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Munro, Aeneas.

Publication/Creation

London : John Murray, 1900.

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THE LOCUST PLAGUE AND ITS SUPPRESSION

ÆNEAS MUNRO, M.D.

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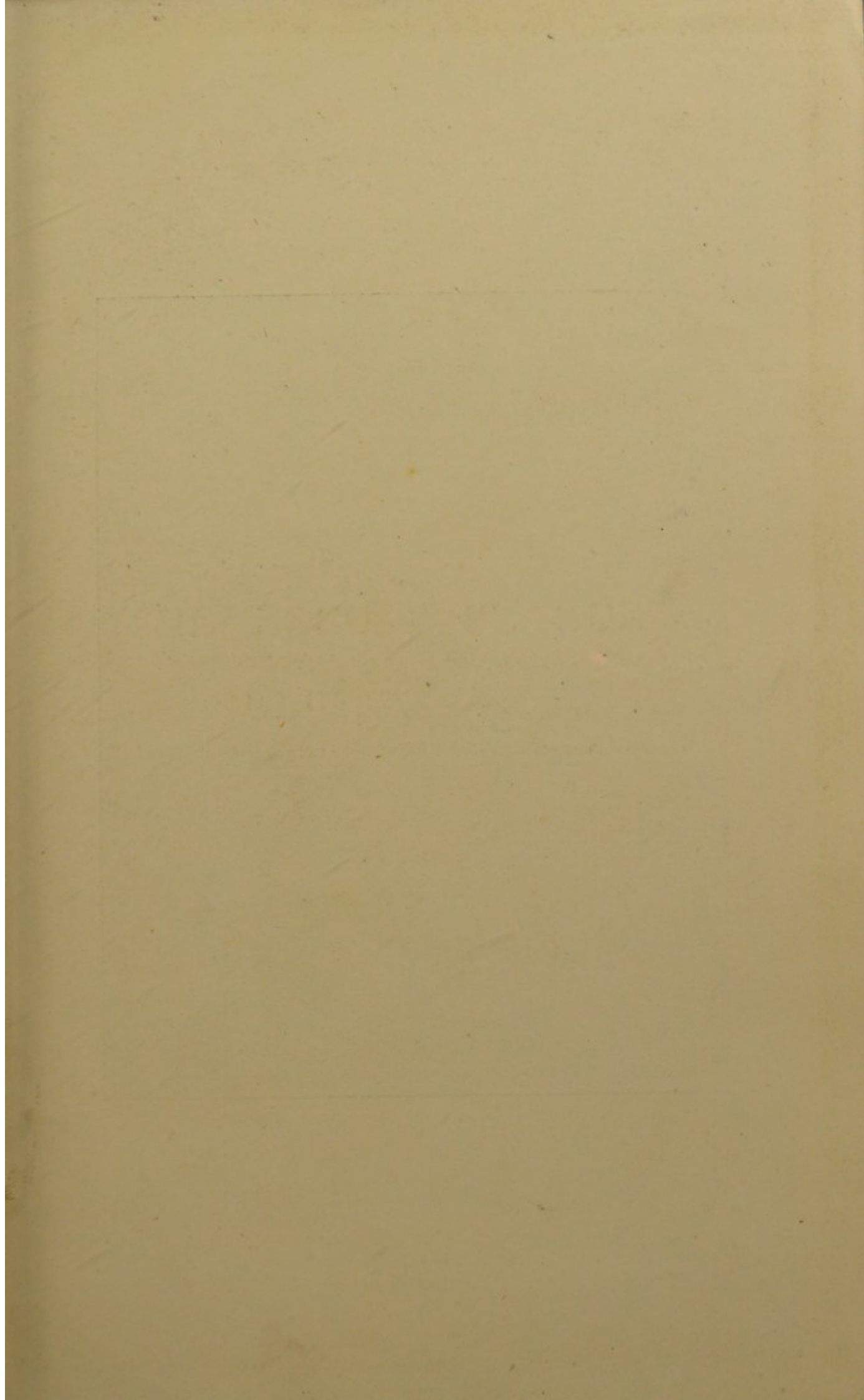
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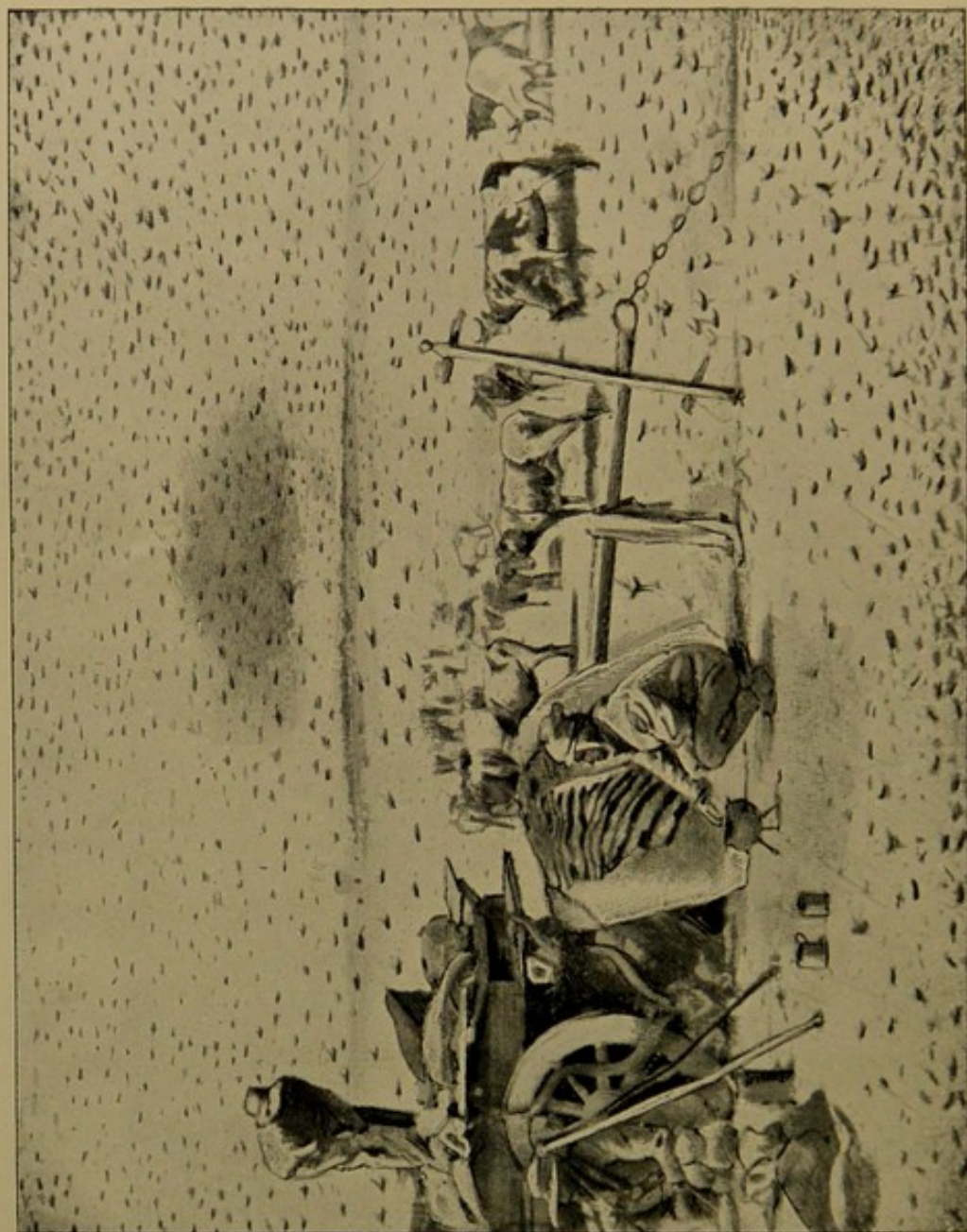
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THE LOCUST PLAGUE

AND ITS SUPPRESSION







From "A Breath from the Veldt,"

Storm of locusts.

[After J. G. Millais.

THE
LOCUST PLAGUE
AND ITS SUPPRESSION

BY ÆNEAS MUNRO

M.D. EDINBURGH AND CORDOVA

FELLOW OF THE FACULTY OF PHYSICIANS AND SURGEONS OF GLASGOW

WITH ILLUSTRATIONS

LONDON
JOHN MURRAY, ALBEMARLE STREET

1900

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"Agriculture is the most healthful, most useful, and most noble employment of man."—WASHINGTON.

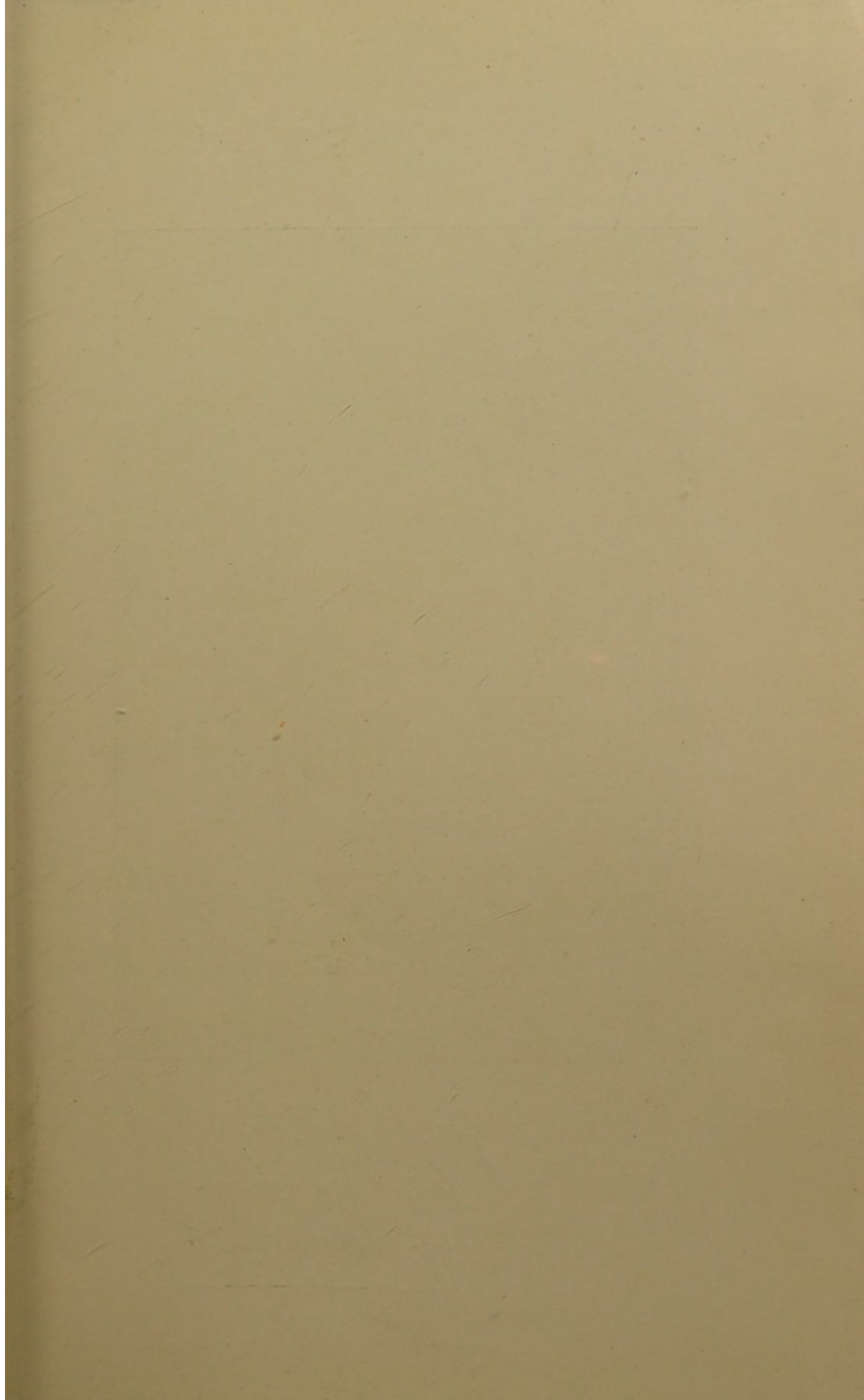
"Food can only be got out of the earth and happiness out of honesty."—JOHN RUSKIN.

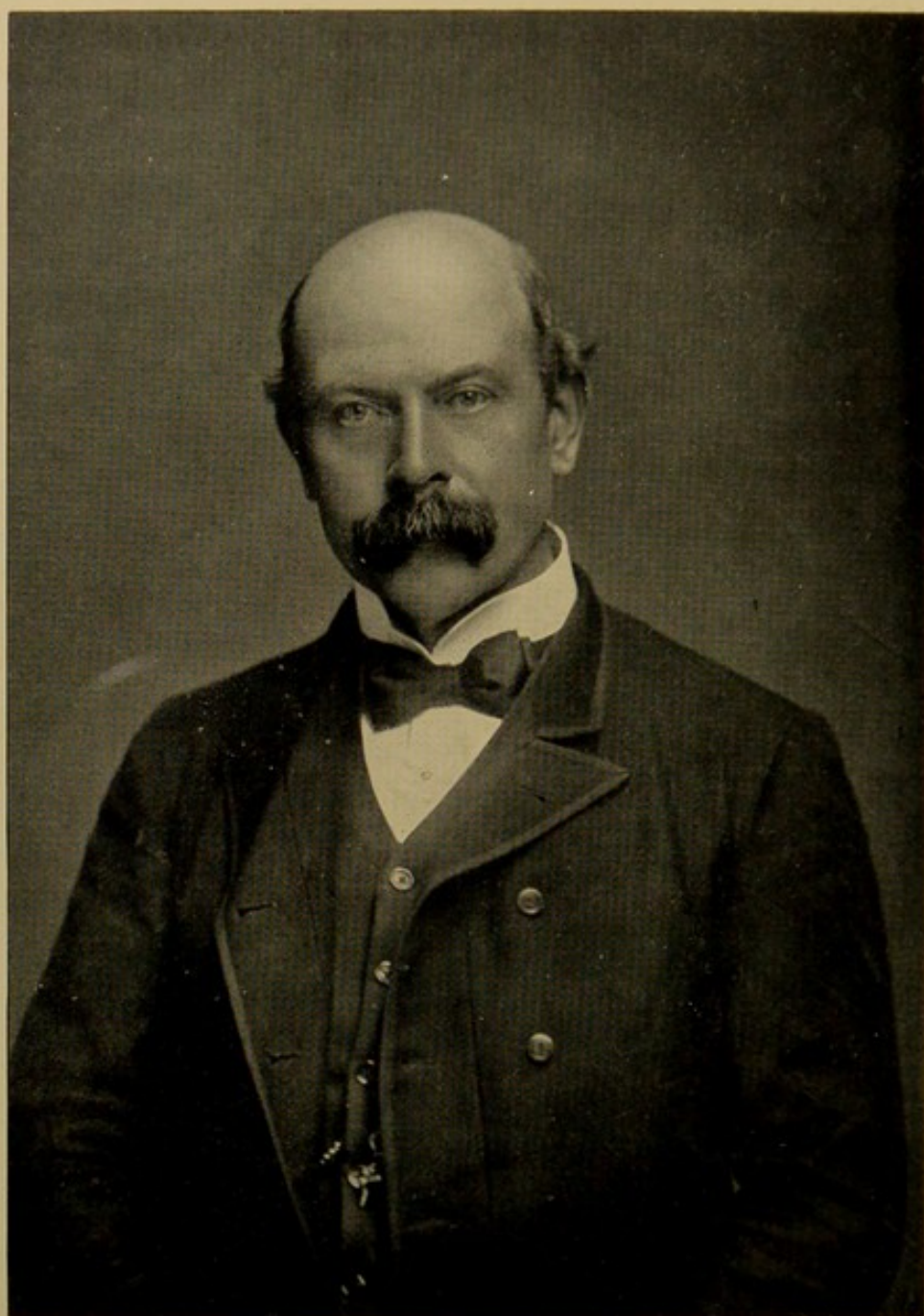
"The eye sees what the mind has the power to make it to see."—CARLYLE.

"Trifles make perfection, and perfection is no trifle."—MICHAEL ANGELO.

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Yours faithfully
R. Munro

PREFACE

1. I first saw the locusts in the latter end of the year 1890 in the neighbourhood of the Mar Chiquita ("small sea"), province of Córdoba, Argentine Republic, South America, in company with Mr. James Temple, who had invited me to accompany him in making a tour of inspection of the vast fine lands he had recently acquired in that province. This was the commencement of the "present visitation" of the locusts to that region. They were not numerous then, but their appearance interested me much. Next year their number greatly increased in the above-named province, and still more in the neighbouring province of Santa Fé—the mother province of colonisation in that Republic. The plague had become established.

2. Ever since that time I have closely observed and noted the progress and characteristics of the pest. In 1891-92 I called attention, through the press, to the importance of making a specific attack on the "army on the march"—the most destructive period of the insects—by means of *rollers*, on ground specially prepared for the battle. It is gratifying to find that, in that country, the *principle* of the method thus advocated by me has recently been confirmed, though in a modified form, as the best mechanical means of attacking the plague.

3. I came to South Africa in 1896, and found the locusts were here—to all intents and purposes—the same plague, although the insect entomologically presents some different physical features, which are of very minor importance in the present inquiry. The life-history, habits, and essential characteristics are identical with, or similar to, those in South America. Thus, for about eight years, I have had my attention directed to observing the insect and studying watchfully the best means to check and if possible to exterminate the pest.

4. On arriving at Johannesburg, I occupied my leisure time in preparing a work for publication on the locust plague, and studied what means should be adopted to get rid of it. I knew of no work, nor do I now know of any, dealing with this subject exclusively, and I

felt convinced that some such "handbook" as I had planned, if I could carry it out, would be of inestimable value to the people generally of the country or countries affected by the pest. I found, what is not uncommon, that many, indeed most, people had a superficial knowledge of the features and habits of the insect, but that they knew very little of the more essential traits of its life-history, without which knowledge it would be almost impossible to cope successfully with its inroads. Moreover, the knowledge possessed by the people generally is not only meagre and superficial, but not unfrequently quite erroneous.

5. From reports that reached me I was induced to believe that another worker in the field was about to publish a book on the same subject as was in my mind and on similar lines; but, after careful inquiry and waiting for a year and a half, I can find no trace of it; and now I must believe that the purpose, if it ever had being, has, from some cause or other, been abandoned. I am encouraged by such workers as Dr. Edington, Director of the Colonial Bacteriological Institute at Grahamstown, Cape Colony, to go on and, as he says, "prosecute the work you have taken up." Although I think there is a brilliant opportunity here for good work, I had no desire to occupy the field, had a more suitable or a more capable workman come forward.

6. I therefore trust that my attempt may find acceptance with the peoples of the localities where the plague prevails. My object is to instruct the people who suffer from it as to the nature of the insect, and to give a clear synopsis of the best means, by concentration and combination of energy, of exterminating the pest, and so to alleviate the burdens of the husbandmen or agriculturists of the country—a class that forms the backbone of every country of the world and from which every country draws its best blood. If this industry is directly relieved by removing the scourge in whole or in part, it indirectly aids the whole body of the people, for all industries are indissolubly bound up and linked together. One depends on the other. If one member suffers the whole body sympathises with it, and *vice versa*. And what is true of a member of a family or an industry is true of all the interests that affect a community or a nation.

7. The locust plague causes more pecuniary loss and misery than a native war or a series of native wars combined; or for that matter, and to give it a more practical and immediate significance, a greater loss both in blood and treasure than a war even between Great Britain and the South African Republic, deplorable and lamentable as such calamities and catastrophes are necessarily in themselves. The annual income from the gold-mining industry in the district of the Witwatersrand, S.A.R., is now stated at about £20,000,000 (the most recent output, March 1899, being over 464,000 ounces, and valued at £2,000,000), at which

rate it is over the amount stated for the year ; but in the United States of America the plague from locusts caused, it was estimated, a loss in one year equal to no less than twice that large amount ! The plague has ruined thousands of well-to-do colonists in the Argentine, South America, and in Algeria, Egypt, and North Africa generally. The land of Goshen in the north-east of Egypt and within 100 miles of the valley of Sharon in Palestine, has likewise suffered much. This identical valley was famed for, and in ancient times became the symbol of, fertility, for its fine flocks, herds, pastures, and flowers. The valley of Sharon has, in this respect, passed out of knowledge, and would become, except for travellers, blotted out ; it is a wilderness, but it may in the near future occupy in fact, as it has in symbol, its proper and real place. The promise stands sure—

“I will bring forth a seed out of Jacob,
And out of Judah an inheritor of my mountains,
And Sharon shall be a fold of flocks.”

Sharon shall be regained, and what Sharon shall become, all Africa may become, the possessor of peace and plenty for man and beast—an ideal much to be desired. In all countries, but especially in one so productive and fertile as Africa, it ought to be the aim of all in authority to make bread, the staff of life, so cheap and accessible to the people that the poorest of the very poor should at all times have the conviction that this prime necessity of life is within reach ; and that starvation (a cause of death not unknown in even the Golden City) in one of the richest countries of the world is a disgrace and a reproach which must be removed at all costs. Why should the feeding alone of a horse cost in such a country from £6 to £8 a month—about the same as a man ? It is a disgrace !

So much for the devastation and the actual loss of treasure caused directly by the injury from the locusts to the growing crops ; but large as the figures show these to be, there are yet indirect losses still larger which cannot so easily be set down in figures at an estimated value, although they are quite as real. Such, for example, are the mortality among the cattle, as well as the check to their growth and increase ; the hindrance to the occupation of the land and the farming industry itself ; the stagnation caused in business generally and enterprises of all kinds ; the impediment put into the way of improvement in farming, breeding of all kinds of stock, etc., by means of which progress, comfort, and well-being are retarded, if not paralysed. It cannot be difficult to perceive that countries afflicted with a visitation of locusts have not only to suffer from a loss of capital and its inevitable results and depression, but from the further consequence that capital is kept from being invested in those parts and is driven away elsewhere. Men

and money forsake those countries. This loss, if it were possible to gauge it, would probably be found to be overwhelmingly greater than the direct or actual loss to which I have referred, and both are attributable to the same cause. Our greatest enemies are very often not our most apparent ones.

I have, however, said that there is not merely loss of treasure, but also that which is of even greater importance, namely, much loss of and injury to human life, and moreover of such a kind as to make even a war insignificant beside it. Beyond all doubt or contention it is recorded by authorities of the most unimpeachable and trustworthy kind (including among them the distinguished St. Augustine) that at various times during separate visitations, deaths of 30,000 to 800,000 persons have taken place through famine and disease brought on directly by the locust plague! And this is constantly going on. Differences as to race and creed ought to vanish in face of such stupendous facts.

8. The two great and chief plagues to farming in Africa are DROUGHT and LOCUSTS. I am convinced that both could be overcome if only proper means were adopted—the former by a matured and well-considered system of irrigation, which is required, is attainable, and would pay “hand over fist,” for the average rainfall is not so very low, and the supply of water is not deficient; and the latter by adopting the most recent and approved measures, under the combined action of the Governments and peoples of the country. With these plagues staring them in the face, farmers have no heart to engage in the noblest of all industries; and good farmers are prevented coming into the country and engaging in agricultural pursuits. Whereas if these plagues were removed an impetus would be given to farming commensurate with the vast resources and necessities of the country.

9. Having undertaken this self-imposed work, it is useless to apologise to the reader for its faults and imperfections, or even to deprecate criticism on the plea of its difficulty. I have, however, an oppressive sense of anxiety, lest from want of full description of details the merest tyro who will read it should fail to comprehend what is meant. My desire is to form some common stock of knowledge for all, in regard to adequate and proper means to cope with the mischief.

10. In the text I have tried to carry out Emerson's advice, namely, “Set down nothing that will not help somebody.”

“For every gift of noble origin
Is breathed upon by Hope's eternal breath.”

Boers as individuals, or as a class, may be generally considered as typical objectors to the carrying out of concerted remedial measures. These (examples are given throughout the following work) are found in the Transvaal, Orange Free State, Cape Colony, Natal, and indeed

may be said to serve as types all the world over, especially where ignorance and self-assertiveness prevail. Therefore obstructives in the following pages are types of those occurring everywhere.

11. Thousands of colonists in the best agricultural parts of the Argentine Republic have been ruined during recent years by the locusts. To such an alarming extent have the ravages extended that the merchants of Buenos Ayres formed from amongst their number a "Merchants' Locust Investigation Commission" to examine the evidence, and to report to the National Government. This Commission engaged a special entomologist from the United States of North America for one year to aid the Commission and superintend the work. Towards the close of the period of engagement this specialist (Professor L. Bruner, of Nebraska University, who has kindly permitted me to use his illustrations), made a Report, in which he properly says: "The account of the insect's life-history and habits is of great importance, since upon this knowledge must be based the various recommendations for its subjugation and destruction." This opinion, at the close of his work, carries the greatest weight, as it indicates the absolute necessity of knowing the insect in order to combat it successfully. And he concludes with this strong "recommendation": "Allow also the assertion to be made here that no one remedy—disease or mechanical, natural or artificial—can be recommended to the exclusion of all others when it comes to dealing with so formidable a pest as is *Schistocerca paranensis*." These are the words and opinion of one who had devoted his life—for years exclusively—to the study of such things as this plague, and who for a space of an entire year worked and thought of it and nothing else.

12. There is only one example on record of success in endeavouring to exterminate the pest, and that was in Cyprus in 1883-84. Now, what was done once may and can be done again, certain conditions being given. If the people are only united and well led, I have not the slightest doubt, nay, I have the fullest conviction and confidence, that the plague of locusts can and may be completely overcome in Africa and all the other countries affected.

13. That such a question as combating the locust plague is coming to the front gradually, appears evident from the accompanying "lead-erette" in the *Standard and Diggers' News* (Johannesburg) of the 21st November 1898, a newspaper much more given to devoting itself to "gold" interests and representing the views of the Transvaal Government (which Government refuses to countenance artificial human remedial measures to check the pest) than to discussing questions of this kind affecting chiefly the poor. It is pleasing to see even a recognition of this kind. There are certain errors in the details, but as these are dealt with in the text nothing need be said of them now.

The prominent points are that—(a) The question of subjugating the insects will have to be faced; (b) the conviction that the plague can be overcome; (c) that union and co-operation of Governments are requisite; and (d) that whatever may be the outlay necessary to exterminate the locusts it will be one of the best investments for African Governments. The writer of this article had, no doubt, seen the Cyprian pamphlet, giving details of the combat waged there, but he evidently did not read it carefully, and is ignorant of the rudiments of the chief principles necessary to be acted on. To exterminate a plague is not so easy a matter as the writer would have the reader to believe, and indeed in the world's history there is only one successful recorded instance. Here is the leaderette referred to:—

“THE LOCUST PLAGUE

“Another grievous problem that has to be faced by South African Governments is the annihilation of locusts. Co-operative action can surely accomplish this. In Cyprus the ruinous *Pachytylus migratorius* was completely banished by five years' work under the Government (?). They were trapped in deep pits which were fenced, on the side remote from the swarm, with barriers of polished zinc. In the years 1883-84 it is computed that 250,000,000,000 locusts were killed in this way at the cost of £27,500, or two shillings the million. The plan was entirely successful in Cyprus. There is no reason why it should not succeed in Africa. Only it will need the active co-operation of all the Governments. It may cost half a million to destroy the pests entirely, but it is one of the best investments open to African Governments.”

14. Separation of a colony or state, like an individual from his class, tends to a belittling parochialism in thought and act. Isolation creates prejudices, fosters ignorance, and diminishes the mutual services of states to each other. Surely in the matter of a plague or common foe, if anywhere, union and sympathy are eminently desirable, and if these are withheld, a serious responsibility rests on those who withhold them. To further this end it is essential to nourish and promote in every possible and legitimate way the sentiment of unity which binds the human race together, to strengthen the conviction of the solidarity of the community of our interests, and to quicken the sense of a common responsibility for thus directing and inspiring our lives for a common end. It is not unbecoming at the dawn of the twentieth century to launch the idea of a combined attempt to suppress this plague and to put the ideals whereby this may be done into practice. *Is not this great theme and problem worthy of the effort and the period?*

15. It is acknowledged that Government exists for the benefit of all the governed, alike and equally, and without any respect of persons.

The true function of the State is to make and do most for the citizen. This is its permanent and inalienable function. If it does not do this, there must be an increase in its burdens, and misery in other and numerous directions. The Government of either the colony or state is a reflex of the people of the country, if the casting of the individual vote—one of the most sacred choices and acts of life—has been properly discharged. It therefore represents the intelligence, conscience, and will of the people. The verdict of the social aggregate—the aggregate as a community, Provinces, Colonies, States, an entire Nation—determines the happiness and progress of millions. Humanity has no distinguishing badge for any particular nation or race—it embraces all: the black, yellow, or copper-coloured, as well as the white.

“ We live in deeds, not years; in thoughts, not breaths;
In feelings, not in figures on a dial;
We should count time by heart-throbs. He most lives
Who thinks most, feels the noblest, acts the best.”

108 PRITCHARD STREET, JOHANNESBURG,
May 1899.



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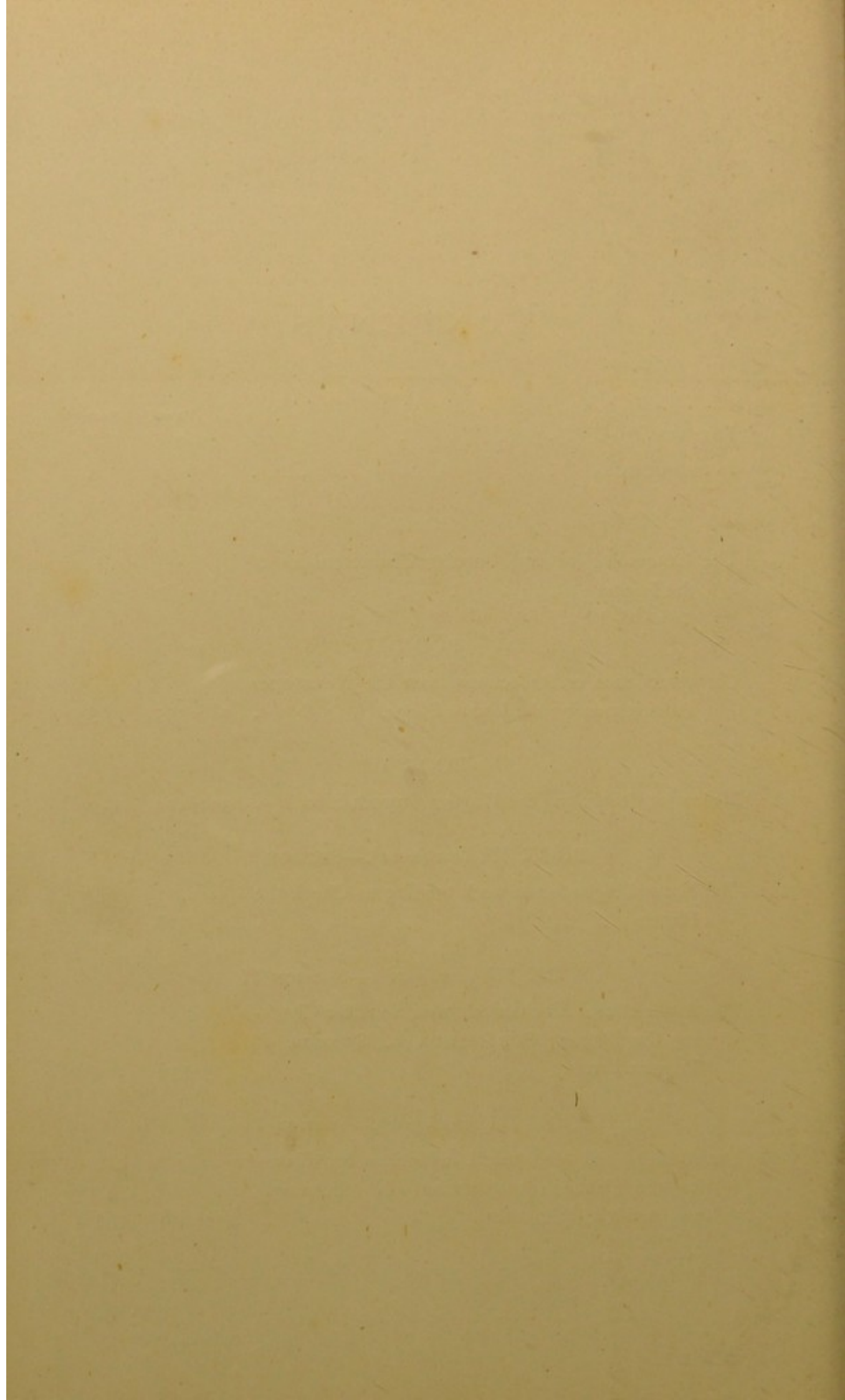
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NOTICE.

THE Author regrets that several of the Illustrations are less distinct and effective than he could have wished; but this is largely due, in the first place, to the difficulties in which he was placed when he wrote the Book; and, secondly, to his subsequent inability to procure special photographs for his purpose in consequence of the Boer War and the disturbed state of the country. He hopes, nevertheless, that, as the Illustrations are more in the nature of diagrams than pictures, their indistinctness will not detract from their usefulness, and that the Reader may find them helpful in explaining the text and in enforcing the contentions of the Author.

NOTICE

The Author regrets that several of the illustrations are less distinct and effective than he would have wished; but this is largely due to the fact that the plates in which they are placed were so small, and the paper so poor, that it was impossible to procure better. The illustrations are more in the nature of sketches than pictures, and the Author may find them useful in explaining the text and in indicating the positions of the Author.

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THE LOCUST PLAGUE

INTRODUCTION

16. Characteristics of a visitation.—In order to have an adequate appreciation of this subject, it is necessary at the outset to realise in some measure that the characteristics of a visitation of locusts are practically the same now as they have always been. A visitation of these insects constitutes a pest or plague or pestilence precisely as it did in all former times. This fact, apart from individual experience, is proved by knowing what ancient and modern history has recorded on the subject, which description, so far as it goes, exactly tallies with all that we now know of the insects. There is scarcely a particle of noteworthy difference in their destructive effects now as compared with all ancient visitations. Once this truth is realised, its importance and the whole association connected with it will be apparent. Just as in those countries where cholera and yellow fever prevail, these plagues are the same terrible and fatal diseases that they have always been of old. We have therefore now to deal with a plague or pestilence, and ought not to regard the subject in any narrow or warped spirit. It is a subject which, wherever the insects abound, is quite worthy of consideration by the ablest specialists; nothing can be more so, in Africa, and therefore it becomes us to approach it circumspectly, the reverse of carelessly, or as a study for pastime.

17. The subject a large one.—Now, some at the outset may be inclined to ask, What can we find to say new about the locust? and, further, Are we not familiar with the insect? If there is more than a passing thought or curiosity to be brought out, should this not be brought out amongst and by addressing the people employed in the country—rural people—and by one of themselves? Now, the answer to the first question is comparatively simple. A great philosopher has said, "The eye sees what the mind has the power to make it to see," so we shall find that there is more in this subject than what at

first sight appears. No doubt there is much that we do not yet know regarding the home and some of the intimate habits of the locust, but there is also much that we can and should know respecting the insect and what happens when a number of them visit us in force. In point of fact the subject is a large one, and the difficulty will be to keep it within reasonable limits and at the same time to give a full and faithful account of the insect and its habits so far as we know them. To keep back interesting details or such details as may excite thought would be manifestly wrong.

18. A question, too, of pressing importance.—Books have been written on insects, exceedingly interesting and useful books, from a scientific point of view. We have books, for example, on ants, others on bees, still others on domestic insects, another on worms, and so on. Can any one of these insects surpass by comparison, in point of importance, the locust, so far as the general well-being of the community, or the urgent necessity to have it carefully studied, is concerned? Why, the answer is self-evident. The locust question is of commanding and pressing importance throughout the whole of Africa—the Cape Colony, Natal, Zululand, Basutoland, the Orange Free State, the Transvaal, the lands of the Chartered Company, and indeed every corner of Africa—the north and centre as well as the south—from the north to the south, and from the east to the west.

19. The subject a personal one.—The locusts are a devouring or devastating pest, and cause desolation and misery wherever they visit. Is, then, the locust or the plague caused by a visitation of an invading "army" of locusts of less moment and interest to us when it threatens to deprive us, and is actually depriving us, of the very means of existence, than the insects to which I have referred as having had the honour of books being published concerning them? Surely not.

20. This work educative.—The specific object, then, I have in view is to attempt to lay before the public what we know of this interesting insect and the various natural and artificial means used for combating the plague. This, therefore, is an educative work first, and afterwards a suggestive one. Now, this is by no means an easy or a short work. It must be admitted, by anyone who has given any consideration to the subject-matter in hand, that it is a most important one, and one in which the welfare and prosperity of Africa (or the specific country that is visited) is very much, and intimately concerned.

21. Object in writing this work.—About 90 per cent. probably of my readers, or indeed the public, have doubtless not carefully or specially studied the subject, because possibly they have not had the

necessity or opportunity or inclination or ability for doing so. I trust therefore to be the means in this case of arousing or awakening a new interest regarding an almost wholly unknown subject. While a small percentage of my readers, who have given some special attention to this matter, will bear out what I say, and perhaps support me in the difficult task I have undertaken, namely, to lay before the public in a clear and intelligent way, in language that the great body of the people can understand, not only what we know of the insect, but also all the chief means in vogue for checking its progress, if not exterminating the pest altogether, there are or may be a still smaller number to whom I may not be able to advance anything new, or may not even cover the field as known to them. If such be the case, I can only trust that these will see I have tried to do my best in laying the whole subject, so far as I know it or thought wise to state it, in a popular way before the public, in order to bring our knowledge of the matter to a focus. If they will favour me with any additional information bearing on the subject, I shall be most happy to insert the same should a subsequent opportunity present itself of my having this in my power. If the duty of elucidating the subject and adding new facts to our knowledge fall into other and abler hands, then my humble effort will not have been lost, and in fact it will so far be successful if it call forth the ability of other workers.

22. This work the first on the subject.—My object thus is to give first an accurate and fair entomological view of the insect and its habits, and then the means that have been chiefly relied on for combating the pest which now periodically pays a visit to certain parts which may be called its temporary homes—a guest which has in very truth become a plague. So far as I am aware there is no work dealing fully with the subject published. I have made careful inquiry regarding this matter, and can find, I may say, nothing.

23. Research employed.—In breaking new ground, discretion is needed, for in a subject of this kind it is easy to run on into irrelevant and endless descriptions, such as one constantly sees given in the newspapers, by those who are tempted to write on any of the many bristling points connected with this many-sided inquiry. It is nevertheless true that in a work of this kind it is not only necessary but blame-worthy if all the sources of information available to us are not tapped, so that in this way, it is hoped, a complete view of the subject shall be presented to the reader. For this purpose extracts will be made and acknowledged from published accounts, as well as from numerous correspondents. To acquire an accurate knowledge of the life-history and habits of the insect is of the first importance, for it is on this knowledge that the various recommendations affecting its subjugation and extermination must be based. It has been given to man at the

first to have power or dominion over every living thing, and this includes the locusts.

24. Conflicting theories.—Fortunately or unfortunately, it appears that on this subject especially, everyone thinks himself capable and entitled to propound a plan of operation for the destruction of the pest; so that it has actually passed into a proverb that "Every fool has his theory." This view is not peculiar to this country, it prevails in every country visited by the locusts. The black man as well as the white man has his theory and thinks his view and plan of campaign the best, and that those who differ from *his* methods are of little or no value, and consequently *he*, and not they, should be supported.

25. Distrust engendered.—Hence carelessness and indifference spring up, and there is want of compliance with the executive or central authorities. A complete callousness is therefore manifested not only in regard to the methods considered most worthy of a trial, but also a sort of contempt or ridicule of the officials themselves. Motives of an altogether unworthy nature are attributed to the authorities and officials in both exalted and humble stations. Great prudence and tact are required on the part of the authorities in dealing with this matter, and patience and willingness are also required on the part of the public. There can be no doubt that in managing and dealing with this subject errors are extremely prevalent on both sides—on the one probably as much as on the other. The authorities, knowing probably how inadequate are the means at their disposal for the purpose of lessening or checking the mischief, are very often far too ready to treat lightly the wail of the farmers, heard here, there, and everywhere at the same time, just as the insects are devouring or about to devour the entire fruit of their labour. The feelings of the farmers are very acute, and at such a moment they cannot bear with philosophic equanimity the slightest ruffle. If practical sympathy is not put into action in their favour, they chafe, and farmers are not slow to recognise true from false sympathy. They may not be able to express themselves in words, but their hearts are quick and can recognise aid if extended to them in a true and proper spirit, just as much on an average as other people can do who assume greater airs of acuteness and importance. Why should they not? Human nature is human nature all the world over, and it is a good thing that it is so. Farmers are not fools, and what is more, they are capable of reciprocity. It comes, then, to this, that they should be dealt with honestly and fairly, and make-believes should never be put before them.

26. Apathy of farmers and indifference of officials.—It is, however, not to be affirmed that the farmers are always right. They are not. As a rule, they are industrious; but, in regard to the subject-

matter now in hand, it is feared that often they do not take sufficient and timely precautions to cope with the mischief. They may be, and no doubt often are, living or resting on the offchance that they may escape the plague, as it can scarcely be said to be quite universal. Sometimes, therefore, they live or exist in a haphazard way till it is too late. In this respect they are blameable, for they have never been unanimously alive to the very serious nature of this plague, and consequently there is no well-formed combinations amongst them to deal with it. A wail or piteous appeal for help comes from this, that, or the other farmer to the district official whose business it is to succour, and he in turn, not knowing how to obtain the desired help, perhaps replies in a twitting or ironical mood; and certainly in this respect abundant opportunity exists and proofs can be given. Offence is easily excited and spread. This alternate bickering is constantly manifested, and may be observed everywhere. It is due to carelessness and want of proper management. It is, moreover, preventible, and is a practical disgrace in connection with the putting down of such a terrible and crying evil. It is a slur on the administration and all connected with it. It shows that the public spirit of the people in the place is very low indeed. Education in morals and ethics, respecting the putting down of the plague, is at a low standard, and requires to be lifted up out of the slough and placed on its own proper altitude and level. If we take a fire or other calamity, it will be seen that such conduct would not be tolerated; and yet here we have something that does much more damage than fire. The public mind, therefore, requires to be awakened and educated on this point.

27. Unanimity in aim imperative.—Now, if what is stated be true, as undoubtedly it is, when applied to a district, it holds equally true when applied to larger localities—provinces, states, colonies, or countries, bordering or contiguous with each other. Just as no person is independent of his fellow,—for, unconsciously, we—our sum total—are made up of the constituents of those we meet and who have influenced us,—so it ought to be recognised, for it is the truth, that no state or nation is independent of its neighbours. There is a mutual interdependence. One cannot exist alone. There is a community of interests pervading the universe. Therefore in battling with the plague it is necessary, if it is to be done effectually, that there should be unanimity in aim, while there may be diversity in method, in order to overcome the common foe. This is only rational, for the person who escapes now may be attacked shortly in his turn. There is none secure or free from risk. What is true of the person will also be found to be true of the district or nation. It is in certain things impossible to secure complete isolation and immunity from a pestilence. History proves this beyond all doubt. It is necessary, therefore, to be

diligent and adopt every precautionary measure for the purpose of preventing its spread, and if possible of exterminating the pest completely.

28. Wisdom of extirpation.—To recognise the object and purpose of the sending of a plague is one thing, and to take steps to remove and lessen it is another. Both are good, and are not incompatible or antagonistic the one to the other. It is, moreover, true that to recognise the first may be a wise means in order to deal properly with the second; it cannot be wrong to use every means which the ingenuity of man can devise in order to try to get rid of a pest which not only destroys the produce of the soil, but also kills the beasts of the earth and sets the industry of man at nought.

29. A national council.—With regard to the idea of more particularly addressing the rural people, who are primarily and more directly or immediately affected, I may be permitted to say that some such way as I now attempt is the only expedient mode in which this can be done effectively. The matter must be laid before the entire body of the people clearly, so that they can understand and reflect on all the bearings of the question, and they can refer to such a work as this at convenient spare moments, and master the subject. The utilitarian character of the press at the present time is deserving of all praise. But there are certain things which may be discussed and studied to greater advantage when it is presented in book form, rather than in the columns of the newspaper, which, as a rule (though the rule may not be right), passes away largely with the using.

30. Design of this work.—The object, therefore, at present is to place this important subject in a permanent and convenient form before the general body of the people, so that it can be familiarised and studied as it deserves to be studied. My work is therefore primarily and chiefly one of education. In this way it will, I think, be conceded, there is a greater probability that mental fruit and ripened activity may be secured, than the irregular articles in the newspapers, however able they may be, can procure. Then it is hoped there will be a greater unanimity and consensus of opinion obtained than at present prevails. Of course it is desirable that the immense influence and power of the press should also be brought to bear in disseminating an accurate and proper idea of all the facts and bearings of this subject upon the people. It is a subject eminently fitted to call forth all the means at our command.

31. Time and labour here expended.—Furthermore, I beg to disavow any great or deep or "patented" knowledge of the subject in hand. I only claim to realise, to a certain extent, its vast and commanding importance throughout the countries where the pest exists. I have devoted a little more, as may be easily understood, than an

evanescent or passing attention to the subject during the past few years ; at the same time, such knowledge as I possess may certainly be obtained by anyone who will only study the subject, and this I earnestly recommend as a study likely to repay the student who undertakes it, as well as to be profitable to the country concerned. With these introductory remarks, I pass on to the consideration of my subject.



BOOK I

THE LOCUST AND ITS HABITS FROM AN
ENTOMOLOGICAL AND POPULAR POINT
OF VIEW

"Reading maketh a full man ; conference, a ready man ; and writing, an exact man."

"Here, in the country, my books are my sole occupation ; books my sure solace and refuge from frivolous cares. Books the calmers as well as the instructors of the mind."

BOOK I

THE LOCUST

32. Scientific definition.—What is the locust—zoologically and entomologically? Without entering, in the text of this practical and popular treatise, into needless and more or less useless disputatious questions regarding the number or variety of the species of the insects or any detailed account of their exact place in the animal kingdom, let me say that the locust we have here (in Africa) is, to all intents and purposes, the same as the insect called technically the *Acridium peregrinum*, *Locusta migratoria*, or the wandering locust (Fig. 4, a, p. 37). It belongs to the same *order* of insects, *Orthoptera*, as the cockroach, cricket, and grasshopper, the latter of which, as you may know from history (especially that most perfect of all histories, the Sacred Record), has also visited the earth as a plague.

33. Differentiated from other species.—The locust is unlike butterflies, beetles, etc., inasmuch as it does not undergo any true metamorphosis, or remain in an intermediate quiescent or pupa stage between its larval and winged stages, as these others do. It does, however, as we shall see, undergo certain changes or moults.

34. Country of origin.—Where do the locusts come from? We cannot tell. This wandering locust is practically the same in its terrible results, though seen in many parts of the world and far removed from each other. There may be some minor distinctions of species and differentiations, which we need not wait now to consider. These distinctions may be left to the special entomologists, and the ordinary reader's attention need not be burdened with them.¹

¹ Thus right away we note a difference between two such eminent entomologists as Mr. L. Bruner, Professor of Entomology and Ornithology in the University of Nebraska, U.S.A., and Mr. A. Stuart Pennington, Zoologist to the Argentine Rural Society. The former, specially engaged to leave his chair in North America to study the locust for one year in South America, says (p. 2 of *The First Report of the Merchants' Locust Investigation Commission of Buenos Ayres*), "The statement has been repeatedly made by writers of note that not only are the Argentine locust (*Paranensis*) and the large North American species (*Americana*) identical, but also that both of these and the Oriental (*Peregrina*) belong to one and the same species." Mr. Bruner

35. Their migratory habits.—Some regions are never entirely free from them, and these parts are said to be their Permanent Homes. But occasionally they take flights—they migrate—thousands of miles from their homes, and then they have therefore Temporary Homes. Their permanent homes are those parts which border on the Mediterranean, limited parts of India, Central Asia, China, Central and North Africa, stated parts of the United States of America (near the Rocky Mountains), some parts of South America, and certain parts of Australasia. Their temporary homes may be laid down as the southern countries of Europe, France, Germany, Central Europe, various States in North America (Iowa, Kansas, Missouri, Nebraska), the Southern Republics of South America, South Africa, Cyprus (where indeed they made it their permanent home for two hundred and fifty years), certain parts of Asia, Egypt, and Arabia, and parts of Australasia. They have even gone to Britain (the last visit in 1869) as far north as Edinburgh, but without doing any harm there. These were this same migratory locust, and supposed to come from the west coast of Africa. Or, to state it otherwise, as in the United States of America, the permanent home in North America equals from 38° to 54° N. L., and from 102° to 118° W. L., which equals a superficies of 400,000 square miles. The temporary or subpermanent home there equals from 28° to 54° N. L., and from 93° to 119° W. L., and equals 1,700,000 square miles. In 1885 the permanent home in the United States of North America was reduced to 35,000 or 40,000 square miles.

36. Does not remain at home.—The locust then is not confined to any one country or continent, but is particularly the pest of the farmers in India and Africa, where the sirocco or hot winds facilitate the hatching of the eggs. Tropical South America¹ and equatorial Africa are said says the Argentine locust is *Schistocerca*, which is a typical one in America, and which "differs considerably" from *Acridium*, which is "peculiar to the Old World." But Mr. Stuart Pennington, in an article in the *River Plate Sport and Pastime*, says directly the opposite, that the locust found in the Argentine "is the *Acridium peregrinum*," which "is known in the southern countries of Europe, and to a much greater extent in the north of Africa." When two specialists such as these mentioned differ so egregiously on so simple a matter as the classification of this well-known insect, surely it is enough for ordinary people to leave this point and try to come to a better understanding on the results and other traits of the insects. Mr. Bruner thus (p. 2) refers to the differentiating features: "The characters which separate the various species of *Schistocerca*, and which are more or less permanent in each, are such as the form and sculpture of prothorax, size of head, length and size of prosternal spine, comparative length and size of hind thighs and shanks, amount and arrangement of tegmina mottlings, comparative length of wings, and the general build of entire insect, which may be either robust or fairly slender. By having large series of these insects from all over the earth before him, the specialist would have no difficulty in making a synoptic table for their easy separation."

¹ On pages 2 and 85 of the Report cited, Professor Bruner says that locusts are to be met with in tropical and subtropical America and adjacent islands.

to be free, but so far as Africa, at all events, is concerned, the statement turns out to be undoubtedly incorrect. It is already known that they exist throughout Central Africa, and it is highly probable that they will be found all over the continent of Africa, the high plateaux in the centre making Africa quite different from America. See Drummond's *Tropical Africa*, p. 174.

The following letter is a further proof that locusts abound in Central Africa :—

JOHANNESBURG, *January 23, 1899.*

37. Testimony from Central Africa.—DEAR DR. MUNRO,—I have pleasure in stating, according to your request, what I saw generally, as well as *re* locusts, in my travels in the north of South Africa and in Central Africa. There were three partners of us, and we went on a trading tour as well as on a voyage of experience and discovery. We started from Buluwayo, and trekked northwards, along the Guay River, crossing the Zambesi River at Wankies Drift, about the 27th degree longitude, that is, seventy or eighty miles east of the Victoria Falls, or about the confluence of the Guay River with the Zambesi. We travelled in a northerly direction to the Mashu Kalumbwe country, passing through parts of the Betonga country, and crossing the Mashu Kalumbwe northern border at Naupagi. We then journeyed north-west to the Kafue River, extending about 250 miles into Central Africa proper, to the north of the Zambesi River at the point mentioned. As far as we could ascertain, never did any white man travel in these parts or along the same route through the Mashu Kalumbwe country before. The natives made long journeys to see us. In the Betonga country, for a distance of about 100 miles to the north of the Zambesi, over which the Chartered Company has some sort of influence, the natives are peaceably inclined, and before approaching you, the custom—amounting to a rule—is universally observed, namely, to lay down their arms—assegais. But farther north in the Mashu Kalumbwe country they do not do so, they do not acknowledge this right or obligation upon approaching a white person, so they retain some seven or eight assegais under the left arm, and one in the right hand, ready for action if they see occasion. In all that country the natives have no firearms, and all appear to be very frightened of them. The Betongas use the old elephant muzzle-loading guns, and seldom do they ever waste a shot, as they shoot at a very short range. We met with some trouble on more than one occasion from the Mashu Kalumbwe natives.

38. The locust plague extends all over the country through which we travelled. We passed many swarms on the wing during our journey. The natives suffer immensely by the locusts, and many of the Betonga natives are in great wretchedness from this cause, and are actually dying of starvation, the locusts having almost cleared the fields of grain.

39. In order to illustrate the state of things induced from this cause in that country, it will be well to state what I passed through—

of course, any description must fall short of the reality in such a case. The thought of the sights I saw makes me still shudder as I recall them to mind. In the course of our business it fell to my lot to return alone by a certain route. The journey was one of twelve days' fair or good travelling, and I had to walk all the way. I left my partners at a native village called Marico, about forty miles from Mondy, where I intended trading, and securing enough grain to last me until my arrival at the Zambesi River, which was five days' journey from Mondy. So, after providing myself with the necessary beads and limbo, *i.e.* calico for trading, and procuring food, I proceeded from Marico to Mondy. But on making the requisite inquiry at Mondy, I found to my surprise and consternation that no grain could there be had to help me in the way I expected. The locusts had eaten it up, so that I could at most secure only one small wooden bowlful (just enough for one meal). All the way down from Mondy to the Zambesi River I discovered in several instances that the natives had been starving, and that many had died from this cause. On arriving at the native village, called Matagalli, it was very evident that the people were in great distress, for they subsisted for the means of living solely on roots and the bark of a certain tree. Out of the five days' march from Mondy to the Zambesi River I had only three meals, which consisted of boiled Kaffir corn.

40. Game of all kinds is very plentiful north of the Zambesi River; but, having run short of ammunition, I was unable to kill or procure any game. Often on the march I had to delay an hour or two to enable the "boys" who were travelling with me to dig up roots to eat.

41. Then again I have seen the natives eat the locusts. They cook them by roasting them entire on the cinders obtainable from a fire of wood, and they eat all except the wings. On arriving at the Zambesi River, the difference there was notable—there the natives were more fortunate, for they had an abundance of fish, and a fair amount or supply of grain. I managed to secure enough grain to carry me on to N'Gwatie's, where we had left our waggon on the outward journey, with ample provision for our return journey. At this place I met my partners, and there we exchanged accounts of our respective perils and experiences. They had in their tour observed the same distress amongst the natives, caused by the locusts, along the route in which my companions also travelled.

42. The Mashu Kalumbwe country possesses very beautiful scenery. Its large palm trees give great picturesqueness to it. It abounds in fine pasture, and there are numerous herds of cattle, especially north of the Kafue River. Some large droves of sheep and goats are to be found in the Betonga country, but very few cattle there.

43. Anything that could alleviate this vast extent of fine country from the plague of locusts would be a great benefaction, not only or merely, though very directly to the natives, but also to the entire country—a gain to the world in its own way.—With my compliments and best wishes for the success of your aims and objects, I remain yours faithfully,

DON. S. GARVIE.

44. The locust an African.—Which part is their native or original home is a matter shrouded in doubt and obscurity. It is really impossible to say upon which of the two hemispheres one can localise their primary or native home; perhaps the balance lies in favour of the African home. Midway between the two hemispheres they have been met with by passing vessels while crossing the Atlantic more than 1200 miles from land. Those who have made themselves therefore acquainted with their great vitality and power to overcome all obstacles in their way will not be altogether surprised or unprepared to know of their undertaking an aerial journey so extended as that from one hemisphere to another.

45. The locust abroad.—Our non-acquaintance with them in their permanent homes renders it impossible for us to acquire accurate knowledge of their habits or their customs in everyday life, as we may term it. We only know them when they migrate from home, that is, considerably over 1000 miles from their real habitats, and it may be even two or three times that distance. From the nature of their movements we are limited in our field of observation. How they conduct themselves in their own country at home may not be exactly the same as they do abroad. They may be on their best behaviour at home, but certainly we could dispense with their devouring and devastating manners and appetites when they leave their own regions to visit us.

46. Our knowledge of the locust and its permanent abode partial.—Clearly, therefore, there are things which we do not yet know about the insect or its habits. Thus we do not know what precise influences, if in quest of food, cause them to migrate from their permanent habitations, such as we observe when bees *swarm*; nor do we know the exact length of life of a locust or its breeding power. We do not know the exact or precise locality in this or any other country which may be defined as their permanent abode; *e.g.*, here in South Africa, they are supposed to come from the waste arid lands in the "centre" of the great Sahara Desert—far far north, beyond the Kalahari Desert; in the United States of North America, from the arid waste lands adjacent to the Rocky Mountains; in South America, from the waste lands in the west of Brazil or in Bolivia. There is a story on some hearsay evidence in respect of the abode of the locusts around some lakes in the latter country, where they breed and go from hence in clouds periodically. These lakes are situated in the centre of a valley 120 miles long in Bolivia, and they are called Laguna Mosquera (because the banks, as the name indicates, are infested with flies), the Laguna Limon, and the Laguna Langunilla. As the last name indicates, it is on the banks of this lake that the locusts are found and where they breed. So that it is asserted if the locust could be destroyed here on the borders of this lake, where they winter and perhaps breed, they could be exterminated from the whole of South America.

47. Light from Bolivia.—The following letter sets this out in detail.

WHERE THE LOCUSTS COME FROM

We call attention to the following interesting letter, which we find in the columns of one of our Argentine colleagues :—

DEAR SIR,—In the course of my excursions to the north of the Republic, and particularly in Bolivia, I have often seen clouds of locusts flying sometimes southwards, sometimes northwards, other times eastward, but very rarely to the west. Where did these locusts come from? In crossing the Cordillera province and Santa Cruz de la Sierra in Bolivia, I stopped at a place called Gutierrez, and there I was told that every year, from the 12th to the 15th September or October—I forget which—the first cloud of locusts arrived at that place. As it was winter when I gathered this information, I continued my excursions, but returned to Gutierrez eight days before the date I have mentioned, in order to verify the information. Well, on the 13th the first flight of locusts arrived in a northerly direction; a few days afterwards came a second cloud, then a third, and finally a fourth. These clouds subsequently moved in a contrary direction, to the Chaco, Paraguay, Jujuy, Salta, and Santa Fé. I then made inquiries as to where these locusts came from, and I received the same reply from settlers as well as Indians—these locusts came from some lakes in the south, on the banks of which they remained (sometimes a yard thick) during the winter. The eggs develop in the springtime, and the young locusts begin to fly more or less about the date I have already mentioned.

48. I wanted to visit these lakes, but, owing to the terrible ravages of smallpox amongst the Chiriguano Indians, I had to give up the idea, so that I could not verify the degree of truth in the statement I had heard as to the origin of the locusts.

49. When I was in Zaipuru I had occasion to speak with two persons from Langunillas, who confirmed the story of the lakes. These lakes are a good distance away, the intermediate country being quite unknown and in the hands of the Indians. They are situated in the centre of a valley about 120 miles long, and are called the Laguna Mosquera, because the banks are infested with flies, the Laguna Limon, and the Laguna Langunillas. It is on the banks of this last one that the locusts breed. If in winter the eggs could be destroyed, there would be no locusts.

50. Some people say that the locusts, or a good many of them, come from the Chaco and Paraguay. I have travelled over the Chaco and Paraguay in the Sola Expedition, and I am convinced the locusts do not come from there. I may say the same of Misiones, through which territory I have travelled.

51. If the Foreign Affairs Minister would take the trouble of getting a report on the locusts from the authorities and settlers at Langunillas, he will obtain a confirmation of what I have stated.

J. JUNYENT.

CALLE SAN MARTIN, BUENOS AYRES,

Dec. 20, 1892.

