

The salient points of this hopper are :-

i. It is made of metal and therefore lasts long. It is always worth its weight of metal. It is elegant in design, fire proof and rat proof.

ii. The same hopper can be used for sowing all kinds of seeds only by changing discs. A continuous rope for fixing it on to the drill is not needed.

iii. The bottom half is provided with three projections which fit into the tin tubes, thus giving more stability. Tin tubes work better with this hopper.

iv. It is provided with a seed box and a stirrer which helps in the uniform distribution of seed.

v. There is a disc shutter to open or close the holes as necessity demands.

vi. If the stirrer gets out of order the hopper can be used like the wooden ones for sowing seeds with the hand.

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THE ECONOMIC DANGER IN THE INTRODUCTION OF SOME FOREIGN ANIMALS AND PLANTS

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Introduction. It is well known that, due to the action and reaction of various factors in nature, there is maintained what is called 'a balance of life' in this world. One of the most potent influences which helps to upset this even equilibrium, and bring about abnormal conditions in nature, is the part played by human agency. And, among the many such human activities, one has been the indiscriminate transportation of plants and animals from one country to another, without in the least realising or foreseeing the disadvantages and the often disastrous results of many such introductions. We have some examples of how man, without any evil intention, has been responsible for bringing about a very undesirable state of affairs in different regions of the world, by thoughtless introductions of different forms of life from one region into another. Though the geographical position of India is more or less isolated, situated as she is, clearly separated by natural boundaries of mountain walls or seas from other regions, in these days of quick and easy transport facilities for all sorts of animal and vegetable products not only by land and

sea but even by air, there is every likelihood of undesirable and harmful exotic forms, gaining admission into the country without our knowledge. This is the case particularly with insect pests and plants of different kinds. In this paper an attempt is made to survey the present position with regard to some of the important exotic plants and insect pests which are already with us or are likely to be introduced, pointing out the evil effects resulting thereby, and to offer some suggestions in the way of preventing such introductions as far as possible in the future.

Indigenous, Exotic and Cosmopolitan Forms: In the study of the geographical distribution of different forms of life inhabiting the world, it will be found possible in many cases to divide the flora and fauna of any region into two groups, *viz*, those which are natives of the tract, and those which have managed to gain admission into the region from outside—the forms included under these two groups being popularly known as indigenous and exotic forms. Such a grouping however, may not be quite accurate in all cases, unless one has reliable records or the history of each and every plant and animal inhabiting any country. But for all practical purposes, a classification of this kind based on the knowledge, observations, and experiences of scientific workers, might be sufficient and satisfactory to a great extent. In addition to these two categories, we have also to note that some plants and animals have a world-wide distribution and are practically cosmopolitan. To make our knowledge of these different categories of organisms as correct and complete as possible, at least as far as the future is concerned, a biological survey of every country will be extremely valuable not only from the point of view of the pure biologist but also from an economic point of view. The United States Government maintains such an organisation called the United States Biological Survey for such a purpose, an arrangement which every civilised country might copy with great advantage. Of these three categories into which the fauna and flora of any country may be grouped, we are in this paper more concerned with what are known as exotic forms and the influences they exert on the economy of man. It has been found by practical experience in many countries that in the great majority of cases, introduced forms become far more destructive in their new surroundings than in their original native habitats. This is biologically explained by the fact that all organisms in their native surroundings have to contend against many natural enemies which play their role in preventing these creatures from undue multiplication; whereas in their newly adopted homes many of them find that such natural checks are absent, and on that account multiply rapidly and thereby become pests. It may be argued that the new insects introduced may not be able to contend against local insects, but the experience so far has been the other way.

