are being planned, which, it is hoped, will benefit many other parts of the Empire, including Canada, Australia, New Zealand, South Africa, and Kenya Colony.

News and Views.

AN agreement between the I.G. Farbenindustrie (the German Dye Trust) and the Standard Oil Company of New Jersey for the exploitation of a new process for the production of synthetic petrol which the I.G. has evolved, was reported in the *Times* of Aug. 11. This agreement relates solely to the American markets, and further negotiations, it was stated, may be expected with European countries in respect of the realisation of the patent rights concerned. Much speculation appears to have arisen as to the precise nature of the process in question, as only the most meagre information has been officially forthcoming. But the few details provided in the *Times* report are sufficient to identify it with reasonable certainty as that which forms the basis of a group of very recent patent applications emanating from the I.G. This new process, described as the destructive hydrogenation of carbonaceous materials, appears to comprise nothing more than a development of the well-known Bergius method, according to which coal or similar material is subjected to thermal decomposition in the presence of hydrogen under pressure to produce hydrocarbon mixtures of the nature of petroleum. But whereas berginisation is essentially non-catalytic, the new process is based upon the discovery that the introduction of certain catalysts leads to the formation of more valuable hydrocarbons, with increased yields and at an enhanced rate.

THE first of these catalysts to be protected by the I.G. were compounds of nitrogen, whether added as such or formed *in situ* from added nitrogen; then followed molybdenum and its compounds, then chemically combined sulphur, then tungsten and chromium, until now a whole host of such substances have been described. Furthermore, the hydrogen need not be so highly concentrated as in the berginisation method; it may even be present as combined hydrogen, *e.g.* as hydrogen sulphide or methane, or it may be produced by the introduction

of steam which reacts with the carbonaceous material. Otherwise, the reaction conditions appear to be very similar to those obtaining in the berginisation method. Like the latter, it is applicable not only to coal and other solid materials, but also to the treatment of tars, mineral oils, or their distillates, and even to such bodies as asphalts and resins. Presumably it is in the treatment of heavy oil distillates and residues that the Standard Oil Company is interested, for any process using coal as starting material could scarcely be an economic proposition for some years to come in the United States, considering its natural oil resources. It may be remarked that the engineering difficulties associated with the treatment of large quantities of materials under the high temperatures and pressures proposed (of the order of 500° C. and 200 atmospheres) are very considerable, even to an organisation like the I.G., which has unparalleled experience of the technique of high-pressure working. Any estimation of the commercial importance of the process must therefore be reserved until it has definitely emerged from the experimental stage and more detailed information is available concerning it.

It is now twenty-one years ago since the Victoria Falls and Transvaal Power Company was granted rights to utilise the Falls for the generation of electric power. Hitherto the Company has only used steam plant to produce power, and recently it has received a communication from the Northern Rhodesia Government in which stress is laid on the principle that it is not in the public interest that this source of power should remain indefinitely unused. The Company has replied that it has always been anxious to utilise the power of the Falls commercially as soon as possible. It is quite willing that the rights and conditions granted twenty-one years ago should be suitably modified or expanded, in a similar way to that adopted in other countries for the control of power undertakings. The Company was founded with the object of supplying the Transvaal gold