52. Caution necessary.—It is needless to say that all these assertions, valuable as every idea, observation, and suggestion may be, have at the same time to be scrutinised and verified, inasmuch as we are dealing with lands and peoples that are wholly unknown, or countries sparsely peopled or civilised, and where data and statistics are not, to say the least, very accurately recorded or accessible. Some arrogant, presumptuous, self-assertive person or persons affirm, for example, that the locusts which have been migrating to the Republics adjacent to the River Plate, in South America, for the last eight years, have their permanent home in the Gran Chaco of that same region, where they are said to dwell or hibernate actually in “haycocks”—a preposterous idea! Although numbers of men who are careful and even skilled observers have travelled (and in the cold of winter, too) in all directions over the Chaco, yet they have never seen any trace to lead any one of them to such a conclusion (§ 50). Surely some one of these would have come across a *trace* of things as large as “haycocks”! Moreover, we know it is not a habit of the locusts to congregate in this precise way. They, no more than the members of the human family, cannot divest themselves of their habit and character, which is an indestructible quantity. It cannot be too strongly emphasised at the outset that there is nothing connected with the life-history or habits of the locust, however trivial the same may appear, but what is, or may become, of some value in the consideration and solution of the important points connected with the locust plague. No doubt their migrations, like the forces of nature, are governed by certain laws, but what these are we do not at present know. Certain it is that this migratory quality or character adds largely to their destructive powers.

53. No certainty regarding home of origin.—The truth is that the inquiry respecting the abode of the locusts is involved in obscurity and difficulty, and the inquiry can only be solved with the advance of knowledge and the progress of civilisation in these dark and at present unknown regions. Telegraph wires, railroads, etc., are important factors in pushing on civilisation and getting more accurate information. Who here knows anything of the so-called “centre” of Africa? In the Argentine how many or how few know the “centre” of the Chaco? How shall the “centre” be defined? And to be dogmatic and affirmative about what we do not know is unwise and foolish, although it may be easy and tempting. How often one finds that it is the ignorant who are so ready to be assertive, and the one who knows most to be careful and reticent regarding the making of sweeping statements and random generalisations.¹

¹ “In its winter quarters,” says Mr. Bruner (p. 25 of Report), “this insect gathers in immense quantities. Here it crawls among the underbrush and grasses, and piles up to such an extent that ‘heaps’ of locusts can be found a foot or more high. These

54. Difficulty in gleanings information.—If I were to ask not only the oldest person in the country, or even the person who has lived here the longest and travelled the most, or the oldest living person born in this country, as to any exact data about even the times or periods when locusts formerly visited this country, as they have done for the last two or three years, or how many years consecutively they came, or how long more or less they remained each year, or when they precisely appeared and when they departed each season, or if they came one year earlier than they did another, and if they change in colour or have different habits one year or season as compared with another, I am pretty sure the answers to these and similar questions would be very unsatisfactory, if not meagre and negative and full of contrariety, from any ten persons to whom they might be addressed. All this we must fully and freely acknowledge, because it is the truth. The recording of facts and the influence of the press in every part of the civilised world are doing an immense amount of good. We are accumulating data and making progress. What we do not know now in reference

piles of the *Acridian* are usually formed about some clump or bush of vegetation as a nucleus. During cold weather and at night they do not move, but cling closely to all kinds of vegetation and to each other, as most of us have seen them do in invaded districts during a pampero or a very cold night. When the sun shines brightly and there is little or no wind, they move about to some extent, and even eat a little. The rule, though, during winter seems to be that comparatively little food of any kind is taken by them. On opening hundreds of individuals during the months of July and August for the purpose of watching for the development of eggs, it was invariably the case that they were found quite empty."

But there seems to be in his mind some doubt, for while from the paragraph preceding the one quoted above it is clear that locusts now, for the present, winter between 28 and 32 degrees south latitude, or all along the 30th parallel, yet on p. 18 he says, "These invading swarms are usually composed of insects that have wintered as *Voladoras* in the 'Chaco,' as is the almost general belief here in Argentina." And again, in his conclusion (p. 88), he says, "There remain some important facts connected with the insect's life which should be definitely settled before reliable predictions can be made relative to future movements and possible injuries. Some of these are connected with its movements, wintering, egg-laying, possible permanent origin, distribution, etc. Many of these facts can be obtained by the accumulation of reports from volunteer observers located throughout the regions at times visited by the moving mangas of locusts. These reports can be sent to some central point, and the facts there tabulated to be studied later. The knowledge now possessed roughly indicates what may be looked for later, but is still indefinite on a few important points in the insect's life-history."

Throughout this excellent Report there is, however, not any proof as to actual observation of the wintering or home habits. Mr. Bruner's view as to these "piles" is more rational than is usual by its advocates, namely, that they surround or attach themselves in heaps to a clump of vegetation as a nucleus; but to say that they cluster in such heaps as to resemble our ordinary "haycocks," as some say, requires a straining of the imagination or intellect that I for one cannot credit without further and better information. And indirect confirmation of my view can be obtained from Mr. Bruner's data.

to many of the habits of the insect we shall come to do. We are gradually getting more and more light thrown upon them, and our stock of knowledge is becoming fuller and more accurate every decade. So that by recording what we know now as well as what we do not know, we shall serve some useful purpose in two or three more decades later on. While, therefore, there is much regarding the locusts that avowedly we do not know, let us now turn our attention to some of those things which we do know regarding this wonderful insect.

55. The presence of locusts in force constitutes a plague.—

The first great fact or practical truth that we should realise is that a visitation of these insects is a plague, and the agriculturist's worst enemy. It is not easy for anyone who has never had any experience of locusts to form a true idea of the dreadfulness of the locust visitation. It is worse than native wars or any disturbance of that sort—worse also than a fall in the price of the commodities or produce of the country, such as mohair or feathers, or inferiority in farm produce. The thought of a possible visitation strikes the cultivator of the soil with alarm and terror. It has a heart-chilling effect, and this more especially after other evils are possibly passing away, such as droughts and disease amongst stock. Locusts come in millions and eat up everything. It was in ancient times the eighth on the list of the ten terrible plagues in Egypt, which increased in severity until it culminated in the slaying of the firstborn. As a plague or pest it not only affects the husbandman primarily and chiefly, but also to a certain extent the entire community. No man is independent; one depends on another. There is a marked solidarity in the interests prevailing in a community, and what is true of a man or community is true of peoples or nations.

56. Popular delusions on the subject.—Some ignorant, foolish people assert that the locusts are the "farmers' friends," sent of God to chase or clear away the "stickgrass," a kind of grass which, when it gets into the wool, injures and depreciates its value. But such ideas are very narrow and selfish and unworthy, and reduce the subject to absurdity. The whole of the wool put together, for example, in South Africa, would not annually amount to much over £2,000,000. Suppose it were put at the high price of 5d. per lb., and that the depreciation would lower it to 4d., we should even have a comparatively small loss. It would, as estimated roughly, stand as under:—Reducing all the classes of wool in the colony (*i.e.* fleece-washed, scoured, and greased) to grease-wool, according to the statistics from the Official Handbook, by Mr. John Noble, C.M.G., 1896, p. 317, it would be for 1892, 28,441,212 lbs., which, with even a high average price of 5½d., would yield £2,255,945; and, reckoning the loss at one-fifth, or 1d. per lb. (*i.e.* 20 per cent.), the yield would be £1,845,773. The difference would be £410,172. From a certain standpoint this loss in itself is

great and noteworthy ; yet, in comparison with the millions and millions of pounds annually lost on account of the destruction by locusts to the crops and stock of the country, it is a mere bagatelle. When you compare the fluctuations in annual value of the wool crop with the loss incurred by the locusts, the former will sink into insignificance ; but, on the other hand, the amount is sufficiently important to command attention, and it may and ought to be diminished by the adoption of suitable remedies in other directions. The propagation or continuance of a plague at such a cost cannot be necessary or advisable.

57. Proof of devastation among animals.—Indeed, so sweeping and universal are the ravages from this plague that one hardly likes to leave room for the “lucky” person embraced by the saying, “It’s an ill wind that blows naebody guid.” I will not enlarge on this point more than give one item of proof in regard to the pecuniary loss that the locusts cause when they pay a visit to their temporary home. In four States of North America the yearly loss amounted to £8,000,000, and in four consecutive years it caused a loss of £40,000,000 ; and in one other year the loss was set down in this one sum. And this, remember, refers to the loss as it affects the growing crop, reckoned on an average at one-third of the entire growing crops, *i.e.* 33 per cent., but it may and does go to 80 per cent. in some districts. Who can estimate the suffering to the animals ? “How the beasts groan ! The herds of cattle are *perplexed*, because they have no pasture ; yea, the flocks of the sheep are made desolate. The land is as the garden of Eden before them (the locusts), and behind them a desolate wilderness ; yea, and nothing shall escape them.”

58. God’s care for the cattle.—Now, it can most conclusively be proved that the God of the Bible is most tender and careful regarding the “dumb creatures” which are His handiwork. Among many proofs that could be cited, perhaps there is none more touching or beautiful than that recorded in the Book of the prophet Jonah, where the record closes with a display of the finest reasoning that can anywhere be found. Thus : “And should not I spare Nineveh, that great city, wherein are more than sixscore thousand persons that cannot discern between their right hand and their left ; *and also much cattle* ?” There is pity ! A city saved on account of its *infants and cattle* !

59. The beasts in their own dumb way are suppliants. He who makes them feeds them, and recognises their natural right to be fed and cared for. He who owns the cattle on a thousand hills has the thousand hills for the cattle. Therefore we find that cattle occupy an important place in Scripture. Cattle are often associated with man, and were used for sacrifice. The beasts share man’s natal day, so that they can, as it were, look up in man’s face and in effect say, “We were born on such a day” ; and further, we find they begin together





FIG. 1.—Midsummer view, showing garden with trees, leaves, flowers, and fruit at perfection.

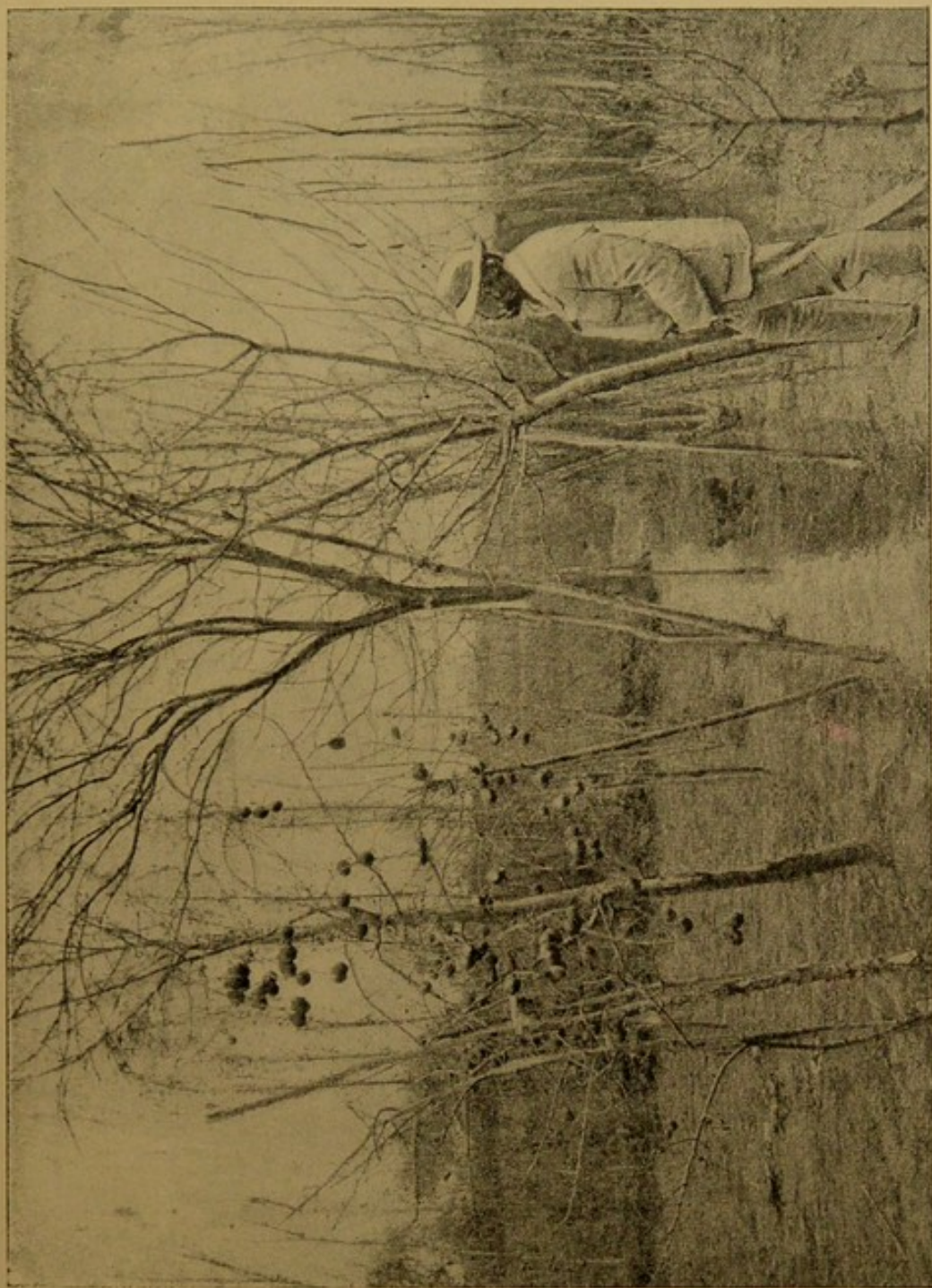


FIG. 2.—Midsummer view of the same as that shown in Fig. 1, *one day after* and attacked by the locusts (hoppers, or voetgangers—"the army on the march," showing only remains of some fruit on stems and branches).



after the Flood. Man got *dominion* over the beasts, but at first it was exercised in love to attract them and not in anger to compel them. The time will again come when the former state will be restored. Isaiah (lxv.) is clear on this point. It is well to bear this in remembrance, inasmuch as there is a duty incumbent on us to provide for the cattle. There is such manifest loss of the vegetable crop that the loss on cattle is not at the time so much regarded, but it ought to be considered.

60. The Divine argument in saving a great city is beautiful, skilful, and complete as told in the Bible. No regard is had to kings, to nobles, or to marching armies; but to the 120,000 infants and the much cattle. God enters the houses, looks into the "cot" where the infant is asleep, counts the hands that play with the toys, and the feet that patter on the floor, and the sweet, frank, open faces where the light of innocence and simplicity still lingers, and where sin as yet has set no brand, and from this fine imagery He does not omit the "*much* cattle"! The infants and cattle command His pity. These, then, were the most powerful intercessors with Heaven. We can picture them in all states and stages of life. "Out of the mouths of babes and sucklings God perfects His praise" and effects the city's salvation. Is there not a lesson and a moral for our present use in this?

61. Our instinct, reason, and duty prompt us to do all we can to provide for the animal creation under our charge, and to prevent their destruction. There is a beautiful chain mentioned in Scripture between the perfect man, ministering angels, men in general, infants, cattle, wild beasts, attendant creatures—a kind of Eden. Possibly a pledge—who can tell?—of that immortal world where there may be a scale or chain of life more vast and more varied than there is even in this world!

62. **Modern observation confirms the Scripture narrative.**—Everyone who has carefully observed what occurs in a visitation of locusts must admit the literal accuracy, at least so far as it goes, of all that is said on the subject in the Sacred Record. Their characteristics to-day exactly tally with the Bible accounts. I saw under my own eye not only a large vineyard loaded with young grapes, but whole fields of corn disappear as if by magic, and the *hope* of the husbandman vanish like smoke (Figs. 1 and 2). There remained not any green thing in the trees or in the herbs of the field. The labour of man and beast is taken and swept clean away by the locust.

63. **Fatalistic objections combated.**—Locusts have at one time or another devastated the largest part of the habitable world. History is full of this truth, so that, without any further words of mine, you must be satisfied that we at present are face to face with one of the greatest troubles that can afflict a country. It is hardly worth spending much effort in meeting the objections of those fatalists

who speak and act on the principle that it is wrong to do anything to check the work of these devouring insects, because they are sent for a divine and specific purpose. Such people, as a rule, are not open or subject to reason. They are a law unto themselves. What alone or at least chiefly will touch these people, a comparatively insignificant and fortunately an exceptionally small number, is self-interest. The sluggard always cheerfully accepts the fruit or reward of the man of action. Those who are loud in affirming that the plague is a visitation from God, and that nothing should be done directly to thwart it, yet try all means to locate the pest on their neighbours; and, if they can, they drive and frighten the locusts away from themselves, so that they may go elsewhere. They thus do not show a very noble or becoming spirit. Selfishness is thus brought into sharp contrast with its antithesis.

64. Reasoning in a circle.—The following curious and mixed letter in *The Natal Diocesan Magazine* of April 1896 is typical of the manner of thinking of a few persons:—

A WORD ON BEHALF OF THE LOCUSTS

DEAR SIR,—Of late the locusts have had a bad time of it. They have been cursed and attacked on all sides. And I do not wish to say a word against their extermination; but nevertheless I am going to put myself in the locusts' place and try and say a word on their behalf. We are, I think, very much inclined to put all troubles and calamities into one bag, as if they were all of a sort. But the coming of the locusts is not like to a railway accident, which can always be—or could be, if we were omniscient—traced to some mistake by a man, and which teaches us that with all our cleverness we cannot guarantee the safe working of any human invention. Nor is it like to a plague, which often comes through inadequate sanitary arrangements, and which thus is a message from God, telling us that cleanliness is next to godliness. Nor is it like to a dearth of water owing to want of storage, as is the case now in golden Johannesburg, where there might easily be a water supply more than sufficient if the inhabitants expended their money more usefully, and less on prize fights and such elevating and necessary comforts.

65. But locusts come to us direct from God, as the creatures of God, and as we believe that God has made everything very good, and everything for some useful purpose, so we must find for them a place in the economy of nature. What is their use? Why does God send them? I am not much of a naturalist, but does not the answer come somewhat after this manner? We Europeans come to a land like South Africa, and find it fair and much to be desired: rich pastures and meadows, with herbage not too rank or too coarse, all ready, generally speaking, for our flocks and our herds. The land in the past has only been very partially occupied and farmed and worked by the people of the soil, and yet is in a fit and desirable condition. And

why do we find it thus? Because God in the absence of man has been for centuries farming the land. Nature has been at work. The elephant, the buffalo, and all kinds of buck have been doing the work of grazing, keeping down, trampling and manuring the herbage, and to these may we not add the locusts, which almost play the part of grass fires? And then the moles, ants, worms, etc., have been at work turning over the soil and enriching it in various ways. And many others of God's creatures we can think of who have been acting as God's farming agents.

66. But when man comes to take the land and win it for himself, for his own particular crops, for his own particular beasts of the field, then these nature's farmers must give way, at least those that interfere with man's way of farming. They have been doing their work for centuries and centuries, and have done it well, and man enters upon the results of their labours, and let us hope not without some feeling of gratitude to these farmers of the past. God has made the earth for man, and through centuries does He watch over the land and keep it that it may be for the use of man; but He means man to win it by the sweat of his brow, and part of the struggle consists in exterminating these old farming hands of nature, and according to man's energy and perseverance so shall man's enjoyment of the land be. Prayer we want, that we may beseech God to save us the trouble of subduing these locusts by sending a strong wind to blow them into the sea. But we need to pray to God that we may have wisdom to conceive the best means for attacking them, sufficient sacrifice to give of our wealth that these means may be carried out, and energy and perseverance to struggle until they be exterminated.—Yours truly,

GERALD C. BAILEY.

Some of the above ideas are rather far-fetched and illogical, but the conclusion finishes up rather better.

67. Cyprus devastated by locusts for 250 years.—It may be useful to give here one illustration of the disastrous effects which the plague of locusts brings on a country. Fortunately, the case in point is perfectly clear. The history of the island of Cyprus is well known and perfectly authentic. Cyprus is an island of some 4000 square miles, situated in the Mediterranean, and it has always been of considerable importance. It was and is picturesque; it had woodlands, fertile fields, and fine valleys. Its Olympian chain of mountains contained copper, gold, silver, and a considerable variety of precious stones. Accordingly, its important commercial value did not in ancient times escape the notice of the Phœnicians, who were the great miners and traders of that remote period, and ruled the markets and merchandise of the world at that time. But in process of time the Greeks replaced the Phœnicians, and they, after building important cities in it, were replaced by the Egyptians, who in turn gave place to the Persians, then it came under the sway of the Arabians, afterwards it became Roman, and in 1171 the Crusaders, under Richard I., conquered it, and

retained it for three centuries. In 1473 Venice then acquired it, and in 1571 it was subjugated to the Turkish yoke. It was, we find, the birthplace of Barnabas, and one of the places which were early visited by Paul. Outside of Palestine Cyprus was the first missionary field.

68. From whatever point of view we can look upon or examine Cyprus, we are forced to the conclusion that no doubt it was a thriving place in ancient times, and a coveted and important part of the world. Were not this so, all these different nations—each for the time being was the dominating power of the world—would not care to possess it, as we have seen they did, one after the other. It was no doubt a very wicked place, but still in the estimation of these leading and for the time dominating peoples, during the sway of each it was deemed an important possession. It seems so to-day also.

69. Now from the year 1600 to the year 1800 these lands once so fertile, exceptionally so previous to the sixteenth century, ceased to be cultivated and became a wilderness. Forests disappeared, the population decreased, villages were deserted which formerly were flourishing, and throughout the island only mounds existed in place of the former habitations, and all this was ostensibly caused by the plague of locusts infesting the island and destroying its produce. The years between 1800 and 1850 or 1860 were exceedingly trying times to the natives, who were nearly starved—many of the people subsisting on bulbs of squill only, there being nothing else for them to eat. Matters were at their worst in 1860. The Turkish system proved to be a horrible one, and the native people were kept working almost exclusively for the benefit of a few placed in high offices, and there was no hope even of coping with and far less of getting rid of the plague. In truth this was finally not desired or worked for. Such was the demoralisation that then existed and prevailed.

70. **A discovery unheeded.**—Count Mattei found accidentally, in the midst of this terrible reigning distress, some means in 1861–62 which he showed would be useful, if adopted, whereby the plague could be checked; but the Turkish *authorities* would not have it. Their system of egg-collecting, which was then, as it often still is, prevalent, was their chief support, and if they did not have that, and if the locusts were exterminated, they argued, they would be worse off than even they were. So they (these few) lived on the existence and continuance of the plague; they did not want it to be stopped. The country was worthless to the Turkish empire, and they ceded it to Britain by secret treaty in 1878. We shall later trace what afterwards happened there, only meantime bear in mind that the plague of locusts got such a hold in that country for centuries—more than 250 years consecutively—that it was simply and completely devastated. What the locusts did in Cyprus they can

do in Africa, or any other similarly circumstanced country, if allowed, namely, make it their permanent home and annihilate the work of the husbandman.

71. Proof from other quarters.—But to convince the reader that the data given specially about Cyprus under the Turkish rule is by no means a solitary instance, it may be well here to give a short summary of other authentic data proving beyond doubt the devastating power of the locusts in different parts of the world and at different periods. I am favoured by and indebted to Mr. S. D. Bairstow for the following, and he summarises from Figuiet.

1. "In 170 B.C. locusts devastated the environs of Capua."
2. "In 181 A.D. locusts committed enormous ravages in the north of Italy and Gaul."
3. "In 1690 A.D. locusts came in three swarms and from three different directions and attacked Poland and Lithuania."
4. "In 1749 A.D. locusts stopped the retreating army of Charles XII., King of Sweden, when coming from Bessarabia."
5. "In 1753 A.D. locusts (plague and earthquake) victimised Portugal simultaneously."
6. "In 1780 A.D. locusts were so numerous in Transylvania that armies of soldiers were employed to combat the plague, and 1500 persons were employed in crushing, burying, and burning them."
7. "In 1784–1797 A.D. locusts spread enormously over Central Africa during these thirteen years."
8. "In 1735 A.D. locusts produced prodigious injury in India and China."
9. "In 1615, 1820, 1822, 1824, 1825, 1832, 1834 A.D. France suffered severely in these years from locusts."
10. "In 1845 and 1866 A.D. the provinces of Algeria were cursed by locusts, so much so that subscriptions were opened up in France to relieve the sufferers."
11. "In 1835 A.D. Darwin gives in his *Researches* a description of a visitation of the locusts in the Argentine which exactly tallies with that of the present South African visitation."¹

72. These instances will help us to realise the awfulness of a visitation of this plague (Fig. 3), and when it once gets a hold of a place or country how difficult it is to get it removed. Many other instances might be given. We will refer later on to the legal measures that have at various times and in different parts been required to be enacted to cope with the evil.

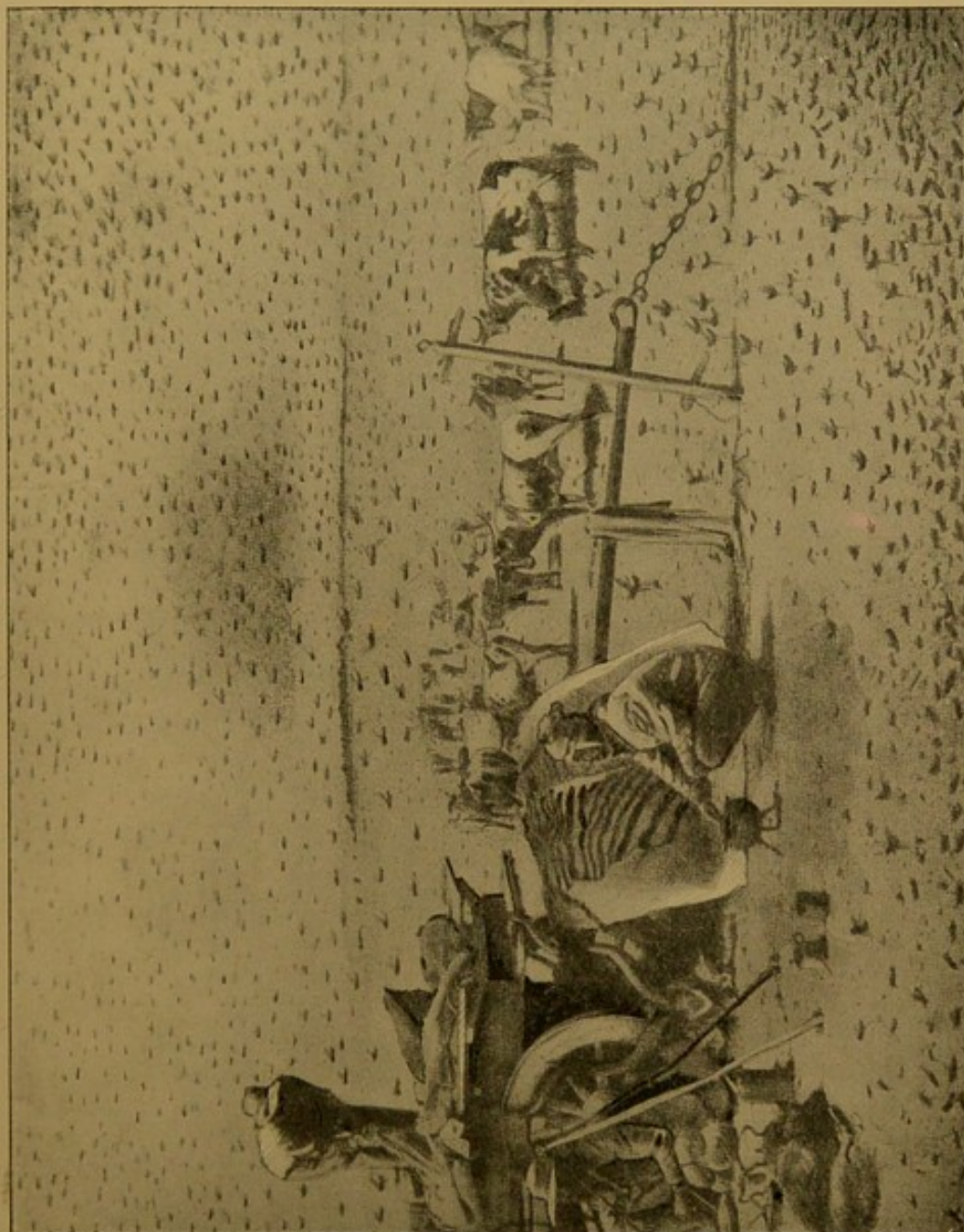
¹ A much fuller account of the visitations of the locust plague to countries in the past will be found by those interested in the subject in the *Second Report of the U.S. Entomological Commission* (1878), commencing at page 32. It is too elaborate and detailed for insertion here.

THE FIRST APPEARANCE OF THE LOCUSTS IN THEIR TEMPORARY HOMES

73. "A cloud no bigger than a man's hand."—The locusts make their appearance in their temporary homes in large companies or swarms, composed of an innumerable number, as flying locusts—these may be termed "invading" or "wandering" companies. They are sometimes so numerous that when about seven to ten miles distant the swarm appears as a cloud in the atmosphere, and really forms one so black in the clear and rarefied air of the countries which they visit as to at once attract attention and wonder from its peculiarity. At first, unless you have experience, you are apt to imagine the cloud can only come from the burning of a forest, or a camp fire from undried material, on account of its unusually *darkened* colour. By watching the cloud you will soon be undeceived, and the "vanguard" of the flock will make their appearance around you. By and by, when the cloud itself approaches near to you, which it does with certainty and force, for it is a travelling community going in a certain direction, you are then at once surrounded by locusts.

74. The constituents of the "cloud."—It is impossible to estimate the number of locusts in these clouds, but some idea may be formed from the fact that when they are driven, as sometimes is the case in a storm, into the sea, so many are washed ashore that they lie on the beach as a bank from three to four feet thick for fifty to a hundred miles in length, and the stench from the corruption of their bodies, it is affirmed, is sensibly perceived for 150 miles inland, enough to generate contagious effluvia and a pestilence. In other cases, when the cloud composes itself and spreads out, there is an unbroken area covered by them of several hundred miles in length and breadth! Captain Beaufort has recorded a cloud of locusts forty miles long by three hundred yards in depth, and which he estimated must have contained 169 billions of locusts; but really in face of these facts one loses all count of numbers, the crowd is so appalling.

75. The "cloud" eclipses the sun.—The movements of the locusts on the wing as seen when they thus surround you is curious, interesting, and pretty. Distant vision for the time being is impeded on account of their numbers and density. More especially is this the case immediately overhead, thus proving the enormous thickness of the cloud. The effect when you look on them in the sun's rays resembles snow falling thickly and gently. This effect is caused by the rays falling on their constantly-moving wings. So enormous is the multitude that the sun can be looked at as if there was an eclipse—its light is darkened, and shadows cannot then be cast from it. Sometimes when thus caught in a cloud of flying locusts, especially if riding against them



From "A Breath from the Veldt."

FIG. 3.—Storm of locusts.

[By Sir J. E. Millais.



and if they are travelling quickly (which they sometimes do), you experience a disagreeable effect when they strike you on some tender part about the face. You will also perceive evident ocular demonstration of their presence and number from their "droppings." The dropping is about one-third of an inch long, and if the roof of the building or house in which you happen to be is of corrugated iron, when a swarm passes that has had a good feed previously, you will hear the effect of the droppings like great drops of rain. You can also see the droppings on the road or ground, but the effect is best seen if they happen to pass over where white linen is spread out on the ground to be bleached.

76. No fixed period for striking their tents.—There is no fixed stated time of the year to a day or a week or a fortnight when the locusts can be said to commence their peregrinations to their temporary homes—that is, to wander and invade a country. Some seasons they appear earlier than they do at others. Probably their advent may have some bearing on climatic influences. Thus in a warm season they may come earlier if the heat be prematurely great and early, and *vice versâ*. Thus, in the Argentine as in South Africa, the invading hosts may be noticed to appear as early as July or in August, or more often in October and November, and sometimes later in the summer. There is no stated fixed time that one would be safe in affirming for their appearance in any given locality.

77. Style of flight.—The height from the ground at which locusts fly varies. They travel in general at a height of from forty to four hundred feet, but they not unfrequently fly as high as five hundred to eight hundred feet or more, and under certain circumstances as high as two miles, when great distances or other unknown circumstances have to be overcome.¹ It is said that the moon on a clear bright

¹ Darwin, in his *Researches*, encountered locusts near Lujan, province of Mendoza, Argentine Republic, 1835, and says: "They appeared as a ragged cloud of a dark reddish-brown colour. For some time we had no doubt but that it was thick smoke proceeding from some great fire on the plains. Soon afterwards we found it was a pest of locusts.¹ The insects overtook us, as they were travelling northward, by the aid of a light breeze, at the rate, I should suppose, of ten or fifteen miles an hour. The main body filled the air from a height of twenty feet to that, as it appeared, of two or three thousand above the ground. The noise of their approach was that of a strong breeze² passing through the rigging of a ship. The sky seen through the advanced guard appeared like a mezzotinto engraving, but the main body was impervious to sight. They were not, however, so thick but that they could escape from a stick moved backward and forward. When they alighted they were more numerous than the leaves in a field, and changed the green into a reddish colour. The swarm having once alighted, the individuals flew from side to side in any direction. The locusts are not an uncommon pest in this country. Already during the season

¹ The species is identical with, or resembles most closely, the famous *Gryllus migratorius* of Eastern countries.

² "And the sound of their wings was as the sound of chariots of many horses running to battle" (Rev. ix. 9).

night has a great attraction for them. No doubt, with clear bright moonlight they do ascend and practise nocturnal flights,—these are, however, exceptional,—but under what circumstances or for what special objects we do not know. This peculiarity more especially will be found towards the latter part of their sojourn, and probably is therefore connected with their “returning” journey, which is subject to the same uncertainty as to date, rather than at the beginning, when, as a rule, they rest at night.

78. Flight invisible to the naked eye.—In regard to the height at which locusts fly there is possibly something yet to be learnt. As a rule, people only notice them when they are within easy seeing distance; but it not unfrequently happens that, for example, on clear days they may, by the aid of an opera-glass or telescope, be observed in myriads high up where the unaided eye cannot detect them. Thus there passed over Johannesburg on the 15th November 1896, and twice in October 1898, a large swarm in evidently a high stratum of the atmosphere, and of which there was no evidence in the town by the unaided eye of their passage. A large company (the first of the season *en masse*) did pass through Johannesburg about ten days before that above stated, and then it was observed that their colour was more reddish than usual. There may thus be said to be three kinds of swarms: (a) Invading company, (b) Local company, and (c) Returning company.

79. Rate of flight.—The speed at which they move in flight varies also. No doubt the wind exercises a considerable influence, but they can fly pretty quick, even when the wind is apparently or perceptibly not moving rapidly. They can be often seen going at the rate of twelve miles an hour, and at other times they seem to enjoy hovering about.

80. Flight affected by atmospheric influences.—In making any estimate of value as regards either the height at which they fly or the speed they make, it is requisite to take into account the size of the flight and the rate of speed of the wind and currents in the strata of the atmosphere. Thus a company on the wing with an unbroken front of fifty miles by perhaps a hundred in length, may take three days to pass,

similar smaller swarms had come up from the sterile plains¹ of the south; and many trees had been entirely stripped of their leaves. Of course this swarm cannot be compared to those of the Eastern world, yet it was sufficient to make the well-known description of their ravages more intelligible. I have omitted, perhaps, the most striking part of the scene—the vain attempt of the poor cottagers to turn the stream aside. Many lighted fires, and with the smoke, with shouts and waving of branches, they endeavoured to avert the attack.²

¹ Swarms of locusts sometimes overrun the more central plains of this continent. In these cases, and likewise, as it appears, in all parts of the world, the locusts are bred in desert plains, and thence migrate towards a more fertile country.

and therefore it encounters a variety of obstacles in its speed or march, while one that can pass in, say, six hours would be different. When there is a company of this kind they make a noise—sometimes sufficient to stampede tame cows.

DEPORTMENT OF A COMPANY OF FLYING LOCUSTS

81. They have no leader.—The next point in the natural sequence is to consider the deportment of the locusts which have come as visitors (*i.e.* the local company), and to which reference has just been made. Although we do not know the laws which regulate the movements of the swarm, yet there is no difficulty regarding the recording of some of their doings. They rise, after resting for the night as a body, in the same way as a flock of sheep or cattle rise, in a gradual manner (and not all at once), with the heat of the morning sun, roam about, coming and going, to and fro, apparently without any known rule—influenced sometimes by the wind, and sometimes as if with the object of knowing the character of the ground, alternately resting and flying, but always, in the South African Republic, tending in the end towards the “south” in their journey. They may hover about a district a whole day in the way indicated, occasionally without doing any harm or damage, and at sundown the sight becomes interesting beyond description, for the whole company then appear to vie with one another in order to roost quickly. This they do so closely to each other that every twig, branch, bush, or the separate stalks of the corn or wheat or flax are completely covered, and sometimes they stick to each other, so that they may be three or four deep. As far as the eye can see the surface assumes a brownish-red hue. Pillars, posts, or the walls of houses are all alike to them at the time of roosting for the night. There does not appear to be any leader among them, as in the case of a flying swarm of bees which follow their “queen.” They appear to act together in their movements by a common sort of instinct or impulse. They move about thus for about six weeks irregularly; sometimes they hover round a given locality for a whole day, and sometimes move away rapidly, flying over a number of miles in the course of a day; at other times they disappear for a few days and then return again. On a cold, sunless day they do not rise at all or move from their encampment.

82. Distinction between “fliers” and “hoppers.”—The remarks now made refer chiefly, or rather exclusively, to those bands of locusts when they come away first from their permanent homes, and are bound upon exploring and visiting or invading a new country. The locusts bred in the district, after they take wing and become “flying” locusts, may not follow exactly the same routine. They hover about in all directions—to and fro—while they last. This, how-

ever, we cannot positively know, inasmuch as two broods of young locusts have not been distinctly observed in the same year in the same place or in their temporary home. Flying locusts eat when they settle down during the daytime, although they do not appear to do so at night or on their roosting-ground before getting up in the morning. They do not always eat when they settle or rest. Comparatively speaking, the flying locusts do less harm to the growing crops than the hoppers. To a certain extent they do injure here and there, where they select to settle and feed; but they do not devour everything clean before them, like the "army" of the larval stage, or jumpers.

83. One way of repelling the attack.—When flying locusts visit a locality various artifices are used by the people so as if possible to prevent them settling down, in case of eating the vegetables, for example, in the garden, etc. The following practice is not uncommon, not merely in South Africa, where it occurred, but also in Spain, Italy, South America, Egypt, etc.

"It was perfectly awful to see the black flying cloud come rushing across, hanging against the top of the bamboos. We were very much afraid they would settle down and destroy everything in the garden, so we turned out all our forces, the coolie gardener and his four tiny girls, a big Kaffir man, and three small boys with paraffin tins, bells, gongs, and anything that would make a noise, and for a whole hour we all paraded about the garden making the most hideous and frantic noise, while the family rang big dinner-bells and lighted fires across the road. It was the most ludicrous sight in reality, but what else could we do? Alice sat down in the middle path and beat her tom-tom with a stick, and cheered on all the small folks to rush about and add shouts to the general hubbub. I got as tired laughing at this scene as I did with beating the dinner-gong. However, the locusts had no chance of a quiet time with us, and betook themselves to less rowdy quarters."

84. Foregoing method not always successful.—This practice, although often, as in this case, successful for the moment, appears to me a peculiar one. Might is right seems marked on its face, and the practice has underlying it the principle, "I won't let you settle here and eat mine; go or pass on to my neighbour, who cannot put you away, for he cannot procure the resources to enable him to do so as well as I can. I'll take care of myself, and I don't care what comes of my neighbour." Is not this spirit and practice, so far as it goes, essentially selfish, anti-Christian, and unworthy? The locusts must and will have food, and on this principle they can only get it from the weakest occupier, who in fact has not the resources to preserve his own produce from them. It is a case of the survival of the *strongest*. This, however, can only be operative in this stage; for, as we shall afterwards

see, such means as those above mentioned would not in the smallest way be effective in preserving the produce of the garden or other part from the "hoppers," who are *invincible*, unless entirely different means are adopted, and they devour everything clean before them. In the period now under consideration, when they settle for resting during the day, or when they roost at night, or keep to their perch on the cold,

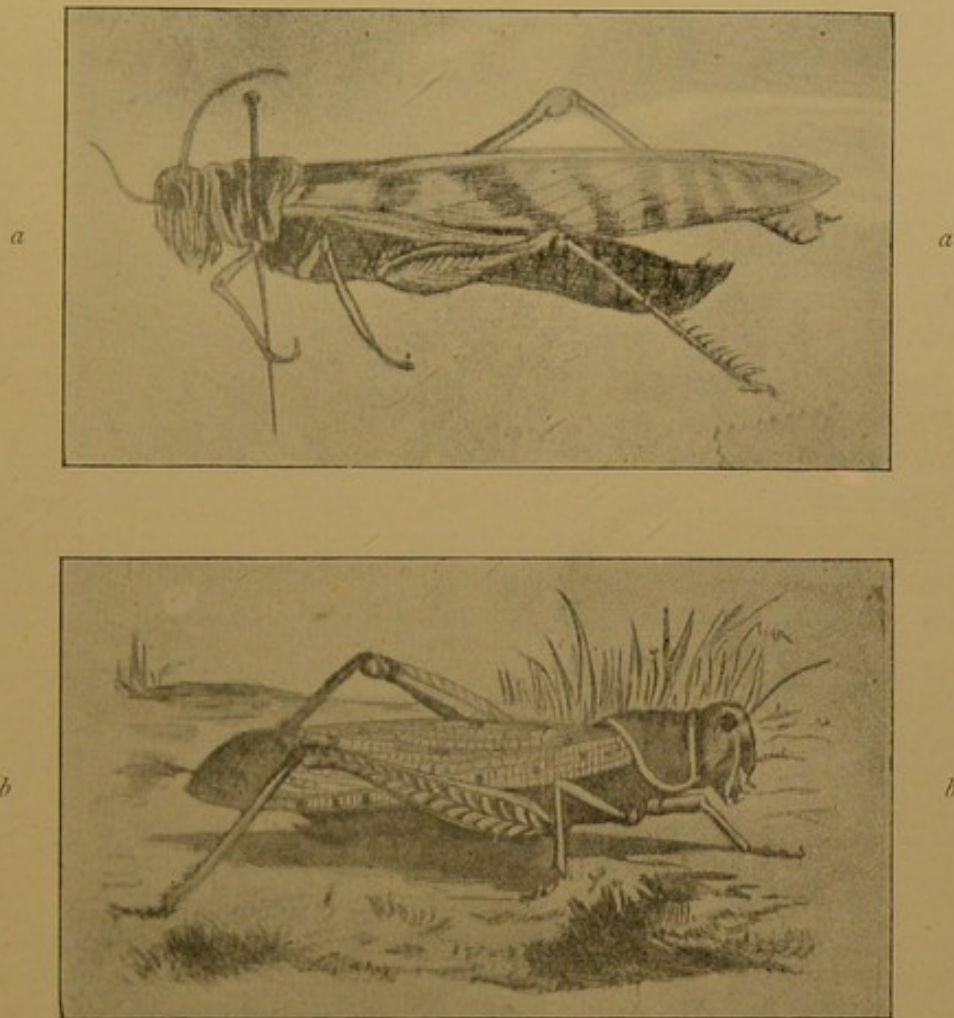


FIG. 4.—Specimens of locusts—(a) The African locust ; (b) the South American locust.

cheerless, and sunless day, you may approach them easily and catch them.

DESCRIPTION OF A (FULLY FLEDGED) LOCUST

85. Description and anatomy or physical features of the locust.—The adult locust has the following very pronounced parts which may be observed : a strong, wild-looking head ; a strong collar, inside which the neck moves ; powerful, peculiarly formed legs, attached

to a short strong square trunk or thorax ; four wings, two antennæ, six legs, and a long segmentary abdomen (Fig. 4).

86. The ground colour of the locust is generally brownish—straw or red—but the colour varies somewhat, according to the particular company or season of the year, or some other unknown circumstance, such as that connected with the hatching, or age or food, or some provision of nature by which they are made to resemble the leaves, grasses, or pastures in which they exist for the time being, for purposes of protection or warning—probably the former, but which variation does not probably signify any great change in the species.¹ That is to say, that locusts of one particular colour, as observed by us at any one time, may become themselves changed in colour, or give birth to a generation which presents to us a somewhat different shade of colour when seen by us at another time. Therefore in one year you may see a flight of locusts of a more marked red colour than the brown or pale-straw of the previous year, and *vice versâ*. Mere ground colour is immaterial, and does not signify another species. Three distinct ground colours have been observed—namely, yellow, red, and grey. Upon these ground colours may be found markings of a black, white, or coffee colour, which conveys to the eye the general impression which characterises the particular company in question. It may be that the nature of the food, or the age and condition of the insect, or the influence of the sun, in some occult way may make or account for the difference in colour ; but at anyrate, so far as can be detected from the habits of the species so far as the different varieties of colour are concerned, in other respects they are precisely the same. It is probable

¹ Mr. Bruner (p. 9 of Report) says : “ Thus we find that the same insect exhibits three distinct colour-variations during its life as a *Voladora*. Similar colour-variations have been reported in the Old World *Peregrina*, as seen in different regions, at times visited by it. But we do not recall any record of an attempt at an explanation for these variations in the insect. Similar but less decided variations in colour have been observed by us in wintering locusts in North America. In fact, most of the brown or yellowish-brown locusts become more or less tinged with red late in fall, after they have been several times exposed to frosts.” On page 18 he says : “ These invading swarms are usually composed of insects that have wintered as *Voladoras* in the ‘Chaco,’ as is the almost general feeling here in Argentina. They are, as a rule, of the dark or reddish form. This, as shown in a preceding page, indicates that they are *old* locusts, which have wintered over.” On page 85, at the close or summary, he says : “ That it winters as a *Voladora* in the vicinity of the 30th degree of south latitude ; and also that the freshly-winged, the wintering, and the egg-laying insects can each be recognised by their prevailing colours. In other words, these three stages in the insect’s career are to be known by special colour-characteristics we have ascertained, or believe we have,” etc. The late Professor Drummond, in that interesting chapter on Mimicry in his *Tropical Africa*, says : “ A still more elaborate set of forms are those which represent leaves. These belong mostly to the mantis and locust tribes, and they are found in all forms, sizes, and colours, mimicking foliage at every stage of growth, maturity, and decay.”

that the kind of food they happen to eat, or the quantity, or the cold, or the heat, influences the shade of colour more than anything else. This is not surprising if we remember and realise the fact that the effect on the barn-door fowl, the common hen, from eating the locusts, causes a change in the colour of the yolk of the egg of the hens that eat them in quantity, and also the colour of the "comb" changes. Ducks' eggs change in colour, etc., with the food—food changes and gives character to the secretions, such as, *e.g.*, the milk of the cow in autumn when fed on turnips—the first few days the change is noticeable.

87. Head.—Besides the pair of compound eyes which form so noticeable a feature in the head (where the organs of sense are located in locusts, as they are in all insects), which give the animal such a ferocious look from their fixation and prominence, there are three other simple little eyes, placed like shining dots at the three angles of a triangle below the two antennæ or feelers, appendages so highly essential to all insects' comfort and vitality, and which are trebly jointed, but which are here not remarkably long or pointed—they are rather strong and blunt—about three-quarters of an inch in length.

88. Mouth.—It would be unpardonable (in giving this rapid description in order to make the work more complete and connected) not to note in a more or less detailed manner its pronounced and fearful mouth, in which are placed the trophi (τρεφω—I nourish). The mouth consists of a set of nine distinct and well-marked organs. An anterior or upper lip (labium), which consists of a plate deeply cleft, and capable of opening enormously, and admirably adapted for apprehension or gathering-in, and it folds down from above. Two true jaws or powerful mandibles behind this plate, which are strong horny plates, carved and notched at their meeting faces or margins. There are two lower jaws. The mandibles and jaws move laterally from right and left. There are two pairs of jointed organs in addition, which are called (maxillary) palpi, and which are probably the seat of some peculiar sense by which they are enabled to choose their appropriate food when there are varieties for them from which to select.

89. Varied formation in insects.—Now, insects are variously formed and adapted for varying purposes. Thus some insects bite, others suck, others appropriate nourishment by bathing themselves in juices or liquids. Some *Orthoptera* are carnivorous, some are omnivorous, but all are vegetarians.

90. The thorax.—As the head carries the organs of sense and mastication, so the thorax carries the organs of locomotion—the legs and the wings. It consists really of three rings, which are called the prothorax, mesothorax, and metathorax. In this case they are so consolidated that it is more or less impossible to distinguish them. But to the first ring, *i.e.* the prothorax, is attached the first pair of

legs; to the second ring, or mesothorax, are attached the second pair of legs and first pair of wings; and to the third ring, or metathorax, are attached the third pair of legs and second pair of posterior wings. The abdomen contains the alimentary and generative organs.

91. Vegetarian dietary.—These insects, then, are provided with organs in the mouth capable of eating almost any vegetable that may come in their way. Once the food is masticated in the mouth there does not appear to be any further difficulty.

92. Limbs.—The legs, six in number—like all insects—are very noticeable, especially the hind ones. These may be considered under the three following parts: the feet, the shanks, and the thighs. The tarsi of the feet consist of three joints, and these are long and very mobile. The shank (shin or tibia) is the longest, and along the posterior margin there is a well-marked serrated (spinous) arrangement which you are made to feel the moment they attach themselves to you. Through this means they adhere and grip forcibly. The thigh or upper part—about one inch and an eighth, or twenty-seven millimetres in length (*i.e.* femur or trochanter)—is not quite so long as the shank; but it is well supplied with a powerful set of muscles, and has quite a fleshy, highly muscular appearance. The length, strength, and formation of the hind legs enable them to take great leaps. The adult can jump seven or eight feet high, and it is supposed in length two hundred times that of their own body, which would be equal in proportion to about a quarter of a mile for a man. The claws on the front and middle feet are short and weak, so that they cannot stick to smooth hard surfaces, such as glass or tin, like flies. This fact, as we shall see, is of great importance, for they cannot climb up smooth surfaces. The legs are firmly attached to a short strong horny sort of trunk, which serves as a *point d'appui*. From the character of the legs they are pronounced to be clean by the inspired lawgiver: "Every flying creeping thing that goeth upon all fours, which have legs above their feet to leap withal upon the earth." The thorax or trunk appears to be full of a fatty sort of substance. Inside this strong thoracic encasement I have seen six maggots, each of which was half an inch long by $\frac{3}{16}$ of an inch thick, in a swarm of locusts suffering from disease. This was first pointed out about thirty years ago as one of the natural means of getting rid of the plague. I shall afterwards have to refer to this subject. As many as seven in number have been seen, but I have only seen six; of course I have seen many with only one, two, three, four, and five. How these get there will be afterwards explained.

93. Size.—The size of a full-grown locust varies according to certain circumstances. The female locust is normally larger than the male by about $\frac{1}{4}$ to $\frac{1}{2}$ an inch in length, and is rather thicker. Then the abdomen of the insect consists of a number of horny segments united by an elastic

membrane, and it is liable to be distended, and thus it may vary in length and thickness at one time as compared with another. The length of the migratory locust may then be put down as a general rule from $2\frac{1}{2}$ to 3 in., or 63 to 75 millimetres, and about $\frac{3}{8}$ of an inch in thickness in the abdomen. The chest or trunk is thicker or larger— $\frac{1}{2}$ an inch, or 10 to 12 millimetres—and has a square shape. The North American and Cyprian locusts are smaller, but the South American is practically the same in these respects as those found in Africa.

94. Wings.—The wings extend beyond the extreme tip of the abdomen by about $\frac{1}{2}$ an inch, and sometimes even $\frac{3}{4}$ of an inch. The wings are not soft and velvety like those of a butterfly, but rather resemble in material silica quartz or thin mother-of-pearl, and seem almost weather-proof. The exterior pair of wings, which more or less overlap the other pair, generally have a greenish or grey tinge, and are covered with a series of blackish-brown or brown markings or stripes, many of which are in the form of parallelograms, and sometimes in certain species little squares or specks, as seen in Fig. 4, *a* and *b*. The back pair of wings—rather more delicate in structure and larger—are rather triangular-shaped, and are probably more serviceable for flight than the fore wings; and when in a quiescent state, they are folded up fan-fashion by about twenty folds, and these extend (beneath the forward or upper pair) beyond the farther point of the abdomen as indicated. The exterior or forward wings are the longest, and the other pair fold themselves under their protection.

95. The ear.—Behind the wings and in the first segment of the abdomen may be seen the auditory membrane, which indeed performs the functions of an ear. The characteristic sound or noise, “cri-cri,” from which the name “cricket” is derived, is produced by rubbing the femur of the back pair of legs upon the wings. The male is supposed to produce this more than the female, and it is perhaps most observable in the period when the hoppers are beginning to fly.

96. Respiration.—The breathing is carried on by openings in the various rings of the body, each of which leads into a respiratory tube (spiracle), which we may call a trachea. This tube extends its ramifications all over the body, terminating in a series of sacs or air chambers capable of expansion and contraction, so as to assist in long and high flights. The arrangement or mechanism whereby this tube is worked is not unlike in principle that of a spiral wire introduced into an indiarubber gas tube. There is a spiral thickening on the inside of the trachea (composed of chitine) which keeps its sides from collapsing. These tracheal or bronchial spiracles are always open. When locusts take high flights, continuing their flights for days and nights together, as no doubt they do, *e.g.* on sea, and sometimes they go as high as two miles, it will at once be apparent how important this

mechanism is for the object. Locusts, like all insects, never breathe through the mouth, but through the aforesaid spiracles, which are extensively distributed over the body, and thus their bodies are very highly charged with air or gases.

97. Circulation.—The circulation of the blood is carried on by a tubular vessel which serves as a heart, and which is best seen in the abdomen. It is a contractile chamber, and the flow of blood is regulated by its dilatation and contraction. There is no heart proper, and except in the tube mentioned the fluid that circulates is more lymph than blood.

98. Genital organs.—But by far the most interesting part in the anatomy of the locust is that which deals with the organs of generation, especially that of the female locust. The organs of both male and female are situated at the extreme tip of the abdomen and near the dorsal or superior surface, but a description of this wonderful function and the corresponding organs, particularly those in the female, will be found later on, when we deal with the nesting or laying.

“PAIRING”

99. Locusts both “polyandrist” and “polygamist.”—The next interesting event about our flock of visitors is the “pairing.” The law or rule among the locusts seems to be similar and like that among birds. There seems to be one female for every male, and *vice versa*. They pair. This event occurs in a period of five or six weeks after they make their first appearance in or invade a locality. Inasmuch as it may not be the same company which first appeared in the district that now pair in it, of course no definite time can be stated as to when the event comes off, nor what is the age of the locusts that engage in this operation. When it takes place there is no difficulty in observing it. The whole company are engaged in this process, and more or less at the same time. It lasts only as a rule for a day or two. Of course they move little at this time, and only by a series of jumps made by the female—the male being fixed and quiescent above her. By walking among them at this period you can catch them with ease. Indeed, this would not be a bad time—or at least it is one of the times—to attack and destroy them, as we will afterwards see. The engagement, in which the female receives the marked and deliberate attention of the male, lasts at least hours—more probably the whole of the livelong sunny day—and is concluded quietly and systematically. The operation passes on simultaneously through the whole band in about a couple of days, as if in obedience to the example set by the neighbours. When these attentions are over, the parties seem to take up their former place in the company, and dance about and do everything as

before. This life continues as before to all appearance for a few weeks (about three or four), and then comes the period where the signs of the attention alluded to bear their natural and legitimate fruit. The rule is that the male and female locusts *pair*, but Mr. W. F. H. Blandford says: "Locusts exhibit both polygamy and polyandry, but the fact of the oviposition is no sign of the approaching death of either sex, except in the case where it happens to be the last egg-pod of the female that is laid."

NESTING AND LAYING

100. Deposition of the eggs, or the laying.—Like most other animal creatures, the locust springs from an egg, and the process we are now to consider, in my opinion, is one of the most interesting and curious in this inquiry. I am not aware what is the exact time that elapses between the "pairing" and the "laying," but the latter operation is performed with a similar degree of universality as the former. At a given time these careful females having selected by natural instinct the best breeding ground, prepare for the wonderful operation. The whole flock breaks up into smaller companies, which, so far as I have noticed, are mainly formed of females, but on this latter point I do not at present wish to speak affirmatively. So far as I could judge from the observations I was enabled to make, the males made themselves scarce on the laying ground, inasmuch as you see all on the spot almost completely sunk in the holes I am about to describe. Where the males are at this time I do not quite know.

101. Breeding ground.—What is their breeding or laying ground? The female visitors select parts that are dry, hard, untilled high waste land. But they may lay in any kind of soil, though such is not the rule. Preferentially they select the foregoing when allowed, but in meadows and pastures they sometimes nest, and are there undisturbed, and you may find them in abundance. They avoid loose earth and places that are damp or wet. Thus in cultivated regions they do not choose the loose, well-tilled, and damp earth, but the harder and more compact parts at the margin ("headrig"), which is compressed, and does not happen to be so loose. They seem to have a wonderful tact so as to select the hardish ground of the field. Along a road or the banks of a railroad where the grass and turf has been removed, and where the soil is free from rootlets of the grasses, or along a well-made waggon road in the open camp or veldt and not much frequented, are suitable situations for them, and there you may see myriads of them at the operation, which lasts only a couple of days or so. This is the rule affecting the healthy female swarm, but disease and other circumstances may intervene and change the normal rule.

102. The nest.—To understand how the hole is made, it is requisite

for me to here take up that part of the anatomy of the creature which I postponed under head "Genital Organs." The female possesses an apparatus for digging or drilling her "nest" and "laying her eggs" in a particular kind of order therein. She places them there in a uniform order, and not *helter-skelter*, like a bird in the ordinary nest. At the very extremity of the abdomen are two pairs of horny valves or hooks (Fig. 5, III. *b*), each pair placed back to back, with their points directed outwards and arranged so that all four hooks can be brought with their points close together, and in this way a sharp pointed lever is formed which can be turned around, evolved, and forked. With this apparatus so adjusted, she commences to penetrate the hardish ground which she has selected. She bores or drills a small hole in the earth in a few minutes. Then she separates the hooks, which are hollowed out so as

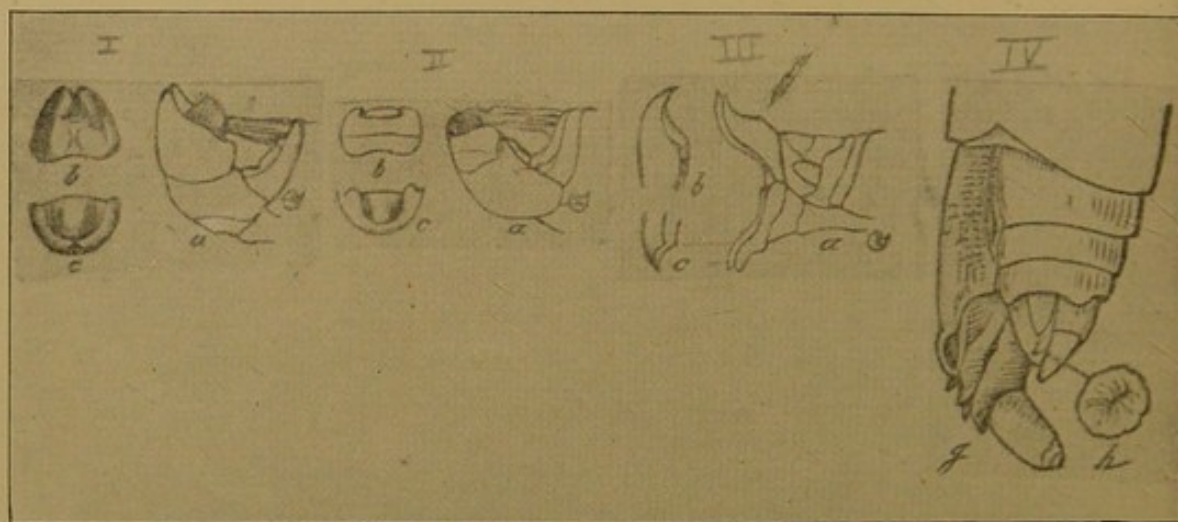


FIG. 5.—Showing the tip of the abdomen. I. and II. illustrates that of the male, and III. and IV. that of the female.—After RILEY.

to form shovels. By moving the body, she can in her own special and distinctive fashion either throw up the earth thus loosened or make the earth so loosened harder round the hole; or, more probably, the hole is drilled by a mixture of both methods. By carrying on this process successfully and continuously she contrives to make a deep hole—3 to 4 inches—in the ground.