Some Experience with Introduced Forms. Before dealing with the probable influences of thoughtless introduction in the future, it will be worth while to have some ideas regarding the results man has, and is gathering, of careless and unrestricted transportations already made of undesirable forms of life from country to country. The introduction of the rabbit by the early settlers into Australia was later found to be a blunder of the greatest magnitude! Within the course of a few years the creature increased abnormally with disastrous results; so much so, that in some parts of Australia sheep began to die of starvation since the rabbits had eaten away all the grass! The same has been the story of the well intentioned introduction of the mongoose into the West Indies. This little carnivorous mammal (*Herpestes birmanicus*) was purposely introduced from Asia to be used as a natural enemy of a species of rat, which was causing serious damage to the sugarcane crop in the islands. Though in the beginning some relief was visible from the rat pest, in course of time it was found that the immigrant mongoose itself began to show evidences of becoming a pest in its turn; a number of useful lizards, birds, etc., were found destroyed by the mongoose and at the present moment the creature is found to be a veritable pest in some of the islands. While such has been the history of higher and bigger animals one can easily conceive how easy it will be for smaller organisms like insects, mites, fungi, seeds of weeds, etc., to get dispersed, or transported with diverse commodities like stores, provisions, live plants, ornamental shrubs, orchids, packing materials, etc., which are now-a-days exported and imported from various regions. The United States of America has been one of the greatest sufferers from damage caused by imported insects. In that country where this subject has been receiving some attention for some decades the names of such imported insects as the Gipsy moth, the San Jose scale, the European corn borer, the Japanese beetle and the cotton boll weevil are dreaded; these are notorious forms which managed to gain entry into the states and have been giving considerable trouble and causing enormous damage to the farmers. Striking examples of introduced insect pests in India are the Potato tuber moth (*Pthorimoea operculella*), the diamond back moth of cabbage and other Cruciferae (*Plutella maculipennis*), the coffee green bug (*Lecanium viride*), the apple wooly blight (*Eriosoma lanigera*), and the fluted scale of orange (*Icerya purchasi*). Potato growers, coffee planters and fruit growers in India will readily testify to the fact that some of these insects have become major pests in their adopted country and some are likely to become a menace if proper measures are not adopted in time. Going to plant introductions of a similar nature we have two well known and notorious examples in the Prickly pear (*Opuntia spp.*), and the Lantana (*Lantana spp.*) both natives of the New World and introduced into parts of the Eastern Hemisphere with the best of intentions. Some account of the early history of the

Prickly pear in India and its present position may be found in the writer's paper * * on "The Coccidae of the Prickly pear and their economic importance" and the present plight of the plant in the hands of its natural enemy—the *cochineal* (another introduced form by the way) is now in evidence practically everywhere in S. India. Another notorious plant which gained entry into the country more or less as a contemporary of the Prickly pear more than a hundred years ago is the Brazilian Water Hyacinth (*Eichornia crassipes*). That it is a veritable pest in tanks and lakes, that it causes a good deal of trouble to navigation in inland waters and that it has the honour of having become a subject for Government legislation are facts very well known to all of us. Of recent introductions we have the weed popularly known as the "Khaki weed" (*Alternanthera cchinata*) which is said to have been noted in parts of S. India since the days of the Great War and which is now a veritable nuisance in many places covering up sides of roads and foot paths and overgrowing meadows and lawns. We have also observed that within the past ten years or more the "Goat weed" (*Eupatorium glandulosum*) has spread considerably over cultivated areas and hill sides and is becoming a serious weed pest on the Nilgiris. These are only some of the more important examples which have been actually noted by us; it is not, however, possible to state how many smaller animals and plants have also gained entry into India without their attracting any body's attention!

Some Forms which are likely to get in. However sufficient unto the day is the evil thereof with existing and already introduced pests and we are anxious to avoid, if possible, any more unwanted guests; and unless sufficient precaution and care are exercised it is not unlikely that some other pests not present in India at present are liable to find their way in. In a paper, * under the title "Some foreign insect pests which we do not want in India" the writer has already pointed out as far as insects are concerned some of the very serious insect pests which we have to carefully avoid. Some of the most important of those are the Mediterranean fruit fly (*Ceratitis capitata*), the Mexican cotton boll weevil (*Anthonomus grandis*), the West Indian sugarcane weevil (*Sphenophorus succhari*) and the grape vine Phylloxera (*Phylloxera vastatrix*), insects which have caused terrible havoc in many countries and brought about very heavy losses to the cultivators. A few years ago in a parcel of sugarcane setts received from Antigua, the Imperial Entomologist, Pusa, actually noticed two live grubs and a cocoon of this destructive cane weevil of the West Indies. During the course of his inspections the same officer also came across another cane pest of Java (*Holaniara picesens*), a beetle in a similar parcel from Java. These

* * "Agriculture & Livestock in India"—Delhi, Vol. I (3), May 1931.