103. Implements used.—To enable her to carry on this to the requisite depth, she is provided with a structure or formation of the abdomen by which the latter can be enormously extended (Fig. 7, *c*). The abdomen, as we have seen, consists of a number of horny segments which are joined together by an elastic sort of membrane, a construction which enables the animal to extend its body several inches beyond its normal extent. It can be also increased in thickness, for the superior encasement is larger and different from the inferior. The

abdomen is thus capable of a double enlargement—extension and expansion. It is enabled to, and actually does, bore a hole to the extent of from 3 to $3\frac{1}{2}$ in., or $7\frac{1}{2}$ to 9 centimetres (*i.e.*, larger and bigger than her own body), in the first instance, to provide a receptacle for the eggs. In this way we find the females sunk as it were into the earth, so that little more than their heads are visible outside during this period. The hole is straight or perpendicular, and in this respect the migratory locust seems to differ from the Rocky Mountain locust, whose holes seem to be almost invariably curved or oblique or slanting. Our locusts require a deeper hole, because they therein deposit eighty eggs, instead of the others' twenty-eight (see Fig. 6).

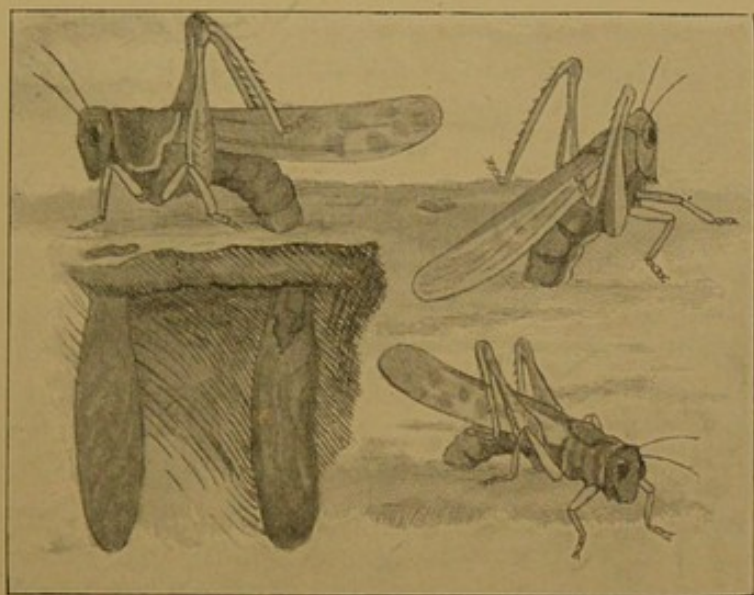


FIG. 6.—North American (Rocky Mountain) locusts nesting.

104. Orderly deposition of eggs.—Between the spades or hooks, we have seen, there are two fine sort of projections or little black fingers which assist in placing the eggs in position in the nest. The eggs pass through the *oviduct*, which is on the ventral aspect of the abdomen, into a spoon-shaped expansion (Fig. 5, IV. *g*) of the last segment, which conducts them in turn between the parts of the fingers or *ovipositor*. By the ovipositor they are lodged into their position in the hole or nest, and so are built or planted there, one after the other, in a uniform and well-recognised position, to which I shall presently refer. It is natural to suppose that the eggs are lubricated with the spumous or glutinous material or secretion, which helps to make them adhere and keep in their places more easily.

105. Shape of eggs.—It may be well for me to say, in reference to what is called *locusts' eggs*, that they are not egg-shaped, like those seen in the clusters of round eggs of the "blow-fly" or "bluebottle."

They are elongated bodies, about a quarter of an inch long, or rather more, and resemble in shape grains of small wheat and boiled rice in colour.

106. Number of eggs and method of protection.—Each female of the migratory locust lays about eighty eggs, and they are placed in the nest or hole already described, after the pattern of the grains upon an ear of barley, or, better still, bere—(Fig. 7, page 51), glued together by a proper secretion, so as to keep them in that slanting attitude all the time. When she has deposited thus her seventy to one hundred eggs, as the case may be, she throws a white, frothy, spumous or glutinous sort of secretion—a material almost impervious to water—on the top of the eggs, to the extent of an inch or an inch and a half, until the whole is quite tapped up and on a level with the adjacent surface of the ground, as a sort of cork or stopper or protection.

107. Depth of the nest.—The *depth* of the nest depends somewhat on the nature of the soil. There may be a certain degree of firmness or other quality required, but in any case all in that immediate vicinity have their nests about the same depth. The depth may vary somewhat according to the nature of the ground or climate, or number of eggs to be placed in the nest.

108. Gregariousness in planting nests—how to detect them.—The *nests* are all very close together, so that there is only a thin stratum of earth between each nest. Thus, if you dig round so as to remove a solid portion of, say, 4 in. in diameter by 5 or 6 in depth, you might have some twenty separate nests in this one piece. Each nest can easily be made out, and with care the lump of earth is such that it does not fall asunder when removed. If you remove bodily portions in the way I have described, and take the mass away from the influences of the sun, etc., progress towards fertilisation or hatching is stopped. The eggs in this case become addled, also, if the ground is harrowed or ploughed. With a little care and practice it is not difficult to detect the localities where these nests are. The evidence is that you observe this spumous material of a whitish-grey colour as you walk over the ground; and, if in doubt, the removal of a thick layer (one-third of an inch in thickness) will manifest this still more; or, take out one spadeful, and it will be enough to decide the point. This is an important matter, for, as we shall afterwards see, egg-collecting is one of the most general means employed up to the present for the purpose of combating the plague.

109. A field for chemistry.—I feel convinced that some naturalist could reap much renown by performing some well-directed experiments while the eggs are in the nests. Some conditions may be discovered in which the eggs could be rendered sterile. Life in them could be

arrested possibly by some chemical solution sprinkled over the surface of the ground, so as thus to arrest the process of hatching. Many of the concomitant circumstances regarding the matter we do not know. Our physicists have not perhaps yet had the opportunity to resort to the breeding ground of the locusts, or even their temporary homes; but, if they did, it might yield beneficent fruit.

110. Left to their fate.—The female having finished its nest in the interesting way I have now tried to describe, has for ever done with it; and she is therefore unlike birds in this respect, both in the manner of depositing her eggs and nursing them afterwards. As soon as the operation of laying is ended they fly away from the district, and for the time disappear entirely. They “flee away, and the place is not known where they are.”

111. Theories regarding future procreation.—Some suppose that these female locusts after they once hatch die, or are of no further use, and resemble snakes in this respect; but it is very unlikely that such is the case. Their mechanism is such in construction that such a theory cannot be supported without other than hearsay evidence. Various stories are in circulation to support this view, such as that they have been seen to go to where they can get water and drink of it until they die, etc. I do not think that any one of these stories is worthy of credence. Others again say that the locusts hatch twice a year, and that the life of a locust lasts only six months. It is supposed that the companies that migrate here are young locusts which have just obtained wings, because they resemble the young locusts bred here when they take wing. But not a particle of proof has been advanced to support such an hypothesis. In some parts locusts have been known to lay three times in the same season, about thirty eggs each time. Notably has this been observed in Cyprus. There are some cogent reasons that could be adduced against these views, while as a matter of fact we have no certainty as to the length of life of a locust in its natural state, or the number of times the female lays, or the age at which this function begins or ends. Of conjectures there are many, but of actual facts to settle the points involved there are few.

“HATCHING,” OR STAGE OF INCUBATION

112. The period of hatching.—The so-called “eggs” deposited in the manner described come to maturity in about forty days. The exact time to an hour has perhaps never been carefully watched or ascertained. No doubt it is possible to do this, and it should be done. The period may vary a little according to the state and nature of the soil, the climatic conditions which prevail during these forty days of incubation or maturation, the heat or the cold, or the dry or wet

weather, as well as to some other unascertained accidental circumstances; but the event arrives simultaneously, not only in respect of all the eggs in that one hole or nest, but also in respect of all the others in the immediate neighbourhood, and which have been laid at the same time. The young locusts make their way to the surface at the appointed time with surprising rapidity.

113. Time occupied between nesting and birth of young.—

In a very few minutes from the appearance of the first one above ground, the entire batch from the eggs in that nest are issued forth or hatched. Each nest of eggs gives out its own insects, and the whole surface of the ground seems alive with these tiny greenish-white creatures. From a few seconds to a few minutes at most after these creatures appear above ground—as soon as it can throw off its “amniotic” pellicle, which it sets about doing at once with alacrity—they begin to move freely about and eat. They are surprisingly active, and of course come out or are liberated with the heat of the sun. The event of incubation of the eggs is watched and looked for with more or less certainty and anxiety by the people living in the district. It is well understood to take about forty days between the nesting or depositing of the eggs and the appearance of the young. At least this is the case in the Republics bordering on the River Plate, in South America.

114. Nevertheless, one now and again comes across statements such as that it takes a year—that the flying locusts deposit the eggs this year in a certain locality and the young appear next year. On what authority this and such statements stand I know not, and from what I have seen I cannot believe it refers to the migratory locust. Others affirm that after a period of five years the young are hatched. Some say after sixteen years, and even some hold it is done after fifty years! There is proof that in cold or very temperate regions longer time in hatching is required: eggs, *e.g.*, are deposited in August and are only hatched in the following April. But in climates such as that in the Republics bordering on the River Plate, and generally in Africa, India, and China, the period of hatching will be found to be as stated, about forty days—from thirty to fifty. Therefore the climate, position or locality, and the nature of the soil undoubtedly exercise an influence on the length of time in regard to the process of hatching.

115. Remarkable fecundity.—As a rule all the eggs in the nest are fertile—that is to say, that when eighty eggs are laid eighty larvæ come out. In a square yard of superficies the number of young hatched must be prodigious. If in 4 in. square there are, say, 20 nests, or 1600 young larvæ, at the average of 80 to a nest, in a square foot there will be 90 nests, and in a square yard 800 nests. Then at the rate of 80 young ones in a nest there will be produced

in one square yard 64,000 larval locusts ! Sometimes, however, disease affects the eggs in a nest, others are liable to be attacked by worms or flies, so that in this case a certain percentage of the eggs are not fertilised, or at all events do not come to maturity—in certain seasons and districts at all events this is the case. The breeding power of insects can be imagined if, as Hader affirms, a single female house-fly produces in one season 20,080,320 eggs !

116. Insects deposit their eggs variously.—Some eject one at a time, here and there, as if flung carelessly away to take its natural chance ; some do the same with more or less greater design and care ; some deposit a number of separate eggs as if in a cluster or group—“blow-fly” fashion ; some cover the eggs with body fluff or some sort of glutinous secretion ; some leave the eggs quite exposed ; some carefully hide or cover them in self-manufactured dung-balls (*atenchus*) ; some choose one kind of material and some another in which to deposit them ; some require more moisture than others ; some do not appear to have any system, while others follow a well-known systematic order. There is observable in this function of insect life an infinite variety.

117. Locusts deposit their eggs methodically.—The laying or depositing of the eggs in the case of the locust is extremely interesting and notable. They always follow a definite line or practice, which fortunately may be well observed by any person who will. All the different kinds adopt the same principle. One species may have some minor differences as compared with another. Thus the Cyprian and Rocky Mountain locusts only lay in one nest about 28 separate eggs, while the migratory locusts, as seen in South and North Africa, Algiers, Egypt, and South America, lay on an average about 80 to 90 (60 to 120). It was noticed, however, that the Cyprian locust laid three times in what may be termed the same season. The same observation has not been made in regard to the migratory locust. Yet, in most other essential points of comparison in regard to laying and nesting, what applies to the one species will hold good also of the rest, with, so far as I know, this single trifling exception, namely, that the nests of the migratory locust are straight, and not curved like those of the Rocky Mountain locust. The eggs in all are placed in a slanting or oblique direction, and arranged after exactly the same pattern, somewhat as the grains are formed, as already indicated, in a bere or barley ear. This general plan may be seen more or less in Fig. 7, which deserves special attention.

118. Labour saved and the orderly exit of the young secured.—Even the most casual observer cannot fail in noting that the female locust takes great pains to arrange the eggs in her own special and particular fashion, and no doubt there are special objects to be derived if we can only interpret them correctly. There are some

very obvious reasons why she should do so, and not throw them in the hole in a haphazard sort of way. One reason is that by arranging them in a given order she economises the space and does not waste her energy or labour. Between the size and shape of the hole or nest she drills on the one hand, and, on the other, the number of eggs she has to deposit therein, there is a fine coaptation and a saving in adopting the method of arranging to which she has recourse. Nature is a beautiful and excellent artificer. Another reason is, that in the mode in which she places the eggs it is best for facilitating the escape of the young locusts, when they issue forth from their shells, without disturbing the rest until their precise and appointed time comes to do the same. As the bottom eggs were the first laid it is not unnatural to suppose that the lowest eggs may be the first hatched, and in such a case an easy exit should be possible, without incommoding the others. Now the arrangement of the eggs, as indicated, renders this exit expedient, for the youngsters can go up along the channel seen on Fig. 7, *b*.

119. Description of channel (Fig. 7, *b*).—This channel or canal is formed of the angle made by the slanting attitude of the four columns or lines of eggs. In each line there are, more or less, from eighteen to twenty eggs. In some nests there are fewer and in some there are more. The centre of the hole or nest is lowest (Fig. 7, *c*), and naturally the first egg drops into that portion, then others are placed side by side, being on slightly different planes of altitude, and the eggs are rendered cohesive or attached to each other by the frothy spumous fluid secreted therewith. This spuma becomes gradually dried up, but by its means the eggs stick or adhere together, and may be removed in apposition from the adjacent earth which surrounds the whole. The channel is more or less in a straight line; and, through this avenue, the exit of the young, when commencing at the bottom of the nest, would encounter the least difficulty of all. Sometimes these young locusts, after issuing from their shells, show a wonderful power of overcoming difficulties and forcing their way to the surface; but this is exceptional, and nature's mode is the easiest and best.

120. Changes in egg during incubation.—The next point that should perhaps claim attention is the changes that occur in the egg, so far as hatching is concerned. To notice this it will be best to take a separate egg, and then the changes or parts can be well seen by a good magnifying-glass. It is not my intention to do more than give a cursory outline of the condition. I will try to avoid intricate complex descriptions. If an egg that is approaching maturation, such as in Fig. 8, be taken and examined, it will be found to consist in its shell of two layers. These layers can be readily separated and removed. The outer covering is called the *chorion*; it may be easily ruptured; and, if frozen, it is still more easily broken and separated. When examined

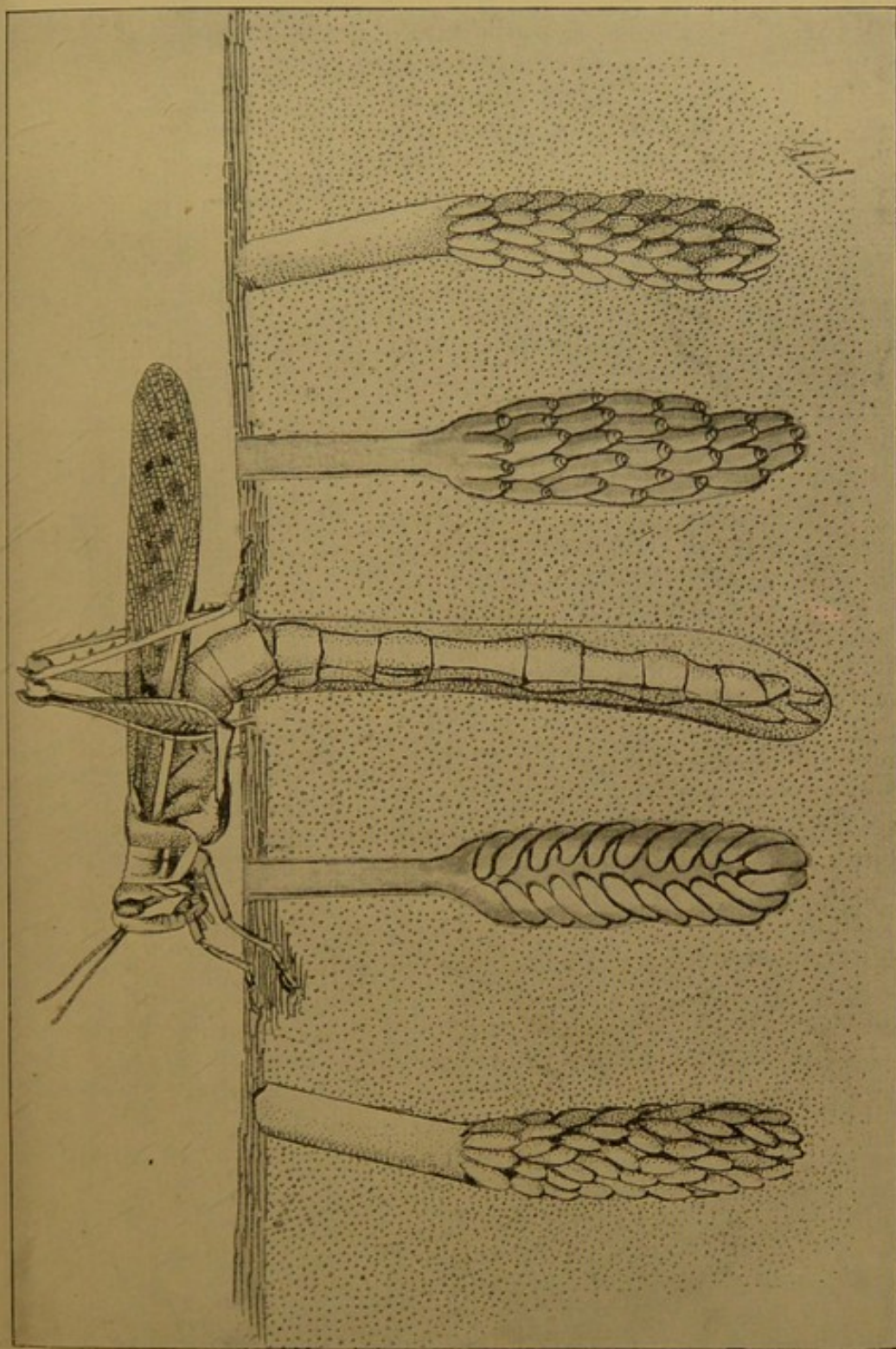


FIG. 7. — Mode of nesting of the African and South American locusts, showing the deeper part containing an average of eighty eggs, and the narrow neck above, filled with "spuma." — After BRUNER, modified.



by the microscope, it will be found to be pitted all over, and present an uneven surface and bearing a resemblance to that in *b*, Fig. 8, full of hexagonal cells. The inner layer is thicker and smooth. This layer is tough and more or less transparent, so that the form and position and parts of the insect-embryo can be distinctly discerned through it. The analogy in this case to that which occurs in the bird's egg is very similar.

121. How the embryo gets an exit.—In Fig. 8, *c*, it will be seen that the parts of the animal are so compactly placed there is no room for motion, and the wonder is how, when the exact time arrives, the embryo manages to break its shell and effect its escape. Nature is wonderful in all her workings, while she has many different ways of reaching the same end. She is never in a difficulty, and is rich in her contrivances. Although this inner covering or membrane is very tough and strong, yet the young tenant held within has at the proper time means whereby he does effect his escape. He breaks the membrane and manages to get an exit. How does he do this? He does not do this with his mouth as the young chick does with his beak, for we find that the head is doubled and bent on itself; but, from the position, etc., of the hind legs (the shins or shanks of

which we have already seen are provided with strong spinous processes along the posterior margins—especially are the terminal ones powerful), and these are in contiguity with the same membrane. The spines were on the inside of the four anterior legs, and they are small and comparatively of less account. There is little doubt that these spines serve an important prenatal or embryonic purpose or function in bursting the membrane as well as affording a firm hold to the insect in walking, jumping, and climbing, or holding fast in its after existence.

122. Position of embryo in shell.—By the naked eye, or, better still, by the aid of an ordinary magnifying-glass, the embryo when fully

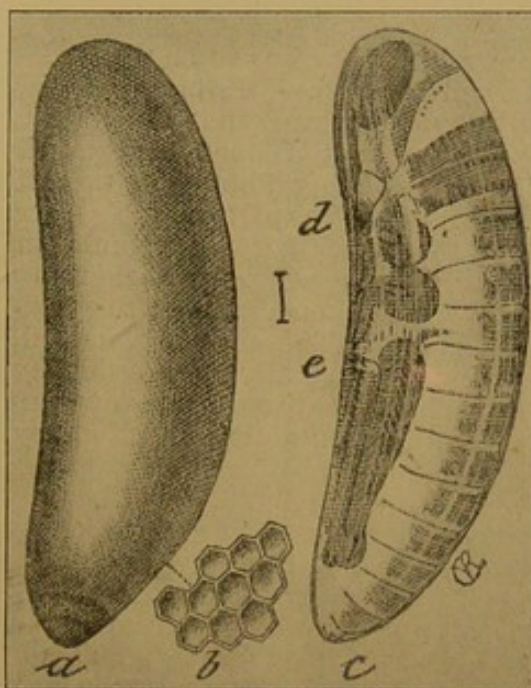


FIG. 8.—Showing fertile locust's eggs magnified—(a) entire egg approaching maturity with outer covering (chorion) intact; (b) the microscopic structure of outer covering or chorion; and (c) the embryonic locust *in situ* or as it lies within its shell; (d and e) points where the covering ruptures at maturity.—After RILEY.

formed can be seen to lie within its shell or lining, as in Fig. 8, *c*. The antennæ come down over the face and lie in close relation to the mouth—the parts of which are really well developed. The head is bent so that the mouth rests on the trunk or thorax. The legs are folded upon the breast. There is no difficulty in discovering the strong terminal hooks on the hind legs—they reach as far as the middle of the sternum or trunk. Towards maturity there is a continued series of contractions and expansions of the several parts of the embryo. With these the membrane gradually gives way at the points *d* and *e*, and very often there is a transverse slit as well. The membrane tearing in this way, the young embryo gradually manages to disencumber himself from his imprisoned position, and effects his escape through the channel already indicated without disturbing the other eggs, the embryos of which in turn and almost at the same time follow suit.

123. Casting the slough.—As soon as the little insect escapes, its first duty is to cast off a pellicle called, as we have seen, the amnion, which completely surrounds every part of it. This it does almost immediately, and then it is free to move about actively and eat. This amniotic covering is highly useful to the animal as long as it is under ground. It preserves it in some way, and seems necessary for its safety. The amniotic covering does not interfere with its forcing or pushing power to get free and “into the open,” for sometimes its passage through the channel already referred to may be interfered with, and it can, under certain favourable circumstances, make its way through the loose earth to the top, but when it gets to the air the covering seems to be then quite unnecessary and an encumbrance to it. To enable it to be perfectly free, it sheds it off at once. This amniotic covering is common to most hymenopterous, dipterous, coleopterous, hemipterous, orthopterous, and neuropterous insects. When the covering is accidentally removed, while the insects are still under ground, they seem to lose much of their forcing power upward; with it still intact, they can do much to effect their escape; without it, they seem sometimes much more, if not absolutely, powerless. They instinctively know the nearest way to the free surface and open air, a fact which has been demonstrated by many decisive experiments. We then see our little creature as in the following Fig. 9, 1. In this figure may be noticed the varying stages of growth up till the period of last moulting—2, 3, 4, and 5.

LARVÆ AND LARVAL LIFE—THE “ARMY”

124. Metamorphosis.—We have now to consider the locust in its larval stage, in which it is found to be most destructive to the crops

over which it passes. As the larva undergoes certain changes or moults, it will be better to follow the natural order or course of events. The metamorphosis is not complete, or, as it is termed, it is hemimetabolic. From the birth or exit from the nest of eggs till it assumes the state of being of a fully fledged flying locust a period of seven or eight weeks elapses. I am not certain that the exact time to a day has been annotated or fixed by any observer as to when the various stages end, and perhaps some variation may prevail. At the same time, it will be found convenient to attend to the prominent features connected with its several stages at this time. It is not till from fifteen or twenty days after birth that the very first appearance of wings can be traced, and this is done then only in the form of *tiny scales* on the trunk or

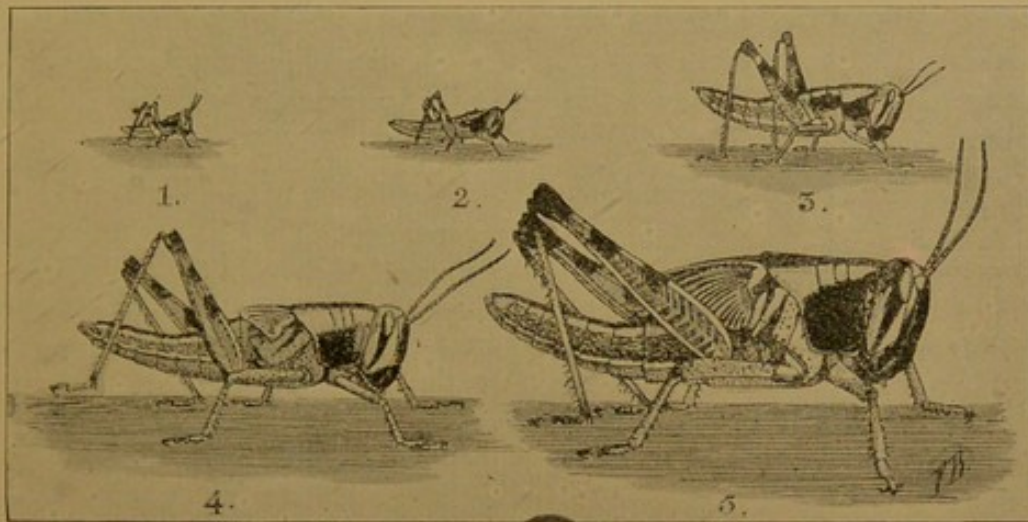


FIG. 9.—Showing various stages of the locusts between the time when they are hatched from the eggs and before they get wings and arrive at maturity as flying locusts.—After BURMEISTER.

thorax. The stages through which it passes in the larval condition are manifested by a growth and the distinct stripping off of its outer layer or skin at certain well-marked periods, somewhat after the fashion that the gloves are removed from the hand. As the animal increases in size you may, towards the latter portion of its larval life, forcibly remove the external covering and find the formation of the wings underneath.

125. Appearance in larval form.—When the tiny creature issues from its nest (Fig. 9, 1) it is of a greenish-white or creamy colour, about one-eighth of an inch or 7 millimetres long, and when it throws off its covering, which it sets about doing at once, it soon begins to move and creep. The very dust of the ground, which was so still before, now seems to waken into life from the vast multitude that exists of these tiny creatures. When they come out of the nests, they appear as in the accompanying illustration. The number of these small forms seems

infinite. In a day or two, according to the state of the weather, the whiteness disappears, they become mottled, and the heat of the sun turns the colour gradually into a homogeneous blackish-brown or dark hue. You find the chief rudimentary parts of the body of the full-grown locust there, less the wings, even in this early stage.

126. Early movements.—They begin to move by a process of twisting or rolling over one another, so that for the first few days they receive the name of "twisters." At night they gather themselves into companies, or heaps, or bunches, so as to keep themselves warm, and thus rest for the night. They early show their gregarious nature. During this initiatory period, if there is plenty of pasture about for them to eat, they do not march far away; if they do, it is *en masse*; but they spread out, selecting warm and sunny places, and eat and grow, keeping pretty well in the vicinity of their birthplace. Within eight or ten days they can jump about 4 or 6 inches, and so they evince considerable progress. Their eating and movable apparatuses show evident signs of rapid development.

127. "Grasshopper" stage.—In the first three or four weeks, until they cast off their second or third skin or covering, they keep pretty near to the pastures in the neighbourhood of their birthplace, and do not show till then any desire to go farther afield, if they have plenty to eat; but, if not, they move on *en masse*, and not in open file, like a semi-liquid stream, till they find food. In the United States of America the locust at the stage of which we are now speaking (*i.e.* at the third or fourth week) receives the name of grasshopper on account of its hopping or jumping qualifications, the legs being then more adapted for hopping or jumping than those of the wandering locust. But it is not the technical grasshopper, as we are accustomed to view that insect.

128. Orderly instincts.—At the age of three to four weeks a new characteristic makes its appearance. A desire to explore manifests itself, and in a surprising manner. The whole company moves in a body in one general direction, and more or less in a straight line, which is a matter worthy of particular attention, as if by one common instinct, without apparently having any recognised leader or commander. "The locusts have no king, yet go they forth all of them by bands." Now, they thin off or spread themselves out, eating everything that comes in their way—wheat (if sufficiently young and tender), maize (even if strong and old), corn, sugar-cane, linseed, alfalfa (lucerne), pasture of all kinds, vegetables of all kinds (tomatoes and celery) and all garden produce, potatoes (ordinary and sweet), the leaves and even sometimes the bark of the trees (with one or two exceptions)—the fruit of course is lost for the season, sometimes causing the ruin of the trees; orange, willow, poplar, palm, banana, peach, pear, plum, vine, acacias, roses,

etc., are stripped, with the exception of the gum and paradise trees, which seem to be poisonous to them. They make everything "clean bare"; sometimes they will enter houses and eat the very clothes and curtains at the windows. Figs. 10 and 11 show the locusts eating and attacking fruit. Scarcely anything comes amiss to their ravenous

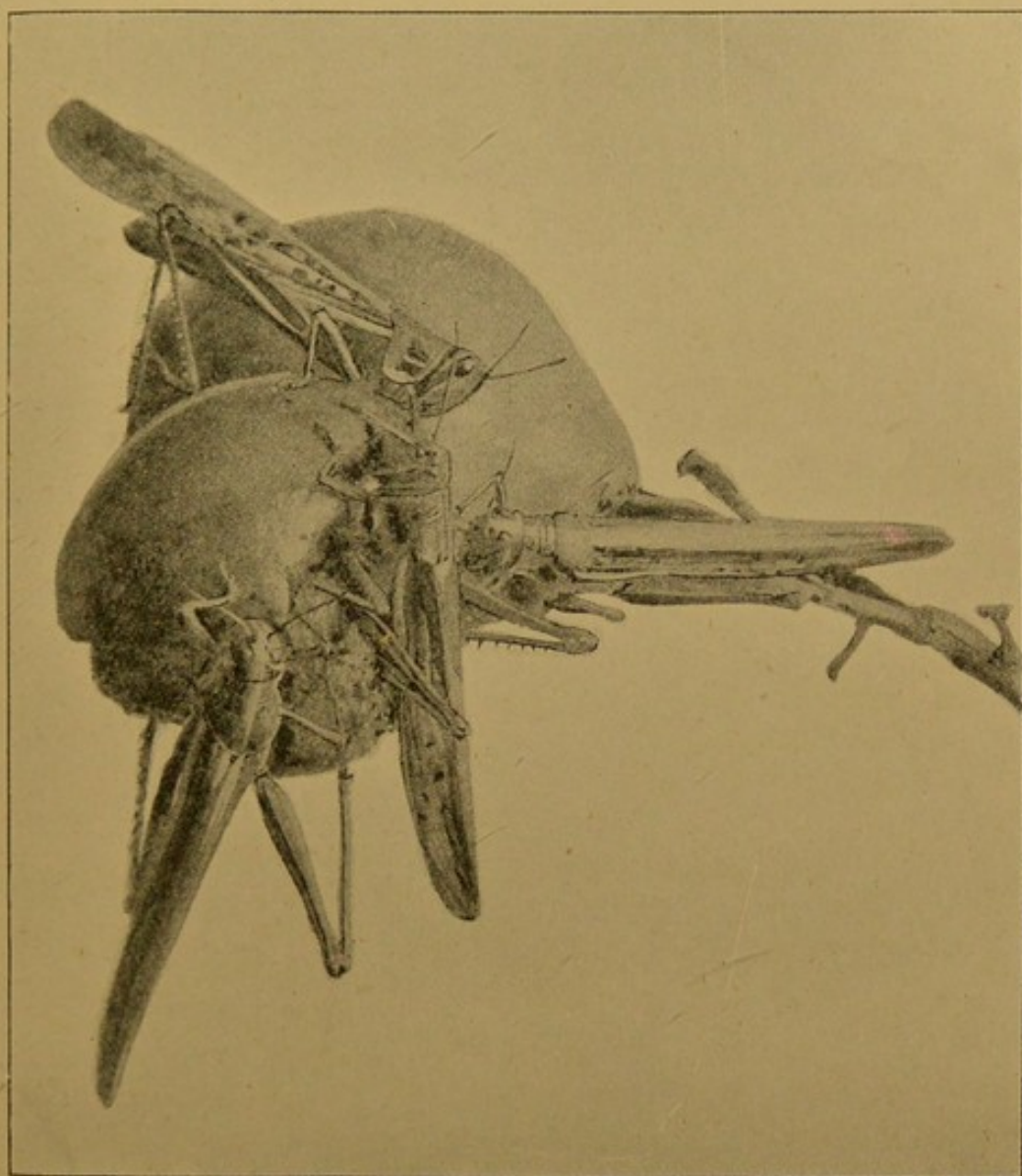


FIG. 10.—Locusts attacking fruit.—After BRUNER, reduced.

appetites when sufficiently famished—even dry lint on used-up fences, planks, dry leaves, paper (entire books), cotton, woollen fabrics, wool on the sheep. Further, if compelled by hunger, they have been known to eat dry animal substances, and even cannibalism as a resource when all other food fails. They eat their own weak ones.

129. Preferences in food.—But if one were to specialise in regard

to the food the locusts particularly like or dislike, it may be said few things come amiss to them, on the one hand; and, on the other, where food is more plentiful or abundant, they are somewhat fastidious or capricious. Thus, in one case, they do not refuse to eat their own

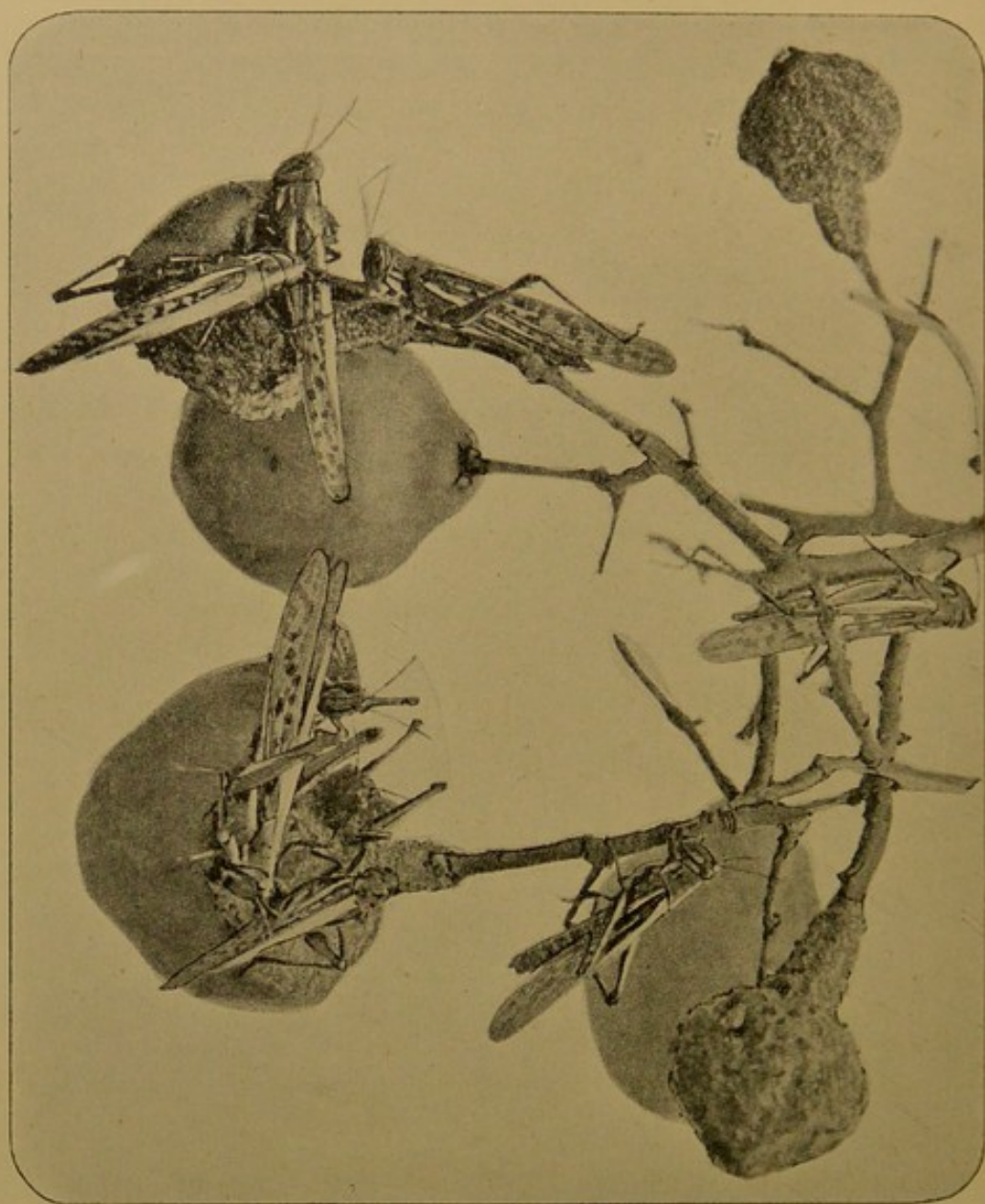


FIG. II.—Locusts attacking fruit—about one-third natural size.—After BRUNER.

diseased or weak kind, and even feed on dead animals; while, in the other, they pass by sweet stuffs, and seem to prefer the bitter, acrid vegetables and plants. Natural grasses are not appreciated so much as cultivated plants—grains and cultivated pastures suffer first and chiefly! They are not specially fond of melons, pumpkins, or the poisonous weed Mio-mio (Romerillo). When wheat is pretty far

advanced, they pass it by—not so with mealies, tobacco, etc. Indeed, most vegetables and all fruit and garden plants they eat with avidity.

I have seen fields of pasture over which this scourge passed, and there was not a blade left, not even for a goat to nip. The surface there was “desolate,” and quite black-coloured.

130. Destructive powers universal and unsparing.—It is a curious phenomenon to see the trees stripped in one day of their foliage just in the season of the year when they ought to be covered with leaves and fruit. (See Figs. 1 and 2, pp. 22 and 23.) In a month or two after being stripped bare by the locusts, young leaves again sprout out; but in trees such as the orange a visitation like that described destroys the fruit for two seasons, and not unfrequently the trees are permanently injured. Thus in one district the account of the plague runs:—The locusts have devoured everything—grapes, wheat, beans, and potatoes—the running stream is infested, and the loss is calculated at £1,000,000 sterling. Now this took place in a vine-growing district, so that nothing seems to escape them. (See Fig. 2 (p. 23), par. 62 (p. 25), and Fig. 16 (p. 95), par. 206 (p. 94)). Other instances can be cited illustrative of the universality of the destroying power, but it is unnecessary, for all will concede it.

131. Appearance on the march.—When these hoppers or jumpers (“voetgangers”), or “saltonas,” are on the “march,” they sometimes appear so determined and bent on the fearful execution of their work that they resemble in certain aspects and have got the name of an “army on the march.” They move in open file, and carry themselves in a proud, haughty way, with heads high up and fixed. It is rather beautiful and interesting to see them “on the march,” if we only divest ourselves for the moment of the idea of their devastating object. In this stage they can both jump as well as walk, but walking is the feature. If left alone, they walk (hence “voetgangers” in Dutch); but if you approach them or meddle with them they jump. They can hop about a foot or so in height, and of course the older and stronger they become, they acquire more strength and can leap better. The comparatively slender hind legs of our voetgangers do not tend to good jumping; but these acquire more and more strength, so that the adult can jump six or more feet.

132. Marching stage the most deadly.—It is in this marching stage that they do enormous damage, and eat every edible thing in their path, and completely destroy the work of the husbandman. They are not content with levying toll merely, but they will have all, and will leave nothing behind but desolation. They therefore are unlike the flying company of locusts, which only levy toll here and there; but these when they pass leave nothing.

133. No fears deter.—The whole of the company begin to walk

at the same time, as if by order ; the head is kept erect, and the neck is as if stiffened. They go straight on, irrespective of danger ; and though they manifest a decided power sometimes to select a slightly different course, yet they are not easily turned from their course, and being so numerous and closely phalanxed nothing escapes them. The sight of this "army" is a very impressive one, and once seen will never be forgotten. In some respects it is an awful sight ; the spectacle strikes you with pity and sorrow to see at once before you that the toil and the labour for the season, or indeed the year, is lost.

SOME EFFECTS OF AN "ARMY ON THE MARCH "

134. Resistance futile.—From the foregoing, it will be seen that it is by no means an easy matter to stop this "army on the march,"—in fact, it has only been within the last two or three decades that some devices have been obtained whereby they can be successfully prevented from following their own course, the direction of which may be slightly diverted, but only if special means are adroitly placed in their way. Otherwise, they are pertinacious regarding their course, and they surmount all difficulties in their way ; they are impeded by no barriers, except, as we shall see, of one special kind. They are therefore, as a rule, more difficult to manage than the proverbial obstinate pig. A pig you can drive anywhere by trying to drive him in the opposite direction ; but the locust knows which way he wants to go, and at certain periods, if he is absolutely precluded from going that way, he will go no other, until he tires you out, and then he serenely marches on. There is abundant proof of the fact that any ordinary obstruction you may put in their path, and which might stop the progress of most other creeping things, is of no avail in this case. It will suffice to give an instance, and all persons who are acquainted with this fact can at once realise the condition and truthfulness of the portraiture. An experienced writer and observer describes the circumstances, which will be found detailed in par. 222 (p. 100) following.

The rule prevailing is that, when any particular "school" or company of the army is on the march, they are not hindered or deterred from pursuing the course they have elected. The column follow the vanguard, and when the vanguard changes its course the change seems to be curiously communicated in wave-like fashion all along the company following. Sometimes the army will be more dense at one part than at another, and it may happen that some of the companies appear to be going in different or even opposing directions. Therefore it is occasionally seen that the direction as it were to-day is different from what it was yesterday ; but this is a matter of elective instinct and not of force or compulsion. Hence we find them jumping into the water

or river one after the other until they bridge it with their own bodies, and the rest of the army cross over in force to the other side, even though the expanse of water be a mile or more in breadth. The army in the main thus persist in carrying out a general direction in regard to march, notwithstanding apparent minor differences in parts of the column.

135. Every expedient has failed.—You will see from the character of the fight that if it were possible to stop the “army,” it would have been done. But it was impossible. However, progress has been made in this, like everything else. Means do now exist which did not then exist, whereby such a march can be stopped. At the same time, it is astonishing how, among all the Latin races who have had to deal with these insects, they persist in using these same means that have been recorded over and over again as having utterly failed in checking the “march” in question. Trenches, ditches, etc., do not stop the voetgangers. No, not even with water in them. And yet, at the present day, you will find these means practised. Any moat of the kind serves to delay their progress, but only for a few minutes. Such a system must fail; it is labour in vain. If the ditch or trench were filled in burying those that were in it, it would only be an infinitely small number of the army that could thus be secured, and there are not labourers enough nor money enough to open another and another, and continue this process successfully, in order to exterminate the pest in this fashion. So, again, “beating tins,” kindling fires, etc., in the case of the flying band, are all comparatively useless and trifling means. It is well to be assured of all these characteristics of the insect if we are to battle successfully with it in this stage and checkmate it here.

CHARACTERISTICS OF THE “ARMY”—DIRECTION OF MARCH, ETC.

136. Natural dangers not reckoned with.—It is important to note the direction in which the voetgangers invariably move. As we have seen, they move in a body, as if by a common instinct, in one general direction. What is that direction? It varies in different countries. The flying locusts in the Argentine come from a northerly direction, and the hoppers or creepers march towards the south; although it might be, so far as abundance of suitable food goes, to their manifest advantage to go in an opposite direction. In Egypt, and also in North America, the flying locusts came from a westerly direction to their temporary homes, and they pursued an easterly direction. So it is written, “they came with a west wind and departed with an east wind.” The important thing to bear in mind is that they march in one direction as a body, irrespective of all natural dangers, etc., that may be in their way. Then the great point is that in certain countries the direction

may be known. In this country (South Africa) it will be found that they march towards the south, and not towards the north, although often, so far as suitable pasture is concerned, it might have suited them infinitely better to march towards the north, or the east, or the west. The direction may not be true south; it may incline at one time to the south-east, at another to the south-west, but taken as a whole it will be southwards. Of course this has reference to those companies here when they are free to choose and select their course. It is known that if a band happens to be on the march and come upon a path, or a road, or a railway line, they will preferentially follow the said road, at all events for a time. But this is entirely a matter by itself. It is very important to be certain about the direction, should it be decided to give them battle, as preparations may require to be made. The company or band may present a marching front of some miles in extent; but it will be found that all are moving in the same direction, more or less in a straight line. No doubt they will be more dense at one point than at another.

137. Food preferences determine line of march.—It would appear that the column in their march have some instinctive modes of choosing their path, as, for example, they can pass by fields or pastures they do not care for, such as wheat-fields far advanced towards harvest; while, if necessary, they can overcome great obstacles, such as scaling walls in their path, thirty or more feet high, or cross trenches, moats, and streams. They go over rocks and hedges, up mountains or down dales, according as their instinct leads them. If proof be needed that the saltonas march in one direction only, it is abundantly found in the experience of the screen and trap or Cypriote system, which is based on this fact, and on this alone. This is conclusive demonstration.

138. Rate of speed of the army when marching.—The army can march more or less a mile per day, but of course the distance depends on the work they have to do—sometimes they may not go half a mile, and sometimes they may go two miles. Naturally, if the pasture is copious, they will not be able to go so far. They begin with the heat of the morning sun about eight o'clock, and proceed till near sunset. On a cold and sunless day they are more or less stationary.

139. Extraneous effects of the marching army.—In this march they sometimes fall into wells, cisterns, etc., and so pollute the waters by putrefaction as to cause danger to health and life. "Otherwise they can run upon the walls, they shall climb up upon the houses; they shall enter in at the windows like a thief." If you keep some live locusts in a small box, they will live days without food; and then after death, in a couple of days, the smell from putrefaction will be abundantly manifest, which will remain perceptible a week or more.

NON-POISONOUS EFFECTS OF LOCUSTS

140. They are used by Arabs and others as food.—Although insects do not constitute any portion of our Western dietary, and doubtless prejudice would go far against the trial, yet in some countries, especially if old, they have been eaten from time immemorial by the poorer classes of the people. According to Diodorus, some tribes in Ethiopia (in the north of Africa) were nicknamed, in consequence of eating locusts, *Acridophagi*; and Pliny mentions that it was not rare amongst the Parthians. Then, again, the Arabs at Mecca, when corn is scarce, grind locusts in a hand-mill, or grind them in a mortar, and make a sort of meal of their bodies, of which they make cake and bake them like bread. At other times they boil them well and stew them in butter. Morier also informs us that on an occasion of a great swarm at Bushire, crowds of poor people gathered up the insects to dry and salt them for sale in the bazaars. "When boiled, the yellow ones turn red, and eat like stale or decayed shrimps." These and numberless other evidences tend not only to prove and confirm the impression that they are not poisonous in any way, but also we are helped to a plain and literal understanding of the statement, that John in the wilderness fed on locusts and wild honey.¹

141. They do not communicate poison.—Locusts, as a rule, only injure vegetable life, not animal life directly. In fact, men have

¹ In a very excellent book, entitled *On Veldt and Farm*, by Frances Macnab, p. 224, it is said, pertaining to this subject: "On the whole, the case is one for administration. The Kaffirs throughout South Africa require instruction and keeping up to the mark on the subject. Let us take Bechuanaland as a fair sample of the way they have been taught to meet the difficulty. Not a locust was heard of in Mafeking, on the north-eastern border of British Bechuanaland, until 1891. Then they began coming in very small swarms indeed, and the natives looked upon them as a godsend in the way of food. Other people treated them as curiosities. No one thought of destroying them. Now they are there in myriads, and have spread destruction right across Bechuanaland, and yet no steps have been taken to destroy them. The natives, of whom there are many thousands, depend upon mealies and the milk of their herds. The pasture and the mealies were both alike swept away by the locusts, and the natives themselves are now dying of diseases engendered by improper and unwholesome food. To meet these difficulties, distributions of seed have been made, and the people are given mealies to plant the plots with.

"If we look at Bechuanaland—both the Protectorate and the old Crown Colony—we shall see that almost without exception the fine soil in well-watered districts belongs to the Kaffirs. But who has taught them to make use of these opportunities for irrigation? . . . It would also have been a wise measure to try and discover whether some plants, such as those above alluded to, would grow there, instead of courting a repetition of the disaster by having no other crop except mealies or corn, which, of all others, are the crops most affected by locusts. It is a case for minimising loss, and something should be demanded in return for the free gift of seed, so as to eventually turn at least one corner of the loss into profit. Improved roads, the digging out and kilning of lime, the planting of trees, the erecting of water-storage, are all points on

from ancient times taken them as food, and in some exceptional places they do eat them still. Kaffirs all over Africa eat them when other food is scarce. This shows conclusively that they are not at all poisonous. Of course locusts in a state of putridity obey the usual law, like all other substances when putrid, and then they cause disease and death. But not otherwise. There is no proof whatever that pasture of any kind over which the locusts have gone is tainted or poisoned for the use of animals. Live locusts can be thrown into a vessel, cooked immediately, and eaten, without the person suffering injuriously in any way. It is well, therefore, to be explicit on this point. In the periodicals of the day one frequently sees that the locusts cause this and that other complaint. The following is given as a sample only :—

“SORE EYES AND LOCUSTS

142. “Do locusts injure the eyes ?—The question is not a new one, but it has a new significance in Colenso, which is at present suffering from two evils—sore eyes and a plague of locusts. Every child, it is said, and some adults too, are afflicted with a painful eye complaint. Whether this is due to the locust or not is not known, but it is a fact beyond dispute that in the Tugela Valley the plague has been very extensively felt.”

143. Ophthalmia from putrid water.—From time to time one sees the same in regard to other complaints prevailing in the locality. The mischief is ascribed to another evil with which no connection whatever has been shown. The only reasonable way in which it could be explained that there is any connection between the plague of locusts and the general affection of the eyes of the children in the district in the case referred to is, that the locusts (hoppers) falling into the water, which in time became putrid, a disagreeable form of conjunctivitis or ophthalmia (an ailment which might easily assume a contagious epidemic character) is set up. But there is nothing peculiar or exceptional in this, and it is neither fair nor correct to charge them falsely. They have enough to bear without that.

144. Good for food for “humans” and “animals.”—The inspired lawgiver makes specific mention of the locust among animals permitted to be eaten: “every flying creeping thing that goeth upon all fours, which have legs above their feet to leap withal upon the earth, even these of them ye may eat, the locust after his kind,” etc. Now, what is

which Kaffirs in Bechuanaland might have been as profitably employed as the natives in India in similar times of distress.”

As the author says the information relating to the locusts dealt with in this chapter was supplied by another, I will not refer to them. I should take grave exception to the special characteristics mentioned about the locust.

safe for a man to eat, as a rule, cannot surely be productive of harm for the lower animals (cattle) to eat. Yet notions prevail to the contrary, and with the view of still further convincing the populace, it may be useful to give publicity here to the official published opinion of the Colonial Veterinary Surgeon, whose opinion, as could only be expected, supports that of the sacred writer already given, and explains satisfactorily the supposed evil in another way.

145. Prejudices.—Superstition and ignorance often prevent the mind of the common or uneducated people from judging fairly between cause and effect, and sometimes it is difficult to eradicate opinions caught in this way. It is well, therefore, to deal plainly with it. Here is an instance:—

LOCUST-TAINTED GRASS

“At the Umzimkulu recently,” writes a correspondent, “after the visit of large swarms of locusts, a number of cattle mysteriously died. One Kaffir lost ten, and others lost beasts in twos and threes. The idea prevails among the natives that they were poisoned by eating (not the locusts) but locust-tainted grass.”

In February 1896, Mr. Wiltshire, the Natal Colonial Veterinary Surgeon, stated:—

146. A specialist's opinion.—“That he had been to Harding to inquire into the cause of the deaths of certain cattle belonging to natives in that district, said to have died after feeding in their mealie gardens, the said mealies having been partially destroyed by locusts. Upon his arrival he found that the popular impression abroad was, that the cattle had died from poisoning, and from the information afforded him it looked as though death had been caused by vegetable poisoning. The theory adopted by many persons in the district,” wrote Mr. Wiltshire, *inter alia*, “is that cattle are poisoned by the excretion of the locusts on the mealies and grass, ignoring the fact that they were unable to point out excretory matter, and also that it is by no means uncommon to see cattle eat locusts without injury, if not with actual benefit. Having no preconceived notion on the matter, I entered upon my investigation without prejudice, and visited the kraal where recent deaths had occurred. I found several cattle still sick, which I examined. They appeared to be healthy enough. I then made an examination of the contents of the stomachs, but detected nothing but grass and mealie stalks. I ascertained that the cattle that had died, as well as those that were sick, had broken out of the kraal in wet, foggy weather, and had gorged themselves in the adjacent mealie gardens.

147. “The owner of the cattle observed discreet silence when

interrogated as to whether the animals had not been fed elsewhere before going into the garden. In each instance, when animals were discovered to be sick, they vomited. Cattle eating young mealies or corn when wet would cause the symptoms which had been observed. In books on animal diseases, it is stated that the illness among cattle, similar to the cases in point, was described as blown, hoove, honor, fog-sickness, etc. Such sickness was common in every country where animals that chew the cud are allowed to feed greedily on tender, succulent food, especially if wet. It was also common in England, where animals had access to young clover, and cases were by no means uncommon in Natal, especially amongst the sheep, after feeding on young grain.

148. "The sickness was caused by rapid fermentation and the formation of gas due to the warmth of the stomach and the action of the secretion, together with the moisture of the juices of the plant, which brought pressure to bear upon the heart and lungs, and sometimes caused diaphragmatic rupture, which was followed by immediate death.

149. "The treatment of this disorder required prompt action to relieve the urgency of the symptoms, on account of the danger of suffocation caused by extreme abdominal tension. The rumen (*i.e.* the first stomach) should be punctured to allow of the escape of the gas, and for this purpose a trocar and cannula should be used, about eight inches long and nearly half an inch in diameter; when the trocar is removed, the gas rushes through the cannula, which may be left in as long as deemed necessary, and secured by a piece of tape. Punctures must be made on the left side at the point midway between the point of the hip and the last rib. The instrument must be inserted in a direction downwards and forwards. If pushed straight into the side, there is a danger of puncturing the kidney. When the instrument above referred to is not available, a long sharp knife or other instrument may be used—I have heard of a pointed piece of bamboo having been used for the purpose. In cases less urgent the introduction of a probang down the gullet into the stomach would effect relief.

150. "Active medicinal treatment must follow, to dissolve the gases and stimulate the digestive organs. I recommend administering aromatic spirits of ammonia, two to four ounces in a quart of water, together with a teaspoonful of ginger. This might be supplemented by whisky, gin, rum, or any other spirits. To check fermentation it is advisable to give the affected animal antiseptics."

Editorial comments on above.—In regard to the foregoing, *The Natal Witness*, a newspaper that has done yeoman service in this cause, says :—

“LOCUSTS AND CATTLE—REPORT BY THE COLONIAL
VETERINARY SURGEON

151. “The numerous queries we have received from farmers residing in all parts of Natal *re* the reported poisoning of cattle by locusts, caused us to make inquiries at the S.N.A. Office yesterday as to the purport of the report handed in by the Colonial Veterinary Surgeon (Mr. Wiltshire), who, we ascertain, had been making experiments and diagnosing cases of sickness and death amongst cattle said to have been caused by locust-poisoning. Mr. Moore supplied our representative with the Veterinary Surgeon’s report, from which we extract the above information.”

THE VARIOUS CHANGES OR MOULTS THE
LARVÆ UNDERGO

152. **Colour changes, wings appear, the outer skin disappears.**—It will have been noticed that the tiny insect after leaving its nest undergoes certain changes or transformations, which are called moults. From being a greenish-white or creamy colour, on issuing to the surface, it gets blackish from exposure in a few hours to the strong heat of the sun. For the first three or four days it crawls or twists about in the most active way. Then in about fifteen or twenty days, if examined carefully, the first pair of wings may be seen in the form of minute scales upon the trunk or thorax. By this time the insect has grown considerably, and can jump some four or six inches in height, and receives the name of “hopper” (“saltona” in Spanish), and it can walk also, hence the name “voetganger” in Dutch. In this period it simply changes itself by shedding or stripping off its outer covering or skin, somewhat after the fashion that a glove is removed from the hand and fingers, and it does so all over the body to its very eyes. In another period of somewhat the same length (fifteen to twenty days) it does the same exactly again, with of course an increased development of the parts. So that when it casts off its covering for the last time its two pairs of wings are perfectly formed. The front or first pair is sooner and more fully developed than the second. These changes are more or less completed in from fifty to sixty days from its birth. There is then a short time of comparative inactivity, and it begins to use its wings for short distances, but increases the length gradually, so that in eight or ten days a difference is observable. The hind triangular pair of wings gradually fill out and extend, so that the poise of the insect is better, and you can see that it can sustain itself with greater ease. It extends its operations, and finally the whole swarm take wing and become flying locusts. All this takes place in about two

months, more or less, according to weather, pasture, and like circumstances.

153. Periods.—The varying periods therefore are :—

| | |
|---|---------------|
| The flying locusts prolong their visit before pairing | 5 to 6 weeks. |
| Between pairing and nesting | 3 „ 4 „ |
| Hatching | 5 „ 6 „ |
| Larval stage | 8 „ 9 „ |

— — —
Total length of visit per annum about . . . 21 to 25 weeks.

In reference to the moulting or transformation process, Mr. C. V. Riley (of the United States), who has done excellent service in this field, and made a special study of this subject, says :—

154. Moulting process.—“When first hatched the little locust is



FIG. 12.—Showing the last stage of the final moulting, before getting their wings—
(a) outer covering or skin just split on the back ; (b) the imago in the process of extruding itself ; (c) the imago nearly out ; (d) the imago out and with wings extended ; (e) the perfect locust.—After RILEY.

quite pale, but soon becomes mottled with grey and brown. Except in having a shorter narrower prothorax, sloping roof-fashion to a medium ridge, and in lacking wings, the young locust scarcely differs in structure from its parent ; and the perfect winged form is gradually assumed through a series of four moults, during the first three of which the wing-pads become larger, and during the last—from the pupa (Fig. 12) to the perfect state—the thorax becomes flattened, the wings are acquired, and the insect ceases to grow and is ready to procreate. The time required from hatching till the wings are obtained averages from six weeks to two months.

155. “In order to illustrate the interesting process of moulting we will trace an individual through the last moult—from the pupa to the winged insect—as it is the most difficult, and, on account of the larger size of the animal, most easily watched. The other moults are very similar.

156. "Let us now imagine we are watching one from the moment of this splitting, and when it presents the appearance of Fig. 12, *a*. As soon as the skin is split the soft and white fore-body and head swell, and gradually extrude more and more by a series of muscular contortions; the new head slowly emerges from the old skin, which, with its empty eyes, is worked back beneath; the new feelers and legs are being drawn from their casings, and the future wings from their sheaths. At the end of six or seven minutes our locust—no longer pupa and not yet imago—looks as Fig. 12, *b*, the four front pupa legs being generally detached, and the insect hanging by the hooks of the hind legs, which were anchored while yet it had that command over them which it has now lost. The receding skin is transparent and loosened, especially from the extremities. In six or seven minutes more of arduous labour—of swelling and contracting—with an occasional brief respite, the antennæ and the four front legs are freed, and the full and crimped wings extricated. The soft front legs rapidly stiffen, and, holding to its support as well as may be with these, the nascent locust employs whatever muscular force it is capable of to draw out the end of the abdomen and its long hind legs (Fig. 12, *c*). This in a few more minutes it finally does, and with gait as unsteady as that of a new dropped colt, it turns round and clambers up the side of the shrunken, cast-off skin, and there rests while the wings expand and every part of the body hardens and gains strength—the crooked limbs straightening and the wings unfolding and expanding like the petals of some pale flower. The front wings are at first rolled longitudinally to a point, and as they expand and unroll, the hind wings, which are tucked and gathered along the veins at first, curl over them. In ten or fifteen minutes from the time of extraction these wings are fully expanded, and hang down like dampened rags (Fig. 12, *d*). From this point on, the broad hind wings begin to fold up like fans beneath the narrower front ones, and in another ten minutes they have assumed the normal attitude of rest. Meanwhile the pale colours which always belong to the insect while moulting have been gradually giving way to the natural tints, and at this stage our new-fledged locust presents an aspect fresh and bright (Fig. 12, *e*). If now we examine the cast-off skin, we shall find every part entire, with the exception of the rupture which originally took place on the back; and it would puzzle one who had not witnessed the operation to divine how the now stiff hind shanks of the matured insect have been extricated from the bent skeleton left behind. They are in fact drawn over the bent knee-joint, so that during the process they have been bent double throughout their length. They were as supple at the time as an oil-soaked string, and for some time after extrication they show the effects of this severe bending by their curved appearance.

157. "The moulting, from the bursting of the pupa skin to the full adjustment of the wings and straightening of the legs of the perfect insect, occupies less than three-quarters of an hour, and sometimes but half an hour. It takes place most frequently during the warmer hours of the morning, and within an hour after the wings are once in position the parts have become sufficiently dry and stiffened to enable the insect to move about with ease, and in another hour, with appetite sharpened by long fast, it joins its voracious comrades and tries its new jaws. The moulting period, especially the last, is a very critical one, and during the helplessness that belongs to it the unfortunate locust falls a prey to many enemies which otherwise would not molest it, and not unfrequently to the voracity of the more active individuals of its own species.

158. "As already stated, there are four moults, exclusive of that which takes place upon leaving the egg. In the first stage—that following the egg—the wing-pads are not visible; in the second (after the first moult) they project but little beyond the meso (the meta) thorax, differ but little in size, and are directed downwards, lying separately close to the body; in the third stage (after the second moult) they are directed upward, the hind covering and hiding more or less the front pair, and the joints bearing them retreating more beneath the prothorax; in the fourth stage (after third moult) they are enlarged as seen in the pupa, and with the fourth moult the fifth or perfect stage is attained."¹

¹ As the stages or moults which the insects pass through from the time they are hatched until they get wings are somewhat more minutely and differently divided by Professor Bruner to those commonly and anteriorly made, I reproduce them, so that the reader may reap the full advantage:—

"*First Stage*.—There is no trace of wing-pads. The antennæ or feelers are thirteen-jointed, and have the eighth joint noticeably longer than any of the others. When first hatched quite light in colour and without any definite marking, but soon changing to a dull greyish-brown. Sides of prothorax and middle thorax, ill-defined bands on hind legs and stripes along the back much darker, almost black in some specimens. Length from 7 to 9 mm.

"*Second Stage*.—There is still no indication of wing-pads present. The antennæ are now seventeen-jointed, and the third joint is slightly longer than any of the others. The general ground colour is somewhat lighter than it was in the first stage, being yellowish-grey, and the markings much better defined and clearer. The dark line along the back is well defined, and bordered on either side by a lighter one. Length from 10 to 12 mm.

"*Third Stage*.—The wing-pads are now distinct, though very small, and project obliquely downward and backward. The antennæ have from twenty to twenty-two joints. The body or ground colour has become decidedly more yellow, while the face, sides of prothorax, and hind thigh bands are jet black. The other markings are reddish-brown. Length from 18 to 20 mm.

"*Fourth Stage*.—The wing-pads are now of considerable size, and project obliquely upward and backward, so that the tips of the hind pair almost reach the back edge

THE PHILOSOPHY OF ECONOMIC ENTOMOLOGY.

BY S. D. BAIRSTOW, F.L.S.

159. A bitter cry.—"This country (South Africa) has during the past few years had a bitter awakening to the fact that small insects, locusts, *Dorthesia*, cattle insects, and the like, when allowed free and unretarded location, multiply until they swarm, and it becomes disheartening to tackle them in the bitter end. This is entirely our own fault, and a fault that all we students of Dame Nature have been nagging at and battering against for the last decade. 'Can you give me the name of enclosed grub? It is playing havoc amongst my carrots.' 'Please tell me what is good for the cabbage pest.' 'There is a small moth up in these parts which is more destructive than the locust.' Such are the notes and queries we receive day by day, a sure sign that the spirit of inquiry is abroad. I fear, however, this may be taken as the sole cause for hand-shaking and mutual congratulations, for, after the first spasm of intelligent inquiry, observation tires, and the

of the following ring of the abdomen. The antennæ have twenty-four to twenty-five joints, and the colours are even more marked and brighter than in the preceding stage. The reddish-brown markings of the abdomen have changed to blackish-brown, while the eyes and top and back of head are tile-coloured. Length from 26 to 30 mm.

"*Fifth Stage.*—The wing pads are now quite large and projecting backward; their tips reach the back edge of the second ring of the abdomen. Antennæ, twenty-six-jointed. Colours same as before. Length from 35 to 40 mm.

"A very few of the saltonas, about 1 in 10,000, instead of being the usual shade, have the general ground colour greenish, and the dark markings very faint, though apparent. These greenish larvæ are very conspicuous when among others. They differ, though, very conspicuously from the greenish saltonas of *Cancellata*, which can at once be recognised by their lack of all dark mottlings, save a number of minute black and white raised dots.

"*Sixth Stage, or Voladora.*—This insect was described by Burmeister as follows: 'It is the most nearly allied to *A. rusticum* *fabr.* of North America, but it is well distinguished from it by the much thicker head, plainly betraying its greater powers of mastication, and some variations in the markings.' While this description of Burmeister is rather inadequate, it suffices, since the type still exists in the Museo Nacional in Buenos Ayres, and has been examined and compared by the writer with specimens from various parts of the infected region. A more complete description is herewith appended, in order to aid future students to recognise the insect after the types may have been destroyed. Length to tip of wings of average specimens, male, 62 mm., female, 70 mm.; of prothorax, male, 10 mm., female, 10.5 mm.; of hind thighs, male, 23 mm., female, 27 mm.

"*Newly-winged Specimens.*—General ground colour of body above and of legs, reddish-tile, streaked and dotted with darker and lighter markings, as shown in the different illustrations presented herewith. Front wings, or tegmina, greyish-white, mottled with dark brown. Hind wings transparent, with the veins and cross-veins near base and hind border white; those towards and along front margin and apex dusky. Hind tibia reddish, the spines white, tipped with black.

"*Winter Specimens.*—As cold weather approaches in fall, the bright contrasts of

pest goes quietly on its life's errand unmolested and encouraged. Take your pest in time! Watch its habits! Learn wherein its weak points of character repose, and through the weakness reduce the strength. Take the pest in time, and the chances of swarms are materially lessened. Surely this is simple logic and worthy of attention. It is not prompted by a spirit of antagonism to old-fashioned ideas, or of dictatorial intrusion. Not in the least! But I must insist that, by co-operation and hand-in-hand stubborn opposition, we can lessen the evils of multiplication, and in time master our severest insect enemy. It is unfortunate that our own lethargy punishes our neighbours. If we do not stop the carriage of *Ceratitis*-infected peaches and apricots, our Western neighbours may look for an early visitation, and there is no more difficult, destructive, or omnivorous rascal than the peach maggot.

160. "My Graaff Reinet friends will remember a year or two ago that I interviewed their Town Council, and the members thereof seemed to agree that there was only one method of ridding themselves of the terrible codlin moth, which is sticking to the Gem like a leech.

colour in our locusts disappear, and the insect takes on or assumes a dullish-red tinge throughout. The crown bands on top and sides of prothorax and face become almost obliterated, and the white bands in the middle of sides and on lower edge of pronotum entirely disappear. The hind wings change to a beautiful rose colour, which is quite decided on the basal half, and which gives the insect quite a different appearance when flying, from that which it presented under like circumstances when it first became a *Voladora*, and for at least two months thereafter. The colder and longer the winter, the deeper appears to become the reddish tinge in the hibernating insects. Some few show a dull smoky-brown, while others become almost dirty-black in their general colour. In all, however, the wings are more or less vividly rose-coloured.

"*Spring Specimens.*—In spring, when the insects forsake their winter quarters, and begin to feed on the fresh vegetation, and the time for mating approaches, the reddish hue of winter gradually gives way to a lighter shade. The rose colour on the wings slowly disappears, and in time is lost altogether. By the time egg-laying begins, the insects have assumed a yellowish-olive hue where in winter they were red, and the wings, instead of being rosy, are yellowish-hyaline. When the wings are transparent the basal veins and cross-veins are white, as they change to rose colour the veins also assume that hue, and when they lose the rose colour and become hyaline the veins change to yellowish. Thus we find that the same insect exhibits three distinct colour-variations during its life as a *Voladora*. Similar variations have been seen in the Old World *Peregrina*, as seen in different regions visited by it. But we do not recall any record of an attempt at an explanation for these variations in that insect. . . . In fact, most of the brown or yellowish-brown locusts become more or less tinged with red late in the fall, after they have been several times exposed to frosts.

"By observing the general colour of the locusts making up an invading manga, it is possible, therefore, to tell whether they are young, middle-aged, or old. None of the quite red specimens that were dissected by us here at headquarters contained fully developed eggs, but some of the lighter-coloured ones showed them in an advanced stage of development."

It was 'to lose the latest crop of the season's fruit *en bloc*.' Lose the lot! Where was the loss? All the apples and pears were already lost, and other kinds of fruit were visibly threatened. But Town Councils cannot do all they would wish, and somehow or another this simple remedial plan was allowed to drift. Now, where are we? Three most intelligent orchardists and scientific friends absolutely assure me that *Carpocapsa pomonella* (codlin moth) is increasing, and there is only my suggested plan left them to adopt, but will this be adopted? Anything short of it will hurt the Graaff Reinet fruit industry almost irretrievably, and *Carpocapsa* will finally disport itself amongst less ruined and more fertile pastures—somewhere else. It may be possible, I do not say it is impossible, for Nature to step in and balance matters, by furnishing a parasitic *Microgaster* or *Ichneumon* fly to fight against the codlin moth, but we ourselves could assist in no wise. This is my opinion, for I should not like to accept a contract to force the propagation of minute species of parasites, as was done in the case of *Rodolia* and *Vedalia*, which so nobly fought under the ægis of Government against *Dortheisia* (*Icerya purchasi*), the Australian bug. We say, 'It is never too late to mend.' Quite so, but 'A stitch in time saves nine.' When in Yorkshire worsted coatings and worsted fancy trouserings came into vogue, the old-fashioned manufacturers of Sattarras, Venetians, faced cloths, and shoddy scribbled silk-striped and checked narrows, opposed the novelty as a rude innovation, and stuck obstinately to ancient played-out looms and unsaleable patterns; it meant for them either change with the times or die. Those who postponed the obnoxious day—died. Those who followed the flag lived and prospered. Remedial measures against insect pests rest with ourselves. Omitted or delayed makes the ultimate burden far heavier to bear. We know what we can do. We know not that which we may have to accomplish.

161. "If we follow the pages of this Journal and the reports of industrious farmers, we may discern a simple fact. Wherever proper regulations were enforced to keep down locust attacks, they proved satisfactory, and entirely or partly effectual. Dr. W. G. Atherstone, of Grahamstown, lent me, the other day, a Journal of the Colonial Institute. My countrymen cannot do better than obtain a copy, and read what our friends in the island of Cyprus have been doing to check locust attack, and how their efforts have been crowned with success. Mr. Peringuey has sounded a warning, and told us of a new migratory locust, which, I presume, is the same as that generally termed in the high Midland districts 'The King Locust,' and occurring at times simultaneously with the common species, *Pachytylus migratorius*. Many specimens have been sent to me from different parts; and, Dr. Schönland says, one was taken alive in Grahamstown. Thus we are apprised of another possible foe in good time.

162. "Dr. Gill said—'That the cause of the periodicity of locusts would probably be found in the natural history of the parasites. When locusts are plentiful the parasites had a good time, but when they had eaten up all the locusts they died for want of food, and the locusts' opportunity came again, and thus the reproduction went on in cycles.' It is desirable that members of farmers' associations keep a sharp look-out for the parasites, and find whether they are identical with those on *P. migratorius*. I have found fly-worms attacking *Cyratacanthacris ruficornis* fab., and a common blue and yellow species which affects garden plants and is particularly fond of *Tecoma capensis*. The latter locust is easily subdued with a little care and attention. Whilst on the philosophy of economic entomology, I should just wish to refer to a strange point mentioned by me in a lecture delivered to the Cradock Farmers' Association. In the pupal stage many males and females may be observed *in coitu*. Is it within the bounds of possibility that such connection could result in fertility? If so, having two or three broods per season, and a preliminary progeny assured before maturity is reached, what a prolific pest it would be; but we can scarcely accept this hypothesis. There, however, is the fact. Again, has anyone noticed the comparative absence of butterflies during the last few years? Have the locusts eaten up vast tracks of butterflies' larval food, and starved down the broods? In this very district, which used to be a sure ground for collecting butterflies, I miss many old faces, and common visitants or residents are common no more. The beautiful *Papilios* are extremely scarce, and *P. demoleus*, our Christmas butterfly, is comparatively rare. Is this feature noticeable in the West?

163. "Observations on many injurious insects seem to have been discontinued. We may hope that the insects themselves, by reason of total or temporary retirement, have prevented discussion. The Kaffrarian wheat beetle, *Heteronychus arator*, so disastrous a few years ago, where is it? The mealie pest or chafer, *Eriesthis stigmatica*, what of him?

164. "The Bean *Bruchi*—have they disappeared? Cabbage *Plutellæ*—did they bid us a long and lasting farewell? *Ceratitis* in Grahamstown, and *Dorthesia* in every part—what notes have we respecting them? Farmers' associations will do well to keep at it, and furnish unbroken records. They cannot do better than appoint a curator in each society to formulate lists of periods, notices of observations, etc. For a few shillings Dr. Marloth would provide a neat glazed insect case in which specimens of injurious insects are easily fixed, serving useful purposes, and practical, technical illustrations of 'things we talk about, but know not by their classical names.' I should rejoice to learn that the Farmers' Congress is moving in this matter, for no obstacle bars the way; and, excellence of setting a

preservation is after all a secondary affair. A reference object stands paramount. Entomologists are often good insect men, sound observers, necessary appendages, but not always botanists, orchardists, or farmers ; they want running-fire information and unbroken records. They can assist, but seldom cure. They lack opportunity, place, and ownership. Toxine is not distilled in five minutes, anti-toxine will take longer to discover, and the minutest addition to scientific knowledge sometimes requires a lifetime to put together. Let us all unite in the combat against evil, and the task is eased ; our object more speedily attained."

A NEW LOCUST

165. Identity of this and Mr. Peringuey's specimen.—A correspondent has sent us from Kimberley a specimen of locust which he considered a new variety, and which we find is identical with a kind on which Mr. L. Peringuey read a paper at a late meeting of the Philosophical Society, and of which the following report was given in the *Cape Times* :—

Mr. Peringuey's new variety.—"Mr.

L. Peringuey exhibited specimens of a migratory locust which has lately made its appear-

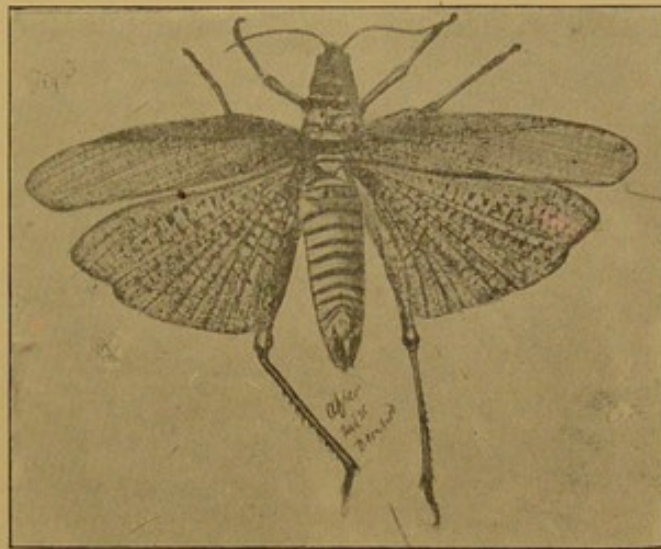


FIG. 13.—An insect called "The New Locust." It is perfectly green, and the interior parts of the hind wings are of a deep purple-red colour, which can be seen only to advantage when the animal flies.—After BAIRSTOW.

ance (Figs. 13 and 14). He feared that this species, a close ally to *Acridium peregrinum*, the migratory locust, would prove still more injurious than *Pachytylus migratorius*, the species the country has suffered and is still suffering from. The examples exhibited were forwarded from Barkley West by Mr. Geo. Paton, who wrote as follows :—"I send you by this post a box containing some locusts of a sort new to this country that have appeared here lately. Some of my servants from the interior recognise them, and say they are not good to eat. They have not appeared in large flights, but in troops of a few thousand. Our ordinary locust has passed over here in swarms on their way to the North, followed by the small locust bird. They have done us no

damage. Their habits, so far, are regular—disappearing, returning, or their progeny, by March, laying their eggs to be hatched out by October, and going through the course again of disappearing in the end of December and the beginning of January. At one time I was under the impression that this country and to the westwards was their breeding ground. I now find that it is the Free State and Eastern Province. I have had no young ones for some years. The last that brooded out within reach of my homestead were bagged and put on the dung-heap to the extent of nearly ten tons, at a cost of £1 a ton.' Mr. Peringuey stated that he had received almost simultaneously the same kind of locust from Burghersdorp, through one of the members of the Society, Dr. Kannemeyer. This showed that the troops were more numerous than Mr. Paton thought, since they appeared almost simultaneously at places so far apart as the Hartz River and Burghersdorp.

166. "As already stated, the present species was very closely allied to *Acridium peregrinum*, and in the same way that that species had swarmed into Algeria after the myriads of a smaller locust, *Jauronotus maroccanus*, had been destroyed at great expense, this present species was following in the rear of our smaller locust, *Pachytylus migratorius*. He wished to call special attention of the meeting to the paragraph of Mr. Paton's letter in which he said that he had destroyed ten tons of voetgangers at a cost of £1 a ton. Everything had been done to show people how to 'bag hundreds of tons of locusts,' but the people had done nothing. The new locust was twice the size of the others, and if its eating capacity was equal to its size, he pitied the colony.

"Dr. GILL.—Is its breeding capacity equal?

"Mr. PERINGUEY replied in the affirmative. He hoped that, as these locusts were now in the colony, something would be done. The reason for their reproduction, he believed, would be found in the want of parasites.

167. "Our Kimberley correspondent says the natives are quite aware of the difference between this new animal and the old variety. They say they are unwholesome, and that men who ate some of them became very ill, and some of them died. EDITOR."

168. **Mr. Solly on the new variety.**—"As I notice that the New locust has been reported in many districts of the colony, the following observations may be of interest. A new sort of locust arrived here in small numbers about the end of last year, and at first I took very little notice, as, the numbers being few, I thought it was a local grasshopper, and not of special interest.

169. "On Saturday, the 4th inst., the De Aar railway camp was invaded by a large swarm of these insects, and the place was fairly full of them till yesterday; but I have observed them moving north and east under the influence of strong south-west winds, flying high up.

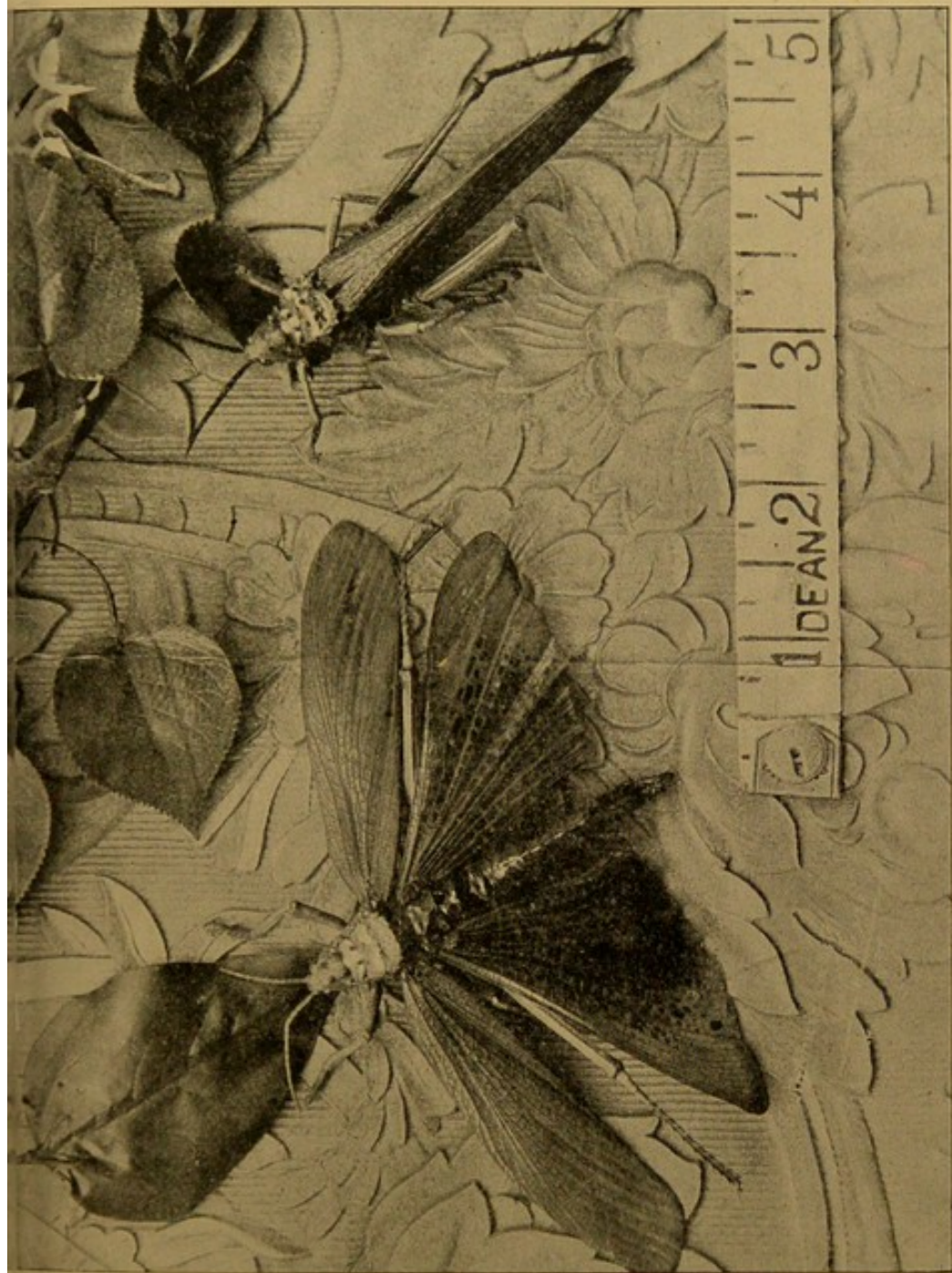


FIG. 14.—A species of locust (natural size, gauged by tape measure on drawing), uniformly green when wings are closed (as seen by the insect represented to the right), but when flying have a rich dark (or violet) red colour at the base of the inner or posterior pair of wings. —By kind permission of Mr. NICHOLS, photographer, Johannesburg.



"On Saturday and Sunday, 4th and 5th, the veldt all round De Aar was thick with these locusts, which were feeding on the young grass resulting from the late rains, and I observed that eggs were being laid by the females on the flats to a very large extent.

170. "To-day very few locusts are left, and these are chiefly confined to the large gardens in the camp and to the plantation.

"I have noted the following points:—(1) The New locust is considerably larger than the ordinary one. (2) Body and wing-covers yellow and mottled. (3) Wings when spread, reddish-purple at base, giving a purple effect when flying. (4) Hind legs covered with strong spines between thighs and feet, which are used most effectively for defence. (5) This locust attacks grass, all garden stuff except tomatoes, but especially beans (French and Broad), also all fruit trees, the leaves of which he partly eats and partly strips on to the ground, so that a garden looks as if it had been visited by a severe hailstorm. (6) When disturbed on the ground, the locusts swarm into the trees, and remain there out of reach, hanging on though the trees be violently shaken, and when hunted in the trees, clamber and jump about to avoid capture, and are very wide awake. (7) At night they sleep in festoons on trees of almost every sort, and leave to feed when the sun warms them. (8) I have noticed a few dead locusts about to-day and yesterday, some with a puncture in the thorax, looking as if some worm had eaten its way out near the base of the hind legs. (9) In the veldt, where they were thick, I noticed swarms of small flies, about the size of wine-flies, which I have not seen in the veldt here before.

"H. S. J. SOLLY.

"RAILWAY CAMP, DE AAR, *January 9th.*"

171. **A Grahamstown farmer on the new variety.**—"The New red locust, which during the last month has spread from the Orange River to the sea, coming apparently from the north as well as from Natal, is doing terrible damage. Everywhere fruit trees are being destroyed—quince, apricot, fig, orange, lemon, and naartje trees. The leaves are not only eaten, but young branches are all barked, so that they are probably killed. It is therefore useless to talk about growing fruit in these districts. Crops which the ordinary locust does not damage are destroyed by the new species. A splendid crop of mealies, covering the whole of Peddie, Lower Albany, Alexandria, and other districts, has been entirely destroyed. Pumpkin plants are being eaten too. Vegetables of all kinds—lucerne, cattle-cabbage, and kale—are also swept away.

172. "The locusts are laying everywhere, and no doubt the plague will continue for some years. What is the agricultural farmer to do? He has no opportunity of growing any kind of crop. The ordinary locust may be expected to come between April and June; the new one

in January. It is impossible to grow crops for silage or for cattle-feeding.

A DISGUSTED FARMER.

"GRAHAMSTOWN, C. C., *January 16th.*"

Mr. W. Roe has published the following remarks on the New locust:—

173. The New locust.—"There is one feature in the habits of the strong-jawed, destructive insects that may be used against them, namely, that they eat the leaves and shoots of trees more than do our usual locust. Now, leaf-eaters amongst insects can be well dealt with by poisoning their food. This can be done without detriment to the trees, by spraying all within reach with insecticides, as Climax Insect Powder, Paris green, or arseniate of lead; and if these were not handy, I think Cooper's Dip Powder would make a fair substitute. Any of these well sprayed over the trees would poison the leaf-eaters. For delicate fruit trees, use 1 lb. of the above to 150 gals. of water, and a stronger mixture should be used for hardy trees; it ought to be well mixed up and sprayed, the cost can be but little, and much poisoning of the locusts will result.

174. "A good spray pump, either knapsack or other form, should be part of every farmer's tools; it would help him with his stock, cattle, horses, or ostriches, for ticks and lice—help him against his prickly-pear foe, and help him, as above, against insects.

175. "To those who have a supply of the Scrub Exterminator and bluestone (sulphate of copper), the following simple plan will furnish a good and cheap poison for spraying trees, to kill insects that eat their leaves:—Weigh out $\frac{3}{4}$ lb. of the Scrub Exterminator (a crude arseniate of soda) and $1\frac{1}{4}$ lb. of bluestone, dissolve each separately in hot water, and when well dissolved, mix and stir well; the whole will make up to 100 or 150 gals. of water to spray with for the above purpose. The mixture becomes green, and will settle out, if allowed to stand—so, in using, the whole must be kept well stirred up as it is sprayed."

176. Poison.—We hear that considerable success has attended attempts made in Natal to poison this kind of locust. Being leaf-eaters, and were it not for the enormous numbers, there would be hope that the country might get rid of them altogether. Still, a good deal may be done towards it.

177. Contagious disease.—In the neighbourhood of Fort Jackson, in the East London division, whole swarms of young locusts are dying of some apparently contagious disease. They collect together on the stalks of grasses or other like plants and die. If the disease can be propagated by its introduction among living swarms, then its general extension will be suggestive of the method adopted in America for the destruction of chinch bugs.

178. Mr. S. D. Bairstow's Experience and Notes.—"Mr. Solly's remarks in the *Agricultural Journal* (23rd January) are most interesting, and call for similar attention—a record should be kept of all districts affected. I have had a very bitter experience of the pests, and it is a case of biter bitten. They have lived with me now on the cheap, off and on, for one solid month. When they first arrived, advance inspectors took stock of surroundings. Finding these suitable for board and accommodation, continuous streams poured in from the south-east, backed up by detachments from the north, and then they seemed to come from all parts. They fell upon the young grass, and touched nothing else for some time. Then they tackled young mealies, then maturing ones, and skeletonised them. Thinking to humbug the swarm, I cleared the crop for cattle food. Unabashed, they cleared my lucerne undergrowth, but never touched the fodder, and have not done so now. After which, with eminent system and precision, they proceeded to denude my garden of almost every vegetable and fruit it contained in the following order, viz.:—(1) Young radishes, French beans, peas, onions, carrots and turnips, not touching potatoes, matured celery, or tomatoes. Why not the last-named I cannot imagine, as the leaf is not particularly bitter. (2) They now wanted an appetiser or tonic, so they stripped a dozen poplar trees—old, not young—of every fraction of foliage. (3) Apricot trees—oh, how they loved these!—they skinned every tree. (4) Orange trees and lemons. These are temporarily ruined. An occasional orange protrudes all by itself, in grim and silent sarcasm. After finishing leaves, they eat the young stalks of the fruit, and the ground is belittered in orangelings.

179. "This large and fine-looking insect does not appear to have been thoroughly worked up, so I offer the following notes on its life history:—

"Its eggs are of a dull, muddy colour, half as large again as those of *P. migratorius*, and torpedo-shaped, deposited in soft soil or leaf débris. I do not think they are laid in such clusters as those of the latter. There are two broods during the year. My first rearings were full-fledged last November. Breeding once more, they are adult now (April), and the eggs probably survive the winter.

180. "Amongst many varieties of plant food, the larvæ are particularly fond of orange trees, the foliage of which they quite denude, and though their size is considerable, and they resemble in colour the leaves which they eat, birds might easily overlook them. They devour, moreover, the flowers of oleander. They stand climatic changes well, are free from epidemic disease, and seem impervious to parasitic attacks.

181. "Miss Ormerod says that this locust is 'very variable as regards

colour'; but I find the Zuurberg specimens decidedly persistent in that respect.

182. "I found the individual weight after three weeks' fasting to be $\frac{1}{2}$ oz., and this is an interesting item, proving endurance beyond expectation. If the migratory locusts have a similar power, flights of them could cover vast areas very easily.

183. "The thorax and wings are green, with yellowish markings in latter, and hind wings purplish-brown with yellowish-brown markings at base. Abdomen, grey-green. Legs similar to abdomen, tinged with purple, having series of black and purple spots; spines, deep purple almost black. Head same colour as abdomen, dotted with black spots. Eyes almost black, prominent. Antennæ, greenish-black. The thorax is a formidable affair, having two large up-standing tubercles, with two lesser ones in front, and others behind varying in size. This locust is extremely sluggish, travels seldom, and not far, jumps clumsily a short distance forwards and not across. Such beautiful wings are used, perhaps, for locomotion, but seldom for flight, so we need not fear migratory swarms. Its entire body has a most unpleasant sticky surface. Mr. Janson mentions as a footnote to Miss Ormerod's description that 'the highly-coloured individuals in which the vermilion predominates are exceedingly gorgeous insects.' The Port Elizabeth specimens seemed almost gregarious on peculiar bushes near the Cape Road native location, and, when swarming, a measly odour indicated their quarters. They squirted out some offensive fluid in defence, and exuded matter from beneath the helmet. The males, as with most of our locusts, are much smaller and apparently rarer or less long-lived than the females. I have so far noticed that very few of our towns are entirely free from these insects. Mr. Janson says 'they occur as far as the river Congo, in West Africa, and are said to be also found in Madagascar.'

184. "The voetganger, or wingless young, is more of a bluish-green. Thorax, brilliant green; face, green; sides of head, jaws, eyes, and antennæ, black. Two straight green lines, inside of eyes, lead from thorax, and point off between bases of antennæ, forming a nose-like prominence to face. Upper abdominal segments, very green and bordered with heliotrope; lower segments, bluish-green, divided by black-purplish bands. Front legs black, and hinder ones green. Wing cases streaked with pale-green.

S. D. BAIRSTOW.

"ZUURBERG, 7th April 1896."

185. I have received many private letters regarding the locust, and questions allied to the insect. I do not wish to trouble the reader with the many interesting details contained in these, but an extract or two from those of Miss M'Neale, of Durban, who has taken, in the most

cordial way, no end of trouble at my request to procure information in this cause may be given. In one letter she says :—

I was calling on some very charming people yesterday, who have been in the colony a long time, and they told me of the curious attitude the Boers take up towards the locusts. They look upon them as a Divine visitation, and that it is wrong to try and relieve themselves of their presence, but must wait until they are taken away as they came. . . . There is a locust officer here, whose business I believe it is to assist the farmers to get rid of the creatures (locusts) when they happen to make a call on them. I heard of one man who wrote imploring aid, and who received a polite reply (from the locust official) saying "how sorry he was" to hear that the locusts were paying him a visit, and hoping that he would be able to *persuade* them to go quickly, but that he was quite unable to render assistance. This information comes from the man himself, and was not in the newspapers. They say that there is some stuff that will destroy them, but because it is so very expensive the Government will not use it; probably you know this.

186. There is another creature here which I think must be first cousin to the locust. This insect has quite a different shaped head, which he can move backwards and forwards and from side to side like a human being. It is of a beautiful green colour, and flies about at night in the most tormenting manner; directly the lamp is lighted it settles down on some convenient spot and looks at you in the most distressingly impertinent manner. They call it the "Hottentot god." I do not know why. [And later, as if by way of correcting, she said]: I find the proper name for the little green god is the "Praying Mantis." Did you know they were cannibals? I shut one (that was brought to me) up with a locust, and forgot about it till next day. When I looked in, the mantis was twirling his moustache in a very jubilant fashion; no, I mean he was stroking himself complacently with his antennæ. I looked to see what the cousin was doing, and there was nothing left of him but the wings and two legs. The wicked little god had eaten him up!

Once again the same lady writes :—

187. I was talking to a lady the other day who lives with her brother on a big farm on the slopes of the "Berg." "They seem to think it waste of time to destroy them (the locusts), because they pour in in such overwhelming quantities. What they try to do is to save the crops that are worth saving, and let them have the rest. They (the locusts) seem to dislike noise, and will rise up like sparrows from a corn rick if you only clap your hands."

I have no intention to enter upon the many interesting questions concerning the several species of locusts, or to give any minute scientific description of their anatomical parts, etc. This would be foreign to my purpose, which is mainly practical, namely, the suppression of the plague.



BOOK II

CORRESPONDENCE OR REFLECTIONS FROM THE NEWSPAPER PRESS RESPECTING THE LOCUST PLAGUE:—

1. VISITATION IN THE ARGENTINE, 1891, AND IMMEDIATELY
AFTER.
2. VISITATION IN THE ARGENTINE (*continued*) AND SOUTH
AFRICA, 1896-98.

“There is no better company in the world than good literature. Whenever one chooses he may enter the society of the purest-blooded nobility this world has yet produced.”

“Among literature of information and facts you have the newspapers. Newspapers are a portion of literature, and a very important part of printed matter.”

BOOK II

CORRESPONDENCE OR REFLECTIONS

188. A new departure.—In introducing the subject matter of Book II., as I now do, I am aware of making a “departure” from the usual use and wont; but at the same time I feel justified in so doing for the following reasons:—

1. The press has done signal service to the cause.
2. The press can still do greater service than it has done.
3. In this course the public will see the nature of the current views entertained generally respecting the locust plague and the work actually attempted and done to combat the pest, inasmuch as the press is a sort of mirror in a country which more or less reflects the opinions of the people on particular subjects.
4. The press acts as a *carrier* of news, discovery, important events, to countless numbers, and therefore is a stimulator of thought. In this way it instructs and elevates and makes for progress.
5. Recording in a permanent form important facts and data that otherwise might probably be lost or not utilisable.
6. If there are points which the reader may not have grasped from want of sufficient perspicuity on the part of the writer, or other cause, by perusing the correspondence and data generally in this part of the work it is probable he will thus come to have a fairly good and tolerably accurate up-to-date knowledge of the insect and its history, as presented by other and different minds, before proceeding to consider the natural and artificial means to check its progress as a plague.

189. Pitman's advice reiterated.—The advice given to learners of the great Pitman's method of acquiring shorthand is *apropos*, namely, not to run or skip over *by reading* the Teacher or Manual, but to master *by practice* the different items or characteristic signs, etc., by assiduous practice in the several stages as you go along; master one set of

exercises before going on to the next, is put forward as the secret of success. So here the habits, the characteristics, and the various means that have been used should be first mastered, and then one may be expected to be in a favourable position to attempt to decide on the best means whereby to give battle to the enemy. Otherwise, failure may be expected to ensue.

190. The power of the press.—I trust the foregoing reasons will be considered sufficient in justifying me to venture on such a pronounced "departure," and that it may be profitable in placing some of the correspondence about this common pest before the whole body of the people as clearly and fully as I possibly can. The newspaper press, an important part of literature in Buenos Ayres, has so opened its pages that now whole columns are taken up almost daily with intelligence bearing on the plague. The Government authorities (such as the Postmaster-General) have placed themselves also in line. The railway companies have followed suit. Telegrams giving information are received from all parts of the country, and tabulated next day in the newspapers, as well as free railway tickets and travelling facilities given to the officials in the locust campaign on all lines. Of course errors will creep in, but in this or some such way are we most likely to derive accurate or worthy information, and arouse the requisite enthusiasm respecting the insect, so as to profit in combating the plague.

191. An eye-opener.—I commence with an "eye-opener" in the shape of a telegram from the President of the Argentine Republic, giving a glimpse of the richness of that country and the gravity of the plague that threatened its chief industry. I then give in letter form a description of the insect, its habits, and a new process for checking the locusts in their worst form—when on the "march." Then follow various opinions arising out of the same. Respecting South Africa, I found various letters and suggestions had been published, or rather I have inserted a selection from them, together with a short résumé upon the artificial means advocated for combating the plague, from the *Agricultural Journal* of April 1896.

KALÆDOSCOPIIC FORECAST OF ARGENTINA

TELEGRAM FROM THE PRESIDENT OF THE ARGENTINE REPUBLIC
TO DR. NOUGUES, ACTING PRESIDENT.

SANTA FÉ, Oct. 9, 1891.

192. A prosperous country.—I have visited the principal colonies of this province, which present a most encouraging picture in these difficult moments. Not many years ago, when navigating, I may say, through a sea of wheat from Chicago to St. Louis [see Fig. 15], I wondered how many years would pass before such a sight would be

seen in our country. Yet to-day the spectacle is reproduced here from Rosario to Santa Fé through Galvez, and from Santa Fé to Rafaela. Railways cross here in all directions; Rafaela, for instance, which, a few years ago, was an Indian hunting-ground, is now connected by six railways with almost all parts of the Republic, and the harvests produced cereals to the amount of \$30,000,000 per annum.

193. Industrial development.—The pioneer colonies, such as Esperanza, are undergoing a new evolution, and are becoming industrial centres. Thirty chimneys betoken as many factories, flour mills, distilleries, breweries, and a manufactory of agricultural implements founded by an Argentine, the son of a colonist, who this year has sold more than 3000 ploughs, reapers, and drilling machines. In



FIG. 15.—Harvest—Anglo-Saxon method, with "Binder" Reapers, "stooks" or shocks—unaffected by locusts. "Peace and Plenty."

another two years, with good seasons, the colonists of Santa Fé will have ploughed up the whole province, and invaded the neighbouring provinces and the national territories, and they have already passed the frontiers of Córdoba.

194. The locust plague.—Here can be seen what a terrible public calamity is threatened by the enormous locust plague of this year. Spreading over hundreds of leagues of land, the flying locusts destroyed much wheat; but, fortunately, it has sprouted again, owing to opportune rains, and is now in excellent condition. But though the wheat has not been permanently damaged, the locusts have left their eggs in the earth in incalculable quantities.

195. Eradicatory measures.—The magnitude of the danger is agitating the whole province, and in all the colonies committees have

been formed, which are energetically supported by the inhabitants, and skilfully directed by the Central Committee and by its indefatigable president, Sr. Loza. Men, women, and children are engaged in the work, and hundreds of millions of locusts' eggs have been destroyed. I have given orders to the railway companies to send gangs of men to clear the embankments of the eggs which are deposited there in enormous quantities.

196. Nature's aid.—In every field ditches are dug to bury the jumping locusts, which, in spite of all that can be done, will appear at the end of the month in vast quantities. Nature has come to the rescue in the shape of a small fly, which deposits its larvæ wherever the eggs of the locusts are laid, and the larvæ feed upon the eggs, of which great quantities are destroyed.

197. Colonists remain calm.—The colonists are not much alarmed. They believe that when the jumping locusts appear, the wheat and flax will be too hard for them, and that they will feed upon the soft grass until the harvest begins, say at the end of November. Let us hope that it may be so, but the jumping locust converted into a flying one will pursue its course southwards, spreading all over the province of Buenos Ayres, if measures be not taken to attack it from the first moment. Here everything possible has been done, and the resources of the nation have been made available opportunely.

198. Money market steady.—I see that there is much excitement in Buenos Ayres about gold, and that the Bolsa is looking to Congress to do some wonderful thing or other. From this distance we see things in a clearer light; the bills may be good or bad, but they are not worth all the fury which they excite, nor will they ever produce the exaggerated effects which either their supporters or opponents predict. Here in the country there is no crisis; on the contrary, there is abundance. The harvest, sold at the prices which the farmers expect to get, will enable them to double their sowings next year, to increase the number of their mills, to build up new towns, and yet leave a surplus sufficient for establishing banks like that of Esperanza, for which 2,000,000 dollars capital has just been subscribed. Who is in the right? It is absurd to think of solving such complex problems with Bolsa axioms or rhetorical phrases. Meantime, the people work hard—that is the grand measure. I leave to-day for Entre Rios, to visit its colonies, and I shall afterwards return to Buenos Ayres. CARLOS PELLEGRINI.

LOOK ON THIS PICTURE AND THEN ON THAT

FROM THE "HERALD" OF BUENOS AYRES

199. The bright side.—President Pellegrini has been visiting the wheat-fields of Santa Fé, and telegraphs to the Acting President a joyous description of the vast fields of waving grain which cover the greater part of that rich province, and he becomes hopeful and almost jubilant at the sight, which is indicative of the development of the country. Facts justify more than his fervid description, and anyone who has not got away from the pavements and artificial life of the city

would be as greatly surprised as was the President with what he saw. In view of this magnificent sight, the Bolsa, Congress, and financial discussions fall into insignificance in the President's opinion.

200. The dark side.—The *Herald* has been for years repeating what the President has just realised, namely, that the productiveness of the country has not been impaired; that it is great, but destined every year to become greater; that the world has no heritage of man richer or more beautiful than Argentina; but the President did not call attention to the reverse of this picture, showing the contest between the riches and development of the country and bad management and a corrupt Government—a race between prosperity and misgovernment. He did not show the corruption which has undermined the Government, which has made office a place of profit rather than patriotism. He did not point out the shattered oath that he made to obey the Constitution, the broken promises he made to the people; he did not say that the best scheme to flood the country with worthless notes must be laid at his door. In the race between incompetency and corruption on the one hand, and the rich products and future of the country, the latter have not only been beaten, but there is no sign whatever that Argentina will get much of a chance with the oligarchy which holds her in manacles.¹

¹ To bear out the possibilities of the nation which President Pellegrini forecasted, I insert here the accompanying résumé of the American report from the *Standard*:—

“THE FUTURE OF ARGENTINA

“June 28, 1897.

“We have received by the mail—at a moment when we had given up all hope of hearing from the American Commissioners—a very neat pamphlet, containing an account of the travels of those gentlemen through Argentina, Uruguay, and Brazil. Like our own handbook, the *brochure* is brimful of statistical facts and figures, on which we shall dwell in other issues. For the present, what most interests us is the horoscope cast by the Commissioners. It is good for the mental health to occasionally see ourselves as others see us, and we gladly make room for these views, which, although the result of a flying visit, embody nevertheless the opinions of experienced and practical men. We extract as follows from the pamphlet:—

“There is hardly a single country which is not now passing through great changes in its commercial relations with the outside world, but there is probably none where commercial development and changes are more evident and the future more promising than in Argentina. In 1860 comparatively an unknown and insignificant country, it has now become an important one, with 4,000,000 people, with evidence of progress on every side in the development of new industries, the increase in population and trade, and the establishment of new means of communication.

“Its importance is not so much due to its population, which is small, nor to its area, although it is ten times greater than Great Britain, as to its financial and commercial relations with the great nations of Europe, and to the leading part it must inevitably take in South America in absorbing surplus European capital and population.

“In the raising of cattle and sheep Argentina can doubtless excel the world. A temperate and delightful climate, the rich soil of the level and unwooded plains, perfectly adapted to stock-raising and agriculture, will in the near future make Argentina one of the most important factors in feeding and clothing Europe. As an agricultural and pastoral country, Argentina, in many respects, excels in natural conditions every other country in the world, and with the aid of foreign capital, the improved farm machinery of to-day, and modern means of communication and transportation, her development will be even more marked and rapid than that of our own marvellous West. Up to the present, the resources of the country have been barely

201. The locust no respecter of persons.—The locust news to hand yesterday was decidedly ugly. The saltona has appeared all over the province of Santa Fé, which proves that the unpatriotic insect was not in the least influenced by the honour of a visit from President

tested; the soil has been turned over only here and there, and has yielded a wealth of millions upon millions, which has staggered not only the old nations of Europe but our own country.

“As is the case with every new country which experiences a too rapid prosperity, Argentina has passed through a disastrous period of financial depression. In 1889 the country became for a short time the scene of a veritable “South Sea Bubble.” Every kind of speculation was rife. The great financial houses of Europe, such as the Barings and others, combined with many greedy English speculators, literally poured money into the Argentine Republic, through the National and Provincial Governments. While a considerable portion of this money went into the pockets of the middlemen, there are but few comparatively undeveloped countries which have had so much capital freely invested for railway construction, public works, and for the opening up of new districts. Between the years 1881 and 1892 the Federal Government received nearly \$300,000,000 directly. It has been estimated that in all some \$1,500,000,000 English capital has been invested in Argentina, much of which is now unremunerative and in jeopardy.

“Our Commission, during its visit in Argentina, observed many circumstances which tended to show that the business of the country is constantly improving. The credit of the country is rapidly regaining the position it held prior to the financial crisis, as is shown by the heavy decline in gold premiums. Men who have been long resident in Argentina expressed to us the opinion that they never knew a time when business looked so sound. The total volume of foreign business for the first six months of 1896 amounted to \$121,100,000. This is considerably larger than in any of the corresponding periods for the three previous years. The most marked advance was in imports, which figured \$51,700,000. This is \$8,700,000 more than for the first half of 1895. One of the most significant signs of better times is the importation of railway material, which, during the first half of 1896, amounted to over \$1,000,000. The indications are that this class of imports can be greatly increased in the near future, as considerable railway extension is contemplated. The importation of agricultural implements has also increased considerably during this period, as well as dry goods and hardware.

“First and foremost among the drawbacks to American commerce with Argentina I would place the character of the population. The amalgamation of races in the Argentine is a counterpart to that of the United States, with this difference, that while the civilisation of this country is Anglo-Saxon, there is going on in the Argentine a welding together of nationalities which are purely Latin. The civilisation of Argentina is wholly European, and this fact must always greatly influence her trade relations. The immigration is being restricted in the United States, and there is no country open to this immigration which can hold out so many inducements as Argentina.

“As will be seen from the statements on immigration, the great bulk of the population has recently come from the Latin countries of Europe, principally Italy. Their tastes and inclinations are all for goods similar to those used at home. They are cheap in quality and low in price. This fact, I think, explains better than anything else the decrease in the exports of Great Britain from 43 per cent. in 1884 to 27½ per cent. in 1895, as also the increase of the German and Italian trade, which is principally in the cheap and common lines. Germany increased from 7 per cent. of the total in 1885 to 15 per cent. in 1895, and Italy made even much greater increase, from 4 per cent. in 1885 to 12 per cent. in 1895.

“The second great disadvantage that Americans encounter is the fact that Europe is the consumer of Argentine products. The great bulk of her exports are taken by France, Germany, and England, and other European countries. The Argentine exports to Europe are 85 per cent. of the whole. How do the trade relations between Argentina and the United States stand? About 4,000,000 Argentines consume \$10,000,000 worth of North American goods; 70,000,000 North Americans consume \$5,000,000 worth of Argentine products. Let us take, for instance, the trade relations of the Argentine with the United States for 1894. Argentina exported to

Pellegrini, and also that all the fuss made and shin-plasters¹ wasted on the "extinction" of the pest was pure gammon. The insects have also appeared in the south of Buenos Ayres province, at Guamini, Trenquelanquen, Carhue, and other places. The primitive Bœotians in those parts can think of nothing better than rockets and rattling old kerosene cans to frighten the invaders.

ROSARIO² NOTES

202. Prosperity.—The wheat and "alfalfa," or, as it is fondly called, "alfa" fields, are in splendid condition in spite of the locusts and all their works, and the colonists, in this department at least, are in high feather, reckoning their possible gains and planning what they will do when they all get rich, as they must, if Heaven vouchsafes a few years of prosperity in succession. The experienced farmer of the period is giving all his attention at present to agriculture, it being the general opinion that little or nothing may be expected from fine stock breeding, at least for two or three years. Certainly agriculture, like stock-breeding, has its drawbacks, but they are not such that they may not be overruled.

203. Possible foes.—The two formidable enemies of the agriculturist are the droughts and the locusts. The former could easily be provided against by a judicious system of irrigation. We have turned our noble river³ to account for the enrichment of foreign shareholders and directors, why not make it serve as well for the protection of one of the greatest industries of the Republic—an industry that asks no subvention and which promises the richest returns? As for the locusts, their habits and peculiarities are becoming better known every

the United States in the same year \$10,100,000 worth of goods. This great difference was materially altered in 1895, owing to the heavy imports of wool into this country from the Argentine. The exports to the United States were \$8,950,000, and the imports were \$6,700,000.

"A considerable amount of the exports from Argentina to Europe eventually find their way to the United States, principally wool, and, to some extent, wood products, such as quebracho, a tanning material. The amount of Argentine wool bought by American manufacturing concerns at the auction sales of Europe is estimated to be considerable. There is no reason why all our importations of Argentine wool should not be direct.

"The third great drawback is the fact that Europe has invested such enormous sums of money in the Argentine. Not only has there been the vast amount of capital invested by Europe in public improvements, but European banking institutions are everywhere throughout the country.

"The fourth obstacle is the lack of steamship service and banking facilities. As a customer in Argentine general trade, the United States is insignificant, standing only 7 per cent. of the total, as against Great Britain with 27½ per cent., France 15 per cent., Germany 17 per cent., and Belgium 11 per cent. It will be seen from the table of exports of this country to Argentina that the principal articles are pine and petroleum. The indications are that the trade in lumber can be very greatly increased, especially if the Argentine can be prevailed upon to lower its import duty on this article. It is estimated by competent individuals in Argentina, that if the import duty were reduced 50 per cent. the importations would increase fully 100 per cent."

¹ A nickname for the paper currency of the country—paper only is used.

² A port town for large ocean-going ships, situated on the river Paraná.

³ The Paraná.

day, and we doubt not but some means will soon be devised for their effectual suppression. When these two things are done—*i.e.*, the guaranteeing of constant irrigation and a means devised for the annihilation of the locusts, that have so strangely stirred the Presidential mind of late—we may say that agriculture will attract as many people to our shores as ever the gold fever did to California or Australia, and we may also venture to assert that the comers, if experienced and willing to work, will not be so numerously disappointed as they were in the above-mentioned countries.

THE LOCUSTS: A NEW PROPOSAL FOR EXTINGUISHING THEM

BY DR. MUNRO

In this country public attention has now for more than a year been directed mainly to three objects:—

204. (1) Politics.—A condition has been disclosed in which it has not been merely the usual or ordinary question of party politics, but one in which has been discovered sufficient reason to account for the complete want of confidence not only at home, but also more especially and worst of all abroad in Europe, and which tends to political ruin and the very worst evils of misgovernment.

205. (2) Finances.—Inasmuch as we have no banking (for virtually we have none), nor any fixed basis of reckoning or computation, our financial state cannot be right, the commerce of the country cannot prosper, it must be more or less at a standstill, and even the rootlets that it took in the country must at least be strained, if not torn up altogether.

206. (3) The locust plague.—"He gave their labour unto the locust"; "there remained not any green thing in the trees, or in the herbs of the field, through all the land of Egypt." I saw under my own eye not only a large vineyard loaded with young grapes (see Fig. 16), but whole fields of corn disappear as if by magic, and the hope of the husbandman vanish like smoke. The same scourge literally and exactly now hangs over and threatens this country (Argentina).

207. The situation serious.—Any one by itself singly of these three existing evils would be enough in any one of the best and richest countries of the Old World to command the entire energies of its people, in order to cope with and overcome it. Imagine, then, what it is when all three, at the same time, afflict in reality a country so young and with such a sparse population as exists in the Argentine nation. To serious, thoughtful persons the condition of this country in the immediate future must therefore cause grave anxiety. The soundest and best established men and institutions, from these combined evils, tremble and shake, and are threatened with ruin. There is no security nor certainty either to property or life at present in the country. At one time, the question of banking occupies the most prominent place; at another, it is more purely finance or a loan or a moratoria; at another, it is politics or a revolution; at another, it is the locust plague, and so

on—the public mind is disturbed and in a state of restlessness, and there is no peace nor tranquillity—all contributing to form a crisis in which even the social well-being is threatened. It would be difficult, notwithstanding the optimistic opinions of H.E. the President, as expressed in his telegraphic message from Santa Fé on October the 9th, to parallel a crisis in such a severe form or of such duration as the country is now passing through.

208. Foreigners and Argentines should meet on common ground.—As a foreigner I am precluded (if I cared or were able) from

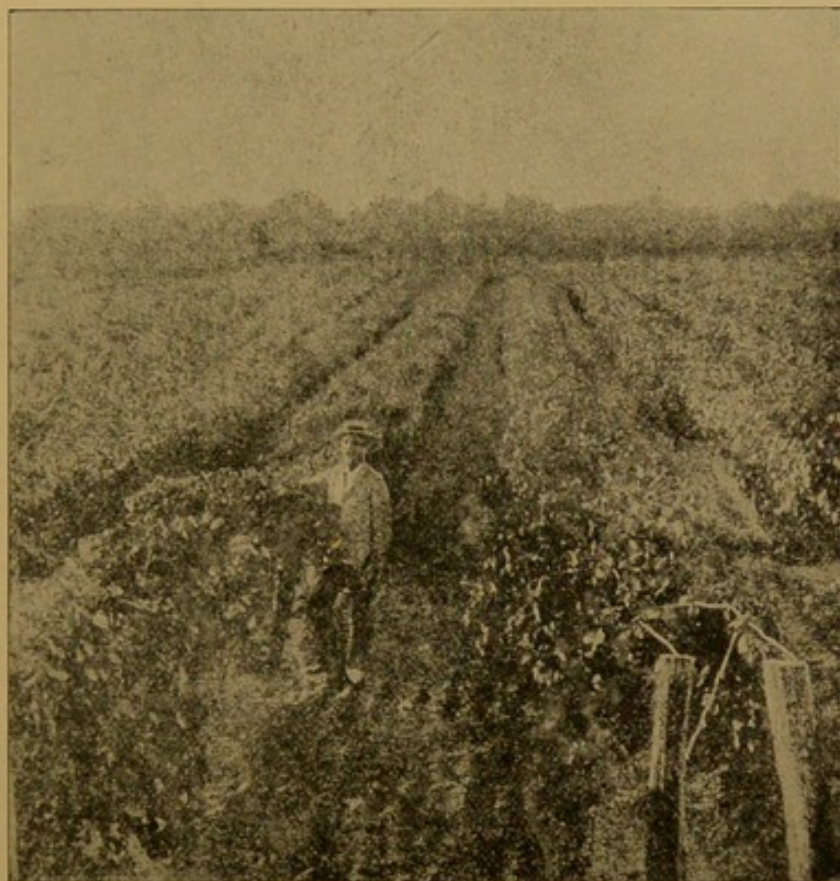


FIG. 16.—Vineyard. The locusts attack the vine with great avidity, and have been known to cause loss in the vine-growing provinces of Argentina (Mendoza and San Juan) to the estimated amount of £1,000,000 sterling in one year.

taking any active direct part in the political or financial questions or topics above referred to, and therefore I pass from these to the third of the great topics that have so much occupied and still agitate the public mind, namely, the visitation of the locusts in this country. Argentines and foreigners may here practically occupy equal ground, although theoretically they cannot do so, inasmuch as the former make certain laws and therefore command the latter, who must obey by force or choice. In combating a plague of this sort there should be some mode of obtaining a consensus of opinion from foreigners as well as Argentines, so that all should be unitedly done, if possible, heartily

with one accord. It is surely good to have abundant harvests, although these cannot cure a crisis in a country where the politics and finances are so far wrong and out of joint, as they are at present in this country; yet they may contribute to alleviate, and they certainly enrich directly, the particular or individual recipients, and to that extent, and so far as it goes, they enrich the country, but in this latter case it is clear that any general good effect may be more than counterbalanced by the commanding and predominating evils—the crisis may therefore continue.

209. A Crisis.—When our President directed public attention to the prospect presented by the fine and extensive wheat-fields in the province of Santa Fé, with the view of diverting attention from what was taking place financially, and politically also, in the capital of the Republic, through the common-sense of the people at large, it was seen that he had made a mistake by magnifying unduly the one (that is, the vast ocean of riches and resources of the Santa Fé camps), and unduly not recognising the other (that is, the crisis). The effect he and his counsellors intended was altogether, or very much, frustrated. As a practical people, we ought to look matters in the face. We are in a fearful crisis—a crisis that springs from a combination of circumstances. Undoubtedly, a great part of the country is suitable for agriculture, and there is little doubt that husbandry is one of the chief, if not the greatest, of the resources of the country. If the people only would work and learn to be frugal, this would materially help, as soon as the political and financial situations improved, to bring us on to the proper track again. The present inquiry is to back or second the efforts of the husbandman.

210. The locust we have always.—Locusts have at one time or another devastated the larger part of the habitable world. I do not enter upon the varieties or species—I take the one here as sufficiently representative. Some regions are never entirely free from them, and those parts are said to be their *permanent* homes, such as parts bordering on the Mediterranean; certain parts of India, Central Asia, China; some parts of Australasia, Arabia; a large part of Central Africa; parts of the United States of America. But occasionally they take flights and have temporary homes, for example, in France, Germany, Central Europe, the River Plate, etc. They have even gone to England, but, as far as I can gather, without doing any harm there.

(Under a series of seventeen heads were epitomised the characteristics of the insect, which need not be recapitulated here, as they are fully embodied in Book I.)

211. Sum voted too small to cope with plague.—How can this terrible scourge be extinguished or foiled? In the United States Report, already referred to, we find that no less than thirty-eight machines were invented for the purpose of annihilating them, but up to the present all have proved unsuccessful. As far as I can learn, they have been extinguished only in two places, namely, in the island of Cyprus in 1883 and 1884, by the British, and—according to the *brochure* of M. C. Lemée, a synopsis of which I only saw in the *Standard* on the 21st of October last—in Algiers, in 1888, by the French. The British applied the “screen and trap” system, and the

French seem to have succeeded by the "egg collection," according to the recent data of M. C. Lemée. Although these two parts stand alone in point of view of extermination, yet no doubt the area of the permanent or subpermanent abode of the locusts has been much reduced in the United States. But what applies to the projects once adopted and taken in hand by nations such as Britain and France cannot equally apply in a country like this. Those nations have immense capital resources, and men necessary for the practical carrying out of such an object, while the Argentine nation is lacking—sadly lacking—in all these requisites. Thus, for example, the British spent for this extermination, in little more than one year, when they got possession of the island, £66,000, and on account of the benefit produced in the saving of the crops, it was considered extremely cheap—a mere flea-bite at the money. But note that in the island there are only 4000 square miles altogether, of which only 1600 square miles had to be operated on and protected, and compare this with the paltry sum of \$20,000 (*i.e.* less than £1600!) voted by the National Government of this country for extinguishing a pest in one province (Santa Fé) at least ten times greater! At the rate, therefore, which the British paid, it would cost in Santa Fé \$13,000,000! Could \$20,000 be practically of any use under the circumstances? I say *no*. Then what of all the neighbouring provinces? It is simply impossible that the same means could be adopted or put into force in this country as those adopted by the nations cited. We ought manifestly to look in another direction.