* Agricultural Journal of India, Pusa, Vol. XIV, 1919, pp. 500—511

are only a few of the many cases that have come to the notice of responsible individuals while it is quite conceivable that there occur many cases of such imports unknown to most persons. It may be added that since the publication of the writer's paper in 1919 what the writer apprehended did happen unfortunately in the case of at least one exotic pest, *viz.*, the cottony cushion scale (*Icerya purchasi*), the dreaded fluted scale of citrus and other plants in the Australian and other regions. About four years ago this was noted on Australian wattles grown on the Nilgiris and it has not been possible yet to fix the responsibility of having introduced the pest on any individual. The Madras Government, as many readers are aware, had to make special efforts to get the natural enemy (*Vedalia*) of this scale and carry on some special work against the pest on the Nilgiris; though at present the insect has not spread, as far as the writer believes it has come to stay and though it may be kept under some control it may not be possible to completely exterminate the same. Another form which bids fair to get into the country or has even found its way to a certain extent but was promptly checked is the coffee borer beetle of Java (*Stephanoderes hampei*) a very serious pest of coffee beans in the Asiatic Archipelago. The Government having come to know of this have promptly checked the introduction of all unroasted coffee seeds from abroad.

Existing checks to Pest importations and suggestions for the future. Till about 1906 there were no restrictions of any kind and any one was quite at liberty to dump into the country any forms of animals or plants; and with the gradual increase of facilities for easy transportation both by land and sea, chances for exotic pests considerably increased not only for reaching the country but even to distribute themselves free into the different parts of the interior. However, we have to thank ourselves that in spite of such easy facilities during these many decades comparatively very few forms have, however, gained entry and this might be attributed to some extent to the climatic conditions of the interior also. In 1905 the Government of India, apprehending the danger of the Mexican cotton boll weevil gaining entry into India with consignments of American cotton, issued orders that all parcels of cotton seeds from the New World should be admitted into India only after fumigation at the port of entry; this did not, however, prevent the danger of small parcels of seed being forwarded by post. Five years after this, the Government of India appointed a committee of experts who went into the question of imports of not only of cotton seeds from America but of all plants which were likely to introduce insect and fungus pests from any outside country and at their suggestion legislation was enacted and the Act II of 1914, an act to prevent the introduction into British India of any insect, fungus or other pest which is or may be destructive to crops, was brought into force and

subsequently in 1917 a more comprehensive order was promulgated to control and inspect imports into British India of various suspected materials. This dealt with the restrictions applying to the admission of things like potatoes, flax seeds, cotton seeds, coffee seeds and plants, Rubber plants, sugarcane, etc., and the penalties for the infringement of the rules. The rules insisted on pest free certificates being got from the consignor in the country of origin on some and fumigation in the case of others. The importation of overseas consignments of plants was restricted to eight important ports in India including Madras, Negapatam, Dhanuskodi and Tuticorin in S. India. Restrictions were also imposed on the import of plants, etc., from abroad by post giving powers to the postal authorities to deal with them in the proper manner. Passengers bringing live plants were also made liable to subject these imports to the same restrictions such as examination, fumigation, etc., at the port of entry. In this connection, it may be interesting to record the writer's experience while on board a passenger steam-ship across the Pacific in 1926, a few hours before the ship entered the harbour of San Francisco; remnants of all vegetables like cabbage, tomatoes, etc., fruits, like bananas, oranges, melons, apples, etc., and similar perishables stocked for use of the passengers and crew on board and those with the passengers were all thrown overboard into the sea before the customs officers admitted the ship into the harbour and only properly treated and certified packages of fruits and other vegetable parcels were allowed to be brought ashore.

In spite of such restrictions it must be admitted that there are various chances of pests of different kinds gaining admission, unless these restrictions are thoroughly overhauled and carefully worked out, and properly trained men are deputed to attend to this work at the important gates of entry. A more thorough set of rules covering all possible imports of a suspicious nature should be framed and a regular system of plant quarantine should be established. Last year the National Plant Board of the United States of America issued a set of regulations approved by all the 48 states under the title 'The Principles of Plant Quarantine' which is a valuable contribution setting forth the principles that ought to be applied in the establishment and enforcement of plant quarantines. It may be found valuable to reproduce the same here for guidance of plant pathologists and entomologists who have to play an important role in this matter.

Principles of Plant Quarantine.

1. **Definition.** A quarantine is a restriction, imposed by duly constituted authorities, whereby the production, movement or existence of plants, plant products, animals, animal products or any other article or material, or the normal activity of persons, is brought under regulation, in order that the introduction or spread of a pest may be prevented or limited, or in order that a pest

already introduced may be controlled or eradicated, thereby reducing or avoiding losses that would otherwise occur through damage done by the pest or through a continuing cost of control measures.

2. Basis in Logic. Since the ends to be attained by a quarantine and the measures required by it could not be undertaken by private individuals or groups, involving as they do restrictions on areas, persons, or activities for the benefits of wider interests or the public at large, resort to regulation imposed by public authority is logical.