212. A suggestion.—Before entering upon the direct destructive means, I should like to suggest a means of foiling them, and that is, by "dodging" them so far as cereals are concerned. The wheat this year will, in all probability, be saved here by the fortuitous fact that it was sown early—early enough to be too far advanced to be touched by even an early visit of locusts, such as we have had. But the maize crop is not circumstanced as wheat, for the saltonas will eat and ruin maize although far advanced, therefore for such a crop as this (or potatoes, etc.) it is best, because safest, to abstain from sowing altogether until about fourteen days of the advent of the "army" of saltonas, and when the young maize is not yet above ground. When the "army" marches past all is safe.

PERIODS WHEN IT IS BEST TO GIVE BATTLE TO THE INSECTS

213. The five epochs.—Let us now enter on another consideration or aspect of the subject. If an impartial person of common-sense will look into the known characters and habits of the locusts, such as I have detailed, or any others which he may know, and which I have not enumerated, I believe he would come to the conclusion that there are five periods or epochs specially marked out as preferable times, because of their number and compactness, for the purpose of attacking and destroying them:—

- (1) When they come in a large flying cloud;
- (2) When they (the flying locusts) camp or settle at sundown;
- (3) When the males and females "pair";

- (4) Destruction of the eggs ; and
- (5) Destruction of the saltonas, or young larvæ.

214. (1) Destruction when on the wing.—The destruction of the locusts when a large company is on the wing I consider to be impracticable and inexpedient, because of the vast extent—hundreds of square leagues—to be affected at the same time, and there is no known explosive yet invented that would be effective.

215. (2) Destruction when they camp at night.—It would not be difficult to catch and kill locusts as they “camp” at sunset, or on cold sunless days, under certain circumstances. I believe this mode, if taken up heartily, would give better results than “egg-collecting,” to be afterwards dealt with. “They camp in the hedges in the cold day ; but when the sun riseth they flee away, and the place is not known where they are.” But they camp in other places than the hedges. If it were only in hedges and the scrubs in our waste lands and camps, then I believe destruction at this time would have been largely had recourse to ; but when you think of the extensive wheat and flax fields on which they settle (but to which at night these flying locusts do little or no harm), it becomes a totally different question as to attacking them while they camp at night. Great slaughter might no doubt be effected, but also there would of necessity be immense and irreparable loss to the crop through which such a conflict occurred. For this reason, as well as the uncertainty of where they would camp and the nature of the manga, I venture to suppose that this epoch would be found less effective than one or other of the remaining plans.

216. (3) The period of “pairing.”—This period is another time when much slaughter could be effected, but the destruction then would be very limited, and they could not certainly be extinguished in this way. There is no certainty when or where they select to settle and “pair,” and the probability is that the mangas could not be easily got at.

217. (4) Egg-collecting.—The next mode of destruction is the collection of the eggs. This is an old Spanish (Latin) custom, and is the one in vogue in this country and in some other parts. The percentage of eggs destroyed by natural influences or causes, such as wet weather, birds, flies, grub-worms, swine, incidental diseases, etc., must be very small,—probably not five per cent. of the whole,—and in practice it is scarcely worth reckoning, or at least relying upon. Why, when the eggs are hatched the very dust seems to creep, and there is usually a deluge of living forms of from one to two inches in thickness, sometimes much more. Therefore this is unreliable. It is to trifle with the plague to think of trusting to such means. To plough up the breeding ground of the locusts may not generally be possible or expedient, but if perchance they choose to lay in cultivated land, it might be worth while to consider this means, if the manga be limited enough and if they could be thereby stamped out, notwithstanding the loss of the crops in the spot, which, though great for any one individual, might not be much felt when divided over a whole colony. In selected and expedient localities, I affirm ploughing up is a good and sure means of destruction. To plough up the breeding

ground will, however, as a rule, I believe, be found either inexpedient, impossible, or too expensive.

218. Enforced collection of eggs.—The enforced collection of eggs, by requiring the people to dig up a certain number of kilos. per day, and the offer of a price or bribe of so much money per kilo., has something catching in it, and, I believe, also something of an opposite nature. This method has been adopted for many years in several other countries, and, so far as I can learn, with one exception, has been completely unsuccessful, the exception being the case of the French in Algiers, recently made known by M. C. Lemée, but the details of which I have not seen. There has been much experience of this system in the United States, Egypt, Turkey, and other places. It was in vogue for years in Cyprus, when the British got possession of the island in 1878. They watched the process pursued by the natives (the Turkish Government paid more than £12,000 for collecting eggs), and they were so convinced of the utter inutility of the process, year after year, that they discarded it, and in 1883 they exterminated the locust in the island by another system already mentioned. In 1881–82 there were collected in Cyprus 1330 tons (the largest amount ever collected up till then or recorded), representing 70,000,000,000 eggs, at the above cost, and without any adequate abatement of the plague in 1883, when the British began their new operations.

219. The work not thoroughly done.—If anyone observes the perfunctory way in which this egg-collection system is generally carried out in this country—it is chiefly in the province of Santa Fé—one cannot help but despair of any satisfactory result being obtained. What! but surely the collection of so many locusts' eggs—tons (it more usually should be kilos.)—entails a destruction of so many locusts, and therefore there ought to be less damage? I am inclined to take exactly the opposite view. There will be sufficient left to produce enough saltonas to destroy all green things available to them. Therefore egg collection as practised is labour lost, and, even worse, it is an entire misappropriation and misconception. I confess I should like to know the details of how the French managed to extinguish the pest in Algiers by this method. It must have been done at enormous cost of money and labour, if done solely in that way. It would be equal to digging up all the breeding ground. In this country there can be found neither people to do such a gigantic work nor money to pay for it. At best, here, it can only be a palliative, and that of a very slight kind.

220. Drastic measures.—The laws passed on this subject, as years roll on, may yet appear ludicrous. A penalty of \$100 is imposed on any family who do not collect 30 lbs. of locust eggs! A plague cannot be checkmated by the enactment of absurd penalties, and hence we have cruel cases, such as the following:—

“An unfortunate storekeeper at Canada de Gomez, named Debarroeris, was arrested, put in the stocks for several hours,—with his baby in his arms,—and fined thirty dollars for refusing to leave his store without anyone but his sick wife in the house, in order to turn out and kill locusts. Verily there be some authorities who are worse than their locustships!”

From considerations such as I have tried to express, I am convinced that the egg-collection system for destroying this pest will be found worthless and unsatisfactory.

221. (5) Destruction of larvæ.—I come to the fifth and last mode, namely, the destruction of the locust in the stage of larvæ, or saltonas. The reader will have seen that, so far as the writer can judge, up to this point, in the four previous stages, there is little or no hope of being able to extinguish the pest in any one of them or in all the four stages together. In this stage we have the advantage that they can be seen; they are above ground; their movements, though active, are restricted and well known. They cannot escape us by flight; it is only in number and continuous persistency that they may conquer us. It is clear that safety lies in coming somehow or other into close quarters with them. Let us therefore see what success has attended various methods in the hand-to-hand fight with this army.

EGYPTIAN METHODS—TRENCHES, BEATING, BURNING

222. Trenching, beating tins, etc., futile expedients.—We find "a careful observer and compiler in Egypt," after an experience of more than twenty years previous to 1857 (the date of the record), stating, after an encounter of this kind: "We dug trenches and kindled fires, and beat and burned to death 'heaps upon heaps,' but the effort was utterly useless. Wave after wave rolled up the mountain-side, and poured over rocks, walls, ditches, and hedges—those behind covering up and bridging over the masses already killed. After a long and fatiguing contest, wearied, I returned, and gave over the vain effort to stop its progress. . . . At length, worn out with incessant skirmishing, I gave up the battle." From this account one would imagine that it referred to precisely the same processes which are carried on here now. In Santa Fé you can now see make-believe trenches, made this year, as if that were to prevent the living deluge or river advancing. It will be impossible to cope with the evil in this way. To fill that ditch, and thus bury with earth as many as it will contain, will do little, and there is neither labour nor money available to meet the requirements for such a system, which must fail. So, again, "beating tins" to make noise, kindling fires, etc., all are comparatively useless and trifling. This is all proved, not only by the careful experience derived more than fifty years ago in Egypt, but in many other places.

"SCREEN AND TRAP" SYSTEM

223. This method inapplicable here.¹—In 1860-61, Mattei established the fact that the saltonas cannot ascend a smooth surface. The British authorities in Cyprus took notice of this observation, and turned it to account in the following way in their operations in 1883-84. The plan, therefore, was to make a barrier of canvas about a yard in height, arranging at the top margin about three inches of American cloth, the lower margin for two or three inches being covered with earth. This barrier is called a "screen." The larvæ, or saltonas, coming to the barrier, ascend the canvas to the smooth

surface of the American cloth, fall back confused, and are, while thus confounded and looking out for another way of escape so as to continue their course, entrapped in a pit or "trap," specially adapted for them, in front of and at right angles to the "screen." There were 318 miles, or more than 500 kilometres, of continuous length of these "screens" used in Cyprus, and in front of these 65,000 pits or "traps"; 55,000 of the latter were filled, and it was estimated that not less than 195,000,000,000 larvæ were destroyed. This was the "screen and trap" system, by means of which, in Cyprus, in the course of one year, the locusts were exterminated.

But in a country such as this, where there is more than a hundred times the extent of land affected, without anything like the resources which the British could throw into Cyprus, it would, under these circumstances, be absurd to think of embarking on this system here. It is from such contemplations that we may realise the enormity of the plague in this country, and how helpless we may be to cope with it. The consideration of it is baffling, and to think of overcoming this army seems to stupefy or make the head reel. The "screen and trap" system is inapplicable here because of the cost, while trenches and other means mentioned are insufficient and inadequate.

TRAMPING WITH CATTLE

224. A cheap and effective process.—The only other system, so far as I can learn, which has been practised in the River Plate, and which is one that I think deserves much attention, because specially adapted to this country, I shall next proceed to examine. An able friend of mine recently told me, when visiting Santa Fé about two or three weeks ago, that in the Banda Oriental and in certain parts of the provinces of Entre Rios and Buenos Ayres, with all of which he has had an extended knowledge, the system was to kill the saltonas with a "majada of mares" (flock of mares). He wondered why this was not practised in the province of Santa Fé. This seems to be both a cheap and an effective process. A couple of hundred mares can easily be obtained,—the cost is scarcely anything,—and with a little care in the training at the first outset, I am told that they can be made to go round and round in a circle or in any given space easily, and so tread upon the saltonas that the whole mass is reduced to a pulp, and by this means the whole army is, or can be, slaughtered. By referring to head 14, of the known characters of the locusts, it will be observed that, from practice, we are aware that the march of the manga may be slightly diverted. In this way it could be managed to make the shape of the manga suitable for treading by the mares.

225. Lemée's objections not sound.—I am glad to see that Lemée mentions this plan in his *brochure*, already referred to, but I respectfully differ from him when he says that it would be inexpedient to put this system into practice if the manga of saltonas be in tilled land. If it is an effective and expedient mode, what matters it if the manga can be circumscribed and made manageable? These are the

requisites (if desired to be a radical measure) in reality, rather than the waste from injury to crop, no matter what that crop may be.

226. An Act necessary.—Mares may usually be found, and a useful and legitimate Act might be passed obliging those who had mares to give the use of them for this purpose, whether the locusts settled on their own ground or not; it is something for the general good of the colony and the nation at large. This would be praiseworthy, but the passing of Acts enforcing the compulsory gathering of eggs, which more than fifty years' experience has shown to be at least unsuccessful, if not wholly useless, is exactly the opposite: besides, the enforcement under penalty of these arbitrary Acts gives rise in this country to acts of cruelty to human beings, such as that before referred to. To compel the temporary use of a neighbour's animals—mares or other cattle—for the public welfare is a totally different thing.

THE NEW PROPOSAL—CRUSHING BY ROLLERS

227. Some districts not suitable for tramping.—There are mangas which it would be impossible to circumscribe so as to make the work of the flock of mares efficient or useful, and it is with a view to operate on them that I respectfully venture to throw out a suggestion. I am aware that I may, by so doing, arouse susceptibilities in respect to the systems and means now in vogue with the view of lessening the evil, and, among those who have preconceived notions with regard to the subject, any new thing or proposal for this object will at first probably be laughed at and laid aside, more especially if simple and cheap and of general application. In the absence of any other suggested plan, and without the object of obtaining the offered pecuniary reward or fame, I venture to expound a plan which I think, if a fair and persistent trial were made, would succeed and give excellent results.

228. To succeed with new plan—(1) the ground must be reconnoitred.—Let us suppose that a tillage farm or colony exists on the south side of open "camp," and that the flying locusts have, as they prefer to do, settled on the uncultivated camp and deposited their eggs in the dry soil, and that the occupiers of the cultivated land, being aware of the proximity of their enemies, prepare to resist an invasion. For this purpose one of the first things to be done is to reconnoitre and ascertain the extent of the enemy—what is the probable breadth and length of the manga or column to be dealt with. This is usually not difficult to ascertain, and if the natural camp be available, I take it for the scene of operations; but if, from its nature, it be not smooth, clean, and suitable, I prepare a line along the northern margin or boundary of the tilled land, and clear it of the fences running north and south, so as to allow me to have a perfectly free pass of the width of the manga or army of saltonas.

229. (2) Rollers are to be procured.—I have, in the meantime, while the eggs are being hatched, obtained either by way of loan or by purchase as many wooden rollers as I think will be required, and a few more as a reserve for emergencies. Ordinary one-horse wooden rollers should be about seven or eight feet long by about two or three in diameter, and, as there is much timber in the country, they could

easily be put into shape for about 20 or 30 dollars each. The number requisite would depend on the size of the manga or column, care being taken to be prepared for the widening of the column towards the east and west, because success would depend upon the column not being allowed to pass the northernmost line of the cultivated camp, which has been prepared for the battle. Another element with which to reckon is the probable speed of the column on the march. We know that when free and unmolested, the column travels about 150 yards an hour, but doubtless, when the vanguard is killed, and those coming after, meeting the dead bodies of their comrades, stop to eat them, at least to their fill, it will be found that the advance would be very considerably impeded.

230. (3) Method of using rollers.—The plan, then, consists essentially in having a number of ordinary wooden rollers—an inexpensive and useful implement on agricultural land, almost as much so as ploughs, harrows, or carts—and when the vanguard of the column has come within the northernmost line of the tilled land, to commence rolling from west to east, and back again from east to west, and so on, with as many rollers as are requisite, in order to kill the column *as it advances* (I should think that from five to ten rollers would be enough to engage in an encounter with a tolerably large or average manga). The roller should always be taken over the same ground, say from 20 to 30 ft. in width, according to the number of rollers available for rolling the whole length of the ground in front of the manga, the object being to crush the front line of the column as fast as it advances on the ground specified, and we know that the locusts on the march are bound to come onwards and southwards, and they do this irrespective of the dangers that await them. Such is my proposal, shortly and baldly stated.

231. No quarter given.—The fight must go on day after day without cessation or intermission until that entire "army" is annihilated. The commonness of the means, its easy attainment, and its inexpensive character should not be deterrent causes from giving the plan a fair trial. Because no machine has yet been invented capable of exterminating a manga of locusts, one should not therefore conclude that it is of no use to attack the enemy. It appears to me that the rolling system suggested would answer better for slaughtering purposes than all the other means, separately or together, that are now in vogue, and would fitly represent in this battle the mitrailleuses or Gatling guns which are used with such destructive effect in modern warfare.

232. Wine barrels or wheels may be used.—But if rollers should be scarce, or if none should be available when required, the colonists ought not to despair or give up the battle; they ought to find some substitute for the roller such as their own inventive faculty, individually or collectively, may discover in the camp: thus, for example, in nearly every colony there are plenty of empty barrels, either bordalesas (wine barrels), flour barrels, or cement barrels, and these might be easily converted into rollers. The wine barrels could be filled with earth or stones, or indeed anything at hand, to weight them and adapt them. They would prove useful wherever the ground is more or less uneven, and would have the chance to kill more locusts

than one long ordinary roller, which, where the ground is not level, might miss some. But if the ground is tolerably even, then flour-barrel rollers would be better than wine-barrel rollers, from being more uniform. These could be filled with earth or stones and tapped up, with their corresponding pivots at the ends for axles. Then, again, if barrels are not at hand and ordinary rollers not obtainable, two cart (or other) wheels could be taken and a roller made by uniting them with deal boards and filling the inside so as to weight them. Very slight ingenuity would get over the difficulty of a scarcity of rollers, if the principle be sound and accepted.

233. All barriers to be removed.—Even though the enemy should be met with in any part of the tilled land, the principle of attack should be the same, namely, clear a space of all barriers, such as fences, etc., nothing more than for an engagement—a hand-to-hand fight—with this vanguard always; and the result, I think, will be a complete victory.

234. Sanitary measures.—The question may arise whether or not danger would be caused to health or life from the putrefaction of the saltonas during and after the combat and necessary slaughter. If any doubt existed upon this point, the danger might be easily avoided by throwing some lime over the battlefield; the whole mass would then make excellent manure. The earth, etc., might afterwards be removed and spread over poorer soil, which would be greatly enriched. If left alone, the land on which the battle took place would not yield any crop for a few years, but if the fat material and earth were removed and replaced by poorer earth, the field of battle would produce a crop next year, the same as if nothing had happened upon it.

235. Suggestions invited.—The object of this article being limited to calling attention to some of the known characters of the locusts, and to throwing out the above practical suggestions for extinguishing them, in view of the universality of the plague that now threatens the country, I leave the matter to other hands, but I shall be glad to receive any authenticated data respecting the plan of operations suggested or the locusts themselves, from anyone who will do me the honour to send the same to

Æ. MUNRO.

CRITICISMS AND SUGGESTIONS ON DR. MUNRO'S PLAN

THE OPINION OF THE *Herald* ON THE SUGGESTED PROPOSAL IS
THUS STATED:—

236. The plan feasible.—We publish to-day the concluding portion of Dr. Munro's interesting article on locusts. His plan for getting rid of the plague seems to us to be feasible, and if it did not entirely stop the advance of an army of locusts, it would certainly cause the destruction of enormous quantities, and this in the easiest and cheapest manner possible.

We invite suggestions and criticisms from those who have had practical experience of the plague.

ON THE LOCUSTS, FROM THE *Standard*

237. Résumé.—We have been favoured by Dr. Munro with an exhaustive and instructive article on the locusts and the best means to destroy them. Owing to the extreme length of Dr. Munro's article, we are unable to find room for it in our columns, but we shall proceed to point out its more salient features. Dr. Munro begins by calling attention to the necessity of the united action of foreigners and Argentines to extinguish the plague, and he then gives an interesting account of the habits and peculiarities of the locusts. In the United States and Egypt the locusts travel eastwards, while here the voracious insects invariably pursue a southward course. The rate of travelling is about a mile a day. Where the locusts come from it is impossible to determine. Dr. Munro alludes to M. C. Lemée's *brochure*, which we summarised a month ago, and which, as our readers no doubt remember, contained some very interesting particulars in regard to locusts. Dr. Munro calculates that at the rate the British Government paid for the extermination of locusts in Cyprus, it would cost Santa Fé 13,000,000 dollars to wipe out the present invasion. By a fortuitous circumstance—early sowing this year—there is no danger of the wheat crop being destroyed, but the maize is certain to succumb if something be not done to oppose the voracious invader.

238. After showing most exhaustively the comparative uselessness of the egg-collecting system, so much fancied for the destruction of the locusts, Dr. Munro adverts to M. Lemée's suggestion of running mares over the ground and thus treading down the invaders, a suggestion he considers feasible and advisable under certain circumstances. He then suggests his own plan, and we cannot do better than quote his own words. (These have already been given, see par. 227 and following.)

TO THE EDITOR OF THE *Herald*.

239. Approval of "roller" plan.—DEAR SIR,—It has given me much pleasure to read Dr. Munro's article on locusts, and I think it very excellent, and that his idea of crushing the saltonas is very good. Of course this depends on the accuracy of the statement that the saltonas, actuated by instinct, invariably move from north to south, and, such being the case, it is obvious that the northern boundary of the cultivated land is that which must be watchfully defended, and that if this be done the crops will be saved from destruction, and therefore I think that, while Dr. Munro's proposed rollers (wooden) are being rolled from east to west, and then from west to east, children, peons, and others, armed with smaller manual rollers, might act as a helping "light brigade" to destroy the saltonas.

240. A suggestion.—If, as is affirmed, the saltonas invariably proceed south, I think that the agriculturists should dig a wide ditch or trench about two feet deep along the northern boundary of the cultivated land which is the one first invaded. This trench should be filled with water, if it be available for the purpose. The ditch should be very wide, so as to act as a kind of moat.

241. I agree with Dr. Munro that his wooden rollers would be cheap

and effective to a certain extent, but by the supplementary means that I have suggested the defence would be much strengthened.

242. The aid of electricity might be called in.—Accepting Dr. Munro's plan of using rollers, aided in the manner before mentioned, as the first defence, I now propose what seems to me the *best, most practical, and cheapest means* for killing any quantity of saltonas. I propose that on the very boundary where the moat-trench has been dug an electric gauze wire fence should be erected and be served by a powerful galvanic battery and a Rhumkoff's bobbin, and the result would be that every locust that attempted to pass the electric gauze wire fence would be killed instantaneously and would fall into the trench-moat. The fence need only be high enough to prevent the saltonas from jumping over it without touching it.

243. The advantage of using electricity is that it is certain, that it is cheap, that it acts constantly, day and night, that the fencing, batteries, and bobbin can be removed and put away after the locust season has passed, and that it needs few persons to manage it, and above all, that it works notwithstanding the changes in the temperature, droughts, pamperos, rains, storms, cyclones, or any other disturbing influence, because its action is uniform and sure.

244. Both suggestions might be conjoined.—Finally, Dr. Munro's large wooden rollers, assisted by the children's small hand rollers, would crush the saltonas as they invaded the battle strip of ground to the north. This would be the first line of defence. The saltonas which escaped would march blindly on and meet the wide water moat-trench, which would be the second line of defence. Those saltonas which had escaped the rollers and moat-trench would meet the electric gauze wire fence, which would be the third line of defence. Notwithstanding Dr. Munro's excellent plan, I think my electric one superior, but I think that both plans could be worked conjointly with satisfactory results. The cost, compared with the results, would be insignificant.—Yours truly,
"GALVANIC BATTERY."

245. Editor's note.—The superiority of Dr. Munro's plan consists in the fact that the materials required for carrying it into execution are on the spot and can quickly be made ready for use; the motive power is also immediately available, and the working operations would be comparatively inexpensive. Not so with the electric gauze wire fence, for which and for the necessary dynamos and motors the outlay for the protection of a large district would be enormous, and the working expenses, including the salaries of trained engineers, cost of fuel, etc., would be very great. How would our correspondent find the money?

LOCUST KILLING

TO THE EDITOR OF THE *Herald*.

246. Successful trial of Dr. Munro's plan.—DEAR SIR,—If the locust question is not yet settled, please give me space for a few lines on the subject. Dr. Munro's plan of the rollers was successfully tried in February 1852, a terrible locust year, and on the grounds of

Mr. James White, at Belgrano. Mr. James Bannon, who was present helping at the killing, has given me the following details:—Mr. White at the time had some fifteen squares (*i.e.* sixty acres) of maize growing beautifully, and being aware that the saltonas were in his field, and coming to it in millions, determined on saving it if possible. For this purpose he got two rollers made of sheet iron, I believe, about 2 metres long by 18 inches in diameter, the axles projecting sufficiently at the ends for the fastening of horse shafts, on which they turned freely, and for the construction of a frame, on which was fixed a driver's box above the roller. Twenty peons (labourers), with as many of the neighbours, who gathered to see the fun, were then sent in early in the morning among the standing corn, armed with whips, sticks, branches, bags, etc., with orders to drive out the locusts to a clear space on the outside of the maize, where the rollers were waiting harnessed, with horse and driver ready for the slaughter. Then with whip, shout, hue, cry, and smash, out hopped the insects in millions, and away went the rollers up and down, to and fro, pounding them to a jelly, till they were lying dead in heaps piled a yard high. The result was a complete clearance of the field, and the apprehension of a pest by the people round from the stench arising from the decomposed bodies of the locusts. For a while after the place was called the "Killing Grounds."

247. Mr. Bannon's plan.—Mr. Bannon also told me of a plan which he himself tried for defeating the flying locusts, and which answered admirably. Being located with sheep in the Carmen districts in the year 1860—a year noted for immense invasions of locusts—he was told by his peons that a large army had camped out for the night just within a short distance of the house. Alarmed at this, and anxious to save the produce of his garden from their voracity, he got up before break of day, and, with his peons, drove down his largest flock right on the top of the locusts, keeping the sheep running about till the locusts were nearly destroyed, the few escaping flying off in another direction. I remember hearing of this invasion, or a previous one, which proved very destructive to the southern camps, though not reaching Tuyú, where I was at the time. Immense long lines of seagulls were seen standing before the advancing army gorging themselves to their hearts' content; but what freed the south from the multitude of locusts was a tremendous pampero which blew them into the Atlantic, the air for miles inland being afterwards tainted by the decomposition of the heaps of dead locusts strewed along the coast.

248. Combination of Dr. Munro's and Mr. Bannon's plans.—Saying nothing against the electric fence scheme suggested in your issue of the 17th, or the powder one suggested a short time ago in the *Standard*, the above facts are mentioned to show the superiority of the roller plan, not as regards the mere killing of locusts, but from its cheapness, and being within the reach of nearly all who are now troubled with the pest, or may soon be so, when the eggs now deposited in the soil are hatched. The double shaft and driver's box above the roller might be dispensed with, and a "pertigo" shaft substituted, answering nearly the same purpose with less expense,

while a log cut from a eucalyptus tree or willow, and hooped at both ends, which I suppose is the idea of Dr. Munro, whose article I did not see, might make an admirable roller without going to the expense of stone or metal, and, if too light, a contrivance to hold stones or other heavy weights, as one sees on the street rollers at Palermo Park, could be added. Such a roller could be used effectively for the destruction of the flying locusts as well as of the saltonas, for the former never rise until the sun is up, and the rollers could be down on them at break of day. But I would particularly recommend the camp people to adopt Mr. Bannon's capital plan of running their flocks down the encampment of the locusts at the time. Another plan I heard of was a compulsory measure for the gathering of eggs, which I believe was tried last year in a visited district in Las Rosas, Santa Fé. Every householder round had to deliver to the "Comisario" so many kilos. of eggs on a certain date, the result being a collection of twelve tons; and there is no mistake that if this were enforced throughout all the affected places, and rewards given to the collectors of the eggs, it would prove valuable for the end intended.

J. M'GOWAN.

DR. MUNRO'S REPLY

28th November 1891.

TO THE EDITOR OF THE *Herald*.

249. "Galvanic Battery."—DEAR SIR,—In regard to the article I wrote on the locusts and a new proposal for their extermination, I beg to encroach on your space still further, as I have had some private communications on the subject—all of them satisfactory and encouraging—and your columns have contained two suggestive and excellently characteristic letters. With regard to the letter of "Galvanic Battery," you have appended a note yourself—very pertinent to the point—demonstrating by a simple question the total inexpediency of an "electric wire gauze fence" as a means of extinguishing this pest, on account of the cost alone, and therefore I need not say much. Now it is a pity that the writer, having evidently taken much trouble, should not have gone somewhat into figures on the subject, in order to clearly convince your readers that it is, as he says, the *best, most practical, and cheapest means* for killing any quantity of saltonas; the italics are his own. The writer has scarcely realised, I should suppose, that he would require from 3000 to 5000 miles of this fence through the country; and I believe it would cost much more than the "screen and trap" system, which is a proved and comparatively cheap successful system, but which we have already seen to be out of the question to attempt in a country like this, that has no public funds or people to put it into force, apart even from our existing terrible financial crisis.

250. "Fence" scheme requires further explanation.—Further, perhaps your correspondent, "Galvanic Battery," would explain, as he seems well up in physics, how the gauze wire fence he proposes would be effective in killing the saltonas. The current could only kill when the circuit is complete. The saltona would be safe and

unharmful if it did not touch the wire gauze and the earth at one and the same time—the circuit would then, in this case, be complete. I doubt therefore, apart from its too great cost, if the means proposed would answer the purpose intended, but an experiment by which “Galvanic Battery,” or someone else to whom the plan recommended itself, might easily test its applicability, would satisfy us on this point: so much for this third line of defence.

251. The moat.—With regard to the second line of defence, namely, a moat between the ground set apart for rolling and the cereals to be preserved, I would suggest that such moat would only impede the march or progress of the column, and such impediment from its results would not reimburse the cost of outlay in money and labour. Water could not easily be found at a depth of 3 ft., and then it would not be a running stream. Moreover, it is certain that in Cyprus the saltonas could easily have come out of the pit, which was 4 ft. in depth, had they not been effectually stopped by the layer of tin projecting into the pit about 3 or 4 in. all the way round its margin—this was the “trap.” So much for the inefficiency of the second line of defence, which, as I have shown, could be only a hindrance or slight impediment, and pretty much the same could be obtained by a series of deep furrows of the plough, if wished.

252. The auxiliaries.—Let me say a word now as to the auxiliary of the first line of defence, which, paraphrased, consists of “children, peons, and others, armed with smaller manual rollers, and acting as a light brigade.” The cost of small manual rollers with their equipment would amount almost to that of ordinary large wooden rollers, and, as almost every child in the camp can ride, and as there are many horses, the better plan, in my opinion, is to mount all with rollers—proper horse rollers—and let attention be centred on this one means or line of defence, and not diverted into other and doubtful modes. I am, however, much obliged to “Galvanic Battery” for his kind and warm general approval of my suggestion, and I should be much more so if (should this letter catch his eye) he could but put the idea I have formulated into practice in a few places, and let us know the result.

253. Mr. M'Gowan's letter.—I come now to the letter of Mr. J. M'Gowan in your issue of the 25th inst., and I have to thank him cordially for his testimony, and through him for that of Mr. Bannon, to the effect that the roller system was successful, and is the most expedient one. That is the first satisfactory corroboration of the utility of the plan I have publicly suggested. I think the matter of “novelty” is more or less immaterial, and perhaps should be touched on with a light hand. Were my humble effort of no more use than to draw forth this public testimony, it would not have been entirely useless. Now that we have got Mr. M'Gowan's ready pen as a mouthpiece for Mr. Bannon to certify the success of this system in an isolated chacra in Belgrano, extending to fifteen squares of maize, we may hope surely to hear of further data respecting this method, seeing that the plague is now so widespread in this Republic, for it is over almost every part of every province, therefore we have to deal with a superficies of 1,200,000 square miles. However, sometimes there exists an hiatus between knowledge and the application of that knowledge. Chloroform

was known previously to 1847, but it was not till that year that the distinguished Sir James Y. Simpson (whose private assistant I had the privilege of being) made its application as an anæsthetic known to suffering humanity, the discovery of which merited from the Queen the highest patent of honour—a baronetcy—which has at any time been bestowed on any of the humane members of the profession to which I have the honour to belong. Humanity, however, will for ever be indebted to him, and regard him as a “p(ion)eer,” if his Queen and country were unable to make him a peer.¹

254. Dr. Munro's scheme has succeeded.—I claim nothing. I merely propose, in a humble and respectful way, a method for killing locusts, which I never heard of as practised in this country, but which, apparently, was successfully tried once on a chacra in Belgrano in 1852. I am sure the public will be (as I am) thankful to Mr. M'Gowan for bringing to the surface, rescuing from obscurity, and making public the experiences of Mr. Bannon in this matter, and it will be a just cause of regret (I shall not use any stronger term) that Mr. Bannon has not seen his way clear to give these experiments *sooner* to the exacting and thirsting world. If the plan which we have now his authority for endorsing with his imprimatur, as having a “superiority to all others,” be truly good and suited to the requirements and exigencies of this country, then it is a loss to the commonwealth that it has not been divulged during these forty years, or at least received the attention it deserves, in view of his long experience. To make up for this loss, Mr. M'Gowan now steps into the breach, and I trust he will, by his activity and courage, endeavour to put the plan into practice in several parts of the country, and let us have the result carefully detailed. If so, I shall be glad, for I believe our aims are identical.

255. Need for enlightened public spirit.—In trying to combat a plague of this sort, indifference, slothfulness, pusillanimity, opinionativeness, all sorts of illiberality, and a carping spirit ought to be laid aside—there is plenty good and true work for everyone to do. The country needs at the present time every man's complete powers and energies, both in practical duties and intellect; but some of us are so indifferent that we do not care to apply ourselves to anything outside our own limited spheres and circles; many will not be at the pains to exert such intellectual faculties as they possess for discovering the truth—far less scattering seeds of usefulness and hopefulness; often we are too selfish or proud, and do not care to enter into the patient weighing or sifting of arguments, or an analysis or sustained reflection; while others, again, are satisfied with their own opinion and methods, and consider those of the outside world as childish or futile. Thinking out a thing is not always an easy work, and balancing one statement against another and coming to an actual decision, concerning the result, means a painstaking, often of a rare kind. All truthful data and careful observations which are submitted and recorded will be a gain to the nation, and the present state of the country is especially indicated for this purpose. Imperfect discharge

¹ Since the above was written, in 1892, this reproach on the noble healing art has been wiped out in the well-merited distinction, by making one of its members a peer of the realm in the person of Lord Lister.

of individual duty is a loss to the wealth of the State, and slothfulness in the discharge of the daily offices of life is not without blame, since it is more or less the hiding of a talent in the earth and neglecting a part of the responsibility entrusted to every member of the Republic. The commonwealth is by so much left poorer, from the lack of what a full diligence from each might have supplied.

256. No time should now be lost.—I therefore trust that more may come forward and follow Mr. M'Gowan's example, and not allow thirty-nine years to pass without some progress as to the wisest and best means to be adopted for battling with such an enemy as the scourge that now threatens us—if not this year, then it may be the next, or it may be in a few years hence—we cannot tell, for we have no data sufficient to enable us to give an opinion. To-day we ought to be up and doing, so that we may put ourselves in a condition of preparedness to be able to meet the enemy to-morrow—whenever that morrow may come.

257. Tramping with hacienda.—Concerning Mr. Bannon's plan of killing the flying locusts as they camp, I think it is a very good means, namely, tramping them with hacienda (cattle), or, as Mr. M'Gowan suggests, by the rollers when expedient, and I can only further refer him to my second of the five epochs I have enumerated and dealt with for attacking and destroying the locusts as bearing directly on this point. I am of opinion that, next to attacking the saltonas, more slaughter could be effected when the flying locusts camp than at any other time. But this means is limited, and could not be had recourse to when they settle upon the growing crops.

258. Egg-collecting.—I need not refer to what Mr. M'Gowan says about "egg-collecting" as a means of destruction, but would refer him to what I have already written on the subject. I might here say, respecting this matter, that the reputed extermination of the pest through the egg-collection system in Algiers by the French would seem still to require confirmation, as I believe from the article that appeared in your issue of 17th September, on the authority of Mr. Stuart Pennington, that the insects "have caused and are causing at the present time great losses in that French colony." This was the only place where the egg-collecting system pure and simple was supposed to have been successful. I am not surprised on *a priori* grounds, but I am sorry to find that there is a doubt thrown upon its success. Let us hope that further evidence and data may come to hand on the subject and clear it up.

259. A correction.—Now, Mr. Editor, having discharged the above duties, I am glad of an opportunity to make a correction in the text of my original article—a correction in itself immaterial, so far as the main questions are concerned.

260. Deaths from natural causes 10 per cent.—I allowed too small a percentage for the deaths of the locusts, either in the flying state or destruction among the eggs, from what I termed natural causes, such as, for example, from birds, gulls, worms, flies, etc. The locusts have many enemies, undoubtedly, and no friends. The exact percentage of deaths from these natural causes no one can know; but, even allowing it to be 10 per cent. instead of 5, all the same we should have to contend

with a plague from the remaining 90 per cent., sufficient to devour all, and to actually destroy the work and hope of the husbandman. In countries visited by locusts it is usual to reckon that, on an average, from 30 to 40 per cent. of the crop is lost, and from 60 to 70 per cent. is saved, either by the crop being gathered before or long after the visitation of the insects. Some have ideas about the gulls and other birds, such as the gaviota, that they have a wonderful adaptability for destroying the flying locusts, and I believe they have; but I have seen, when passing through the Santa Fé colonies by rail, to an extent of 200 kilometres, sufficient to convince me that the influence of birds is overstated in this matter. The whole atmosphere, to the extent above mentioned, was literally full of flying locusts, as far as the eye could penetrate, and probably they were as broad or broader in extent than they were in the length stated. Now, where were these birds of nature at that time in this case, and what number of birds would it require to combat such a number of insects? It is impossible to conceive that they could exert a powerful influence in the ordinary sense of things.

261. Nature as yet has no remedy.—Moreover, the very process—a purely mechanical one—as alleged, namely, of gobbling up the locusts and immediately vomiting them again, would of itself injure or kill the birds in time, if continued long enough. This is only reasonable, and, as far as we know, it would be unreasonable to expect the contrary. Gulls and these other birds are not very common in this country, and certainly not common enough to attack and make an impression on the myriads of locusts we see here. Therefore, from my point of view, birds can only do a very limited amount of injury to locusts, nor do I think that nature has as yet provided us with a remedy or a means for annihilating them; if so, it could scarcely amount to a plague. When all is said and done in regard to what birds, worms, flies, diseases, etc., can do, the plague remains a plague in all its terribleness, and, except in one instance, has baffled human ingenuity to contend with it.

262. What was accomplished in Cyprus.—Cyprus was occupied by the British in 1878, but the processes or systems formerly in vogue, such as egg-collecting, were continued under British supervision during the first years of occupation. They passed Acts obliging every adult male inhabitant to collect, either personally or by labour, 80 okes or 22 lbs. of eggs, but there was no serious abatement of the plague in 1880, and up to June of 1881 a sum was expended of £5739. On the contrary, there was a manifest increase of this plague in 1881, and hence the authorities decided to collect eggs on a scale that was never heard or known of before in the island. On egg-collecting alone was spent £12,262, and for this no less than 1330 tons were collected and destroyed, and notwithstanding that these operations were carried on by this and other means, yet the pest increased, so that altogether a sum of £32,470 was spent in these five years. The British authorities, however, had learned a lesson, and had come to the conclusion that egg-collecting as a means for exterminating the locusts was quite unsatisfactory, and from this date, 1882, they abandoned it altogether. They adopted the next year the "screen and trap" system alone, and spent on this £12,511 till June 1883, which helped them by this means alone in that year to exterminate almost the entire pest. The same

means were, however, used in 1884, and at almost the same cost as in 1883, and the plan proved completely successful. The entire sum of £66,841 was spent over these years.

263. North American inventions.—Perhaps you would allow me in conclusion, for the satisfaction of those who may be trying to invent machines for destroying the locusts, to say that of the thirty-eight North American inventions—

Four were for burning locusts.

Twelve were for crushing locusts.

Four were for trapping locusts.

Eight were for burning locusts with kerosene and coal-tar.

Ten were for catching locusts and bagging them.¹

So far as I can judge, or have been able to learn, there has been no chemical preparation—either kerosene, quicklime, carbolic acid, or other chemical compound, such as sheep dip—that can prove efficacious or be trusted to as likely to be effectual or expedient in this country for the purpose of exterminating the locusts; nor have I heard of any instrument, clever and ingenious as many of them are, likely to attain the end in view. I recommend, meantime, the subject of attacking the *saltonas when on the march* by the rollers to the serious consideration and attention of your readers, and I remain, yours faithfully,

Æ. MUNRO.

TO THE EDITOR OF THE *Herald*.

264. Two sides of the question.—DEAR SIR,—Dr. Munro's efforts to destroy the locusts are highly commendable, as they are calculated to aid in killing these innumerable pests, and I sincerely trust that his method, and every good method directed towards so laudable an object, will meet with success. But there are two sides to this question, and it is necessary to consider the *pro* arguments and the *contra* as well.

265. Pro.—I accepted Dr. Munro's affirmations, and I examined at the *Herald* office his proposed "ground of operations" in a "blue copy of the plan," admitting the following data:—

1. That a colony of the form of a rectangular parallelogram, subdivided into fields, of a similar form, of cultivated agricultural products, and which colony was accurately situated with its boundary lines coinciding with the four cardinal points, was the field of operations. This colony was liable to be attacked by an invading army of *saltonas*, which would invade the northern boundary only, as they would proceed from arid land situated to the north of the colony, and would surely move, impelled by blind instinct, towards the south only.

266. 2. That locusts lay their eggs in arid spots, as laid down in

¹ Inasmuch as Prof. Bruner, during his year's engagement in S. America, has never advised (judging from the Report) the use of any of the machines referred to above, illustrations of some of which are to be seen in the two famous American Reports (1877-78), it is therefore reasonable to suppose that in his opinion they were not so good for the purpose as those already in existence in the Argentine, and which are shown in his Report, and are hereafter, with his kind permission, reproduced. And, after careful examination of the details, I agree with his view of the matter.

the blue copy of the plan, and hatch them the same year. Now, admitting this view and the statements as facts, I consider that my "electric wire fence" would aid Dr. Munro, as it is cheap and practical. It has nothing to do with dynamos, motors, or fuel, as the note appended to my letter supposed, as I restricted myself in my letter to galvanism, and hence the notes were a misapprehension of the matter.

267. The "electric wire fence" should be composed of alternate positive and negative wires, which, passing through upright wooden perforated sticks, would form the fence, consisting of a negative screen and a positive screen; the continuous wires would terminate in the poles of a powerful galvanic battery, intercepted, of course, by a powerful Rhumkoff's coil or induction bobbin. Of course the wires and the pile and bobbin would be affected by galvanic electricity, and not by static electricity, and therefore would not need to have any communication with the earth, as Dr. Munro supposes.

268. Suppose the colony to be five squares in frontage and twenty squares deep, then there would be a hundred manzanas under cultivation, with a north boundary line of 750 varas to defend; say 800 varas, to allow a margin. Now, suppose we place four positive wires and four negative wires in our fence, we require 6400 varas of wire: that is not much. Then, say that at every fifty varas we place a wooden key—that would give us twenty wooden keys, which we could make with a few pine boards; the two end keys would cost at the most 10 dols. each, say 20 dols. The end keys are to act as wire leaders to form the positive and negative screens; they could be constructed in two hours of pine and the "leaders" secured, so that is no great difficulty. The Rhumkoff coil would cost, say, 200 dols. gold; that is very little to save a hundred square squares of produce from the locusts. This Rhumkoff coil would kill foxes, bizcachas, polecats, locusts, insects of all kinds, if united to a battery of, say, forty jars. The galvanic battery would be always working, and never get tired, hungry, or sick. There are plenty of galvanic batteries which might be employed, according to the size of the colony and the amount of money disposable; for instance, any of the following batteries could be used: Maiche; Sir William Thompson's; Daniell's battery; Latimer Clarke's Daniell's battery; Kohlrausch's Daniell's battery; Grove's, Bunsen's, Latimer Clarke's, Leclanche's, De la Rue's, Marie Davey's, Bichromate battery, and others. The only care required would be to have one good man to attend the battery and Rhumkoff coil, and lots of children or peons to keep dead locusts from forming heaps against the screens of the fence. I prefer the moat, so that the locusts could tumble in, and the saltonas finding their dead relations most probably would feed on them and move on towards the fence, when a shock would do for them effectually, after they had climbed the steep wall.

269. Contra.—Now that I have spoken of the *pro*, I have to add the *contra*. Practical farmers and an Argentine naturalist (who has studied the matter) state that Dr. Munro's rollers and my electric wire fence are useless, because locusts lay their eggs everywhere, and generally on cultivated land. Our species is the same (so the naturalist stated to me) as the locust which is found in the United States, and

there the farmers find that pigs are the best remedy. The pigs are turned into lands which have been frequented by locusts, and the pigs eat the eggs which they root up. The eggs are hatched in the year following the one in which they are laid. Of course, if this *contra* statement be true, Dr. Munro and your obedient servant are at sea; and rollers and electric batteries may do some good, but, on the whole, they would fail to eradicate the plague.—Yours faithfully,
“GALVANIC BATTERY.”

LOCUST-KILLING ROLLERS

TO THE EDITOR OF THE *Herald*.

270. Rollers cheap and effective.—DEAR SIR,—After the exhaustive treatment the above is receiving in your paper, with the various plans suggested and actually tried to help in the extermination of the locusts, nothing more is required than for interested parties to operate the one they think best for themselves. Now is the time for an enterprising machinist or wheelwright to make his fortune, perhaps by constructing “locust-killing rollers” after Dr. Munro’s model—seeing it is about the cheapest and most effective application to the evil yet known, entailing little expense and labour to operate, a handy apparatus not only for locust-killing purposes but for other uses as well about an estancia farm.

271. Rollers have succeeded.—No estanciero in fact, in places noted for locust visitations, should be without two or three of these rollers, having them ready for immediate use when the saltonas appear in vast numbers above the surface, and for the destruction of the flying locusts as well when settled down for the night. This is certain, as mentioned in my previous letters, that they have been tried and found to do their work most thoroughly, and what can be done once, given the same conditions, can be done again.

272. The roller plan Dr. Munro’s invention.—If the roller plan is to prove valuable hereafter as a locust exterminator, to Dr. Munro belongs the honour of the invention, or at least of bringing it to the forefront in these days, the time being so long since the Belgrano experiment that Mr. Bannon, being only a boy then, and describing just what he saw, has no distinct recollection if the idea was Mr. White’s alone, to use the rollers, or that of another’s. What brought the matter fresh up to his memory was his seeing, in the *Southern Cross* and *Standard*, letters on the locust invasions, some time previously to Dr. Munro’s publication of his idea, when he suggested to me more than once the propriety of informing the public of what he saw done at Mr. White’s chacra, but it was not until I read the article by “Galvanic Battery” in your issue of the 17th ult. that I knew of the publication mentioned, and we determined on publishing his information, not certainly from any envious desire to depreciate the value of the discovery, as made by Dr. Munro alone, but rather to confirm the public faith in its merits, by describing in actual detail his plan as having been successfully tried and operated, and he deserves the best thanks of a

large section of the rural community of this great country for suggesting a cheap and effective remedy for the locust pest, which, if it will not entirely destroy an invading army, will at anyrate reduce its destructiveness to a minimum.—Yours truly,

J. M'GOWAN.

DR. MUNRO'S REPLY TO "GALVANIC BATTERY"

December 8, 1891.

TO THE EDITOR OF THE *Herald*.

273. Comments on several points.—DEAR SIR,—In your issue of the 4th inst., "Galvanic Battery" has again favoured your readers by amplifying his former views, but there are several statements in his letter that would require comment. However, I purpose noticing two or three only, for I do not wish to weight your columns in this case by entering upon topics of mere debate. To anything practically calculated to throw light or excite thoughtful attention on such a dark and interesting subject as the locust plague I shall be happy to subscribe my quota.

274. Laying and hatching of eggs.—All writers on locusts, as far as I know, and naturalists—I can produce the names of several of unimpeachable standing—aver that the locusts lay their eggs as I have stated, viz., in dry hardish waste ground, and not in loose cultivated damp earth; and further, that these eggs are all hatched in about forty days, more or less, according to some influencing accidental circumstances in localities and climates similar to the Argentine, with the species in question. When the locusts migrate and the mangas are vast and extensive, covering hundreds of leagues, no doubt the females must deposit their eggs in the best parts they can select over the cultivated land when nothing else is open to them. Land hardened after tillage (*i.e.* fallow land), and land along the sides of roads or railway lines which has become settled and hard, and on an incline, and freed from the rootlets of the natural grasses, are parts specially selected by them, because easier in which to bore or burrow, and the rains run off without penetrating the soil, and thus the eggs are less likely to be injured. The very habitat of the locust is in dry, arid, waste lands or deserts—this is constantly seen in Egypt, Arabia, Cyprus, the Rocky Mountains, etc. etc.

275. Scientific authority wanted.—The statement that "the eggs are hatched in the year following the one in which they are laid" is contrary to all authentic observations and opinions on the subject. I have never seen any such statement authoritatively recorded, and I venture to think "Galvanic Battery" should fortify this remark by giving his authority for this statement—either some standard work or a living authority of weight and repute, except in more temperate climates and with other species.

276. Name wanted.—Having first protected himself under the shield of a *nom de plume* (to which I do not object, for it has some obvious uses, as, *e.g.*, impartial criticism, and helping on or complimenting a friend with or without that friend's knowledge, etc.), he ought not,

I submit, Mr. Editor, to resort to an additional covert by merely asserting as his authority "practical farmers and an Argentine naturalist" who have studied the matter, but he should give these authorities by name, so that we might know what value to attach to the statement, and respect them for teaching us the truth. Random, hasty, irresponsible assertions are not always safe.

277. "G. B.'s" view in contra.—Upon this statement, to which "G. B." appears to give credence, he hangs the plan that pigs are the best remedy for exterminating the pest, and that therefore there is no occasion to invest in the "electric gauze wire fence" with its necessary paraphernalia. Where have we the pigs in this country to do this mighty and benevolent service, even if we had a year in which to do it, which we have not? The female here appears to make one encasement, with not less than seventy eggs or more arranged in it; but in Cyprus it was observed that she made at least three of these, with about thirty eggs in each; otherwise, the rule is as I have stated; but if "G. B." chooses to believe the authorities he mentions, well and good. While they may be sufficient for him, yet I venture to think your readers will not be satisfied until they receive publicly the dictum signed by men of weight, because it is against all received and recorded opinions on the subject. So much for "G. B.'s" view in *contra*.

278. Saltonas march in one direction.—As I have noticed, in "G. B.'s" inferential bearing, some hesitation or doubt in accepting what I stated in regard to the direction in which the saltonas march, being anxious to secure his good offices and co-operation, I wish to say something on this matter, and, in doing so, would beg his attention again to what I have said in my article under heads 12, 14, and 15.¹ In Egypt, in Cyprus, and in North America, it has been observed that these insects travel in known directions. In Santa Fé last year, I know in several instances that they travelled southwards, *i.e.* not east or west, but towards the south. It might be south-east or south-west, but it was *southwards*, and this was manifestly the case when it would have suited them much better, so far as pasture, etc. etc., was concerned, to have gone precisely in the opposite direction. Now, as locusts, *e.g.* in Egypt, come from the west, and the saltonas there travelled towards the east, so I reasoned, by analogy, that as they here come from the north, the saltonas must travel towards the south, and this is compatible with and corroborated by what I have known. But this has reference to the case when, of course, they are free to choose and select their course. We know if they happen to be on the march and come upon a path or railway line, they will preferentially take this line, which, of course, is an entirely different matter. But this point is evidently one for verification in this country, and is not so material to the plan I have suggested as "G. B." thinks. The important thing is not that the saltonas march south, east, west, or north, but that they march in *one* direction as a body, irrespective of all danger.

279. Attack the vanguard.—The manga may be one, two, three, or more miles in breadth, and naturally the column will be denser in some parts than in others, but the column—all of it—marches in one

¹ These numbers refer to the epitomised heads, which, as already stated, have here been omitted, because included in Book I.

general direction—an army on the march. Now the plan I have suggested is to attack the vanguard, and the vanguard of this army only, in a given prepared space, and wherever that vanguard may be encountered, by a sufficient number of ordinary wooden horse rollers, which are not only inexpensive but useful, indeed requisite implements on every well-equipped farm; and though a small outlay at the outset is entailed at the time, it will prove a good investment to the farmer in the end, *i.e.* even after the plague ceases to trouble him. I might in passing mention that the rollers might be in sections, and so constructed as to allow each section to have great play, either by making **the axle holes large**, or in some other convenient way. The rollers would thus act better if the ground set apart happened to be uneven—having depressions and prominences, etc. I had this specially in view when I mentioned bordalesas as answering the purpose of rollers. The rollers, however, should not go “to and fro”—here and there—as Mr. Bannon said was done in 1852. I advise that the rolling or killing should be done systematically, namely, keep to a definite limited space and slaughter them there. I hope now that I have made this matter sufficiently clear, and “G. B.” or anyone else (especially his “practical farmers and an Argentine naturalist”) can easily be satisfied on this score by a visit of inspection to where saltonas are now. Let them make a trial.

280. Electric fence too expensive.—From what I have said I trust that “G. B.” will not imagine that I am opposed to his plan or to any plan likely to prove effectual in extirpating the pest, or that there is anything actuating me of the “dog-in-the-manger” principle. Quite the contrary, I have been prompted throughout by the impression that the authorities are on the wrong tack altogether in trusting to and encouraging the “egg-collecting” system, which, from the experience of careful and intelligent men charged with the supervision of this matter, has been shown to be perfectly unsatisfactory, discarded, and abandoned, while these same men have obtained complete success by another method—which method, however, is too expensive to be adopted in this country. With regard to “G. B.’s” special plan, let me say that while I admit frankly his double current (positive and negative), which I did not think of at the time, through gauze wire in his electric fence, would kill the insects, no doubt, yet I believe he will find a serious difficulty to obtain anyone willing to try it, on account of its evidently apparent expense. Now, looking at the matter as “G. B.” states it, and taking 5 squares by 20, I do not see why it should be 20, it would be more in accord to be five or six times the amount, or say 20 or 30 squares in frontage, making thousands of squares in all, and not 100, to make the comparison fair and equitable.

281. Cost of installation has been minimised.—Of all the items necessary for such an installation as he proposes, he has only given the probable cost of two, namely, two keys at 20 dols., and the Rhumkoff coil at 300 dols. gold. He has left out of account altogether the price of electric wire, the wooden keys, the boards, the gauze, the battery or jars, the labour of children, peons, and artisans to erect, skilled labour to construct, and “one good man to attend the battery,” etc. Besides, he does not say whether these prices would mean de-

livered here, and we all know what the premium on gold is when we have money to send to England, and the present price of all imported things. Further, he does not tell us whether or not sufficient of the articles he mentions can be found now in the country, or if we have to wait for their arrival after sending an order—most people know the delays in obtaining goods when ordered from England or Europe. Then, again, is there a sufficient number of good men—men like “G. B.” himself—to be found, who understand the work, who can put their hands to anything, and who can make the requisite keys, etc., at little or no cost? For if not properly equipped and attended to, I fear such work would very often be a failure instead of “never get tired, hungry, or sick.” Such an outlay, in my opinion, in this country would cost, in the circumstances named, more than the value of the crop on the ground; but then, of course, I may be mistaken. I have no data sufficient to make me change my opinion. Moreover, the colonists cannot pay even the little that “G. B.” mentions for one article, namely, 200 dols. gold. What colonist can do this at present? But if in one colony, we must then extend it over all—every province. And “G. B.” proposes this as an auxiliary or aid to the rollers I have suggested. But I can only say respectfully that it is inexpedient, in my humble opinion. I therefore, for these reasons, fail to realise that it can be of use in abetting the plan I have suggested, namely, of crushing the saltonas by rollers, and thus materially help to check if not to exterminate the plague.

You see, Mr. Editor, I have gone more into details than I intended at first, probably in the hope of convincing and winning “G. B.,” and at all events I have tried to make a fair bid for getting him along with us; and I remain, yours faithfully,

Æ. MUNRO.

“GALVANIC BATTERY’S” PROPOSAL

TO THE EDITOR OF THE *Herald*.

282. The wire fence withdrawn.—DEAR SIR,—I see that Dr. Munro, in his able article on “Locusts,” in reply to me, says, in reference to the direction taken by the saltonas: “In Santa Fé last year, I know in several instances that they travelled southwards, *i.e.* not east nor west, but towards the south. It might be south-east or south-west,” etc. As Dr. Munro has modified the statement of data, it is fair therefore to state at once that my electric gauze wire fence would not answer, because as there is doubt as to the direction which the saltonas would take, for they might move to the south-east, or to the south, or to the south-west, therefore there would be an arc of 90 degrees no doubt, a quadrant or the fourth part of a circumference, on or towards which they might move, and in that case Dr. Munro’s rollers would be efficient, because they would meet the emergency, while my fixed electric fence might not be visited by the saltonas at all, and would not be susceptible of being changed about as varying circumstances might require. If the direction had been infallibly determined, I think that my electric shocks and permanent currents would have met the difficulty, but as it is, I fear that Dr. Munro will

have to cope with the saltonas alone, and I wish him every success in his attempt to aid the prosperity of the country by mitigating one of the greatest evils to which our agricultural colonies are exposed.

283. Rollers par excellence.—Accepting the data, as stated in his last letter, I feel great pleasure in publicly asserting that Dr. Munro's system of rollers is undoubtedly the best one that I know of, because it is practical and not expensive, and until I have positive proof to the contrary, I consider it the best one.

284. Nom de plume.—With reference to the Argentine naturalist, I am not at liberty to give his name, but possibly, ten months from this date (if alive), he will return from an expedition he is commanding in one of our territories, when I trust he will make his views public.

Repeating my sincere wish that Dr. Munro's efforts may be crowned by success, I remain, Mr. Editor, yours faithfully,

"GALVANIC BATTERY."

DR. MUNRO'S REPLY

17th December 1891.

TO THE EDITOR OF THE *Herald*.

285. Saltonas travel southwards.—DEAR SIR,—I note with pleasure "Galvanic Battery's" position as stated in his letter in your issue of the 15th inst., now to hand, and in concluding a correspondence which has been both pleasant and I trust fruitful, I would add one word to prevent, if possible, the conveying of a misleading impression. The subject is surrounded with difficulty and obscurity. I have not "modified the statement of data" I made in my original article in regard to the direction in which saltonas travel, because at present I see no reason for doing so. I said the saltonas travelled towards the south. I say so still. The terms north, south, east, and west are subject to a different meaning than exactly "coinciding with the cardinal points." When we say it is a north wind, we make reference to the general direction from which the wind comes, and not to the exact "cardinal point," or due north. I think, therefore, when I said towards the south or southwards it would, I presume, be understood by, and clear to, most of your readers, at all events, if not indeed to all, that some latitude was meant to be allowed.

286. Testimony to the contrary invited.—Have any of your readers seen or known the saltonas going, for example, from the south to their northern neighbours? I can produce several instances of the converse in this country, namely, that the pest comes from the northern neighbour and affects the southern. I exclude, of course, the question of direction when the saltonas have plenty of pasture in which to eat from birth and rest until the time arrives for them to commence their march, and then I believe it will invariably be found—"infallibly determined"—to be towards the south in this country. I have never heard or known of their going, for example, in the opposite direction.

287. Remedy should be tested.—I am much obliged to "Galvanic Battery" and to Mr. M'Gowan for having expressed their views so frankly on the subject, and I think we have now obtained a pretty

unanimous consensus of opinion from them (and I suppose they represent many more), to the effect that the best mode of killing the saltonas when they are on the march in this country is by crushing or slaughtering them by means of rollers. The saltona stage is the most destructive of this voracious insect, and it may last twenty or thirty or more days. Of course, in the very early stage, during the first few days before the march begins, there are various modes—all useful—in which they may be killed, and one part may be suitable for one mode, and another for another: in this way, in one place, hacienda (cattle) might destroy them best; in another part, when they are gathered together in small lots or heaps, they could be burnt, or crushed by rollers if the ground be suitable. Although my critics and myself are fortunately at one in considering the "rolling system" the best means for exterminating the plague, I hope they will exert themselves, and induce farmers who may have saltonas to carefully test the matter and let your readers know the results—without this, all our writing and correspondence will be in vain.—I remain, yours faithfully,

Æ. MUNRO.

MONTE GRANDE, TUYÚ, 13th January 1892.

TO THE EDITOR OF THE *Herald*.

288. Subsoiling.—DEAR SIR,—If the interest in locusts is not yet subsided, though it is really surprising that your patience is not by this time exhausted in permitting such an unpalatable subject the honour of so much space in the columns of the *Herald*, perhaps you will allow a fresh idea or two to be published on how to kill them or nip them in their buds of creation, as suggested to me by Dr. Greene, an able authority here on such matters. We believe that if the places where the locusts have their eggs, generally on old rodeos or ground pretty free from long pasture growths, are subjected to the action of subsoiling, the ploughs turning up the soil for a depth of ten inches and seven in width, the eggs which are laid at a depth of about two inches and in masses of about 80 to 120, as already described in the *Herald*, would thereby be smothered, those coming to the surface being crushed and smothered, and broken by cross ploughing, or, if need be, by harrowing or by the use of rollers on Dr. Munro's principle, or they would be eaten by the seagulls and other birds which are generally seen on newly-ploughed fields feasting on the grubs and worms turned up.

This idea is recommended along with the others, particularly to those agricultural farmers who are, or may be, during another such locust visitation as the present, in condition to develop it practically; and, as a capital way of killing two birds with one stone, they would be getting rid of injurious intruders on their gardens and field crops, and preparing the ground for future cultivation. If Mr. Reade be correct in his theory that the home of the locusts is about the Gran Chaco, in which case to get at them there in their nursery haunts and to destroy them if possible, his plan is undoubtedly the best recommended. It is, however, largely hypothetical, and I am afraid that the pest is not yet sufficiently widespread and destructive to induce the Government to

appoint a Commission to ascertain its validity, the trouble, danger, and expense also incurred in other ways being immense. Dr. Greene tells me that he saw on an adjoining *estancia*, during a former invasion, some of the plans partially suggested by the other writers to get rid of the locusts very successfully tried, and I see by the papers that they are now proved in other parts of the country, namely, the burning of the camp, before, in front of, and around the advancing *saltonas*, and the making of ditches close to gardens where they were, and the rushing of them in and filling up the ditches—burying them alive, in fact. I will conclude by mentioning what has been frequently observed, namely, that seagulls, after gorging themselves to the full with hoppers, go for a drink, then vomit up all and return for another feed. So, what with rollers, ditches, galvanic batteries, fires, seagulls, and preserving for food, blowing up with gunpowder, crushing them in their germinal developments, hunting up their cradles, *pamperos*, etc., and all else you have kindly permitted to be suggested in your columns, the readers' stock of knowledge will doubtless be considerably increased on the destructive science of locust-killing.—Yours truly,

J. M'GOWAN.

THIS IS HOW THINGS ARE DONE IN THE ARGENTINE!

289. Señor Sicaire's plan.—"Among other proposed modes of destroying locusts is that of Sr. Sicaire. It consists simply of a zinc tub which is sunk in the ground, the edges being level with the surface. The locusts walk into the tub and are there killed by some chemical liquid. A satisfactory trial of this simple apparatus was made in one of the Santa Fé colonies, and Sr. Sicaire asks, as a moderate remuneration, for four square leagues of camp!"

Had Sr. Sicaire been one in the "inner ring," and gone about the matter in a more artful and discreet way, there would be at least a possibility of his request having been attended to, and something come of it. As it was, it was simply ridiculed.

HOW TO TREAT LOCUSTS

GOYA, 14th November 1896.

290. Mr. Perrens' views.—The locust question is attracting a good deal of notice just at present. There appears to be much haziness surrounding it. The question is grave, and very few people, if any, appear to have grasped the magnitude of it, judging from the various plans put forward for their destruction. I first saw locusts in 1870, and since then have had to defend my crops in different years, so I may claim to be somewhat familiar with their ways and habits, so far as they could be studied in this province of Corrientes. In the first place, I should like to air a theory of my own concerning them. I believe that they propagate twice in the year, once in the north, presumably in Brazil, when they come here. My reasons are these: when they first appear from the north, they are in the same condition, identically, as regards colour, size, etc., as those which are hatched out

here, when they first fly; therefore I believe that they have just received their wings, and, as they soon change after arriving, that therefore they cannot be the same as those that fly away from us in February. They generally arrive in September and leave in February. I believe every individual locust only lives six months.

291. Not on the defensive.—The idea that they come from this or that lake is all bosh, it is not their habit to lie around promiscuously; if it were, there would be some hope of getting rid of them. Every female lays her eggs in the hardest ground she can find, separately, 3 in. deep, and each nest has about eighty-two eggs. Every nest communicates with the surface by a small pipe of dried spume or froth, which the young eat, and so reach the daylight. If anything happens to this pipe (it is a little over $\frac{3}{16}$ in. in diameter), the young locust is imprisoned and dies. Therefore, by hoeing or harrowing, or by any other means stirring the soil to the depth of $\frac{1}{2}$ in., the pest is destroyed where it is most concentrated; but where are you going to get people sufficient to scratch all the Chaco, to say nothing of the populated provinces, and then their maintenance and carriage? The question is a big one. I see nothing for it at present but to act on the defensive, complete destruction being out of the question; but by destroying eggs and saltonas near chacras, much property may be saved. The eggs take twenty-two days to incubate, and the young emerge about the size of a house-fly, and the colour of light cream; but a day's exposure to the sun turns them quite black. This colour they maintain until the first shedding of their skin, which occurs in about a month, they then emerge yellow and black, and shed their skin again in fifteen days, keeping of the same colour; and in fifteen days more they shed the skin for the last time, and come out with wings of a dark Indian red. They are then perfect locusts, and at this stage they do most damage, and are most difficult to deal with, as they are very lazy, cannot be driven, and have most voracious appetites.

292. "Ditches" should be wider at bottom.—Saltonas may be destroyed in many ways—by burning them in long dry grass, although if they are many they easily put out the fiercest fire by weight of numbers; by tramping them in the early morning with mares and sheep; by beating them on the head with spades, with wire whips, or other implements; by driving them into ditches, only it is necessary to make the ditches in their line of march, as they are worse to drive than pigs. A pig you can drive anywhere by trying to drive him in the opposite direction, but a locust knows which way he wants to go, and simply lies low until you are tired, and then serenely marches on. Therefore take note of his line of march, and dig the ditch before him, and he will walk into it without any trouble; but he is also liable to walk out the other side, so it is necessary to have something like canvas or boards to prevent him. If the ditches are dug a little wider at the bottom than the top, it contributes materially to their efficacy. I have seen them, once the ditch was half full, get their legs so mixed up that they could not move any more, and they gave no more trouble.

293. Kerosene.—The young saltonas hardly move for the first five days, but remain in a close phalanx, and I think that kerosene might be sprayed on them and fired with advantage. A litre of kerosene

would then conclude a large manga, but when they are well grown it would be very expensive, and probably not effective. A large manga of well-grown saltonas frequently presents a front of 500 yds. with a depth of 200, while the same manga at first would be only 30 ft. square. Saltonas should always be worked before sunrise or after sunset, with the exception of ditch-work or fire, which is best in the middle of the day. It is quite possible that some substance may exist, like Persian powder, which kills certain insects that you wot of instantly, that might be blown on them wholesale, or exploded amongst them on the ground. We have carbonic acid and chlorine gases, which, I believe, are heavy gases, and would not rise and dissipate themselves in the air.

294. A field for practical chemists.—I would recommend practical chemists to look this matter up; there is a small fortune in it. I have personally tried all the methods mentioned, with the exception of kerosene and the gases, and they are all effective, and it is easy to get rid of a manga or two, or half a dozen; but what of the thousands that exist where they cannot be reached, or where the owners of camp are too apathetic to take any trouble, and the authorities of the same way of thinking? The manga that came from the north this year deserves to be placed on record. It had an unbroken front of fifteen leagues that I was able to verify, and was probably double that length, and in some places it took three days to pass, while in others only six hours; but it came before a strong north wind, travelling over twelve miles an hour, and the noise was sufficient to stampede tame cows. Unless the manga is very thick, they hardly make any noise. I believe people compare the locust question here with that of Cyprus; it is useless—every condition is different. It would be a much more parallel case to compare it with that of Algiers; but then where is there here a force to compare with the French army of occupation and the means of applying it? It would be instructive to obtain some statistics of the means employed, the number of men, the expenses, and the results obtained, including percentage of crops saved and destroyed in Algeria.—I remain, yours very truly,

D. H. PERRENS.

EXPERIENCE IN NATAL

TO THE EDITOR OF THE *Natal Witness*.

295. Mr. Lamport's plan.—SIR,—Referring to my letter in the *Witness* of 28th February, I now find it desirable to lay before the public, who are the parties really most interested, my subsequent letter of 5th March, which remains unanswered. I also append a copy of another letter of 5th March, in part reply to a letter of 18th February, which had not been handed to me when I wrote on the 28th February, and which I cannot accept as disposing of the question.

296. Committee suggested.—Accepting of the well-deserved compliment, I am compelled to point out that those endeavours represent a considerable responsibility and expenditure. As the Government make the excuse that my plans are impracticable, and would entail an expenditure which it would not feel justified in

incurring, I think it necessary to explain that the phraseology was adopted before its adviser and it were acquainted with my methods and their cost. To avoid all grounds for cavil, I have reduced my requisitions to a request that the three gentlemen suggested, namely, the Colonial Engineer (Mr. Barnes), the Commissioner of Natal Police (Col. Dartnell), and Mr. Escombe should be a committee to attend at Verulam, and have offered my services. It is added: "Of course these gentlemen would report how far the services of the Natal police, with propriety and convenience, should be availed of."

297. Power of mortars.—My leading idea is, that the Government is bound to deal with the great swarms on the wing, which may be expected any day, and the mortars could also be employed during the intervals. People have not realised the power of the mortars. Forty-eight cannons are allotted to Verulam and the coast. Each discharge involves 5 cwt. of suitable materials, and costs twopence for the flexible match. The Government must find the powder, which is in stock.

298. John Kirkman's suggestion.—The 1500 yds. netting will be turned over to the C. L. O. and his men, and will very much assist him in his operations—if they have the sense to use it. John Kirkman furnishes a useful suggestion. His directions are:—He smears two sheets of iron, 8-ft. lengths, placed one quietly at each side of the bush, or clump of grass, or sugar-cane, and gently frighten the locusts. The young hopper jingles all about, and he is bound to make one jump on to the sheet of treacle, and that jump is his last. He adds: "Of course I speak only of the young hopper under three weeks old. It may be effective also on older hoppers, but I have none."

299. Netting and mortar discharges combined.—The schedule for Verulam includes rolls of 50 yds. (equal to 1500 yds fencing). I am anxious this new application of netting should be brought into operation, for the period is coming when the immature locusts, who undergo five transformations before their wings are fully developed, will be rife. Their interception and destruction by means of the netting and mortar discharges will be very powerful in diminishing the magnitude of the flying swarms.

300. Cost.—For the information of the public I annex the *pro forma* invoice of the coast and Verulam appliances, showing 750 lbs. powder necessary for twenty-four cannons, and, of course, a like quantity if the second detachment of twenty-four cannons be moved up, and now waiting idle at the Durban station.

So much explanation as this seems to grow naturally out of the subject-matter of the present communication, which I commend to the study of the farmers as well as the planters, for similar effective appliances, if they insist upon having them.—Yours, etc.,

E. PARKE LAMPORT.

MARITZBURG, March 11th, 1896.

(Copy.)

18th February 1896.

301. Government reply.—SIR,—With reference to your letter of the 6th inst., asking that your method of locust destruction may be put

in force in Natal, I have the honour, by direction, to inform you that your proposals have been considered by the Government, who thoroughly appreciate your long-sustained and public-spirited endeavours to provide a means of locust extermination. The Government is advised, however, that the means which you suggest are impracticable, and that in any circumstances they would entail an expenditure which the Government would not feel justified in incurring.—I have, etc.,

(Signed)

G. T. PLOWMAN, Acting P.A.S.

(Copy.)

THE LAMPORT ANTI-LOCUST SYSTEM

MARITZBURG, 5th March 1896.

THE PRINCIPAL ASSISTANT SECRETARY.

302. Former recommendation repeated.—SIR,—I have the honour to acknowledge the receipt of the letter of your Acting Substitute, dated 18th February 1896, which was only put in my hands by yourself on the 3rd of March. "(1) I am informed that my proposals have been considered by the Government. (2) The Government has been advised, however, that the means I suggest are impracticable. (3) That in any circumstances they would entail an expenditure which the Government would not feel justified in incurring." As no grounds are assigned or particulars given to warrant so unreasonable a conclusion, I am quite at a loss. The study of my previous letter of this date may help to clear up misconceptions. I now confine myself to recommending that 750 lbs. Government powder be lodged at Verulam to enable my appliances to be tried, and the gentlemen named to report upon them and the proposal generally. Further, that if locust invasions occur, they may be at once met, before attended by avoidable destruction of crops.

303. Cost can be divided.—The *pro forma* account relating to the coast and Verulam shows that an investment of £421, 18s. 2d. only need be incurred, which would place in the hands of the Government forty-eight mortar tubes, being one-third of the whole number provided, which investment will last for years. Deducting from the total of £2073, 19s. 6d. a portion for appliances which it may reasonably be expected the Governor of Zululand will be glad to avail himself of when their efficacy is established, and the £421, 18s. 2d. to which I have referred, there remains a moderate capital investment only. All this will, however, be reported upon by the Commission of Inquiry I have suggested. In making an estimate, I think that a similar sum may be reserved for Zululand.—I have, etc.,

(Signed)

E. PARKE LAMPORT, J.P.

(Copy.)

MARITZBURG, 5th March 1896.

THE PRINCIPAL ASSISTANT SECRETARY.

304. Mr. Lamport's plan.—SIR,—I have the honour to refer to my letter of 6th February 1896. (1) This letter was printed for general

information in the *Witness* of 28th February, with further remarks. It may be convenient if I enclose the printed sheet for reference. (2) I refer to the "Lampport complete system of anti-locust defence and destruction," and claim that the same be adopted by the Government as a basis. For this purpose I beg to submit a specification of appliances, amounting altogether to £2073, 19s. 6d. (3) I take the opportunity of enclosing at the same time a *pro forma* account, headed "Locust Extermination, Coast and Verulam," amounting to £421, 18s. 2d. This is dated Durban, 19th December 1895, and was drawn up in connection with a letter of that date addressed to the Hon. the Col. Secretary, "to advise the beginning of the anti-locust campaign."

305. Trial should be made, under personal supervision.—

The following are extracts:—(1) After a (third) visit to Verulam, the day before, I decided to move up to Verulam as a centre, four batteries, six each of my newly invented mortar tubes with appliances. (2) It will be observed that to render the mortars available in proportion to the fuses supplied (3000), 750 lbs. of Government powder is required, upon the simple calculation that 4 oz. is necessary for each discharge. This will consist, say, 10 lbs. of "Sydenham grit" (after trial found to be 12 lbs. of Umgeni sand), or coarse river sand mixed with quarry waste. (3) I ascertained at Verulam that there was an armory attached to the Magistrates' Offices, where there would be room for stowage deposit, under charge, there being a magazine as well. I therefore beg to urge that not a day should be lost in granting the necessary orders for the removal of, say, 750 lbs. coarse powder, which would remain under Government control, but immediately available. I made inquiry some time ago from Reid and Acutt, the agents for the sale of small quantities, as to the stock on hand, and the reply was, Tons! The magazine is on the Durban Flat. (4) I submit that it would be most satisfactory to all parties (the public included) if a thorough trial should be made of the foregoing appliances; and I take the liberty of suggesting that the Colonial Engineer (Mr. Barnes) should certainly be included in any Committee or Commission. I shall be glad to accompany them to Verulam and give every assistance.

306. The sinews of war.—The following appliances were forwarded at the same time, with directions:—3000 matches or fuses, each 2 ft. in length. These may be used freely in case of need. Also, in a tin-lined case, 80 gross crackers, coarse river grit, if to be used for mortars, 8 lbs. to 10 lbs. each charge, with crackers. The full charge is 4 oz. coarse powder in a flannel bag, into which the fuse is inserted and tied round. I mean to suggest that the Natal police and locust people be employed in this service, and moved up to Uhmlali and Stanger, where the locusts are rife (see *Mercury* supplement of yesterday as regards Stanger).

307. Administrators.—(5) In this connection I refer to my printed letter of 6th February:—The working to be regulated by—(1) the Chief Commissioner of Police; (2) the Colonial Engineer; (3) Mr. Escombe, not as Attorney-General, but in his capacity of Naval Volunteer, and as representing Volunteers.

308. A misconception.—(6) The reply to my letter is dated 6th

January. It is founded on a misconception. My letter is referred to as asking that I may be allowed to store a quantity of gunpowder in the magazine at Verulam, and I am informed that the Verulam magazine is under the control of the Volunteer department, to whom my letter has been referred. The Commandant of Volunteers reports that the magazine is for the storage of reserve arms and their ammunition only, and that it is contrary to magazine regulations for gunpowder or fuses to be stored in the same magazine with cartridges containing their own means of ignition. He regrets, therefore, that your application cannot be granted. The P.A.S. forwarded to me this information, and takes no further notice, as if the question of the lodging of 750 lbs. powder was disposed of.

309. Room in Verulam for storing powder.—On a further visit to Verulam (on the occasion of the laying of a first stone by Mr. Escombe), I determined that there was plenty of room in the armory for stowing the fifteen boxes of powder, in bags of 5 lbs. each, and that all that would be wanted was authority to do it. In the meantime, for want of the powder, more than two months have been lost, and the mortars remained idle. They might have scoured the whole country of the locusts.

310. A settlement anticipated.—It is to be hoped that some arrangement will be made in anticipation of the enormous swarms which will soon threaten the coast, and against which any existing operations are almost powerless.

311. Former application renewed.—(7) I therefore beg to renew the application that 750 lbs. Government coarse powder may be at once forwarded to Verulam. I suggest that it may with propriety be consigned to the care of Sub-Inspector Mardall. The Umlazi magistrate in Durban, Mr. Titren, and his clerk, Mr. Saunders, have the issuing of permits, and, if instructed, could offer Reid and Acutt to despatch the same by railway.

312. Trial again suggested.—(8) And I further beg to renew the application (the powder being available), as recommended in paragraph 4 and in my letter of 6th February, that a thorough trial be made at Verulam, as most convenient. I have taken the liberty of suggesting (5) the names of the Chief Commissioner of Police, the Colonial Engineer, and Mr. Escombe, and have offered my services.

313. Strong force necessary.—Of course these gentlemen would report how far the services of the Natal police could with propriety and convenience be availed of, and I withdraw my suggestion, "the entire working to be by means of the Natal police"; and I substitute the strongest expression of opinion that the whole resources of the Government, and perhaps some of the military, will have to be called upon when the crisis comes, as come it will in the course of a few weeks.

314. Frank Finney's report.—The Premier will remember that on the 16th October last I directed the attention of the two Governments of Zululand and Natal to the necessity of combined action on the report of Frank Finney, who had just returned from the Zulu country, and had encountered an enormous swarm of locusts in John Dunn's

territory—the more serious as, independent of the devastation in the Zulu country, the swarm threatens also Natal. It was added: (3) “It is so far favourable that in this emergency I am able to offer effective resistance. His Excellency may be reminded of the fact that early in February I directed his attention to the fact that on my visit to England I should seek new appliances of a military character to combat the locust pest. It is sufficient to say that I have ready in Durban thirty-two mortar tubes, ten-pounders, and a supply of matches for the same, also crackers, and a supply of wire-netting fencing specially for the young locusts.”

315. Secretary's reply.—The press copy of this letter was handed on to the inner room, and was returned with the remark that the Premier had already seen it at Government House. The letter was promptly acknowledged by the Secretary for Zululand, on the subject of the destruction of locusts in Natal and Zululand:—“With regard to the question of locust extermination, His Excellency desires me to inform you that the Government of Zululand is fully aware of the existence of large numbers of locusts in Zululand, and is taking steps, in conjunction with the Government of Natal, to deal with the pest.”

316. Mr. Morrison's letter.—It is a pertinent question to ask the Government of Natal whether these steps were practically efficient, and what was the result? I am able to trace these flying swarms from Zululand. In a letter from a planter, T. Morrison, dated Sturkeridge, Umlhali, 20th November 1895, he says:—“*Re* locusts. I am of opinion that if you could see the flying swarms as we get them, you would give up all talk of using your mortar against them. On my small place alone a whole shipload of blank powder would be of no avail when we get clouds of them, that you can scarcely see through, perhaps from one to two miles wide and up to fifty miles long, and lasting from three to four hours passing. The young locusts can be dealt with in many ways, and the wire screen may be very good. Anyway, it is a very serious question, and likely to ruin all agriculture, not only in Natal, but all South Africa, if some strong measures are not taken. As far as I can see, there will be a hundred times more young ones to deal with this season than the last.—T. MORRISON.”

317. Mr. Lamport's war material sent on to Durban.—Now, I had not mentioned to Mr. Morrison the number or capacity of my mortars, but it was partly in consideration of his description of the enormous swarms to be dealt with that I moved up to Verulam my whole stock of twenty-four mortars, with 3000 matches and crackers, to the care of the stationmaster, with leave that if they could get the powder they need not wait for me; and further, that when I got the shipment per *Hawarden*, I allotted an additional twenty-four cannons, without the frames. These remain at the station at Durban. Under an intelligent preliminary “flying” survey of the country, it could be settled how best to manœuvre the eight batteries of six each, and place them in positions where best to protect the crops and drive the locusts into the sea, which is an essential part of my scheme, with the aid of the crackers and double-barrelled, quick-loading shot-guns now in bond, with one ton of shot.—I have, etc.,
E. PARKE LAMPORT.

PRO FORMA ACCOUNT—LOCUST EXTERMINATION FOR COAST
AND VERULAM

DURBAN, 19th December 1895.

Revised 18th February 1896

COLONIAL GOVERNMENT,

318. *Dr.* to E. PARKE LAMPORT.

For appliances forwarded to care of stationmaster, Verulam, for use of Natal Government:—

| | | | |
|--|------|----|------|
| Twenty-four mortar tubes and twenty-four carriage frames complete, at £7 | £168 | 0 | 0 |
| Twenty-four extra cannons (<i>ex Hawarden</i>) at Station Durban (to order), at | 144 | 0 | 0 |
| Tin-lined case— | | | |
| Three thousand 2-ft. lengths match, at 2d. | 25 | 0 | 0 |
| Eighty gross crackers, at 6s. per gross | 24 | 0 | 0 |
| | 361 | 0 | 0 |
| Five bales galvanised netting (<i>ex bond</i>), at £12 | 60 | 0 | 0 |
| Half-inch mesh = 3 ft. Each bale contains six rolls of 50 yds. (equal to 1500 yds. fencing) with double canvas and roping. Paid N.G.R. carriage to Verulam | | 0 | 18 2 |
| | £421 | 18 | 2 |

To be worked by the Natal police with Government powder.

319. *Note.*—750 lbs. would be required for the above quantity of matches, at 4 oz. each charge. Contained in cases of 50 lbs., in flannel bags of 5 lbs. To be had per Reid and Acutt from the magazine at Durban. To be deposited in the armory, Verulam.

320. As will be seen from an advertisement appearing elsewhere, Mr. Parke Lamport intends to deliver a lecture in the Y.M.C.A. Hall, next Wednesday evening, on "The Story of the Locusts." The lecture will be illustrated by photos and lantern slides, and as an additional attraction Mr. Lamport will sing his national patriotic song, "Our Volunteers," and his new national anthem, "Long live Victoria." Having regard to the keen interest taken by Mr. Lamport in locusts, and his knowledge of the subject, there should be a large gathering at the Y.M.C.A. Hall on Wednesday evening.

MR. LAMPORT'S LECTURE

321. **A scanty audience.**—The above formed the title of a lecture announced to be given last evening in the hall of the Y.M.C.A. by Mr. Lamport. Notwithstanding that the audience was not a very large one, comprising as it did about eighty persons, the members present exhibited some impatience for the start of the lecture or entertainment, as some appeared to regard it, and, on mounting, the

venerable lecturer met with a hearty reception. Prefacing his lecture by a few remarks, he said those present could readily imagine that it was a disappointment to him to see so small an audience. The lecture was got up specially for the information of the two Legislatures, and they were invited specially by notices placed in their reading-rooms. They had not, however, thought it proper to come, or they might turn up a bit later (a hope, it may be said, which was not gratified). Proceeding, he requested those present to come up to the front, so that they might be a social gathering, as it was impossible for him to "elocutionise to the far end of the hall." While those present may not have added much to their store of information concerning the locusts, and the possibility of getting rid of them, they at all events had much to tickle their risible faculties in the subject-matter of the lecture and the method of its delivery; in fact, as the lecturer himself took occasion to remark, "their fun seemed to be in inverse ratio to the number of the audience."

322. A diversified entertainment.—The "lecture" consisted to a very large extent of the exhibition of a series of views of native life in Zululand, views of Natal, specimens of rare butterflies, etc., thrown on a large screen by means of limelight. This preliminary to the lecture was, it was explained, thrown in by way of rendering it attractive; otherwise, consideration of the advertised title tended to remind one of Mark Twain's appearances as a lecturer. The subject of the locusts was not, however, altogether left untouched, as, nearing the close, Mr. Lamport gave a vague indication of his scheme for the eradication of the pest, which appeared to be the destruction of them on the wing by means of a double-barrelled, quick-firing, breech-loading gun of 10-bore, and mortars loaded with powder. In this connection he took occasion to ventilate his opinion of the inertness of Sir John Robinson's Government in not attending to his overtures on the matter. He had, he mentioned, reckoned on Sir John Robinson having a present of one of those guns, and of driving the locusts out of the country and into the sea. Before the close, Mr. Lamport sang his national patriotic song, "Our Volunteers," which, he incidentally mentioned, suggested to him the idea of the destruction of the locusts by means of powder, and his new national anthem, "Long live Victoria," both of which were rendered with due spirit and effect, and contributed largely to keep his audience in the best of humour.

A NOVEL METHOD OF DESTRUCTION

323. Mr. Daws' scheme.—A letter appeared in these columns yesterday, calling attention to the appalling ravages occasioned by a new species of locust in the eastern part of the colony, from the Orange River to the sea, and suggesting that the Government should take some steps with a view to devising a scheme for destroying the locusts, with the aid of an expert. As a matter of fact the Government have been in communication with Mr. George Daws, a well-known inventor of this city, who has a scheme for destroying the insects, on the following lines:—The idea being to kill the locusts on the wing, Mr. Daws

proposes on the approach of a flock to send up a captive balloon, held in a stationary position over the track of the locusts by means of two wire stays. From the balloon will be suspended a wire rope, with a pulley attached, and to this pulley a rope runs from the ground, by means of which it will be possible to haul up a bomb, which will by a simple mechanical contrivance admit of being exploded on reaching the pulley. As the locusts travel under the balloon, the bomb will be hauled and exploded, and it is hoped will furnish the wanderers with something new in the way of a sensation. The bomb will be 18 in. in diameter, and will be filled with two or three hundred smaller bombs, to each of which a small fuse is attached, which will be set light to by the first explosion. These smaller bombs, which will thus be scattered right and left amongst the locusts, will be filled either with coarse salt or with a noxious gas, and in either case may be depended on to do considerable execution among the unsuspecting invaders, who will be fully as much astonished as the whale was on a close acquaintance with the torpedo. It is estimated that the first explosion would scatter the smaller bombs a radial distance of about 250 yards. That represents 875,000 cubic yards, for, taking a rough estimate of the number of locusts in the swarm as eighty to the cubic yard, it will be seen that 150,000,000 of the creatures will be within the sphere of influence of the explosive.

324. Proposal taken to avizandum.—So far as the Government is concerned, it has been furnished with details of the scheme, and the Minister of Agriculture is said to be much impressed with its utility. The matter is still under the Government's consideration, however, with a view to placing a sum of money on the Supplementary Estimates for the forthcoming session, but as the Supplementary Estimates will not be under discussion before the end of June there appears little chance of anything being done just yet. This is to be regretted, as the matter is of considerable urgency, and calls for prompt, though at the same time duly considered action.

REDLANDS, 8th January.

325. Mr. Fynn's plan.—As in every paper I look at I see accounts of the destruction done to crops in some district or other by locusts, I wish, through the medium of the *Agricultural Journal*, to let other farmers know how I have so far succeeded in saving my crops.

326. A fishing-line swept across forage.—I got a strong fishing-line, 150 yards long (the width of my oat and hay lands), to which I tied white rags about every 5 yards, and had this drawn along the tops of the forage by two men, one at each end of the line. It was wonderful how soon I cleared the land of locusts; the oftener the operation is repeated the better. For very long lands I would suggest more than one line, drawn by men on horseback, and perhaps different-coloured rags would be better.

As the saying is, "I am not out of the bush yet," but having mastered two large swarms, I have every hope of reaping my oat and hay and mealie crops.—Hoping that my remedy may be the means of other crops being saved,

WEST H. FYNN.

From The Agricultural Journal, 30th April 1896.

327. Dr. Riley's bulletin.—The matter which follows is extracted from Entomological Bulletin No. 25 (1891), of the United States Department of Agriculture, and was prepared by the late Dr. C. V. Riley with especial reference to Rocky Mountain locust (*Calopterus spretus*), a very destructive locust, which occasionally abounds in the Western States of America. As suggested by the author, however, the means for the prevention and destruction of this locust apply almost equally well to other species, and in the hope of furnishing useful information to Colonial farmers, we give the following extracts, which may have a bearing here. *Acridium purpuriferum*, the locust which is ravaging the colony at present, and which appears to be now quite generally known as the red-winged locust, is not affected by smoke, according to the accounts of numerous correspondents. Hence the remarks made on this means are inapplicable to this species.

The means fall very naturally into five divisions—(1) Encouragement of natural agencies; (2) destruction of the eggs; (3) destruction of the young or unfledged insects; (4) destruction of the mature or winged insects; (5) preventive measures.

ENCOURAGEMENT OF NATURAL AGENCIES

328. Locusts' assailants should be protected.—While little practically can be done by man to further the multiplication of the more minute enemies of the locust, much may be done to protect and to promote the multiplication of the larger birds. These should be protected by most stringent laws, firmly carried out, restraining the wanton destruction too often indulged in by sportsmen and others.

DESTRUCTION OF THE EGGS

329. Use and wont.—The destruction of the eggs has been followed in the older countries of the East since Pliny's time, and has long been recognised in Europe and Asia as one of the most efficacious means of averting locust injury. These eggs are laid in masses, just beneath the surface of the ground, seldom to a depth of more than an inch.

330. Destructive agencies.—As a rule, the dead bodies of the locusts strewn about the ground in autumn are a good indication of the presence of eggs in such ground, though the eggs may often be abundant without this indication. The means to be employed in destroying locust eggs may be considered under the following divisions:—(1) Harrowing; (2) ploughing or spading; (3) irrigation; (4) tramping; (5) collecting.

331. (1) Harrowing in the autumn.—Harrowing in the autumn, or during dry, mild weather in early winter, will prove one of the most effectual modes of destroying the eggs and preventing future injury wherever it is available. It should be enforced by law whenever the soil in any region is known to be abundantly stocked with eggs. A revolving harrow or a cultivator would do excellent service in this way,

not only in the field, but along roadways and other bare and uncultivated places. The object should be not to stir deeply, but to scarify and pulverise as much as possible the soil to about the depth of an inch. Where the cultivator is used, it would be well to pass over the ground again with a drag or a brush harrow for this purpose. Some of our correspondents have urged, and with some reason, that wherever land can conveniently be prepared to induce the females to oviposit in it, as by ploughing, and then rolling when the insects are beginning to breed, such preparations should be made. A subsequent harrowing will be the more easy. In practice this method will not often be adopted, because it will pay only under exceptional circumstances.

332. (2) Ploughing.—Next to harrowing this is one of the most generally available means possessed by the farmer of dealing with locust eggs.

The actual experience is somewhat conflicting, and in some light, dry soils a good number will hatch late, if turned under a foot; yet from our own observations, and a vast amount of experience gathered together, we recommend it as profitable. If delayed till spring, it should be done just as the young begin to hatch, as it is then most effectual. The ploughing will be effectual according as the soil is porous or tenacious, and according as the surface is afterwards compressed by harrowing or rolling. From the experiments recorded in the first Report of the Commission, it is obvious that, all other things being equal, a ploughing of from 4 to 6 in. will prove more effectual in spring, if the ground be subsequently harrowed and rolled, than deeper ploughing with no subsequent comminution and compression.

333. (3) Irrigation.—This is feasible in much of the country subject to locust ravages, especially in the mountain regions, where, except in exceptionally favourable locations, agriculture can be successfully carried on only by its aid, and where means are already extensively provided for the artificial irrigation of large areas. Where the ground is light and porous, prolonged and excessive moisture will cause most of the eggs to perish, and irrigation in autumn or in spring may prove beneficial. Yet the experiments recorded in the Commission Reports prove that it is by no means as effectual as had been generally believed, and as most writers had assumed to be the case.

334. In fact, these experiments give us very little encouragement as to the use of water as a destructive agent, and we can readily understand how eggs may hatch out, as they have been known to do, in marshy soil, or soil too wet for the plough; or even from the bottom of ponds that were overflowed during the winter and spring. While a certain proportion of the eggs may be destroyed by alternately soaking and drying the soil at short repeated intervals, it is next to impossible to do this in practice during the winter as effectually as it was done in the experiments; and the only case in which water can be profitably used is where the land can be flooded for a few days just at the period when the bulk of the eggs are hatching.

335. (4) Tramping.—In pastures or in fields where hogs, cattle, or horses can be confined, when the ground is not frozen, many, if not most, of the locust eggs will be destroyed by the rooting or tramping.

336. (5) Method of collecting.—The eggs are frequently placed

where none of the above means of destroying them can be employed. In such cases they should be collected and destroyed by the inhabitants, and the State should offer some inducement in the way of bounty for such collection and destruction. Every bushel of eggs destroyed is equivalent to one hundred acres of corn saved, and when we consider the amount of destruction caused by the young, and that the ground is often known to be filled with eggs—that, in other words, the earth is sown with the seeds of future destruction—it is surprising that more legislation has not been effected, looking to their extermination.

337. One of the most rapid ways of collecting the eggs, especially where they are so numerous and in light soils, is to slice off about an inch of the soil by trowel or spade, and then cart the egg-laden earth to some sheltered place where it may be allowed to dry, when it may be sieved so as to separate the eggs and egg-masses from the dirt. The eggs thus collected may easily be destroyed by burying them in deep pits, providing the ground be packed hard on the surface. In the thickly settled portions of Europe, where labour is abundant and cheap, this method may be adopted with some advantage, but it will scarcely be employed in this country, except as a means of earning a bounty, when, in the more thickly settled sections, it will prove beneficial and give employment to young people and others who have nothing else to do.

DESTRUCTION OF THE YOUNG OR UNFLEDGED LOCUSTS

338. Each case treated on its own merits.—Experience has shown that the results of any particular measure will vary in different regions, dependent, to some extent, upon the nature of the soil, the condition of the crops, and the general characteristics of indigenous vegetation. Circumstances may also render some particular measure available and profitable to one farmer, where it would be unprofitable to another. For convenience, the means of accomplishing the desired result may be classified into:—(1) Burning; (2) crushing; (3) trapping; (4) catching; (5) use of destructive agents.

339. (1) Burning.—This method is perhaps the best in prairie and wheat-growing regions. In such regions there is usually more or less old straw or hay which may be scattered over or around the field in heaps or windrows, and into which the locusts, for some time after they hatch, may be driven and burned. During cold or damp weather they congregate of their own accord under such shelter, when they may be burned without the necessity of previous driving. Much has been said for and against the beneficial results of burning the prairies in the spring. This is chiefly beneficial around cultivated fields or along the roadsides, from which the locusts may be driven, or from which they will of themselves pass for the shelter the prairie affords. Scarcely any eggs are laid in rank prairie, and the general impression that locusts are slaughtered by myriads in burning extensive areas is an erroneous one, at least in the temporary region.

340. In burning extensive prairies after the locusts hatch, the nests of many game birds are destroyed; but as the birds themselves escape destruction on the wing, they may and do return and nest again, while,

on the contrary, many injurious insects, like the chinch bug, for instance, are killed; so that, even leaving the locust question out of consideration, the burning proves beneficial by exterminating other noxious insects, and has some advantages from an agricultural point of view.

341. As locusts disperse more and more from their hatching grounds into the prairie as they develop, burning the grass in spring is beneficial in proportion as it is delayed.

342. There is another method by which large numbers of locusts can be burned, consisting merely of a large bundle of rags or tow, which, after being attached to long wire or iron rods and saturated with kerosene, can be ignited and carried over the field. This method has been quite satisfactorily used in Colorado. A stout wire, say 40 ft. long, is thoroughly enveloped in rags soaked in coal oil. A small wire is wound around the rags to keep them in place, and the simple device is complete. Two men carry this rope, after setting fire to the rags, across the field, to and fro, until the fuel is exhausted, and as it is not necessary to pass over the same ground more than once or twice, a large field of grain can be thus protected during the half-hour or so that the rags burn. The effect is that of a miniature prairie fire.

343. (2) Crushing.—The satisfactory destruction of locusts by this means can only be advantageously accomplished where the ground is smooth and hard. Where the surface of the ground presents this character, heavy rolling can be successfully employed, especially in the mornings and evenings of the first eight or ten days after the newly hatched young have made their appearance, as they are generally sluggish during those times, and huddle together until sunrise. It is also advantageously employed during cold weather at any time of day, since the young, when the temperature is low, seek shelter under clods, etc. In various parts of Europe and Asia, flat wooden spade-like implements are extensively used for crushing young locusts. Large brushes, weighted down by stone and drawn by horses, were in some instances used last summer, but with less success than was anticipated.

344. (3) Trapping.—This can be easily accomplished, especially when the locusts are making their way from roads and hedges. The use of nets or seines, or long strips of muslin, calico, or similar materials, converging after the manner of quail nets, has proved very satisfactory. By digging pits or holes 4 ft. deep, and then staking the two wings so that they converge toward them, large numbers may be secured in this way after the dew is off the ground, or they may be headed off when marching in a given direction. Much good can be accomplished by changing the position of the trap while the locusts are yet small and congregate in isolated or particular patches.

345. Ditching and hedging properly come under this head, and both plans are very effectual in protecting crops against the inroads of travelling schools of the insects. They were found especially advantageous in much of the ravaged country in 1875, where there was little or no straw to burn. They are the best available means when the crops are advanced, and when most of the other destructive methods, so advisable early in the season, can no longer be effectually used. Simple ditches, 2 ft. wide and 2 ft. deep, with perpendicular sides, offer effectual barriers to the young insects. They must, however,

be kept in order, so that the sides next the fields to be protected are not allowed to wash out or become too hard. They may be kept friable by a brush or rake.

346. The young locusts tumble into such a ditch and accumulate and die at the bottom in large quantities. In a few days the stench becomes great, and necessitates the covering up of the mass. In order to keep the main ditch open, therefore, it is best to dig pits or deeper side ditches at short intervals, in which the locusts will accumulate and may be buried. If a trench is made around a field about hatching-time, but few locusts will get into that field until they acquire wings, and by that time the principal danger is over, and the insects are fast disappearing. If any should hatch within the enclosure, they are easily driven into the ditches dug at different parts of the field. The direction of the apprehended approach of the insects being known from their hatching locality, ditching one or two sides next to such locality is generally sufficient, and, when farmers join, they can construct a long ditch which will protect many farms.

347. Where the soil is tenacious, and water can be let into the ditches so as to cover the bottom, they may be made shallower and still be effectual. The width and depth of the ditch are important, and, as experience differed somewhat, I have been at pains to get the experience of a large number of correspondents addressed by circular. Many have successfully used ditches 2 ft. deep and 18 in. wide; a few have made them only 18 in. by 18 in. Those who have used water have found 12 in. by 15 in. sufficient, while the larger number used a ditch such as I have recommended, namely, 2 ft. deep by 2 ft. wide, with perpendicular sides. Having been the first to recommend proper ditching in this country, I have felt particular interest in its results, and have been in no small degree amused at the fault found with my recommendation by those who, through slovenly-made ditches or other causes, have not been successful in this mode of warfare. It is less effectual against the newly hatched young, which more easily crawl up a perpendicular bank than the larger ones, and its efficacy will vary with the nature of the soil and other circumstances; for, in proportion as the soil is loose, and the ditches are hence apt to fill up by the action of strong winds, or in proportion as strong winds carry the insects over, ditching will necessarily fail.

348. Those who, from theory rather than experience, are sceptical about the efficacy of ditching, urge that the locust, especially in the pupa state, can hop more than two feet. In truth, however, whether when travelling in a direction of their own accord, or when being driven or disturbed, they very seldom leap that distance, as all who have had experience well know. That, on a pinch, the pupa can leap much farther is true; but the fact remains that in practice *Calopterus* seldom does. So the chinch bug, though capable of flight, will yet tumble into a ditch by myriads rather than use its wings. Even the larger winged *Acridia* and *Edopidæ* tumble into such a ditch and seldom get out again. I would remark, in this connection also, that a ditch 3 ft. wide, unless correspondingly deep, will be more apt to permit the insects to escape, when once in, than a narrower one. In hopping, the more perpendicular the direction the insects must take, the shorter

will be the distance reached. The efficacy of the ditch depends not so much on the inability of the young locusts to jump or scale it, as on their own tendency not to do so. In the bottom of the ditch they soon become demoralised, crippled, and enfeebled by constant effort, and the tramping and crowding upon one another.

349. Protection by barriers.—Where ditches are not easily made, and where lumber is plentiful, a board fence 2 ft. high and with 3 in. batten nailed to the top on the side from which the locusts are coming, the edges of it smeared with coal tar, will answer as an effectual barrier and prove useful to protect fields or gardens.

350. A modification of this method was used with great success in 1883 and subsequent years in the isle of Cyprus. The *Cypriote system*, as it has been called, consists of a series of traps and screens. The screens are made of light hemp canvas, 50 yards long and 2 ft. 6 in. wide. Near the upper edge of the canvas is sewn a strip of oil-cloth 4 in. wide. The screens are fixed to stakes or hard wood firmly driven into the ground at intervals of 13 ft. 6 in., slightly inclined towards the direction from which the attack of locusts is expected. A cord is stretched from stake to stake. The screens are tied to the inside (locust side) of the stakes and to the cords by tapes. About 6 in. in width of the lower edge of the canvas is folded on the ground inside the stakes and weighted with earth. Pits are dug at intervals of from generally 40 to 50 yards, and the usual size of the pits is 6 ft. long, 2 ft. 3 in. wide, and 3 ft. deep. Round the edges of the pit is fixed the trap, consisting of four strips of zinc, 9 in. wide. The screens having been so fixed as to head the advancing army of locusts, they march until their progress is stopped by the screen. They climb up the canvas until they reach the oil-cloth, which they cannot pass. They then descend and crawl to one side or the other until they fall into the pits, from which they attempt to escape by climbing up the sides until they encounter the zinc sheets which project 4 in. from the edge. They then fall back into the pit, and when this is full to within about 9 in. of the brim, earth is shovelled in, to bury the locusts, a new pit in the meanwhile having been excavated to one side. The trap is removed to the new pit, and the same thing is repeated until the whole swarm has been destroyed. The use of this system has practically rid Cyprus of the locust plague, and has also been of great avail in Algeria, after other methods had failed.

351. Coal oil.—The use of coal tar and coal oil may best be considered in this connection, as both substances are employed in various ways for trapping and destroying the insects. As we shall presently see, in considering the different available agents, coal oil is the very best and cheapest that can be used against the locusts. It may be used in any of its cruder forms, and various contrivances have been employed to facilitate its practical application. The main idea embodied in these contrivances is that of a shallow receptacle of any convenient size (varying from about 3 ft. square to about 8 or 10 by 2 or 3 ft.), provided with high back and sides, either mounted upon wheels or runners, or carried (by means of handles or supporting rods) by hand. If the "pan" is larger than, say, 3 ft. square, it is provided with transverse partitions, which serve to prevent any slopping of the con-

tents (in case water or oil is used), when the device is subjected to any sudden irregular motion, such as tipping, or in case of a wheeled pan, when it passes over uneven ground. The wheeled pan is pushed like a wheelbarrow; the hand-worked pan is carried by long handles at its ends. On pushing or carrying, as the case may be, these pans, supplied with oil, over the infested fields, and manipulating the shafts or handles so as to elevate or depress the front edge of the pan as may be desired, the locusts are startled from their places and spring into the tar or oil, when they are either entangled by the tar, and die slowly, or, coming in contact with the more active portion of the oil, expire almost immediately. In Colorado they use it to good advantage on the water in their irrigating ditches, and it may be used anywhere in pans or in saturated cloths, stretched on frames, drawn over the field. The method of using it on the irrigating ditches in Colorado is thus reported by Professor R. L. Packard:—

352. It consists essentially in pouring, or, better, dropping coal tar or coal oil on the running water with which the irrigating ditches are supplied. The method of supplying these ditches with oil is very simple. It is only necessary to sprinkle a few drops of coal tar on the stream, when the oils contained in the tar are diffused over the surface of the water, and coming in contact with the insects (no matter how many), cause their speedy death. The toxic power upon the insects is very remarkable; a single drop of it floating on the water is capable of causing the death of a large number of insects. A simple and ingenious mode of keeping up a constant supply of the tar to a ditch, I saw exemplified upon the farm of Mr. Arnett. A three-quart can is perforated on the side close to the bottom, a chip loosely fitting the aperture is inserted therein, and the can is then immersed (by a weight if necessary) in the ditch. Three quarts or less of tar, trickling out drop by drop from this slight vent, are sufficient to keep a great length of ditch supplied with coal oil for thirty-six hours. The precise extent of ditch which may be thus rendered toxic to the locusts cannot, of course, be exactly stated. It is, in fact, quite indefinite, for the reason that the quantity of oil necessary to kill one of the insects is almost infinitesimal, and for the further reason that a single drop of oil will cover quite a large surface when dropped on water, so that taking these two facts together, it is easy to see that a very small quantity of tar or oil will serve to guard, by means of ditches, a large tract of territory from the ravages of the young (unwinged) locusts. The pans that were used in Kansas and Iowa, but principally in the former State, were of very simple construction and very effectual.

353. A good and cheap pan is made of ordinary sheet iron, 8 ft. long, 11 in. wide at the bottom, and turned up a foot high at the back and an inch high at the front. A runner at each end, extending some distance behind, and a cord attached to each front corner, complete the pan, at a cost of about \$1.50 (six shillings).

354. We have known from seven to ten bushels of young locusts caught with one such pan in an afternoon. It is easily pulled by two boys, and by running several together in a row, one boy to each outer rope, and one to each continuous pair, the best work is performed with least labour. Longer pans, to be drawn by horses, should have

transverse partitions to avoid spilling the liquid; also more runners. The oil may be used alone, so as to cover the bottom, or on the surface of water, and the insects strained through a wire ladle. When the insects are very small, one may economise in kerosene by lining the pan with saturated oil-cloth, but this becomes less efficient afterwards, and frames of cloth saturated with oil do not equal the pans. Where oil has been scarce, some persons have substituted concentrated lye, but when used strong enough to kill, it costs about as much as the oil. The oil pans can be used only when the crops to be protected are small. Small pans for oil, attached to an oblique pole or handle, do excellent service in gardens.

355. The essential features in all the contrivances are—(1) A platform that runs on the ground, on runners or wheels; (2) a canopy at right angles with it; (3) a reservoir at the junction to contain the liquid.

356. *Coal tar.*—This may be used with most of the contrivances just described for the use of kerosene, and while not equal to the simple kerosene pan for speed in trapping and destroying, is yet very useful, especially in the neighbourhood of gasworks, where the coal tar can be obtained at nominal cost. It also permits the simplest kind of pan. Enough tar is spread over whatever receptacle may be used to cover well the bottom, and when this becomes sufficiently matted with the young locusts as no longer to destroy them, another coating is added, and so on, until it becomes necessary to remove the whole mass, when it is shovelled from the pan and burned, or, what is far preferable, wherever there are wet ditches it may be thrown into these, when the oil contained in it, spreading over the surface of the water, destroys such locusts as may jump into or be driven into such ditches. Where the tar is scarce, as a matter of economy, it will pay to melt the accumulated mass in iron vessels. By skimming off the dead locusts that rise to the surface, and thinning the residuum with a little coal tar, it may be used again.

357. (4) Catching or bagging.—There are innumerable mechanical contrivances for this purpose: the cheapest and most satisfactory are those intended to bag the insects. A frame 2 ft. high and of varying length, according as it is to be drawn by men or horses, with a bag of sheeting tapering behind and ending in a small bag or tube, say one foot in diameter and two or three feet long, with a fine wire door at the end to admit the light and permit the dumping of the insects, will do admirable work. The insects gravitate towards the wire screen, and when the secondary bag is full, they may be emptied into a pit dug for the purpose. Those bagging machines will prove most serviceable when grain is too high for the kerosene pans just described, and they will be rendered more effectual by having runners at distances of about two feet, extending a foot or so in front of the mouth, so as to more thoroughly disturb the insects and prevent them from getting underneath; also by having wings of vertical teeth, so as to increase the scope with as little resistance to the wind as possible.

358. Two important facts should always be borne in mind in using these bagging machines—first, that they should always be drawn, as far as possible, against the wind, if this be stirring; second, that in pro-

proportion as the insects and the grain are advanced in growth, and the former become disposed to roost, in that proportion the machines will prove more serviceable at night.

359. A very successful method of catching pupæ was used by Mr. Lowe and Mr. Hall, farmers, in M'Leod County, Minnesota. It is simply equivalent to a waggon-body with one side removed, to be drawn over the grain after dark. The locusts roosting on the grain fall into it, simply lie there and become entangled in a mass, and may be easily shovelled into a hole. Mr. Hall thinks he caught 800 bushels in the latter part of June; Mr. Lowe, 400.

360. (5) Use of destructive agents.—We had a number of experiments made with different insecticide mixtures in 1876-77, and the results are given in detail in the first Report of the Commission. The only substance which indicated possible results of value was Paris green. Mixed with twenty to thirty parts of flour, it was sprinkled on the ground, and many locusts were attracted to and destroyed by it. This mode, however, cannot be compared with many of those already described. Its use against the young locusts is practically of little value, because of the excessive numbers in which they usually occur. Broadcast spraying of any crop, to be effective, using Paris green or London purple in the proportion of 1 pound to 150 or 200 gallons of water, will be useful where spraying apparatus is at hand, but it will hardly pay to construct such an apparatus for this purpose alone, in view of the cheaper remedies just described.

THE PROTECTION OF FRUIT TREES

361. Whitewashing and tinning.—The best means of protecting fruit and shade trees deserve separate consideration. Where the trunks are smooth and perpendicular, they may be protected by whitewashing. The lime crumbles under the feet of the insects as they attempt to climb, and prevents their getting up. By their persistent efforts, however, they gradually wear off the lime and reach a higher point each day, so that the whitewashing must be often repeated. For trees with short, rough trunks, or which are not very well protected in this way, a narrow strip of tin answers even better for the same purpose. A strip 3 or 4 in. wide brought around and tacked to a smooth tree will protect it, while on rougher trees a piece of old rope may first be tacked around the trees and the tin tacked to it, so as to leave a portion both above and below. Passages between the tin and rope or the rope and tree can then be blocked by filling the upper area between tin and tree with earth. The tin must be high enough from the ground to prevent the locusts from jumping from the latter beyond it, and the trunk below the tin, where the insects collect, should be covered with some coal tar or poisonous substance to prevent girdling. This is more especially necessary with small trees, and coal tar will answer as such preventive.

362. Cotton batting.—One of the cheapest and simplest modes is to cover the tree with cotton batting, in which the insects will entangle their feet, and thus be more or less obstructed. Strips of paper covered with tar, stiff paper tied on so as to slope roof-fashion,

strips of glazed wall paper, and thick coatings of soft soap, have been used with varying success, but no estoppel equals the bright tin. The others require constant watching and removal, and in all cases coming under our observation some insects would get into the trees, so as to require the daily shaking of these morning and evening.

363. This will sometimes have to be done when the bulk of the insects have become fledged, even where tin is used, for a certain proportion of the insects will then fly into the trees. They do most damage during the night, and care should be had that the trees be unloaded of their voracious freight just before dark. Mr. George Gibbs, of Holden, Missouri, found that the whitewash was rendered still more effectual by adding one half-pint of turpentine to the pailful.

DESTRUCTION OF THE WINGED INSECTS

364. Man comparatively powerless.—The complete destruction of the winged insects, when they swoop down upon a country in prodigious swarms, is impossible. Man is powerless before the mighty host. Special plants or small tracts of vegetation may be saved by perseveringly driving the insects off, or keeping them off by means of smudges, as the locusts avoid smoke; or by rattling or tinkling noises constantly kept up. Long ropes perseveringly dragged over a grain-field have been used to good advantage.

365. Catching and bagging effectual.—Of the different contrivances already described for the destruction of the unfledged locusts, those intended for catching and bagging are the most effectual against the winged individuals, great numbers of which may be caught, especially at morn and eve, and late in the autumn. At such times many may also be crushed.

366. Smudging.—Moderate success has been had with smudging as a means of warding off the winged swarms. The best method is to start a fire which burns with insufficient access of air, and which is made, if possible, of materials which, while burning, will give off, besides the dense smoke due to incomplete combustion, unoxidised products of distillation, which in themselves are noxious (*e.g.*, buffalo chips, dung, straw, and coal tar, etc.). The smoke and fumes from such a fire will prevent the locusts from alighting, and swerve them from their course.

367. Difficulties.—The great difficulty experienced in making the smudging successful is in the inconstancy of the winds, as a sudden change in wind direction may render much previous labour unavailing. Mr. W. D. Arnett, of Bear Creek, Colorado, who has given a good deal of attention to the practical means to be employed against locusts, has endeavoured to meet the difficulty by using a portable iron bucket as a receptacle for the fire. A large sheet iron is fitted with a perforated tube, arranged across its bottom, open at one end to admit air, and there provided with a valve to regulate the admission of air. A perforated cover, hinged to the bucket, and a handle to carry it by, complete the arrangement. Filled with substance which burns imperfectly, such as buffalo chips and a little coal tar, and with the cover shut, an amount of air insufficient for complete combustion is admitted

through the valve-tube at the bottom, and the dense smoke comes out through the holes in the cover.

368. Burning old bones.—The burning of old bones has been tried, but found to be no more effective than other slow combustibles. The use of smoke will be effectual, in proportion as farmers combine together and produce it simultaneously over extended areas.

BRAN-ARSENIC MASH

369. M. Coquillet's plan.—In 1885, M. Coquillet experimented with a mash composed of bran and arsenic on the devastating locust in the San Joaquin Valley, California, which was so successful that we quote his account in full:—

A remedy that has been very successful in destroying locusts consists of a certain proportion of bran, arsenic, and water. These have been used in different proportions, but the one that appears to give the best results consists of one part by weight of arsenic, one of sugar, and six of bran, to which is added a sufficient quantity of water to make a wet mash.

370. How mixed.—This preparation is usually prepared in wash-tubs or half-barrels. One of these is filled about three-fourths full of dry bran, and to this is added about 5 lbs. of arsenic, which is thoroughly stirred through the bran with a spade or shovel. Five pounds of sugar is next thrown into a pail, which is then filled with water and the sugar stirred until it is dissolved; when this sugar-water is added to the bran and arsenic, and the three well stirred, more water is added, and the stirring continued until every portion of the mash becomes thoroughly saturated.

371. How the poison works.—About a teaspoonful of this mash is placed at the root of each tree, shrub, or plant infested with locusts, dropping it in the shade when this can be done. In the case of low shrubs or plants nothing more need be done, as the locusts will find their way to the poison; but when large trees are treated, the locusts should be jarred out of them, or be driven out with long poles. I have known locusts to be killed by eating some of this mash that had been put out over a week previously. The poison works very slowly, and when put out early in the morning will show but little effect upon the locusts until quite late in the day.

372. Sugar not necessary.—The addition of sugar to this mash is merely for the purpose of causing the arsenic to adhere to the particles of bran, and not for the purpose of increasing its attractiveness, since bran is more attractive to the locusts than sugar. This I have demonstrated to my own satisfaction. A quantity of sugar was placed upon the ground contiguous to an equal quantity of bran mash; when a locust came to the sugar, he would eat a little of it, move on a short distance, and again take a few bites of the sugar, and continue in this manner until he reached the mash, when he would settle down, eat his fill, and then move off. The locusts which came to the mash, before eating the sugar, would, almost without exception, eat their fill of the mash and then walk away; but occasionally one would leave the mash and take a few bites of the sugar, only to return to the mash

again. None of them ate their fill of the sugar, but always manifested an evident preference for the mash.

373. The poisoned mash successful.—This mash was used upon about 300 acres of orchard and vineyard on the Buhach plantation, and about two weeks later scarcely a living locust was to be seen, where they could have been counted by the hundreds, or even thousands, before the poison had been applied, the ground in many places being literally covered with the dead bodies of the slain. Several other parties also used this poisonous mash, and, so far as I was able to learn, it gave entire satisfaction in every instance.

374. Needful precautions.—Of course this mixture should not be put out in places where poultry or any of the domestic animals can gain access to it. I did not learn of a single instance where this mixture had caused the death of any person, nor of any domestic animal, although it was used very extensively in many parts of the San Joaquin Valley. Neither were the birds killed in any considerable numbers from having eaten either of the mixture itself or of the locusts that had been poisoned by it. During the four weeks following the putting out of this mixture upon about 300 acres of the Buhach plantation, I found only about half a dozen dead birds that had evidently met their death through the agency of this mixture.

375. Should be saturated with water.—As the mixture is saturated with water before it is put among the plants infested with locusts, there is no danger of its being blown about by the wind; and there is also very little danger of its being deposited upon the fruit by the feet of birds and insects that may have alighted upon the mixture and afterwards flown to and alighted upon the fruit. As the mixture becomes dry, its particles adhere together, forming a solid mass which could not be blown about by the wind.

376. Might be tried in grain-fields.—I have never seen this poisonous mixture used in grain-fields, but know of no reason why it should not prove very effectual in such fields. Great care should be exercised in using it in alfalfa fields, but if it were placed upon small pieces of boards it could doubtless be used with entire safety in such fields. Of course it would not be safe to pasture any animal in such fields, even after the poison had been removed.

AN AUTOMATIC LOCUST CATCHER

(Extract from the Russian publication, *Selskaya Khozaylu*)

377. The Italian locust.—Of late years the approach of spring is the signal for landowners in important districts, and especially in the Russian "Black Earth Zone," to turn their attention, not merely to the sowing of spring corn, but also to the protection of the young herbaceous plants from the ravages of the *Pruss*, or Italian locust, which has done farmers so much harm of late.

378. Remedies.—Since the locust spreads very rapidly, and the struggle against him under present conditions involves much labour, it is desirable that all those whom it may concern should make known amongst landowners and peasants the few known remedies, derived

from books or practical experience, which may serve to decrease the ravages of the above-named insect.

Harrowing.—The most rational method for combating the locust would appear to lie in the timely harrowing (to a depth of 1 vershok = 1.75 in.) of the ground where the locust has deposited its eggs. This should be done in September and in March.

379. Measure feasible.—

The application of the measure recommended is perfectly feasible, inasmuch as it only necessitates the reploughing of those particular spots (called Koobe-ishki) where the eggs are likely to be found, and these can easily be determined by a careful examination of the actual ground on which the locusts had swarmed.

380. Specimens.—It would be undoubtedly desirable to provide agriculturists of the infested districts with specimens of the locust eggs, that they might the more readily recognise them.

381. Laying eggs.—The female of the Italian locust, like most of the various varieties of grasshoppers, lays her eggs, as a rule, on hard, fallow, and waste land, preferring slightly raised slopes. On land only

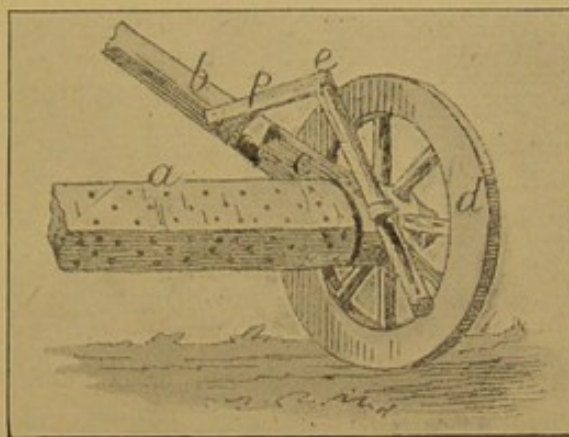


FIG. 17.—First part of locust-catching machine.

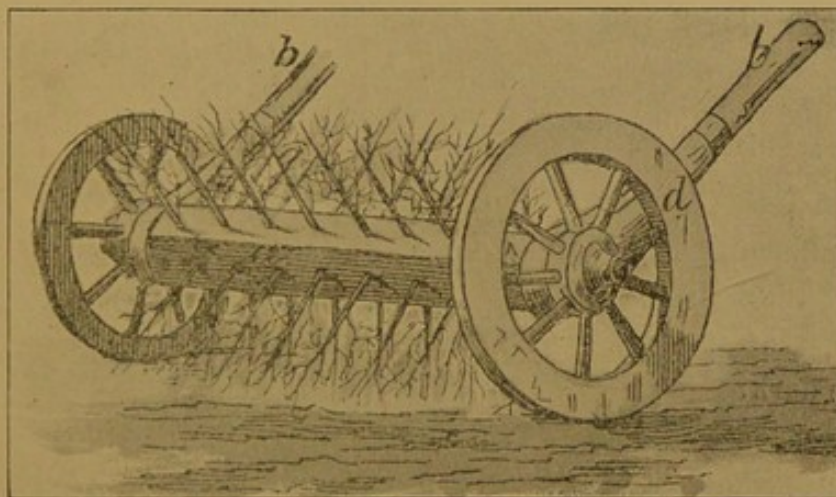


FIG. 18.—Second part of locust-catching machine.

recently allowed to lie fallow, these eggs will be found on the furrows separating two fields along the roadsides, and lying vertically on the surface.