3. Necessity. Establishment of a quarantine should rest on fundamental pre-requisites, as follows: (1) The pest concerned must be of such nature as to offer actual or expected threat to substantial interests; (2) the proposed quarantine must represent a necessary or desirable measure for which no other substitute, involving less interference with normal activities, is available; (3) the objective of the quarantine, either for preventing introduction or for limiting spread, must be reasonable of expectation; (4) the economic gains expected must outweigh the cost of administration and the interference with normal activities.

4. Legal Sanction. A quarantine must derive from adequate law and authority and must operate within the provision of such law.

5. Validity. A quarantine established for the purpose of attaining an objective other than that which it indicates or defines is open to serious criticism, even though the actual objective is itself desirable.

6. Public Notice. If the circumstances will permit, public notice of a proposed quarantine should be given and those interested should be invited to contribute facts in their possession. But if the objective would be defeated by the delay required for such notice and discussion, duly constituted authorities should assume responsibility for the decision to impose or withhold quarantine action.

7. Scope. The extent of restrictions imposed by a quarantine should be only such as are believed necessary to accomplish the desired end, but on the other hand the objective of a quarantine should not be jeopardized by omission of any necessary restriction.

8. Relation to Eradication. If a quarantine is imposed in order that eradication of a pest from a given area may be undertaken, the restrictions involved may properly be relatively extensive because of the importance of the objective sought, and because of the time through which the quarantine will operative may be expected to be relatively limited.

9. Relation to Retarding Spread. If a quarantine is imposed for the purpose of limiting or retarding spread of a pest, but without expectation of eradication, the restrictions imposed should be such as are in line with the objection of the quarantine and should recognise the fact that continuance of the pest in the area where it is established, or possibly its spread in time to new areas, is expected.

10. Co-operating Authorities. Since quarantines usually involve relations between public authorities, such as those of the government of one country with that of another, or of Federal and state governments, or of state government and local authorities, the co-operative relationship that is necessary to adequate enforcement should be clearly recognised and duly provided for.

11. Co-operation of the Public. Because of the fact that success of a quarantine requires that its restrictions be fully maintained, it is essential that all

persons who are affected by it adhere to its requirements. In order that this end may be obtained the administration of a quarantine should seek the intelligent co-operation of the public affected, rather than depend exclusively on police powers, the imposition of penalties, or resort to court action.

12. Clarity. In order that a quarantine may be administered readily and consistently, it should be designed with care, should be phrased clearly, and should be made as simple as is consistent with legal requirements and the objective to be attained.

13. Information Service. Since the persons affected by a quarantine may not reasonably be expected to possess full or accurate knowledge of the circumstances that make it necessary, or the nature and importance of the aim sought, and since compliance with quarantine restrictions will be more complete if the objective and plans are understood, measures should be taken to set forth the conditions existing, the means to be employed, and the end to be attained, and these measures should be continued from time to time as the undertaking proceeds towards accomplishment.

14. Research. If an emergency requires the establishment of a quarantine before satisfactory biological data are available, provision should be made as soon as possible for extending the fund of biological knowledge. The authority that exercises the right to establish a quarantine should command or secure the means for biological research, both in order that the quarantine may be made more efficient and in order that the restrictions may be lessened where possible. The need for research, however, should not be permitted to delay the establishment of a quarantine believed by authorities to be desirable, thereby jeopardizing the objective that might otherwise have been attained.

15. Modifications. As conditions change, or as further facts become available, a quarantine should properly be modified, either by inclusion of restrictions necessary to its success or by removal of requirements found not to be necessary. The obligation to modify a quarantine as conditions develop is a continuing obligation and should have continuing attention.

16. Repeal. If a quarantine has attained its objective, or if the progress of events has clearly proved that the desired end is not possible of attainment by the restrictions adopted, the measure should be promptly reconsidered either with a view to repeal or with intent of substituting other measures.

17. Notices to Parties at Interest. Upon establishment of a quarantine, and upon institutions of modifications or repeal, notices should be sent to the principal parties at interest, especially to Federal and state authorities and to organisations representing the public involved in the restrictive measures.

When rules and regulations based on the above principles are framed and a rational and thorough system of quarantine is established at all the important ports and land gates to the country, and when thoroughly capable and trustworthy men are appointed for this work, and the public properly educated on the necessity for such measures in the interests of the nation, we might rest assured that a considerable part of our anxieties and apprehensions regarding pest imports will gradually disappear and save the country from many undesirable plants and animals.