382. Killing young locusts.—As, however, this salutary measure may not be applied in many districts, and the locusts may hatch by myriads, the full-grown locusts will have to be attacked in summer, by driving them into ditches, burning, stamping, and crushing them with rollers, catching them in curtains, and such-like operations. With

reference to this latter phase, I wish to direct the attention of readers of this journal to a method in the Government of Orenberg, which has produced highly satisfactory results; this is the employment of an ordinary automatic locust-catcher (Fig. 20).

383. A locust-catcher.—How to construct the locust-catcher. Two wheels (Fig. 17, *d*) are firmly fixed to the ends of a four-sided

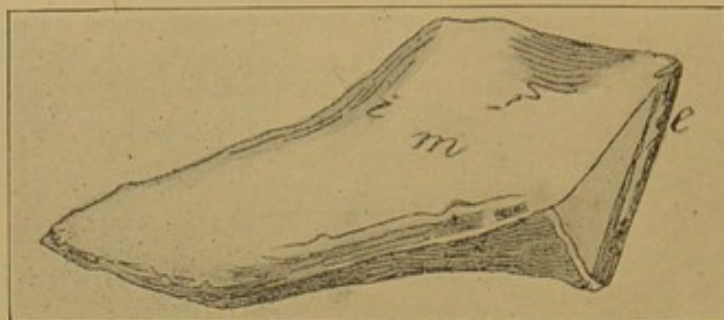


FIG. 19.—Third part of locust-catching machine.

beam (*a*), and close to each wheel circular grooves are cut, to which the shafts are attached by means of iron bands, in which the beam revolves like an ordinary axle. To the iron bands (*c*) and the shafts (*b*) are fixed pieces of timber (*e*), the upper

ends of which are level with the tops of the wheels (*d*), and kept in a vertical position by the supports (*p*) being slightly inclined towards the horses' heads. The lower ends of these pieces project downwards to within $2\frac{1}{2}$ ft. from the ground.

384. The broom.—Between the wheels and along the beam (*a*), arranged checkerwise, a series of holes are drilled with a centre bit or auger about as big as one's finger, and $1\frac{1}{2}$ to $2\frac{1}{2}$ inches apart. In these holes are fixed twigs of willow or branches of any tree whatever (Fig. 18). In this way the revolving beam (*a*) with the inserted twigs form a broom.

385. The bag.—To the upper and lower extremities of the timber (*e*) is attached the bag (*m*), sewn up along the sides (Fig. 19), of 14 to 21 ft. long, according to the strength of the horses, and enough to fit in between the two wheels (*d*), as will be clearly understood from Fig. 20.

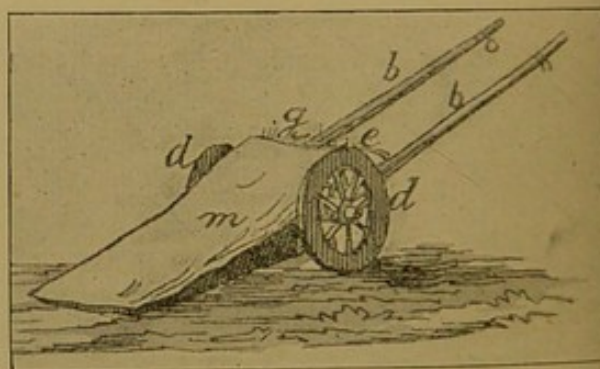


FIG. 20.—Locust-catching machine—entire construction, and ready for action.

386. How worked.—

To this simple machine one horse is harnessed, and it is dragged over the ground infected by the locusts in various directions. The revolving axle thus picks up and sweeps the insects into the bag, which is very rapidly filled. The latter is then emptied into a trench or hole, where the locusts are either burnt or buried.—*Agricultural Ledger*, Calcutta.

387. The balloon hopper-catcher.—Mr. Bairstow has selected the following implement from the 44th Report of the U.S. Museum

(presumably the latest Report), as being the best and most up-to-date mode of all the ingenious and many plans used in North America for combating the plague.

388. How constructed and worked.—"A balloon hopper-catcher was used, consisting of a frame of strips of wood, 18 ft. long, to lie flat on the ground, and carrying upon it a large loose bag of cheese-cloth, with a spout made of a sack sewed into one corner. As this is drawn quickly over the ground by a horse, and the bag or balloon becomes inflated by the wind or draught, the hoppers are scooped up and hop or fly into it. When the bag is filled, the insects are removed to other bags, in which they are tied up for convenient measurement. It worked admirably, and yielded golden returns. The fields were covered with hopper-catchers—men, women, and children, the latter using their aprons and shawls, and the women tablecloths and sheets. The farmers gave up their work for this better remuneration. They would allow no one to share with them in the ingathering of this harvest, all intruders being warned away by such signs as these, posted up in conspicuous places, 'All hopper-catchers forbidden on these premises,' or, 'For the privilege of hopper-catching, apply to ——.' The crop was undoubtedly the best paying one their land had ever yielded. The number of bushels caught and measured in this manner, and paid for by the Commissioners, was 14,357. Result, most of the farms were saved. Ploughing was also successful against the hatching of eggs, etc. Burning over stubble and dead grass was used, and also poisoning with London purple, etc.

389. Result.—"As the result of the operations narrated, the insect has been virtually destroyed throughout the infested districts. Comparatively few eggs were laid last year, and there is no apprehension of serious injury from the few survivals in the coming season. When we recall the fearful losses from this Rocky Mountain locust in some of the Western States in former years, that brought poverty and starvation to thousands of their people, estimated at two hundred million of dollars in a single year (1874), it cannot but be regarded as a triumph for economic entomology that this great scourge (almost equalling in destructiveness, in years of its abundance, the migratory locusts of the Old World) has been brought under control.

390. "There is no claptrap about this. It goes to prove that the economical efforts of a far-seeing Government have (1) been rewarded by the State's assistance, (2) been ably assisted by practical entomologists, (3) been backed by the people, (4) succeeded admirably in keeping down a pest's ravages."

391. Mr. Peringuey's opinion and recommendation.—Mr. Peringuey thus delivers himself in regard to the "screen and trap" system as a means of combating the plague:—"I have told you that a locust takes from six to eight weeks before it becomes winged, and then only can it pair and multiply. It follows that it is during that time that it must be destroyed, and this is to be done in the following manner:—Strips of cotton texture of different length and 2 or 3 ft. broad, with a strip of oil-cloth or other glazed surface on the upper edge, are stretched

in a given direction by means of wooden pegs and ropes, and lead to a trench 3 ft. broad and 3 ft. deep; the voetgangers are driven against the screens, they cannot climb over the glazed surface, and they are then led by sheer pressure from behind to the trench, and there despatched either by the means of the glowing embers. . . . In a word, we have it that at a given time, in a district which has been infested the previous season, there are so many thousands or cubic yards of eggs (pods) to be collected and destroyed, and that at any moment the Divisional Council or the powers that be are prepared to run so many miles of screening, dig so many yards of trenches, and ready to pay a good sum of money towards the desired end.

392. It should be adopted.—"Now such a thing is done elsewhere, why should it not be done here? By means of this *carte de prevision*, the Locust Service in Algeria knows how much work is to be done, and what the approximate cost will be. In 1888-89 they had in two districts of Algeria an area of contaminated ground of more than 100,000 hectares (1 hectare is equal to 1.15 morgen), in 1889-90 this number had been reduced to 30,000 hectares. Keen watch, however, has to be kept. The third district is also invaded from another side (Morocco).

393. Has been tried in Teniet.—"During the months of May and June, in a small parish, no less than 55 miles of locust screens, with their accompanying trenches, have been stretched. From the 16th of April to the 28th of June in that very parish (Teniet), containing an area of 3300 hectares of contaminated ground, 36,000 cubic metres of eggs, which would have given 145 billions of locusts, were destroyed. Let us bear in mind that the picking of egg-pods in the campaign of the previous year, 1888-89, had cost £80,000 sterling."

BOOK III
MEANS FOR COMBATING THE PLAGUE
OF LOCUSTS

“ Errors like straws upon the surface flow ;
He who would search for pearls must dive below.”

“ *Magna est veritas, et prævalebit* ” (“ Truth is powerful,
and will prevail ”).

BOOK III

INTRODUCTION TO REMEDIAL MEASURES

394. Retrospect.—From what has been said in Books I. and II., it will, I trust, be conceded by anyone who has considered the matter carefully and impartially, that although we do not know accurately from whence come the locusts, yet they are a veritable plague. They are the same destructive creatures now that they have ever been. It has been necessary to enter into the foregoing details so that we may the better understand how to deal with the pest. In order to bring this clearly out, I may borrow a simile from what constantly may be observed in the practice of the medical profession.

395. An analogy.—When a person is stricken down with an alarming illness, so that it becomes necessary to call in the aid of the family physician, if the summons is not left too long, which unfortunately it is in a good many cases, the first thing the doctor has to do, if he be a careful and skilful man, is to find out the exact and true condition of the patient, or, in other words, to ascertain what is the matter with him. Professionally this process is called arriving at a diagnosis. In a number of cases there is no difficulty in doing this, but in a fairly good percentage it is a matter of far more difficulty and importance than the anxious friends or bystanders either can imagine or believe it to be. They do not know the intricacies and the difficulties that stand in the way to enable the doctor to come to a fair decision as to the diagnosis. A little more time spent in this part of the inquiry, so that the doctor could arrive at the truth, might be the shortest way to relieve and benefit the sufferer, even although, as often happens, the anxious members of the family, or relatives, do not perceive this or think a prolonged and more careful examination would be productive of more good, or they may even regard it as a waste of time, and perhaps injurious to the patient; sometimes the relatives, it may be still further said, not only do not facilitate the object of the doctor, but even mislead or deceive him, intentionally or unintentionally.

396. Diagnosis.—Still, certainty in the diagnosis is far more to be preferred than haste in prescribing. To try to relieve the pressing

urgency of the moment is, however good and desirable in itself, yet only secondary to getting at the true or real condition of affairs, in the vast majority of cases. The diagnosis in a great number of cases is found not to be an easy matter. The symptoms of which the patient complains may or may not be well marked; or an "organ" remote from the place where the signs are most urgent and trying may be the primary cause of the complaint; or there may be more than one "organ" of the body affected at the same time, and the situation of these "organs" may not be near the seat which attracts and commands the notice of the patient or his friends.

397. The doctor therefore has to look far afield in order to discover the true nature of the cause, and the general bearing and aspect of the complaint. It is in fully grasping the situation that the superior skill comes in, and not the mere writing of a prescription, which is easily done. By carefully studying the symptoms, the physical signs, and bearing in mind the connections of the functions of one part of the body with those of another, the doctor can usually differentiate the case, and this beautiful process of reasoning, etc., he may carry out in many ways. He is not limited to one method. It may be done in a direct or an indirect way, in a positive or in a negative way (that is, by a process of exclusion), according to the symptoms that present themselves or not in any given case, and the several organs he may find affected or not. He finally arrives, let us suppose, at a diagnosis.

398. Treatment.—Having surmounted this important stage—important because without it he is groping usually in the dark, which is a dangerous state in all serious cases (like a mariner at sea without his compass), running after and treating symptoms rather than the *origo mali*, or disease—he comes at length face to face with the true object of his visit of mercy, namely, the relief from suffering, which is generally known as *the treatment* of the disease and cure of the sick person. This stage, from its very nature, is the most difficult, as indeed it is the most desirable one to reach when his services are in demand. Clearly, if the disease be mistaken or wrongly diagnosed, the treatment may be altogether wrong. The one depends on the other. This will be at once evident if, for example, we suppose that the medical attendant diagnoses a disease of a bone or joint, and advises the limb to be cut off. The operation once performed, if the diagnosis were false, the loss would be irreparable. From false premises we get conclusions that turn out to be false. The great aim, therefore, ought to be to have our facts and data set out truly and clearly and faithfully.

399. Clearing the ground.—The abstract process of reasoning is always clear, not less so in the moral field than in the physical. All depends on getting the matter cleared up, so that the ideas may be grasped and handled with adequate fairness and precision. Points will

be raised in the subsequent treatment of the matter in hand that will bear a parallel application with the example now stated. It is for the purpose of elucidating some aspects of the question that it has been introduced. Right and progress do not always accompany hasty actions. The ideas connected with the locust question seem puzzling. All admit its importance. But whether to do anything to get rid of the pest, and if so, what means should be taken, are clearly matters open to question and criticism.

400. The country has not been taught by experience.—

First of all, it is important to know all we can about the insect, and therefore we have been at so much pains in the former parts to state the foregoing details, which ought to be mastered. In the next place, it is important to learn what nature does; ascertain after that what has been artificially done with a view to lessen its ravages; and, finally, point out in detail the best up-to-date methods to combat the plague, so as to bring our information and work to a practical test or issue. We have therefore, in the sequence, given some of the common means practised for centuries by the most enlightened and energetic peoples who have dealt with and seen the plague. These means, as we shall see, were in the main utterly useless; but yet, notwithstanding, there is scarcely a newspaper published where the plague exists that does not in some form or other recommend and contain an account of precisely the same means being employed, or having been used, in our own time, and with precisely the same effect or result. Why is all this useless waste of energy? Simply on account of ignorance. As stated in Book I., all the obstacles, for example, placed in the way or path of the "army on the march"—the *voetgangers*, or *hoppers*—previous to fifteen or sixteen years ago (1883) proved utterly useless (see par. 134), and yet to-day here is the common testimony: "The *hoppers* are doing more and more damage to crops week by week, efforts to keep them out proving quite unavailing." All "efforts" such as are indicated are only throwing away money, and blighting one's hopes, and wasting one's energy. 'Tis throwing good money after bad. "For the last two or three weeks most of the farmers have been able to do little else than try to prevent the locusts from going into their crops, which, as you know, means expense, and it is a fruitless job unless properly concerted and special means are used."

401. Fatalistic objection considered.—Now, then, at the very threshold we are brought face to face with the question: Should steps be taken to check the plague, or should we leave the locusts alone, and simply beseech Providence to take them away, as He sent them? This opens up a great religious question. Most Christians believe that Providence brought the locusts, as He has brought most other things, for wise purposes. A few believe that, as they are a Divine visitation.

it would be wrong to try to get rid of them except by the same Divine agency, and that alone. Thus, as they came with the wind, so ought they to be allowed to remain until the wind carried them away. It would in their view be wrong to kill them, or impede them in carrying out their devouring and destructive object. At first sight there is something very plausible and convincing about this doctrine; but, on closer examination, it "cannot hold water," and it will be found utterly untenable. Let us examine this theory, and practise by what is known and done and considered right in actual life, and upon the ground that these advocates themselves have chosen, namely, the religion of the Scripture.

402. We rise to better things through adverse providences.

—It is a law of our experience that we learn by contrast, that we increase our "living" this life by the aid of the vicissitudes which meet us, and that we ascend on the burning stairs of trial to the amply furnished mansions of human well-being. Life is not monotonous but varied, and by this variety it is enriched. There are the ups and the downs, the sunlit hills and the miasma-filled valleys, sunshine and storm, sorrows and joys, prosperity and adversity, bitterness and sweetness, health and sickness. Who will or can deny that this wonderful variety makes for us a nobler and richer inheritance and possession? The life lived by partaking only of the sweets in a confectioner's shop, to the exclusion of all other nourishment, would be misery itself, and unendurable. Clearly, then, enjoyment depends on variety and the adequate apprehension of the "fitness of things." Providence has bestowed a bountiful supply to meet our varied wants and necessities of life. He has made man in His own image, glorified him, and granted to him reason and knowledge, —a knowledge of good and of evil,—and He will not cease to befriend and glorify him as long as a ray of reason is left. The world is full of the wonderful works of the Creator—everything speaks of Him, from the flowers of the field to man, who is the crowning work of His hands. Man is the monument of Himself, but the All-wise cannot invalidate Himself—He is also merciful to the beasts, and provides for them.

403. Disaster should be met with in the spirit that resists temptation.—At first sight, no doubt, such a plague as a visitation of locusts does appear to be a messenger from the Almighty Preserver, for the purpose of punishing the disobedient and the transgressors—at all events, He permits the locust to cause devastation and an immense loss of valuable property. There is no doubt whatever that there is a beautiful harmony in the operations and purposes and workings of Providence, but which purely worldly and sensuous men can neither explain nor understand. To these they are blind. But, on closer examination, it is perfectly clear and intelligible that while Providence permits the locusts to destroy the industry of man, who on this

account ought to humble himself, yet it is not only not wrong, but also is absolutely his duty to do all in his power to save from destruction the produce which a bountiful Providence has given for sustaining himself and those creatures depending on him for existence.

404. Illustrations.—All departments of life, as well as experience, point out the correctness of this line of conduct, and *vice versâ*. If an animal fall into a pit, is that not permitted? Have we not the example of the Typical or Ideal Man, who commands us to search—search diligently—for it; and, when found, take it out, so that its life and usefulness may not be lost but preserved? If a fly is permitted to settle on the nose, do we leave it there until the same Power removes it? Or are we wrong in using forcible means to rid ourselves of it, lest in the case of a wasp or mosquito it carries out its well-known propensity, and inflicts pain, etc., upon us? Was Paul wrong in shaking off the viper that was permitted, perhaps specially sent, to settle on his hand? If a venomous snake come to attack us, are we wrong not to punish him in doing so? Or are we right in using every means to defend ourselves, and in turn attack the intruder and even kill him, so that he may not disturb the peace or injure the health or life of another less able to defend himself than we are? Need the examples be multiplied? They can be multiplied *ad infinitum*. Sickness and disaster are, or may be, “ministries” for our good as well as the reverse—and so may health and prosperity be used.

405. The new commandment.—Self-preservation, therefore, is the *first* part of the great law of life—it is an instinct—and life is a good thing. And the *second* part is to extend that same principle and practice to our neighbour. Now, these two parts of the same law of the Creator of the universe cannot be separated one from the other. You cannot comply with the first part and discard all responsibility or knowledge of the second, and yet be a Christian man. Nor can you carry out the second part and neglect the first, and still comply with the law of the Perfect Man. Such would be an impossibility and an absurdity in the Christian sphere, and would be at variance with reason, logic, and common-sense. Those who think they can act thus cannot have a quickened conscience.

406. “Trust in Providence, and keep your powder dry.”—Such being the Divine ordination of things, a Christian people would act most in the spirit of Scripture by conforming themselves to humiliation; and, while doing so, at the same time carry out diligently all the means in their power to counteract the evil. While not neglecting the object-lesson to be derived from (in the instance we have supposed) the animal being permitted to fall into the pit, yet do not neglect to look for it, and when you have found it, save it. There would be a sin committed in not searching diligently for it, and in allowing it to

perish if found, while waiting perhaps to learn the full meaning of the object-lesson.

407. This position is still persistently held by His Honour the President, and by the members of the Transvaal Volksraad, as may be seen from his able, if somewhat partial, biographer (*Paul Krüger*, by F. Reginald Statham, 1898, the most recent and authoritative expositor). Mr. Statham says: "There is no logical difference between members of the Pretoria Volksraad who shrink from interfering with a plague of locusts, on the ground that it is a Divine visitation, and the English clerics who fifty years ago objected to the use of chloroform in obstetrical cases, on the strength of an obscure verse in Genesis." Now, without any desire or intention to enter on a metaphysical discussion with the learned author of this biography, I wish first to emphasise the *admitted* fact that nothing is done in the Transvaal to check the plague because it is due to a Divine visitation, and to place respectfully a caveat or protest against the reasoning. The two cases cited are not at all parallel or comparable. The case of the locusts, and the view entertained of them in the Transvaal, has been before the public for centuries and centuries of years—along the ages—and the universal opinion, except in the Transvaal, is that their ravages should be checked, and everything done that can be done to lessen or abate the plague; whereas the use of chloroform was only then a new discovery, and a few clerics—their number was small, and their standing not very important—did take exception; but, when fairly met, and their objections and mode of reasoning exposed, this meagre few were silenced—they hid themselves, and their names are neither now remembered nor known. The cases, therefore, are very different, although there is a superficial similarity. I trust the time may come when Mr. Krüger and his Volksraad may be of the same mind as the rest of the entire world in the desirability and propriety of using means to check the plague, till Providence of His good pleasure sees fit to remove them entirely. Dogged obstinacy on a point of this kind, in the face of the whole world, is not exactly commendable or wise. It is not a course that can be said to be on the lines of enlightenment and progress. It is not defended by Mr. Statham even—he only explains or apologises for it on the *tu quoque* principle. (See footnote on par. 411, following.)

408. **Humiliation, prayer, and solicitation to receive the spirit of wisdom.**—For those who are religious, the first step in the process of being alleviated from the pest is akin to that which is mentioned in the above heading. It is necessary to have this true relationship established between the Creator and Divine Sustainer on the one hand, and on the other the people who believe in Him. Whether this attitude may be distinctly known or not, it is, or will be, as much a consequence as that day follows night, clouds follow after the

clear light of the sun, etc. There will be a remnant that will follow Him, so that many more may be attracted to His side by His matchless workings, and made to think. Hence, while the irreligious and profane may laugh, ridicule, or hold up to scorn, the "great company" of the faithful (now as always) will put in the forefront humiliation, prayer, and a solicitation for aid from the Divine Helper (the Almighty), whenever and wherever dire calamity threatens.¹ Proclamations and exhortations such as the following are therefore resorted to, as a rule, throughout all Christian and civilised countries, and that which follows is only a type of many that could be given:—

"Locusts—The Archbishop² has ordered prayers for the removal of the plague of locusts. The parish priests are to exhort their congregations to aid the work of the Committee in destroying the locusts."

No fault in itself, therefore, can or ought to be found with the spirit of the following proclamation issued directly by H.H. President Krüger:—

"A DAY OF HUMILIATION (from the *Star*).

409. President Krüger's proclamation.—"The appended proclamation appeared in yesterday's *Staats Courant*, and has been wired to the various Landdrosts and Field Cornets. Its piety is unquestionable. If only the Government would recognise that other things besides cattle plagues and droughts are also the manifestation of a reproving hand:—

410. "Whereas the reproving hand of God has lately visited some of the surrounding countries with a heavy cattle-sickness, and the South African Republic and other countries and States with continuous drought and locusts; and whereas this Republic is also threatened by

¹ I believe it may be safe and right to urge this point somewhat further, namely, that all, or at least the majority of men, under certain circumstances have recourse to similar measures. We find in the Ancient Record (Jonah i. 5) that the entire crew of a ship, heathen idolaters as they were in the first instance, did the same—"the mariners were afraid, and cried every man unto his god,"—and further, without a single exception, we then find that all of them became immediately converted to the true God. This is brought out clearly in the narrative (verses 14 and 16)—"Wherefore they cried unto the Lord, and said: We beseech Thee, O Lord, we beseech Thee, let us not perish. . . . Then the men feared the Lord exceedingly, and offered a sacrifice unto the Lord, and made vows." Instead of being separated as they were at first, each flying to his own god—the common mode with heathen idolaters—they now became united, and together made a sacrifice to their common Lord. One of the most remarkable instances on record from several points of view—showing clearly under *fair* auspices the all-conquering power of the Truth. All antagonism will disappear, as it did in the case of this entire crew of sailors when fairly met. Right in the end must prevail over wrong.

² The Archbishop of Buenos Ayres.

the so greatly-dreaded cattle-sickness, against the spread of which the Executive Council has already seen fit to take measures by the issue of my proclamation thereanent of the 11th March last; and whereas, on account of the above circumstances, there is every reason to entreat the Most High under a confession of sin, that His reproving and chastising hand may be turned from our lands and from the adjoining countries and States; that our Republic may be delivered from the plague of locusts; that the drought may be stayed, and that copious rains may fall, and that our land may be saved from the dreaded cattle-sickness. So it is that I, S. J. P. Krüger, State President of the S.A.R., with the advice and consent of the Executive Council, have hereby enacted and determined Sunday, the 5th day of April 1896, as a day of humiliation and prayer for the whole State, in order that the inhabitants and all who feel the need thereof may have an opportunity to offer their prayer in common to the Throne of God. Ministers, teachers, and leaders of the various congregations are invited to more especially consecrate that day to prayer and humiliation, to the turning away of the plagues, whereby this Republic and adjoining States are visited, and to lead their ecclesiastical congregations therein.

(Signed) "S. J. P. KRÜGER, *State President.*
"C. VAN BOTSCHATTEN, *Act. St. Sec.*"

411. Something more wanted.—This is an admirable proclamation; but on the face of it, is it not evident that the same great cause is at work in regard to the three evils mentioned (cattle-sickness, drought, and locusts)? Now "measures" have been devised in regard to the prevention of the spread of cattle-sickness. But the Government is typically held up as the one in South Africa, and, so far as I know, in the civilised and Christian world, as considering it their duty not to take any steps whatever to check the locust plague, other than the prayer that the Almighty would remove it at their request—perhaps, as they think, by a wind blowing the locusts into the sea. Is there not a manifest inconsistency here? If God sent the locusts, did He not also send the dreaded (greatly-dreaded) cattle-sickness? Would it be—is it not—wrong to take "measures" in the one case and not in the other? Wherein lies the difference? Is the loss by the locusts less, or not of the same amount, if different in kind, to the loss of cattle?¹

¹ It affords the writer extreme satisfaction and pleasure to have it in his power to record here and now that the Government of the South African Republic through its Executive have at last seen it their duty and privilege to fall into line with the peoples of all civilised parts of the world, and thus show one united front against the locust plague. Therefore they honour themselves. From a letter of protest against this yielding on the part of the Executive, which appeared in *De Volkstem* of April 15, 1899, written by Mr. H. D. Sassenberg, Field Cornet, Oppermanskraal, Wakkerstroom, it would appear that an official document has been sent to all the field

412. "If you know these things," etc.—Surely, on reflection, light of the understanding ought to and must come, so as to replace the darkness? Would it be wrong to supplicate Providence for wisdom and understanding to carry out the two parts of the Divine law already referred to? If the adjoining countries and States are doing all they can to exterminate the pest of locusts, surely they should and do expect a Government, such as that serving under the President who has issued the above beautifully-expressed proclamation, to co-operate with them in an enlightened manner—a manner which has been approved by all the Christian and civilised peoples and nations of the world? "Do unto others as you would that others should do unto you." "Thou shalt love thy neighbour as thyself." "When Thy judgments are in the earth, the inhabitants of the world will learn righteousness."

413. Union is strength.—Perhaps it may not be amiss to point out that the lethargy, or callousness, or complete inactivity to do anything, except prostration and prayer, which may be powerful and successful, may be accounted for in this way, that little or nothing is known that can be said to prove useful. Even granting that this latter assumption is right, then the excuse or reason for not engaging cordially and energetically with one's neighbours is very poor and lame indeed. United action would or should encourage and excite exertion. In union there is certainly more strength than in isolation, separation, and "masterly inactivity." Zeal in such a good cause should and will *find*, if it does not create, an opportunity, but it may do both.

414. A comparison instituted between two plagues.—Moreover, is it not carrying out in a more becoming manner the Divine mind to adopt "measures," or concert about adopting "measures," to minimise or exterminate one "plague" sent by the same "reproving and chastising hand" as much as the other? It is only a matter of opinion which plague is the more easy or difficult to bear. The evils are admittedly bad, as otherwise they would not constitute plagues. It seems to fall in with what their duty is to God when they (the Executive Government of the Transvaal) take "measures" to check the rinderpest or plague amongst cattle, while they likewise believe it would be exactly the reverse—transgressing against God's laws—if they took any active substantive steps to lessen or stop the plague of locusts, such as all the neighbouring countries and States do, or desire to do.

415. A fresh circular.—While therefore they have up to the present declined to take any active steps to mitigate the ravages of the

cornets and landdrosts throughout the Republic inviting them to co-operate to check the plague as far as they can. There are still many Boers throughout the two Republics and the Cape Colony who think like Mr. Sassenberg. Bravo for the Government which has acted on the line of progress and common sense!

locust plague, because they hold it to be a punishment sent directly by the Divine hand, yet from the following circular which the Transvaal Government have issued, it will be seen that they take a very different view of what should be done in a co-operative way in regard to the plague of rinderpest among cattle, and the circular cannot be too widely known. It runs thus :—

416. How rinderpest was met.—"For your information and for that of the public, I have to inform you that the members of the veterinary profession have given their ideas as regards the rinderpest, and are of opinion that it is their duty to caution the public against the impression that curative means have been found through the treatment with linseed oil and other medicines. They maintain that in other countries rinderpest is considered as the most fearful contagious plague known amongst horned cattle, and has as yet baffled every effort made by science to combat the same with success ; so much so, that even if any number of cures take place through the agency of medicines, the cured animals might be mediums for carrying the disease to all cattle with which they might come in contact. Further, the contagion would remain on the veldt where they graze. For this reason the members of the veterinary profession would insist strongly that every effort be used to prohibit the introduction of the disease, and to get rid of the same at the root, rather than trust to curatives. They hope that everybody who wishes to maintain one of the principal industries of South Africa will work together with the authorities in order that rinderpest may be prevented from becoming a permanent plague in the land."

417. How the locust plague should be met.—In view of the current opinion concerning the locust plague in that same circle, the contrast is extremely striking. The colony of Natal has rendered it illegal and punishable for the time being for anyone to introduce cattle from the South African Republic into Natal. Surely from what has now been said, nothing further need be added to expose the absurdity, and remove the untenable position the Transvaal Government have taken up, and which they have hitherto maintained in respect of the locust plague. Is it too late to hope that better counsel shall and ought to prevail, and that all the countries and States of South Africa should present a suitable front, like one man, to the common foe—the locust plague? (See footnote to paragraph 411.)

THE RINDERPEST. THE LATEST PROCLAMATION

418. Proclamation.—The following is a summary of a proclamation *re* rinderpest by the State President, appearing in the *Staats Courant* of Wednesday, 9th December 1896 :—

"All traffic by ruminants is prohibited for the period of two months, beginning 15th of November 1896. In all districts, however, in which the disease has not made an appearance within twenty days, traffic shall be renewed. Field cornets are requested to report on the spreading (or otherwise) of the disease before the 5th December 1896.

"Only on approval of field cornets can the conveyance of slaughtering cattle be allowed.

419. "This limitation of stopping traffic does not affect farm labour to be accomplished by cattle *salted by pest*, exclusively for the conveyance of productions and provisions within the boundaries, under the following conditions :—

"(1) Before employing such salted cattle, the owner should be in possession of a field cornet's, etc., certificate, which is to qualify for an undoubted safety of the cattle concerned. If the giver of such certificate is in the least doubt as to the truth of the salted condition of the cattle, a certificate may nevertheless be extended on the proper affidavits of two competent people who know that the cattle are salted.

"(2) The officials concerned in the districts whence such salted cattle come shall consult with the officials charged with the rinderpest regulations, in the district to be crossed, as to the best route for the mentioned cattle.

"(3) These officials should effect regulations aiming at the best means for the prevention of contact of any cattle on the way.

"(4) Owing to the scarcity of cattle and provisions, no salted cattle will be allowed to cross the border of the State under any circumstances.

420. "Whereas reports from field cornets regarding this proclamation are received from all quarters of the Republic, and that these reports declare many districts to be disinfected, and that field cornets and landdrosts have approached the Government praying for traffic by ruminants, owing to the scarcity of food stuffs ; whereas it is impossible for the Government to supply help to all, and while it is at the same time conscious of the necessity that the probability of famine should be acknowledged, and whereas a limited traffic was already granted to salted cattle ;

421. "So it is that I, S. J. P. Krüger, State President of the S.A.R., with the advice and approval of the Executive Council, in accordance with Art. 1063 of its resolutions dated 8th December 1896, here proclaim, confirm, and notify that Section 4 of the Ex. Res. of 3rd November 1896 shall be completed as follows :—

A.

"(a) In districts where the rinderpest has not appeared within the last twenty days, traffic by ruminants shall be opened.

"(b) All traffic within infected areas is prohibited.

"(c) (Same.)

"(d) All certificates affecting conveyance can be obtained from field cornets, etc., these certificates to remain on the person of the possessor.

"(e) Field cornets, landdrosts, etc., shall advise and direct on all traffic and routes of conveyance.

"(f) Only Europeans shall be allowed to traffic, and natives under the supervision of Europeans.

B.

"(1) All existing proclamations, etc., *re* the rinderpest, remain in force.

"(2) The Government is informed that several farmers design to effect lawsuits against the Government, with a view to compensation for damage incurred by hedging in of infected areas. The Government hereby warn such people against such attempts, and promises that it will consider their complaints on proofs that their property had been purposely and intentionally damaged.

"Moreover, I proclaim, charge, and notify, to all landdrosts, etc., that they regard this proclamation very stringently.

"God save the Country and the People."

"Given under my hand this 8th day of December, in the year of Our Lord 1896, at the Government Office at Pretoria.

"S. J. P. KRÜGER, *State President*.

"DR. W. J. LEYDS, *State Secretary*."

422. Ruskin's gospel.—It ought to be remembered and taken into account that this great country is only being commenced to be opened up. Cultivation of the soil is at least one of the most important industries of the world. "Food can only be got out of the earth, and happiness out of honesty," is the gospel according to Ruskin. Parts here and there at present in South Africa are only being tapped, and this is being done by some of our very best men.

423. Disaster to the Transvaal.—If by want of knowledge or by want of concentration of energy, this terrible scourge is permitted to overrun the whole country and obtain a hold upon it for years to come, then it may, while so far well adapted for agriculture, become a repetition of Cyprus and other places, and throw the country several years back in its progress. These capable and industrious agriculturists may be ruined, and thus incalculable mischief done to the country and an obstacle thrown in the path of progress.

424. No man liveth to himself.—It is only by wholesale concen-

trated measures in combating the plague that success can be achieved. The agricultural area is extending year by year throughout Africa, and the probability is that it will do so in a far greater ratio in the future than in the past (if plagues of this kind do not impede it), so that the losses will also increase in the same or a greater proportion should the plague be allowed to continue. It is a sorry spectacle to see the toil of a good and poor man for a year vanish in a day. It affects his life and prospects seriously. Is this nothing to a good man? As there is no man in any community who can literally be so isolated from all the rest in such a way that he does not partake of some of the characteristics of those who form the said community, so there ought to be united action. To a certain extent we are a part of those we have met. Those with whom we came in contact, influenced us in some form or other, for good or bad. Farmers are influenced in their habits and ways by their neighbours in a somewhat similar way. Are nations and States not under the same universal law? Surely, therefore, in South Africa—everywhere—there should be felt this inter-dependence and inter-co-operation of one State with another. Can this be anywhere better or more fittingly exemplified than in combating a plague?



BOOK III (*continued*)

SECTION I

THE NATURAL AGENCIES AT WORK TENDING
TO CHECK THE PLAGUE

“ Nature and Wisdom never are at strife ”

BOOK III (*continued*)

SECTION I

425. The two means of resistance.—I now come to deal with the various specific means whereby the plague may be abated or exterminated, and here the subject may be conveniently considered under the two following heads:—

(1) *Nature's methods of alleviation from the plague.*

(2) *Artificial means for exterminating the plague.*

Now, these two methods are not opposed, the one to the other. Experience teaches exactly the contrary, and that the one may be and is, when properly arranged, helpful to the other in bringing about a better condition. The fact that the Creator has endowed man with gifts of ingenuity is proof of itself that when properly exercised it is subservient to His own divine method and purpose of bringing about a purer and happier state, and for the upbuilding of man himself.¹

CONSIDERATION OF THE MEANS NATURE USES TO REMOVE OR ABATE THE PLAGUE

426. The locust has many enemies and no friends, from the various Governments of the countries they visit down to the domestic cocks and hens. They are attacked on all sides—except perhaps by the Executive Government of the Transvaal; even the very insect life seems to have an enmity towards the locusts. The excitement in

¹ In his introduction (chap. v. p. 37 of Report cited) to the remedial part of his subject ("Natural Division"), Mr. Bruner says: "Once a locust becomes a plague it requires considerable energy on the part of man to reduce its numbers sufficiently to render it harmless. Beyond a certain point all the increase in an insect pest is just that much gain on its natural checks. To bring it back to and below this danger-line is of the first importance. This can be done in many ways, as is the following chapter's aim to show. In order to gain the best results, however, everything should be done in accordance with the insect's habits and life-history. Haphazard remedies may or may not be of use in the fight. Where nature can be made or assisted to do the work for us so much is gained; but when this cannot be done, artificial methods alone will win, if persisted in and followed aright."

a poultry-yard during a locust invasion is exceedingly animated, and when once seen is not soon forgotten. The hens gobble them up readily. The effect on the hens is to make the yolk of the egg of a peculiar dull-red colour, and also not a very agreeable taste or flavour is imparted to the eggs, so that at these times one loses the keen appreciation of fresh-laid eggs.

427. NATURAL AGENCIES TENDING TO CHECK OR ABATE THE PLAGUE

(1) Destruction by the wind, or hurricane dashing them into the ocean.

(2) Destruction by birds.

(3) „ reptiles, lizards (iguanas), toads.

(4) „ mammals and fish.

(5) „ wasps.

(6) „ disease.

(a) Internal larvæ or maggots
from the *Tachina* fly.

(b) *Mylabris* parasite.

(c) *Mermis* parasite.

(d) *Cynomia pictifacies* parasite.

(e) *Empusa grylli* parasite.

(f) Various—mites, etc.

(7) „ of the eggs by insects, animals,
weather, water.

428. It is impossible to say what percentage of locusts is destroyed each year by the various means just enumerated. But some idea may be got if we just refer to some of the facts authentically recorded on the subject.

429. (1) **Destruction by the wind.**—This no doubt is the most formidable natural agent in the destruction of locusts, so far as is known at present. It is, in addition, the most ancient, and is the only one of the destroying means mentioned in the inspired Record. "A wind brought them, and a wind carried them away." We are not left in any doubt as to the vast numbers—multitudes—that perish in the sea. There is an authentic recorded case of a steamer being greatly impeded, in the year 1896, in its course for a distance of three miles, in consequence of the immense number of drowned locusts encountered in the waters south of Delagoa Bay, in the Indian Ocean. Then there are repeated cases on record in which the coastline was covered with dead locusts on the bank, 3 to 4 ft. thick, in distances varying in lengths up to even 100 miles—and the stench issuing from their decomposing bodies is reported to extend many miles inland, and it is said in one case to have been perceptible 150 miles. What must it have been within a few miles, or close to it! A putrefying mass of this kind was enough to generate an epidemic of disease. Then, again, steamers in mid-ocean—over 1200 miles from land—have encountered clouds of locusts, and they have swooped down on the ship. Undoubtedly, when they take a high and extended aerial flight, it is conceivable to suppose that often, through exhaustion, etc., they end by being drowned in the sea, and no doubt become food to the fish. When, again, a hurricane occurs, blowing from the land seawards, it must happen that a vast number of them are carried away and hurled into the water. Sometimes, again, when they go high up in the atmosphere, encountering there various currents or strata of air, they are carried away and drowned. They sometimes fall down with great vehemence (from gravitation) on the ground dead, and break in pieces. The cold in the upper strata of the atmosphere kills them. At other times, attracted possibly by the brightness of the moonlight, which has some power over them, especially noticeable late in the season, they ascend higher and higher, as the light increases in intensity, surpass their normal flying altitude, and meet thus with their death in the ocean, just as a fly or a moth or beetle does when it goes to the light of a gas jet, etc., in a room, and is ultimately burnt by going once too often and too near it. Then again, once more, they may be afflicted with some disease or condition of body which renders them lighter for ascending, and when once at a certain height they may be unable to restore themselves or regain their position, and so must inevitably perish.

430. In whatever way it occurs there is no manner of doubt that multitudes are borne away through the atmosphere by the wind, carried away out into the ocean, and destroyed. Not only has this been verified on various parts of the coast of South Africa, but round the coasts of other countries. The following seems one of several authentic accounts, and is reported by a captain whose ship encountered a flock of locusts in the Red Sea. He states: "We were three days in passing through the locusts in the month of May (ss. *Navarino*). The flying locusts fell like snow on the ship, and kept two hands constantly engaged sweeping them up. Many of them died on reaching the deck, and others more lively commenced devouring them. The sea was covered as far as the eye could reach. As we were steaming at the rate of eleven knots, this army extended to 900 miles in a N. and S. direction. It was calm during the time." The destruction by this means is enormous—far and away, before and above, all other natural means.

431. (2) **Destruction by birds.**—In coming now to deal with the natural animal destroyers, it may be well to bear in mind that these are to be found in the two great divisions—the vertebrate and the invertebrate animal kingdom. The former are represented by birds, reptiles, and mammals, while the latter are represented by wasps, flies, parasites, bacilli of various kinds. It is well to bear in mind in this connection, therefore, that the locusts are not poisonous.

432. Birds feed chiefly on insects and seeds. I do not refer here to the exceptions, such as the eagle and other flesh-eating birds, or the humming-bird, that feeds on the juices that are extracted from flowers. As a rule, birds like all other animals have preferences, and by instinct select their appropriate food. They also accommodate themselves more or less readily to existing circumstances, and therefore take the class of food most available or presented to them for the time being. Another advantage is that, in regard to the present subject, birds are pretty generally distributed all over the world. They are naturally in greater numbers in some parts than in others. The birds most useful as destroyers of locusts are—Gaviota (gull), gavilan (hawk), caranchos, chimango, ostrich, martinetti, partridge, etc.

433. Some of these birds are more fond of locusts than others, and are sure to be found on the spot where locusts present themselves. Undoubtedly every precaution should be taken to foster, preserve, and encourage birds for this purpose, and laws should be passed for their protection, and all natural means likely to help in abating the plague.

434. That birds become most animated and gobble up the locusts, when a company of them come round, no one who has seen a "visitation" can doubt, or forget the sight. Reference has already been made

to the action of the common hen. The gaviota, gull, or locust-bird (as it is called), eats the locusts as fast as they settle on the ground (which looks as if strewn with red peapods or shrivelled leaves, according as the bodies or the wings fill the eye most). The gaviota seizes one after the other, munches each and swallows it as quickly as possible, until perfectly full; then vomits the cargo it has had without digesting it, and commences the same process again, until surrounded by little heaps of these broken locusts. So far as this bird is concerned it is a good example of a locust destroyer, but then the difficulty arises, where are we to get enough of them or other birds to tackle thousands of square miles of locusts, or make an appreciable difference in a company of locusts when they have come in force? The birds are not to be found in such numbers in any country,—they have never so been found in and around Johannesburg, South Africa, wild birds being notably scarce,—and the probability is, that they never will be found so as to make any sensible radical impression on a plague of locusts. It is wise, however, to try every means to lessen the damage, and the suggestion to import and breed “starlings” is surely worth the trial.

435. But this difficult work will be more apparent if it be remembered what is the nature of the process that goes on in the case of the birds to which I have referred. It is a purely mechanical process, gobbling up the locusts as fast as they can, and when the “bread basket” will not hold any more they vomit the contents and begin again. This process would, if continued for any great length of time, certainly kill the bird. It is contrary to the normal or natural functions of birds to engage in such a mechanical industry. Abuse of function or abnormality brings its reward in time. Gulls and birds of this class, moreover, are not very numerous in those countries as yet frequented by locusts.

436. Fortuitous lucky accidental circumstances, such as the destruction in this way of a small manga of saltonas or hoppers, do not establish a rule or make a law, but such exceptions help to prove it. Birds such as those described may have a wonderful staying power, but unless it is realised that the whole atmosphere is crowded with these insects—two hundred miles in one direction by two hundred miles in the other, *i.e.* for thousands of square miles—it will not be surprising that a few birds, comparatively speaking, cannot avail much. Remember, further, that these insects are pretty large, and a dozen of them are bulky, but in the multitude of them we lose all sense of count. When you see this vast number of locusts, is there anyone who has ever seen even an infinitesimal impression made on them by birds? Why, a greater impression is made on the birds than any injurious effect on the vast company of flying locusts. Of this there is little doubt. The number of birds it would require to effect any appreciable impression on the

flock would be amazing. It is impossible for anyone who knows what a visitation of locusts really means to conceive that birds, in the ordinary sense of things, could exert a powerful influence in destroying the locust, wonderful no doubt as the birds are. It forms a small item, and as such it ought to be reckoned without doubt as one of the natural causes tending to check or destroy locusts, and so regain the "balance," the losing of which is put forward as the origin of the plague. But it would be unwise to trust to this means as a checking power to the plague when once established.

437. It is not inappropriate to finish this head with a note from Mr. Bairstow, who says:—"Truthfully speaking, locusts have as many enemies as the termite ants, which also occur in the Cape Colony in myriads during swarming-time. I can quite go with my friend and learned contemporary, Dr. Schönland, who says in a letter to me: 'The worst enemies are certainly the two storks (the white and the black), which are called big locust-birds, and *Glareola nordmanni*, the little locust-bird; but every bird which lives on animal food, and many others which are chiefly vegetable-feeders, go for the locust when they are plentiful. Cranes, secretary-birds, hawks of all descriptions, guinea-fowls, korhaans gorge themselves with locusts.' My friend the Professor also states: 'I think jackals also, especially the manhaar jackals, eat a lot of them. I forgot to mention ostriches. On the other hand, even horses are said to eat them.' We have been shown biblically and historically that man has fed upon locusts, and that bread for human food has been baked therefrom. Baboons, and even owls, go for the locusts, and butcher-birds and many of the lesser species. It is only proper for me to point out a fact that may appear strange—stranger than fiction. The Game Protection Association at its annual meeting mentioned that an offshoot of the Association—the Poisoning Club—offered a reward of 2s. for the destruction of each hawk (any time), the skins and tails attached and heads and wings to be produced. . . . I trust that the poor hawks will be exempted from poisoning. They do or may take a chicken now and again, but if they took the lot in South Africa, we should not miss many more birds or prospective fat dinner fowls. Again my friend Schönland goes with me: 'I wish you would put in a word of warning when addressing your farmer friends. Everything in the shape of a hawk or owl which comes within reach of a gun is shot down in South Africa (as it is done at home). But then farmers are destroying their best friends. Of course I am not speaking of big lammervangers, but of the smaller kind, which destroy any amount of vermin (rats, mice, and locusts). It is funny that the secretary-bird should be singled out for protection, since he is such a mischievous fellow, destroying young game wholesale, and regaling himself only occasionally on an odd

snake. In fact, I should consider this as important a calamity as it zebras were exterminated; but what I mean is, that if he deserves protection on account of killing vermin there are a lot of other birds which deserve it a great deal more.' I totally agree with every word my old colleague and collaborateur utters. It is for others to discuss the advisability of supporting or negating the utterances of two brethren who have for pure love's sake made animal life and economy a study, and whose sole object has been the promotion of knowledge and furtherance of fair play to our subordinate fellow-creatures."

438. (3) Reptiles, lizards (iguanas), toads (Batrachians).—

This class of vertebrate animals undoubtedly make insects their chief food, and do eat locusts to a certain extent whenever an opportunity presents itself. As such it is dutiful to preserve them, so that the annihilation of the pest should be encouraged by every means in our power. It would be folly, however, to expect much aid from these animals, severally or combined. Thus on the lands adjacent to the river Paraná—the river having, it is estimated, the second largest amount of water in the world—there are not merely hundreds of thousands, but billions of toads, frogs, lizards, reptiles, etc., and yet the effect on the periodic or annual visitation of the enormous swarms of locusts is virtually nil, a fact that may be believed when it is known that the visitation in recent years has been greater and requires still more stringent measures to be adopted. At the same time, it is good to use every means—put all irons in the fire, and put them in all together, so as to make the blow or effect more powerful and telling.

439. (4) Mammals and fish.—That locusts are not at all poisonous we know, inasmuch as human beings (natives of the country) can and do eat them as food with impunity and relish; wild animals, ruminants (such as the guanaco), eat them; rodents, armadillos, skunks, wild cats, weasels, rabbits, opossums, monkeys, as well as the domesticated animals, such as the common hog, pig, sheep, goats, cows, hens, birds, etc. These taken together prove they not only are not poisonous, but also they consume a goodly number of locusts. But still the plague remains a plague, in spite of all these natural enemies. Needless to add that the fish in our rivers and streams eat the locusts avariciously whenever they get a chance, as in crossing the water.

440. (5) Destruction of locusts by wasps (Amnophila) (Fig. 21).—On the authority of Mr. F. Green, it is stated in such a way by the natives of South Africa, that he gives credence and publicity to the fact that large swarms of young locusts around the district (Nigoya) are seen lying dead and dying. "Black wasps attack locusts in swarms in the Cape midlands. They pounce on a sprinkhaan, sting it into a comatose condition, lay an egg in the carcase, and bury it in a hole.

The celerity and continuity is marvellous." The same has been noticed in South America, and in Queensland, as may be seen from the following note by Dr. A. S. Patton in the *Star*:—

441 "SIR,—In your comings, goings, and doings of to-night, I see you mention a swarm of locusts accompanied by black stinging insects. I have frequently in Queensland seen black wasps or hornets accompanying locusts, and it forms an interesting point in insect economy. On arriving on sandy ground, the wasp stings the locust and renders it unconscious. She then digs a hole in the ground and carries the locust to it. She then enters the hole, in which she lays her eggs; then she draws the locust into the hole and leaves it there. When the wasp's eggs hatch out, the larvæ feed on the locust. A fly also frequently enters into the combination. She observes the wasps, and waits until the locust is drawn into the hole, when she also enters and lays her eggs in the locust, and her larvæ afterwards are parasites to those of the wasp.—I am, etc.,
ALLEN S. PATTON,
M.D."

442. (6) **De-struction by dis-ease.**—This may occur in several ways. I shall endeavour to give an outline of the most common, so far as they are at present known to the writer.

(a) *By means of larvæ or maggots, through the Tachina fly.*—I have seen an immense quantity dead and dying from the above cause in 1892 in the Argentine Republic, and in a very dry part of it I have found maggots or grubs in the thorax or trunk, varying in numbers from one to six, and I am aware that seven have been found. These maggots are large fat brutes, and when you first see them you are surprised how such a number could be contained inside the trunk, not in the abdomen, of a locust. They are about $\frac{1}{2}$ in. in length and $\frac{3}{16}$ in. in thickness. They are creamy-white in colour, the same as you find in sheep from the "blow-fly," or in meat, or in a wound exposed to the air and acted on by the "blow-fly." It is rather puzzling to the ordinary person to know the precise *rationale* of how these maggots get or form inside. If you catch a live locust in a company suffering

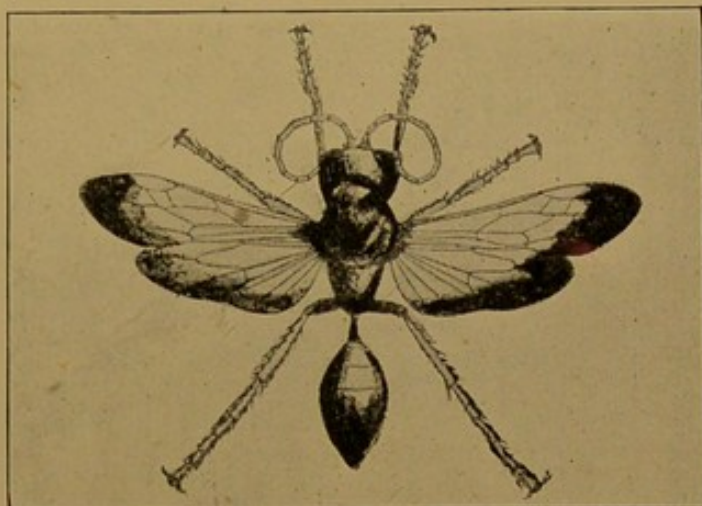


FIG. 21.—*Amnophila*, or Digger-wasp.

from this complaint and tear the abdomen from the trunk, at first you might not detect anything to call for remark, or that is peculiar, as the colour of the maggot is pretty much the same as the fatty substance normally filling the said trunk or thorax. But if you now press the trunk between your finger and thumb, a maggot will soon show himself (should any be present) and begin to come out. In this way, one after another I have frequently seen removed, till half a dozen issue forth. Externally, the locust in question containing the grubs to which I have referred does not present anything peculiar; some in the swarm or manga may be sluggish, dull, or dumpy, but many are not. But, of course, when far advanced in this course they do not appear so lively, and I believe death occurs when these maggots consume them, extract all the blood, and cut through the digestive tube. I am not aware that this complaint has been noticed in any of the locusts seen

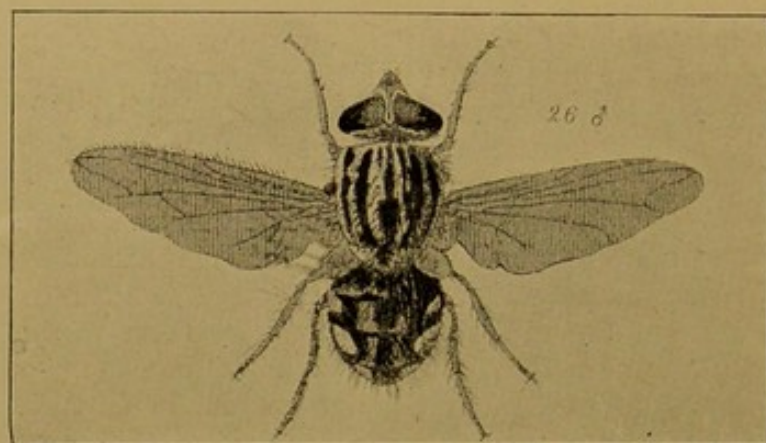


FIG. 22.—*Tachina* fly, whose egg produces a maggot in the interior of the locust. As many as six or seven have been embedded in the insect.

in South Africa. I have seen it in swarms of locusts in South America. But it has been publicly recorded, from twenty to thirty years ago, as a natural destructive agent among locusts. The following is the probable source of the foregoing grub or maggot, according to Mr. Riley, who has given great attention to all the details connected with the locust, and who says:—

443. "The *Tachina* fly (Fig. 22) (which is widely distributed over the earth's surface) fastens its egg, which is opaque, white, oval, and quite tough, to those parts of the body not easily reached by the jaws and legs of its victim, and thus prevents the egg from being attacked. The locusts are attacked while flying, and it is quite amusing to watch the frantic efforts which one of them hunted by a *Tachina* fly will make to evade the enemy. The fly buzzes around awaiting her opportunity, and when the locust jumps or flies, darts at it and attempts to attach her egg under the wing or on the neck. The attempt frequently

fails, but she perseveres until she usually accomplishes her object. With those locusts which fly readily she has even greater difficulty; but though the locust tacks suddenly in all directions in its efforts to avoid her, she circles close round it, and generally accomplishes her purpose, either when the locust is yet on the wing, or, more often, just as it alights from a flight, or hops. The young maggots hatching from these eggs eat into the body of the locust, and after rioting on the fatty parts of the body, leaving the more vital parts untouched, they issue and burrow in the ground, where they contract to egg-like puparia, from which the fly issues the same season, or not until the following spring. A locust infested with this parasite is more languid than it would otherwise be, yet it seldom dies till the maggot's have left. In warm weather these flies multiply very rapidly, undergoing all their transformations in the course of a fortnight from leaving the egg; but in the cooler seasons the pupal development under the ground is much slower, and the winter is generally passed in the puparium, though we have known the larvæ to remain in the ground unchanged all through the winter."¹

The same writer continues, in regard to—

"FLESH-FLIES

444. "They greatly resemble the foregoing in general appearance, but may be distinguished by the stipe of the antennæ being hairy instead of smooth. Judging from the accounts of correspondents, and the well-known habit of breeding in dead and decomposing animal matter, which these flies possess, they are usually attracted to those locusts that are feeble or already dead, and are fond of laying their eggs on specimens which have just moulted, and are yet pale, soft, and helpless."

445. I cannot do better in regard to the next insect agent in this part of my subject, than here give an excerpt from a lecture by Mr. S. D. Bairstow, F.L.S., of the Zuurberg Sanatorium, and well known in Cape Colony as an enthusiastic entomologist, with which I have been

¹Mr. Bruner (p. 47 of Report cited) says: "At least two distinct species of *Tachina* flies are known to attack the locust here in Argentina and the surrounding country. The most important of these is the *Nemorea acridiorum* of Weyenbergh. Generally speaking, these *Tachina* flies are the most important insect-enemies of locusts in all countries. At times, from their attacks alone, severe locust plagues are brought to an end." He adds: "Since all of these flies are less hardy than most migratory locusts, and as a rule require a moister climate in which to live, they only occasionally succeed in checking the pest upon which they live. If the locusts could be placed in a humid locality and kept from migrating for several years [an utter impossibility, and therefore the conclusion or hypothesis following therefrom is necessarily useless and absurd, namely], these *Tachina* flies would end the plague."

favoured. It is so well and carefully stated that such an important matter had better be given in the writer's own words and way, so that it may receive the attention it deserves. He describes two kinds, but first he premises:—

"I lay no unction to my soul as regards the feasibility of a scheme for destruction: it is a suggestion only, a thought, a drop in the ocean of deliberation. Turn we now to those enemies which the great Master Himself hath provided, for assured am I that a very, very simple solution of the problem of visitation clearance will one day be fathomed, and natural enemies must be the key kept to open this big lock. But we need not be too reliant upon given aids. We are to strengthen those provisions of a surety. It must not be supposed for one moment that locusts have no other foes than human.

446. (b) "Peringuey instructs us that certain species of *Mylabris* (a soft-winged vesicatory or blistering genus of beetle) parasite upon the locust. A friend gave me large quantities of eggs, which I thoroughly examined. Some were fertile, others infertile; and some packets sealed up contained a fluffy, gummy bed, but no eggs, or evidence thereof. Many of my former friends told me that the thorax was probed by a fly, and eggs were deposited, which in time hatched into larvæ, and they eventually destroyed their host. It was but natural to attribute the attack as ichneumonidal. Therein I was wrong, but more of this anon.

447. (c) "In considering the parasites on locusts, one may safely quote from a memorandum issued by Mons. Peringuey¹:—"It has been rumoured of late that a new enemy of the locust has made its appearance in the colony. This new parasite, which is of the shape of a thick thread, varies in length from 10 to 12 in.,² and, from several accounts, makes short work of its host. This is indeed good news. The specimens sent for identification are those of a *Nematoid* worm, which requires to be transmitted through a host to undergo its development, and is known to zoologists by the name of *Mermis*, or *Mermis acrydii*, or hair-worm parasite (Fig. 23). They are found in the bodies of insects, from which they escape into muddy or damp soil, where they mature, pair, and—I cannot give any more information, beyond that the female lays eggs. It is possible, however, that the young embryos are devoured by the locusts, which thus become the "host" of *Mermis* at the same time as the green herbage."

448. "Many reports, coupled with my own observations, go to prove

¹ *Agricultural Journal*, 22nd February 1894, p. 85.

² Prof. Bruner says (p. 39 of Report cited) this parasite "is thicker than a hair from the tail of a horse, and varies in length from 6 or 8 to as many as 75 cms. [*i.e.* from 3 to 30 in.]. Usually but a single parasite of this kind infests the body of a locust, though quite often there are two, three, or more."

that one *Mermis* does deal death to its host the locust, but I have found it in no other species than the common migratory one. Would the locust die as soon without the parasite? *Je ne sais pas!* A predisposition to disease on the locust's part offers an invitation to the thread-worm. **I have not much faith in this, one of many means to eradicate locusts, nor in any parasite which demands conditions.** It does not appear, up to now, to have occurred in sufficient quantities for palpable and permanent injury; but it opens up a point of inquiry and interest which may indicate to distant and adjacent observers food for thought. The thread-worm demands gentle handling. It is severed by a touch."

449. Another account of this insect runs as follows:—"The *Mermis* acquires full growth within its host, and then forsakes it by boring out with the head. All the specimens so leaving their victim are sexless, and are characterised by a mouth consisting of a very small aperture at the anterior end, and by a minute anal point, which is usually covered. Unless they are full grown when the host perishes, or unless they reach moist earth, these asexual worms perish; but if full grown, and they succeed in reaching the surface of moist ground, they at once bore into and bury themselves out of sight. Here the sexual organs are developed from a fatty

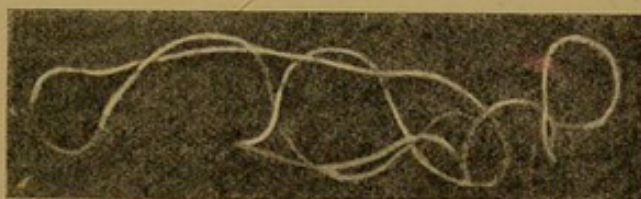


FIG. 23.—*Mermis acrydii* (locust parasite), or hair-worm.—After BRUNER.

body that the parasitic form contains, and after undergoing one moult, the perfect and sexed form is assumed, and the anal end becomes rounded and loses the minute point. During this underground life no food seems to be required, though several months elapse, and the winter is past before the animal procreates. . . . The female lays her eggs on the ground. The young, which are filiform, like the parent, at once worm themselves to the surface, and enter, as parasites, various soft insects, and mostly those that are found under leaves, moss, etc., near the ground.

450. (d) *The plum of injury*.—"The great reducer of locusts' presence is a fly, commonly called Buzzer or Brummer (see Fig. 24), and technically called *Cynomia pictifacies*, and the wonderful blessing that this sarcophagus (!) fly has proved cannot be over estimated. It is the Ajax of locustal warfare—Vastator's Pluto of Hell. I make no mistake, and shall be left wondering at the millennium if our Brummer be or be not the great secret of locust riddance from the scenes of human labour. Cocoons packed in damp moss should be transmitted to persons who would interest themselves in distributing them amongst the various swarms.

451. "The Brummer is larger than our common house-fly, of a pretty steel-grey colour, spotted abdomen and patterned thorax, and is sprinkled with hairs. It must not be confused with another species, not so beautiful, having kidney-shaped spots. It has been fully dealt with in the *Agricultural Journal*, and is now well known. Hovering about a locust's head, the fly shoots out from its ovipositor a living grub in a very slovenly manner upon the rascal's helmet. The young larva, covered with a sticky or glutinous matter which assists it in adhering to its host, thus fastens on the voetganger, pupa, or sprinkhaan, until sufficient time is permitted for penetration. It is a case then; all up with the host—death is a certainty. After development and maturity inside the locust, the larva forces its way beneath the helmet, or through some other part, leaving an emptied carcase to prove the disaster caused. The

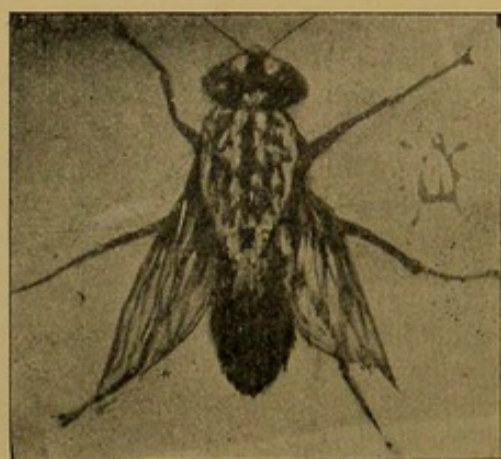


FIG. 24.—*Cynomia pictifacies*.—After
BAIRSTOW.

grub proceeds at once to burrow below the turf (soft manure preferred), turns into a chrysalis within a day or two, and soon afterwards emerges a full-blown, thoroughbred Buzzer or sarcophagus fly, whose progeny has been sarcastically christened 'Bairstow's worms.' The cut does not sink very deep. Our worms have a proud pioneer. He is only too sorry to admit that with vigorous human measures of destruction, innumerable parasites must also suffer, a contingency we must expect in every phase of slaughter.

452. "But do these flies provide really a material reduction of numerical locustal strength? Why, yes! Give me a thousand Brummer pupæ and millions of locusts to tackle in one swarm. Give me a year to operate, and I'll not leave a rack behind. When an infected swarm is *en trek*, thousands drop out of the line of march—dead 'uns, I'm glad to inform you; the flies are here in thousands, and are following in the track of the little pests. Yesterday I watched the flies very minutely, and actually saw them deposit the worm on the locust, only one at a time. After catching a fly, it deposited in my hand about twenty worms. As soon as the worm is deposited in the locust, it seems to give a shudder.

453. "F. W. Wormald says of the fly: 'The fly is doing its work of destruction among the numerous swarms in our districts. . . . It seems to hover over the swarms and scarcely to touch the locust, but its work of destruction is there—such is the wonderful working of nature.'

454. "Finally, there is not the slightest shadow of a doubt whatever in my own opinion that *Pictifacies* is more destructive than all other locust antagonists put together, and as a gallant little rescuer he is here immortalised by his oldest student and most ardent lover, and I recommend (as I did with the effective *Rodolia*, or lady-bird destroyer of *Icerya*) my foreign friends who are harassed with locusts to import into their midst numbers of Brummer flies, as a means of laying a sure foundation of siege, or locust disaster. Here we have a distinct negation to that sneering army of stumbling-blocks to Economic Entomology who say, 'You can talk of remedial measures, but they never come'; whilst we score one for science, and another for the cause so ably and persistently upheld by my esteemed patroness and helpmeet, Miss E. A. Ormerod, F.M.S.

455. "It has been said that the cause of the periodicity of locusts would probably be found in the natural history of the parasites. 'When locusts were plentiful the parasites had a good time, but when they had eaten up all the locusts they died for want of food, and the locusts' opportunity came again, and thus the reproduction went on in cycles.' I am of opinion, nay I am almost entitled to state, that the fly can be transmitted, at all events to other orthopterous insects; so, if we inoculate all the various species of locusts only, our little *Pictifacies* will have an herculean task to chaw up the lot. I feel sure we can keep him amongst us *always*. It is an important point, I submit, and time may reveal one of the biggest problems and wonders of all time. Where came they hence? Whence go they? Ask a parasite! Ask a fungus!

456. "Meanwhile, despite of chaff and banter, of abuse and adverse criticism, despite of noble individual exploits of locust destruction and Government investigation, I stand to my guns, and back, *sans* disparagement of other righteous efforts, 'Bairstow's worms,' hopefully trusting I may be on the right rail of thought, and not feeling ashamed or aggrieved if error be proven against me. My work is in itself a compensation."

The following is a cutting from the *Midland News*, as a sample of what Mr. Bairstow says the press of South Africa does to favour the cause:—

457. "Last season Mr. Thomas M'Cune, of the farm 'Bradford,' Queenstown district, reaped 1500 bags of corn. This year the voetganger locusts swept the lands, and he will scarcely reap 50 bags. In Mossterd's Hoek, Tarka district, 3000 bags of wheat were reaped last season; but, thanks also to this terrible locust pest, it is thought that little more than 300 bags will be saved. It must be remembered that the owners of the farms mentioned have not been idle. Most of them have made a gallant fight from early morn until nightfall, killing swarm after swarm.

We hear that Mr. G. J. Levey, Winterberg, has been doing his best to save his crops. He kept the voetgangers out, and managed to reap his forage, but the flying locusts came on to the farm last Tuesday, and the folk were so tired out with the daily struggle for weeks that they had to give in, and we are afraid that a large proportion of his beautiful wheat crop has been eaten off. From all sides, however, we learn that the worm is doing good work. Mr. Graham, of Tarkastad, informs us that on the top of Roet's Hoek, leading to Molteno, he passed swarms of dead locusts; and Mr. Bairstow, who has acquired a lot of valuable and interesting information on this point, is constantly receiving reports of the ravages committed by this useful worm."

458. There is a note from Mr. L. Peringuey, of date 26th October 1892, who says: "The first place from which I received *Cynomia pictifacies* is Damaraland, and that is some seven or eight years ago. There were two examples only; one I kept, and the other I sent to a dipterologist (Mons. Bagot), who, although naming the insect, did not, however, describe it. The next example I got was from Graaff Reinet. Knowing, as we now do, that the locusts have special dry breeding places, from which they swarm when they have become too numerous, I had no hesitation in considering the Kalahari region as one of these favourite haunts; the fact of that fly being first found in Damaraland, and secondly in Graaff Reinet, implies that the parasite has followed its host in its migration."

459. (e) *By means of a fungus*.—In order to make this clear I am better, not having had the opportunity of actually seeing the disease myself, to give it in the words of two who have seen it, and taken some trouble to verify the same. Mr. W. S. Evans says: "On the 4th of this month last year (April 1895) I wrote a letter stating that a fungus had been found in the locusts, causing their death, and which was afterwards determined by Mr. George Murray, F.L.S., head of the Botanical Department of the British Museum, as *Empusa grylli*. From that time, for a month or two, this fungus caused considerable mortality among the locusts, but not to the extent I hoped. This year, during the same month, from reports and specimens received, I find the fungus is again attacking them, and I judge, from the information received, is much more virulent than last year. We are very ignorant of the full life-history of these low organisms, and it may be that there are conditions present this year which may cause it to be much more widely spread than hitherto. Certainly some of the specimens shown to me indicate that it is very deadly, for the dead locusts (young and old together), in some cases hang three or four deep on the stems of grass (Fig. 25). It is certainly worth while again to try to disseminate the disease by introducing infected insects among healthy ones. The diseased ones may be known by white or grey spongy masses appearing

externally between the joints of the abdomen. I will, however, be glad to identify it, should anyone desire it, and, in any case, would be obliged for information from anyone who has observed it in any district, with particulars as to the ravages, etc. From the dates given, it is quite possible that this time of the year is the one in which the fungus is most actively propagating, and it would be a pity if the time passes without an effort to widely disseminate a disease which is certainly deadly, and which, if favourable conditions (of which we know nothing) are present, may do something to rid us of the plague."

460. Mr. Arnold W. Cooper, F.R.M.S., Richmond, says "that parasitic fungus disease has made its appearance amongst young locusts in his neighbourhood, which proves a very active natural agent in their destruction. The affected locust appears to be more or less covered by a greenish-grey spongy growth, which seems to begin its growth between the abdominal segments, and spreads rapidly over the entire body, being thicker on the lower surface; this growth also appears on the head and under part of the thorax. Upon dissection and examination under the microscope the fungus is seen to have spread to the internal organs, and also to have partially filled up the spiracles and breathing places. The young locusts are dying very fast, and an experiment is being tried to see if the disease can be easily spread.



FIG. 25.—Locust dead from a fungus, such as, e.g., the *Empusa grylli*.

The fungus disease may be contracted either by absorption of the fungus or the spores by the locust with its food, or by external contact, probably the latter. The warm, damp weather is very favourable to the spread of the disease, and when once present in a swarm it must, Mr. Cooper thinks, from its character, spread rapidly and be very fatal. There is a common parasitic disease amongst flies and some other insects (caused by *Entomophthora*), but this spreads from the inside, and as a rule only makes its appearance on the outside of the insects after death. About this time of the year dead flies may often be seen in the windows surrounded and covered by this very minute grey fungus. This disease among the young locusts may be of the same nature; but, so far, Mr. Cooper has not had an opportunity to observe it in the earlier stages."

461. From the reading of the description of these two observers it would appear that the fungus mentioned, though not differentially described, is possibly the same. It is evident accordingly that the fungus may attack the locust from within as well as from without, but they may indeed be two different and distinct species of fungi. The bodies of those that thus die clutching the twigs or strong grass, as in Fig. 25, will grow soft and finally crack. The brown dust-like spores which result in this decomposing process are blown about by the winds, and other locusts eating the vegetation thus affected are similarly attacked, and die from the disease. Not only do such fungi occur here, as proved by Dr. Edington of Grahamstown, as above indicated, and can be produced artificially with excellent results, but these or similar ones occur in the United States and South America. They flourish best in warm, humid climates. Of course careful observation for years must probably be made before arriving, in this case, at any great or definite result. One dare not hope for much in the way of lessening the present plague (or at all events trust solely to this) from such a source, and yet there is cause here for the very brightest hope. I have seen the maggots above described kill large numbers upon consecutive years, and still the plague continues as much a plague as before, and even more so.

462. The locusts multiply so enormously that such remedial means do not show any appreciable lessening on the swarm when the pest comes next season to the same place, although for a few years it has been assiduously used, as the following notice shows:—

"Poisoning Locusts.—The Cape Government Bacteriologist is willing to supply 'locust fungus' to persons who have locusts on their farms. The directions for use are to place some of the poison in the food the locusts eat. This causes them to be infected with a fungus, which spreads rapidly amongst the swarm and kills them. Dr. Edington recommends catching some of the insects, feeding them upon food upon which some poison has been spread, and then turning them loose among the swarms."

When one sees year after year the infinite numbers, one begins to lose faith in the validity of the proverb "Every little helps," and "Every little makes a muckle." Still, doubtless, there must be some effect, though as far as we can judge there is little or no manifest difference in the numbers, up to the present, that visit the locality on each succeeding year.

KILLING BY DISEASE

463. "In yesterday's issue" (*Mercury*, Durban) "we mentioned the success of a simple experiment at Bellair by which young locusts were killed in large numbers. Mr. D'Hotman, who brought the interesting

discovery to our notice, made further experiments on Saturday with gratifying results. In detailing these it is necessary to distinguish between young locusts and hoppers. By the former are meant the newly hatched, and by the latter those that will soon take wing. Acting

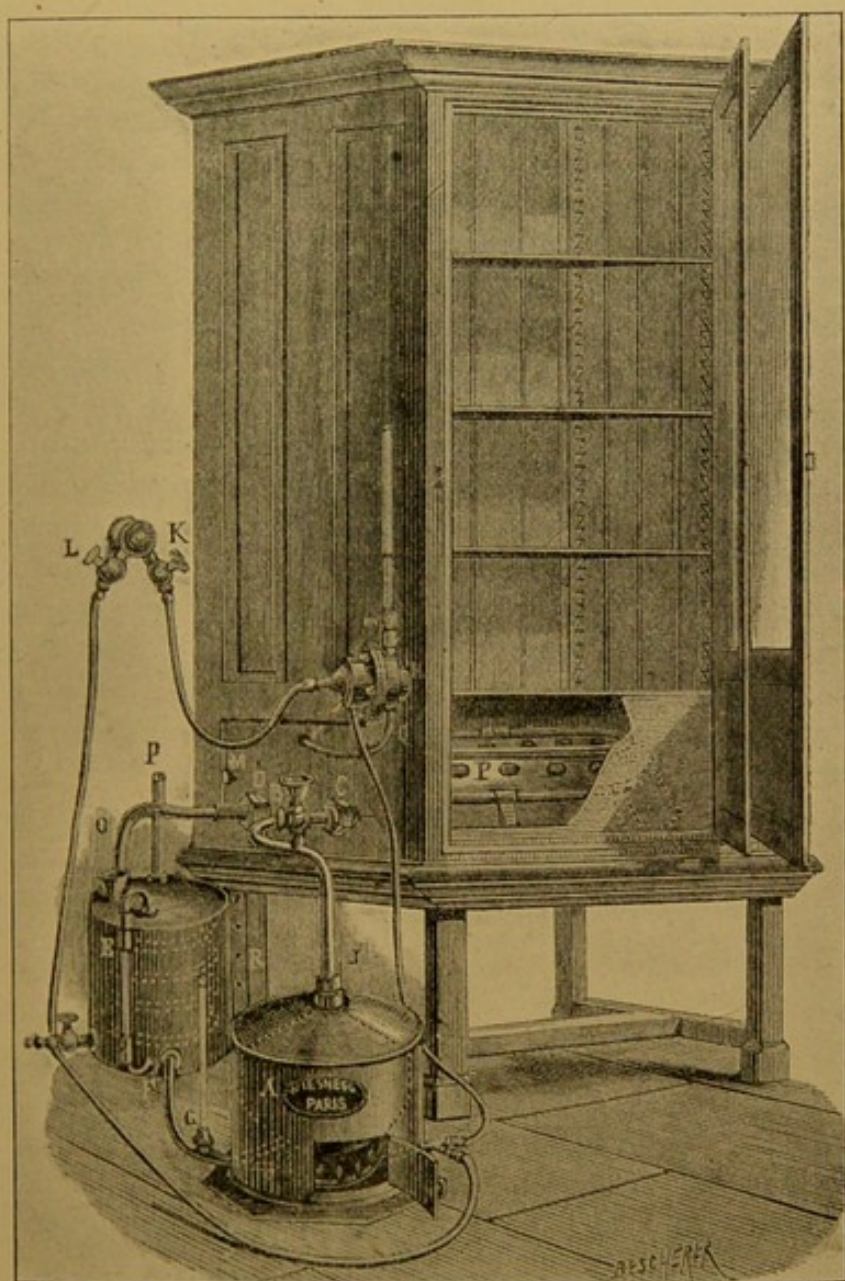


FIG. 26.—Representation of incubator, or breeding cage.

on our suggestion, Mr. D'Hotman placed a quantity of the dead young locusts on a large piece of ground, and left an adjoining piece without the sprinkling of the dead. The result proved as expected, viz., that the dead and evidently diseased young locusts affected the others, and, what is of great importance, also killed the large full-grown insects. The

dead were found swarmed on the grass, on mealies, peach trees, and plants, to which they clung evidently in the grip of death. In the mealie field of about 5 acres, any quantity of dead young locusts were found. Of course the desire was to get at the hoppers, which in about two weeks will take wing. There are billions of these all over the country, but although Mr. D'Hotman placed a large quantity of the dead and diseased young locusts amongst them, the result was disappointing, having apparently had no effect. Yet, as already stated, full-grown locusts are affected. It may be that the hoppers being at a very vigorous stage are able to withstand the attack, or it may be that they take longer to feel the effect. Anyhow, Mr. D'Hotman informs us that the young in their earlier stages can undoubtedly be dealt with in this way. The stench from the dead locusts is sickening."

464. The fungus (*Empusa grylli*) may be artificially produced in a breeding cage such as that seen in Fig. 26, and as such this remedy should take its place among the artificial class, but it is properly placed in the natural list of remedies, because it is eminently and chiefly one of nature's own. The breeding cage is a most excellent adjunct to those who are carrying on experiments and investigations, and studying the characteristics of the insect and plague. The one represented in the figure seems a good one, and Dr. Edington, who has kindly supplied me with the "cut," considers it the best. Of course other kinds of incubators will also answer the purpose, and even sometimes, where the climatic conditions permit, wire netting can be utilised so as to suit the purpose. Some care and allowances have to be made in the results from experiments made in the cage artificially and from what occurs in nature.

SAME EXPERIENCE ON THE BEREA (DURBAN)

465. A similar outbreak of disease on the Berea is reported by Mr. Sewell, who, we believe, is also experimenting. The matter is certainly well worth investigating by the Chief Locust Officer; for, if proved, the pest can be dealt with easily in its earlier stages, while Millborrow's exterminator might be applied to the hoppers if they still resist extermination.

466. (*f*) *Locust Mites*.—These mites (technically called *Trombidium locustarum*), when attached in great numbers to the locusts, say in hundreds upon them, worry their host to death. When on a visit in the spring of 1891 to Mr. Miles, in the colony of Susana, in the province of Santa Fé, Argentine Republic, I saw on his farm as the fallow ground was being ploughed clusters of the orange-red eggs turned up. Each female lays from 300 to 400 of these at a time, and from these the mites spring. The mites stick to the locust much after the same

fashion that a "tick" does to cattle or dogs, and, after arriving at a certain stage, drop off and undergo a change which we need not here pursue. Although I only saw them in the part named, yet I have no doubt they are extensively distributed, a fact that is almost self-evident, seeing that as they are attached to the voladoras, or flying locusts, they must be borne along for considerable distances.

467. The following important Report is worthy of the highest consideration, and has minutiae and details, if attended to, that would lead to excellent and far-reaching results connected with the subject with which this treatise deals. The report is best introduced here in connection with the consideration of the question of parasites, etc. It is taken from the *Natal Government Gazette*, February 25th, 1896. I have paragraphed it for convenience of reference.

"GOVERNMENT NOTICE, NUMBER 123, 1896

468. "The following Report, by Mr. Walter F. H. Blandford, Lecturer on Entomology in the Forestry Branch of the Indian Civil Engineering College at Cooper's Hill, upon correspondence and specimens relating to locusts in Natal, is published for general information.

"J. T. PLOWMAN,

"*Acting Principal Under Secretary.*

"COLONIAL SECRETARY'S OFFICE, NATAL, 24th Feb. 1896

"*Memorandum on Correspondence and Specimens relating to Locusts in Natal*

469. "The specimens forwarded to me for examination from the Royal Gardens, Kew, consist, in accordance with accompanying list, of—(1) A box containing normal locusts' eggs; (2) a box containing eggs infested by the parasite; (3) six microscope slides, of which three exhibit the débris of locusts' eggs, and eggs of the parasite, three the parasite itself mounted dry. The correspondence includes a copy of the special Report, dated 21st November 1895, of the Chief Locust Officer (Natal Government Notice, No. 552, 1895). The species of locust prevalent is not named, and it is therefore impossible to refer to any published accounts of it; possibly it may prove to be *Pachytylus sulcicollis*, Stål, or *P. migratoroides*.

"*The Parasite*

470. "It should be clearly understood that the examples of locust parasite sent have no connection whatever with the insect described in the words of the Chief Locust Officer as 'a species of fly which deposits its young in the shape of a small white maggot on each cocoon.'

471. "The specimens forwarded for examination are not insects at all, but belong to the order *Acarina*, or mites. Among these I referred them on investigation to the family *Tyroglyphidae*, which includes the well-known cheese mite, and possibly to the genus *Tyroglyphus* itself. Mr. A. D. Michael, F.L.S., the leading English authority on this difficult order of animals, has kindly examined them at my request, and confirms my opinion.

472. "He is, however, uncertain whether they belong to *Tyroglyphus* or *Rhizoglyphus*, a closely allied genus, of which probably but one true species is known. *Rhizoglyphus* differs from *Tyroglyphus* chiefly in its shorter and stouter legs, in the shorter bristles of the body, and in its habits. The examples sent appear to be more or less intermediate in structure, but the habits are those of *Rhizoglyphus*. It is impossible without fuller material to say if the species is new; unless it is a cosmopolitan form, this is likely to be the case.

"The eggs sent (both 'diseased' and 'normal') contain many mites, chiefly the former, but they are all dead and dry, with the exception of very young specimens, not half grown.

"*Habits of the Tyroglyphidae*"

473. "The *Tyroglyphidae* feed on all sorts of dead animal and vegetable matter; dried insects in collections, cantharides, cheese, flour, hay, potatoes, are well known to harbour them. They breed rapidly (in about a month in warm weather), and may be very destructive. None are definitely known to attack living insects. Professor Riley has described a *Rhizoglyphus* as attacking phylloxera on vine roots, but doubt has been thrown on the accuracy of his observations.¹ Nietner has also described a *Tyroglyphid* (enemy of the coffee tree, 1861) as attacking scale-insects on coffee in Ceylon. Here again, though the mites were found under the scales, it is probable that they attacked them after they were dead. They appear, however, from the account, to have attacked the eggs as well.

474. "*Rhizoglyphus*, unlike *Tyroglyphus* proper, lives in the ground, and is often exceedingly common and destructive to bulbs, especially hyacinths, potatoes, fungi, etc., and is by choice a vegetable-feeder, whereas *Tyroglyphus* is rather an animal-feeder. There is, however, nothing improbable in a *Rhizoglyphus* living in the ground being ready to attack locusts' eggs. An important point, and one which cannot be solved from the material sent, is whether the mite is ready to attack living eggs, or whether it confines its attention to those of which the vitality has been previously destroyed by some cause or other. The

¹ *Sixth Rep. Ins. Missouri*, 1874, p. 52, and *Ann. Soc. Ent.*, France, 1874, Bull. 98.

latter would certainly agree better with the known habits of *Tyroglyphidæ*; the question, however, can be settled by examination of the habits of the mite when it has access to living eggs, and in that way only. It should form the first subject for inquiry in any investigation on this subject.

"Life-history of the Tyroglyphidæ"

475. "It may be of convenience to give a few particulars on the life-history of these mites. They are hatched from the eggs as six-legged larvæ; these live in the same localities as the adult, moult after a certain time, and acquire eight legs. The eight-legged forms grow, moult, and eventually become adults, the stage immediately preceding the adult reproductive stage being known as the 'nymph' stage. Now, a certain number of nymphs, the proportion varying with conditions of moisture, etc., diverge from the normal course to assume what is known as the hypopus form. These are clothed in a stronger, thicker, coloured cuticle; the mouth parts are temporarily atrophied, the fore pairs of legs project forwards, the two hind pairs are small and short, usually terminating in a bristle, and useless for walking. These hypopus forms are more resistant to drought and extremes of temperature, and though not quiescent, like insect pupæ, may be roughly compared, as far as their purpose goes, with the 'resting-spores' of cryptogams.

476. "They frequently attach themselves to flies or other species of insects, not to attack them, but to be transported from place to place, and they have been found on vertebrate animals. Eventually there emerges from the hypopus a nymph form of a *Tyroglyphid*, which has then to pass into the sexually mature stage. In the material sent I have found no hypopus forms. If they were discovered on locusts, as is possible, they would not indicate that the locusts were suffering immediate injury, but that the mites were being spread from place to place. If further material should be sent for examination, it should be abundant and include all forms of the species. They can be sent in glycerine, in a small bottle. It would be well to send living examples as well. This can be done by packing egg-pods containing abundance of mites with damp earth in a tin box. If the earth is first baked and then damped before the egg-pods and mites are put in, it will not enclose any animals but those it is desired to send. Too much dryness is fatal to the mites.

477. "*Other species of mites attacking locust eggs.*—On this subject some information has been given by United States entomologists. Attention was first called to it in 1875 by Riley,¹ who described two mites—*Trombidium sericeum*, Say; and *Astoma gryllarum*, Le Baron—which infested the egg of the Rocky Mountain locust, and materially assisted

¹ *Seventh Rep. Ins. Missouri*, pp. 175-178.

in its destruction. Of the former species he wrote:¹ 'In parts of Missouri it reduced the eggs to powder over extensive areas.'

478. "His subsequent investigations proved that the *Astoma* was the larval form of the *Trombidium*, and determined the life-history.² A very short epitome of the latter account may prove useful.

"The mite was therein most accurately named *Trombidium locustarum* (Riley).

"In its mature form it lives in the ground as a scarlet velvety mite, 2.3 mm. in length. It feeds on all sorts of decaying animal and vegetable matter, and greedily devours the locusts' eggs.

"*Trombidium Locustarum*"

479. "In spring the female lays about three hundred to four hundred minute spherical orange-coloured eggs in the ground, a slightly agglutinated mass, 1 to 2 in. below the surface. From them there hatch the minute six-legged orange-coloured larvæ (*Astoma*). They are active and crawl upon the locusts, fastening themselves to the base of the wing or along its veins, sucking their juices like ticks, and swelling into a scarlet sausage-shaped form, the legs becoming invisible.

480. "They may be so numerous as to kill the locusts, and are commonest on the winged imagos, but are found also on the nymphs. After a time they let go their hold, drop to the ground, and shelter under earth or stones; they remain here for two or three weeks, the last few days being spent in a 'pupal' stage, from which they emerge as an eight-legged *Trombidium*.

"How far the destruction of the locusts' eggs is due to the larvæ and how far to the adult mites is not clear from the account, but the latter appears to be the chief agent, and, from the published extracts from correspondence, is often a deadly foe to the locusts, both in the egg and the mature state.

481. "A second species—*Trombidium giganteum* (Riley)—has also been observed on North American locusts. This parasitic habit on insects is common to most species of *Trombidium*, but the Natal mite is not a *Trombidium* but belongs to a distinct family, and its habits cannot in any way be inferred from those of the North American species; nevertheless, it is quite probable that *Trombidia* may be found in Natal with similar habits to those described by Riley. The brilliant scarlet or orange colour of mature mites and their velvety surface is a good guide to their nature.

¹ *Ninth Rep. Ins. Missouri*, p. 91.

² *Trans. Ac. St. Louis*, III. cclxvii., 1887; *First Rep. U.S. Ent. Comm.*, pp. 306-313.

"The Winged Fly"

482. "With respect to the existence of a winged fly which lays its eggs (or maggots) on those of locusts, as recorded by the Chief Locust Officer, some similar cases are recorded from North America. In the United States a dipterous fly—*Anthomyia* (*Chortophila*) *angustifrons* (Meigen)—has precisely these habits, and has been credited with the destruction, in 1876, of 10 per cent. of the locust eggs laid in Missouri, Kansas, and Nebraska, and of a much larger percentage in some localities.¹

483. "It belongs to a group of flies of which the maggots feed on plants, and the habit of attacking locust eggs may in this case have been secondarily acquired by a root-feeding larva.

484. "Moreover, two flies belonging to the *Bombyliidae* are known to lay their eggs on those of locusts,² and the blow-fly, *Sarcophaga carnaria*, L., does the same thing, though probably only on locust eggs which have begun to decay from other causes.

485. "Without seeing specimens of the Natal fly, it is impossible to conjecture whether it is the same as any of the American species, and therefore to give any useful indications as to its habits. As with the mite, unless it is a cosmopolitan species, it is not likely to be identical with any North American form.

"Encouragement of the Parasites"

486. "Though no opinion has been specifically asked on this matter, I venture to express my views upon it. While it is most desirable that the life-history and economy of these parasitic forms shall be worked out and that we shall be placed in possession of accurate information about them, it appears to me very unlikely, as far as present knowledge goes, that any good will come of attempts to encourage them—that is, to bring about by artificial means any material increase of their numbers now existing under natural conditions.

487. "The idea of combating an injurious insect by an insect enemy has become popular since the successful introduction into California of a lady-bird from Australia to combat the colony cushion-scale, and now this idea crops up almost every time that an insect becomes seriously destructive.

488. "The above-mentioned case was exceptional, and illustrates the special circumstances when such insect allies may be resorted to with a

¹ Riley, *Ninth Rep. Ins. Miss.*, p. 92; *Suppl.*, p. 88; *First Rep. U.S. Ent. Comm.*, 1878, p. 285.

² *Second Rep. U.S. Ent. Comm.*, pp. 262-271.

prospect of success. The cushion-scale was an imported pest, a native of Australasia; in being so imported it escaped from its natural enemies, which kept its numbers down to a normal level, and therefore flourished and multiplied, being absolutely untouched by any of the indigenous American insects.

489. "In introducing the lady-bird, no attempt was made to increase in any way the numbers of an endemic species; an insect, itself new to the American fauna, a known and proved enemy of the cushion-scale, was imported to supply the natural check which had hitherto been wanting in California.

490. "This method of dealing with destructive insects holds out a chance of success when it is attempted to introduce a known enemy into a country or district where it does not previously exist. Thus it is customary in Germany to import ants' nests into woods in which the supply of ants is deficient, in order to keep down caterpillars, etc.

491. "It would certainly be possible, in the case of the mites at least, to transport them to districts where they were absent. Whether any good would result from it is doubtful; and, in any case, their absence from the district in question, and its suitability for their continued existence, would have to be proved before the attempt was made. The mite is quite likely to be ubiquitous in all parts of South Africa where the presence of locusts is of importance.

492. "Though I cannot find mention of the fact, I have a clear recollection that some years ago it was proposed to import into Cyprus a predatory insect for the purpose of destroying locusts there; but a timely and careful examination showed that the insect was already a native of the island.

493. "In such cases as the latter, where the insect pest and its natural enemies coexist, and the latter under normal conditions are unable to check the multiplication of the pest, it is very unusual and difficult to find any means whereby the efficiency of the carnivorous forms can be increased. It can be done in two ways only: by artificial multiplication of the insect enemies; by modification of circumstances which destroy them or limit their increase.

494. "The former is practically impossible to carry out in such a way as to produce any effect on the numbers of a free living insect enemy. If the dipterous flies were artificially reared in a hatching-house (Fig. 26, par. 464) on locusts' eggs, it would be at the cost of great labour and pains, comparatively few would be obtained, and very likely the result would be the same as if the flies had been allowed to propagate unchecked in a state of nature.

495. "The second way indicated is more practical, and it includes such a well-known method as the prevention of the slaughter of insectivorous birds. Applied to insects, it has the objection that it is

very difficult accurately to ascertain what circumstances do check the increase of any given predaceous or parasitic species. Perhaps the only occasions where it is regarded are when such methods are employed to get rid of an injurious insect as will not at the same time destroy the species which prey upon it. Thus in Germany grease-bands to prevent caterpillars from ascending trees are preferred, *cæteris paribus*, to employing methods of destroying the caterpillars, because in the first case parasitic ichneumon flies and predaceous beetles, which live respectively in or on the caterpillars, are not killed as well.

496. "So with respect to locusts, without comparing on other grounds the respective claims of egg-collecting and the screen system, it is clear that the adoption of the latter has the advantage over the former method that, by the eggs remaining untouched till they hatch, the parasites of whatever kind that feed on them have the fullest opportunity for multiplication and for destruction of the eggs, an advantage that may, of course, be counterbalanced by other considerations.

"Even if the direct encouragement of these parasites be regarded as impracticable, as I believe it to be, their existence suggests one point of importance.

497. "When insect parasites, whether animal or fungus, have reached a certain degree of abundance, it is not necessary to take steps to get rid of their destructive hosts, the work may be left to them. In the most scientifically managed forests it is customary, whenever an injurious caterpillar is tolerably abundant, to make test-collections of, say, 100 examples collected in each district. The caterpillars so collected are slit open and examined for parasitic ichneumon larvæ, or they may be bred in cages (Fig. 26), to see what proportion die of fungus disease: if it is found that a certain percentage, usually 50 per cent. or over, are parasitised or diseased, the diminution of their numbers is left with confidence to natural checks.

498. "Now, with respect to these animals which destroy locust eggs, if examination of the eggs dug in any given district shows that a sufficient number, which can be determined by experience alone, are destroyed already, the further expense of collecting the eggs in that district might reasonably be saved, the screen system being perhaps put into operation to limit the march of any larvæ which escape destruction. Whether this system is practicable is for those on the spot to decide. In any case it follows, if 50 per cent. of the eggs has already been destroyed, that the collection of the remainder is just twice as costly as that of the same quantity of healthy egg-pods would be.

"And this may determine, by the question of expense, the relative advantages of egg-collecting and the screen system in doubtful cases.

499. "The question is asked whether a locust survives after laying its eggs or not?"

"As before mentioned, the species of locusts occurring in Natal has not been stated, and there is always a certain amount of risk in arguing as to the habits of a given species of insect from analogy with those of others. Still, it is likely that locusts are tolerably uniform in this respect, and there is a certain amount of evidence on the question.

500. "It is clear that all the eggs are not laid at once. Riley says:¹ 'The most casual examination of the ovaries in a female (Rocky Mountain locust), taken in the act of ovipositing, will show that besides the batch of fully formed eggs then and there being laid, there are other sets, diminishing in size, which are to be laid at future periods.' With *Calopterus spretus*, the locust in question, he obtained from three females two pods each, laid at intervals of eighteen, twenty-one, and twenty-six days respectively. From two females of *C. femur-rubrum* he obtained four pods each, the laying period covering fifty-eight and sixty-two days respectively. A number of this and of *C. atlantis* laid three times in captivity save only twice.

501. "Yersin found in the case of the Russian *Pachytylus migratorius*, that eggs were laid three times at intervals of a month.²

"Professor Whitney had a female of an American species which laid about the middle of July, and died in September without laying again.

502. "Summarising the work of other observers, Riley concludes, 'That there is the greatest diversity in the time intervening between the periods of egg-laying, and that the number of egg-masses formed by one individual is by no means constant.'

503. "Locusts exhibit both polygamy and polyandry, and a female has been observed to pair with six different males before laying her first batch; afterwards the same phenomena were repeated four times, the insect dying when engaged in oviposition for the sixth time (Koste).

504. "Gerstäcker also indicates two or three deposits of eggs at intervals of several weeks for the European locust. He continues: 'With the last deposit the female has accomplished her destiny, so that she not seldom remains dead on the spot where the laying occurred. On the other hand, the males, even after repeated coupling, appeared to be able to prolong their life, and may be found alive as late as October.' (Having emerged in July or August from the nymph.)

505. "It must therefore be concluded that the fact of oviposition is no sign of the approaching death of either sex, except in the cases where it happens to be the last egg-pod of the female that is laid.

¹ *Ninth Rep. Ins. Missouri*, p. 84; and *First Rep. U.S. Ent. Comm.*, p. 226.

² Köppen, *Die Wanderheuschrecke*, p. 36. Berlin, 1876.

506. "It appears that the egg-pods contain successively fewer and fewer eggs, so that perhaps an estimation of the average number of eggs in the pods at any given laying might determine, after data had been collected, whether they were laid early or late in the life of the mother.

507. "From the nature of the questions asked in this correspondence, I conclude that the officers charged with operations against locusts in Natal are not acquainted with what has been published on the subject in America.

508. "I beg respectfully to suggest that a knowledge of the American Reports will be of the greatest assistance. It is not desirable to take all or any of the statements contained therein without independent proof, at least when dealing with another species in a different country; but unless these very comprehensive and valuable works are studied, much time and energy is likely to be lost in going over questions which have already been fully thrashed out.

509. "For this purpose I recommend the first and second Reports of the United States Entomological Commission (Washington, 1878 and 1880) Whether the volumes are still in print or not, I do not know; if so, they can be obtained on application to the Department of Agriculture, Washington. If not, they are generally to be had from dealers in second-hand scientific books, such as Wesley & Son, Essex Street, Strand, London, W.C.; or Frelander u. Sohn, Carlstrasse 11, Berlin, N.W.

510. "Most official English Reports contain little information, except statistics; but particulars about Indian locusts have been given by E. C. Cotes, in *Indian Museum Notes*, published by the Indian Museum, Calcutta, and the *Journal* of the Bombay Natural History Society. They do not contain many details of importance except on the specific characters of Indian forms.

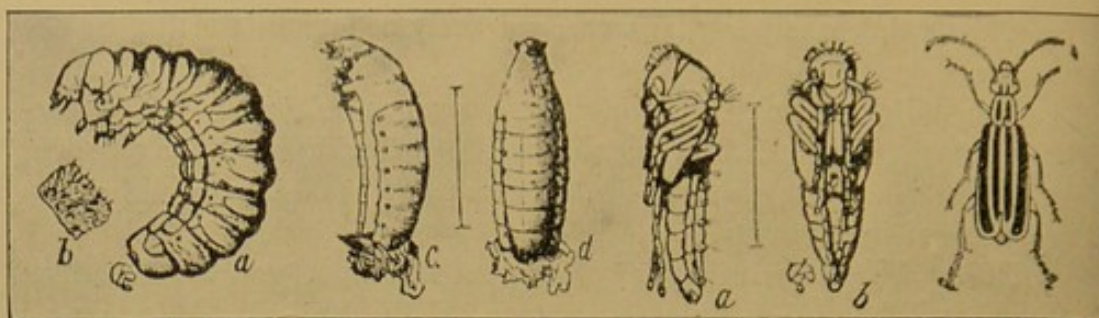
"Any French Reports that may have resulted from the recent plague of locusts in Algeria are as yet unknown to me.

"WALTER F. H. BLANDFORD.

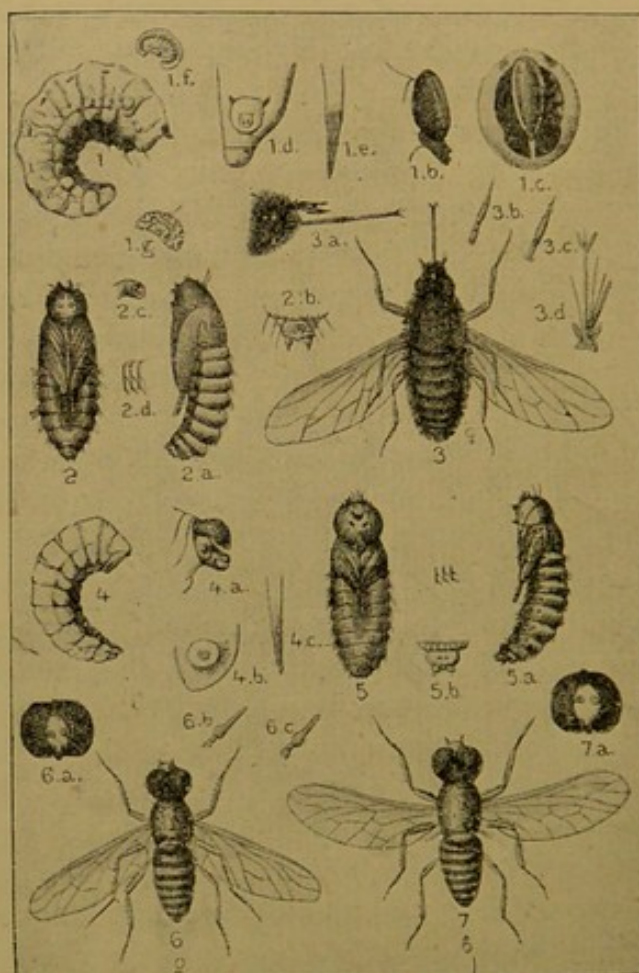
"LONDON, 30th Dec. 1895."

511. (7) **Injury to the eggs.**—It has been known for a considerable time that the eggs in the locusts' nests are liable sometimes to be addled. There are various reasons or causes for this. Beetles (*Cantharides*) attack the eggs, and so does the two-winged fly (*Bombyliidæ*). Insects, worms, etc., moreover, get at the eggs and affect them. While there is no doubt that the eggs in the nest or cartucho or hole are destroyed in a variety of ways, of which the chief will be narrated below, at the same time the general question affecting this mode as a means of destruction or utility is forcibly stated,

as has already been seen in the foregoing Report of Mr. W. F. H. Blandford, Lecturer on Entomology (see par. 497, etc.).



A.



B.

FIG. 27.—A represents stages of beetle (*Cantharides*, or blistering beetles). B represents species of two-winged beeflies (*Bombyliidae*); 1 and 4 show larvæ; 2 and 5 the pupæ; 3, 6, and 7 the adult flies.

512. *Champi*, or beetles.—The number and different species of flying beetles in the Argentine, especially in certain parts, as, e.g., at the city

of Santa Fé, and along the well-watered tracts of land on both sides of the great river Paraná, is markedly noticeable in comparison to anything I have seen in the S.A. Republic. To strangers who arrive there, these beetles are a great nuisance; as soon as night approaches and the light is lit, these insects fly in through the open window (left so for the heat, unless guarded by gauze wire), they alight where they list, into the plate of soup or coffee, or whatsoever other dish or material there may be on the table. These beetles (belonging to the family Trox) instinctively follow and find out where the locusts nest; they attack the "spuma," and soon reach the eggs, where they also lay eggs, and their young reaching maturity first, feed on and destroy those of the locusts. They thus form an important item in the natural agencies of destruction of locusts.

513. General result.—There is no question that between insects, worms, and parasites, attacking the eggs in the nests, a goodly number of the eggs in certain localities are destroyed. At the same time, this percentage on the whole cannot be very great. Then, again, where pigs are abundant, it is said they are useful in destroying the egg-pods to a very great extent.

If an attempt be made to classify the destructive agencies to eggs, the following may be given:—

514. Influence of the weather and climate on the eggs. When the weather is exceptionally wet and inclement, the eggs are affected—addled, or hatching is retarded. The spuma, which in a sense is impervious to rain, may still become altered in character, and the weather may influence in a deleterious way the fertility of the eggs. Damp ground, it is known, is inimical, and the instinct of the locust prevents her depositing her eggs therein. Nor does she do it in loose earth. Thus rain is not favourable. Then, where possible, irrigation can completely destroy the fertility of the eggs. If the spuma at the top of the nest is interfered with forcibly, by harrowing or ploughing, or if the natural process is interrupted, hatching is impeded or stopped. It is on this account, it may be here noted by way of connection, though it will be dealt with later on in the artificial means, that scratching the ground's surface with harrows—even for $\frac{1}{2}$ an inch in depth—is had recourse to when obtainable for the purpose of destroying the eggs. Of course ploughing is still more effectual, as it upsets the "apple cart" entirely—though some affirm that even this does not arrest the hatching process; this view, however, is exceptional.

515. Looking, then, at the whole list of natural enemies or causes of death among locusts, as far as I can judge, they do not on the whole amount to a large, or rather I might say, a sufficient percentage. No doubt sometimes the destruction in this way is immense, but then the immensity of their number is appalling!

516. When the countless numbers that are seen in one manga or flock are remembered (some indication of which may be obtained from paragraphs 73-75, 115, 429, 430, 602-605), and that these again may be many times increased, it is no less than alarming the proportion to which the numbers of the pest may assume. Some wide margin may safely be allowed to destruction by natural enemies. Some persons believe that the life of the locust is only some six months, others believe that the locusts which come here are only a few adventurous youngsters, anxious to see the world, coming away and leaving their home against their paternal wishes, and that they sweep down upon our cornfields after the fashion of swell-mobsmen upon country hotels, run up a heavy bill, and vanish—whither? into the sea?—and that all that visit their temporary home never return to their permanent ancestral home any more. But this nonsensical idea is disproved by what has been seen in the United States, Cyprus, etc.

517. Of course it is easy to make these pet theories, but the difficult thing is to give the shadow of a shade of proof to sustain the theory. As far as one can judge, such is not the case; and in order to throw out what leads one to such a supposition, we must go to places in which some records have been kept and known. Now the best, so far as we know at present, relates to Cyprus and the United States. The habits of the insects there are precisely the same as in other parts of the world. Cyprus being a comparatively small place, surrounded by sea, we have the elements to test some of these ideas. It will be found that the locusts lived there more than six months, that repeated swarms of young locusts came in the usual way, and that they did not perish in the sea as alleged, but that they perpetuated themselves, taking a firm hold on that locality for centuries, and that, moreover, when they were once exterminated there was an end of them, which would scarcely be the case if the theory above referred to were correct, viz., that all the locusts that visit us perish in the sea when they leave us, and never go back again to their home, where they are said to live in the winter in "haycocks"—an absurd idea, for if they did, how could *they* live without air, which would certainly be the case in the centre of a "haycock"? Then, again, in the States mentioned, at the end of the season, the swarms were seen to go westwards, *i.e.* back to the permanent homes, and not into the sea.

518. During the years when locusts are permitted to visit a country, when all is said and done in regard to the natural agencies that can be enumerated for their destruction, the plague remains just a plague in all its terribleness, and, except in one instance, has, up to the present, baffled the ingenuity of man to contend with and successfully overcome it. But this is no argument or reason why means should not be tried and used to exterminate them. The contrary may be more

correct, that in the providence of God such plagues are sent, in part at least, that ingenuity may be put to the test and cultivated. Invention is a good thing. It has from time immemorial received the approval and smile of the world, so that it has passed into a proverb, "Necessity is the mother of invention." Here, then, is a useful field for the exercise of the fine faculty of invention—a heaven-born gift, and the possessor of which is justly admired by all the civilised peoples of the world, and considered a benefactor of his race.



BOOK III (*continued*)

SECTION II

ARTIFICIAL AND MECHANICAL INVENTIONS
FOR CHECKING THE PLAGUE

SUB-SECTION I

EXPOSURE OF POPULAR ERRORS

“Nulla genesi dei fatti la logica è inesorabile”
(“The inexorable logic of facts”).

BOOK III (*continued*)

SECTION II

ARTIFICIAL AND MECHANICAL INVENTIONS FOR CHECKING THE PLAGUE

SUB-SECTION I

EXPOSURE OF POPULAR ERRORS

519. The means go with the end.—We have now come to consider one of the most important and difficult parts of the inquiry. It may be taken for granted, after what has been said, that if some means were without doubt invented whereby the pest could be effectually exterminated, it would be not only foolish but wrong not to use these means. The gift of invention is sent from God, as much so as the “reproving and chastising hand.” The man with the “withered” hand must be obedient and use the means directed for his recovery; he must stretch it out, when desired; and so we do not find him saying he *could* not, or *wait* until it would be done for him. The *withering* was a visitation from the Almighty as much as the cure or the relief from the complaint, and *vice versâ*. Therefore, to invent a means for getting rid of a plague is not a matter to be despised, but the reverse. If it could be achieved, is there any doubt but that it would be a blessing to the world, or that those very persons who are now loud in opposing all human or mechanical means, whether on religious or other grounds, would not hail and welcome the alleviation from destruction? These, then, should be first obedient, and lay aside their religious scruples, and use the means. The very thought of inventing means to get rid of such a pest excites hope and strength, and a belief in the goodness and the progress of humanity.

520. “We are members one of another.”—Everyone should bear in mind that not one of us can or ought to realise himself exactly as an individual and nothing more, attain the ends for which he is made and trained, be nourished and educated, without the aid of his fellows. Apart from our fellows, we are dwarfed in moral stature, unbalanced in

intellectual and moral development, and altogether lack the fulness and the expansion and the richness of truly noble lives. United action and effort are therefore commendable in the highest degree, and are nowhere more praiseworthy than in combating a grievous calamity, which brings destitution on the good as well as the bad, and on the undeserving as much as on the deserving.

521. Trouble and expense not to be grudged.—Coming, then, from the theoretical to the practical, is there any principle of action to guide us in regard to measures that ought to be adopted for the extermination of the plague? At the present time it seems to me, in dealing with this subject, that the principle of action ought to be somewhere on the lines of the adage which says, "That is best which lieth nearest." Destroy the pest by any and every means. That may be best which is most expedient and readiest. Now, as we shall see, some "means" are more suitable at one stage of the insect's life and condition, and others at another, so that this brings us to the point where we must differentiate as to the appropriate seasons and stages and localities for giving battle to the enemy. Experience has abundantly proved that no trouble can be too great or work too expensive which will efficaciously minimise the extent of or exterminate the plague. Even a worse use might be made of the soldiers who serve the countries so afflicted than setting them to turn "their swords into ploughshares" in a manner quite as effective as if literally accomplished, if only they can help to exterminate the plague and free the country from it. Something of this kind was done by the French authorities in Algiers (to their credit be it recorded). It is stated that they utilised 40,000 of the regular soldiers to combat the plague.

522. Ways and means.—Before, therefore, entering upon the divisions that naturally pertain to this part of my subject, it will be necessary in the first place to discuss the subject of "ways and means." Before entering into battle, soldiers have to be provided; and, moreover, these soldiers must or ought to have some preliminary education in fighting if success is to be hoped for. Knowledge is power. Now, all this is a matter of the most ordinary common-sense, when looked at dispassionately, and not in the heat or thick of the thing. The difficulty and mischief is that we put off the preparation until the plague is upon us, and we have to go "helter-skelter" at it and do the best we can to meet the attack; and, as is usual in *surprises*, we act often as though "beating the air." Whereas by premeditation and careful preliminary education much profit may be obtained, and much useless waste of fine energy as well as money may be saved. When training is complete or perfect there should be no wasted energy, or at least it ought to be as small as possible. Every blow should be properly aimed, and have its effect. The trained artisan does not waste his energy or strength, but makes every blow tell. So here, the same principle holds good. The

application is different, but the principle is the same. First, then, we have to get the *personnel*—the men or material to make the army—in order to do battle effectively.

523. The "army."—The *personnel* of this army must be, at least chiefly, taken from those who occupy the land, and this must be augmented where necessary by others who are at the command of those who govern the affairs of the country. An Act must or should be passed empowering the Executive to provide a sufficient number of persons to become active "combatants." There will not be any dissent in regard to the propriety and expediency of enlisting into the "army" all those occupying the land, leaving of course a certain proportion to attend to the wants of the house or home and the dumb creatures pertaining thereto. This enlistment would apply necessarily to all living in a certain district or radius, whether these lands were immediately threatened or not; or, even whether they had land or not—supposing, of course, that they were able-bodied and capable of doing manual labour. If, notwithstanding, there were not to be found in the district a number sufficient to use means to tackle the enemy, then it would be the duty of the Government to provide men to do this, for clearly a successfully concerted plan of campaign might be altogether invalidated or frustrated by having any part insufficiently manned.

524. The "army" to be well drilled and officered.—The entire country ought to be divided up into small districts, and every one of these districts brought up to a point of efficiency. The law ought to apply to large as well as small holdings, and the responsible Government of the country ought to be able to get over the trifling difficulty of who is going to pay, in the case of the large holdings with a sparse population. This is only a matter of detail, and ought not to prove a great barrier in a serious question of a plague. The very name of a plague ought to be sufficient to arouse enough enthusiasm to carry us over minor difficulties; for, after all, this is only a small obstacle. A greater thing is to secure the hearty sympathy of the body of the people—to get the people, as it were, to act as one man; then we should indeed see victory complete and crushing. Of course I am aware there will be growlers and grumblers in a community, even though archangels came down to regulate and govern its affairs; still, this grumbling would be far less if the people understood the work that was required to be done, and if some trouble were taken to carry the people on with the Executive. They will not drive; but, properly treated, they can be led, and led with consummate effect. Much depends on who leads them, how they are instructed, also as to how the orders for battle are given. How many battles are lost by bad generalship, even when the soldiers are of the very best and proved material!

525. The commander-in-chief and all under him.—As in an

army, so here there should be a responsible person who would act impartially as a commander-in-chief. He ought to know, not only all about the plague (this is indispensable), but also, and not less indispensable, how to treat people with great tact and consideration. He ought not to be obliged to be brought into contact with the pettifogging, trifling little people, though he may when he chooses make himself familiar with all the views of the populace and take steps to ascertain the mind of the people. His great aim is to carry out the plan in an efficient way on a large administrative scale, holding himself responsible nominally to the Government, but virtually to the council of war, who in this case is a committee of responsible and representative men appointed by the Government. He ought to have subordinate officers under him, and these in turn ought to have district officers who would be responsible for the work immediately under their charge. Division of labour is necessary for efficiency of service. There is a work to do, and there should be a person appointed to do that special work. The important thing is to allocate the work—not too much, but enough to each person appointed for that particular work. Then there must be those who will have supervision—men who will be impartial and do their duty without fear or favour.

526. Hearty co-operation and service by all.—Now, in the enactment or carrying out of any Locust Law care must be taken that oppression does not form part of it. The moment that the feeling of oppression comes in, it seizes the mind of the people, and sympathy in the cause is lost. Oppression is wrong. The officer that inflicts an injustice to the poorest and meanest subject commits an undoubted wrong to the State, and all the more degrading because of the position of the wronged; and the official that commits it ought to be dismissed from his post. The cordial sympathy and the goodwill of the people in a matter of this kind is of superlative moment. There ought to be a clear proof of transgression before inflicting a penalty or punishment, and more especially in the case of a plague or pestilence. A plague cannot be checkmated by the arbitrary enactment of a legal penalty (see par. 220).

527. Friction between official class and people deprecated.—To be punished as the unfortunate storekeeper was, to which reference has been previously made, is to bring the laws and the lawgivers into disrepute, and to frustrate the end of all law. A Locust Law is undoubtedly good and wise and necessary, but there must be discretion used in the carrying of it out. What mischief and opposition and bitterness would the carrying out of the letter of the law, as in the above case, not cause in the district and neighbourhood! “Verily there be some authorities worse than” the locusts themselves! It is manifestly necessary that the officers in charge of carrying out such an important

work ought to be able to distinguish between true sympathisers who are willing to co-operate, and malingerers in whatever form they present themselves. There will be a borderland wherein doubt may exist, and then it will be better to err on the side of mercy or leniency. There is no great difficulty in dealing with those who are hostile or in open rebellion against the law. But care should be taken that the officials and the public should not be at enmity.

528. The official class to be ensamples.—A public servant, of all persons, ought to realise and act on the beautiful principle of our moral life, namely, that every good thing in our spirit and action tends to reproduce itself in others associated with us, more especially if they see and are convinced it is for their own advantage. "As in water face answereth to face, so the heart of man to man." Thus kindness will produce kindness, unselfishness will reproduce itself, sympathy will beget sympathy, love will gender love, respect will beget respect, forbearance will kindle the same, etc. Generosity will beget generosity; and the principle ought to take root, "Get and give, keep and lose." Good feeling ought to prevail in a work which is avowedly for the benefit of the entire community.

529. The two classes.—For practical purposes the community may be divided into two classes—

- (1) Those who lend efficient service and carry out the law; and
- (2) Those who do not.

530. Class 1.—The bulk of the people, if properly informed respecting the situation of affairs, will manifestly belong to the first class, and of course are composed of those who co-operate heartily with all the measures proposed by the Government; and those who, while they may not be willing, yet fall in with the proposals of the Executive. But with regard to the second class, it must be admitted that they are composed of a more heterogeneous mass, and it is here where the trouble comes in. Clearly they are too numerous, and it would be wrong to leave them out altogether, or not to exact from them their due share of the work which it is hoped would benefit the community in general.

531. Class 2.—This class may be conveniently divided into four, as follows:—

(a) Those who, from poverty or lack of labour, are unable to lend help without putting in jeopardy the lives of those they have to provide for—those who are depending on them in their home.

(b) Those who, from sickness, or their habit of life, or age, are completely precluded from active manual or outdoor duties.

(c) Those who may be properly termed malingerers, that is, persons feigning—professing willingness, but really shirking duty, evading the enactment of the law, and thereby endangering (and becoming burdensome to) their neighbours and the State.

(*d*) Those who are downright opposed to the work, and who avow openly their refusal to aid it, and decline to co-operate.

532. Class 2 (a) and (b).—In dealing with those who come under classes (*a*) and (*b*) much difficulty cannot be experienced by a fair-minded and humane officer in charge of a district. While firm, he must yield to a generous interpretation of the law. The law cannot be intended to add burden to burden, oppression on oppression, cruelty to cruelty. Provision, therefore, ought to be made for those who are literally incapacitated from lending aid. Life is a precious gift, and its preservation is an instinct of our nature. It will be for the officer to use his discretion in regard to this matter, and report to his superior officer. In class (*a*) it might be fair to give sustenance for those depending on the bread-winners, and thus command their labours and sympathy.

533. Class 2 (c) and (d).—With regard to classes (*c*) and (*d*) a sub-committee of fair-minded men of known character should take the case of delinquents in hand, so as to assist the officers whose chief duty will or ought to be to look after those actively engaged in combating the plague. Evidence, however, might be obtained concerning those who come under these two classes, and in proper form they should have the full penalty for the transgression of the law passed on them, literally enforced, and thus made examples of. It is only in this way that the law can be sustained. We see its beneficial effect in regard to the laws affecting Public Health and the Contagious Diseases. Why should it not operate equally well here? If put properly into force, it no doubt would. In regard to class (*c*), it is alleged that great trouble is occasioned in consequence of the difficulty to obtain convictions; for, immediately on a charge being made, a plea of inability is set up, and it is no easy matter, without a tedious lawsuit, to prove and convict offenders. But this battle has to be fought out—there is no other way; and when one or two convictions have been obtained, all difficulty to frustrate the Act will disappear. Any other policy would indeed be very weak, and unworthy of an Administration in charge of carrying out a great work. Do the right, let the consequences be what they may. There can be little or no difficulty in respect of class (*d*). Open transgressors or defiers of the law surely ought to meet with just retribution.

534. The "willing horse."—The officer must be careful not to strain the willing co-operators too much. Timely aid ought to be sent to those parts of the district where the land is more sparsely populated, and where perhaps the plague is most powerful. One has always to be on the alert, so as to take care of the "willing horse," and see that he is not allowed to injure himself. This remark is only put in by way of caution. There are some who think that the officials are careless and

callous, so that provided something is being done, whoever does it, it is of no consequence. The officer ought to be on his guard, dispensing aid and succour justly and impartially where most needed, apart from friendship or influence.

535. Native readiness.—Abundant testimony exists to show that the "natives" are ready to respond willingly to the call of duty in regard to this matter. Let the testimony of one officer suffice to show this feeling: "The report of those officers throughout the colony who are stationed amongst the natives, and observations made by myself while on inspection duty, enable me to state that the natives are freely and loyally responding to the calls made on them, and I find it difficult to express fully my sense of their steady and persevering efforts." So far so good. Surely what the natives do, the foreigners ought to have no difficulty in assenting to, with all their vaunted intelligence and obedience to law and order. The difficulty at present is the want of education about the matter.

536. Law-makers, law-breakers.—Strange as it may seem, it appears that in this work the law-makers are the law-breakers, or, what amounts to practically the same thing—the law is not made to cover or deal with portions of land over which the lawgivers have control! To prove this I quote from the same authority.

537. The "Act" inadequate.—"Passing from the native locations to unoccupied Crown and private lands (and there are considerable areas in that condition), I have had much trouble, for under Act 33 of 1895 they are not adequately provided for. I have not been able to operate on them satisfactorily, because it is not lawful, without special authority from the Supreme Chief, to employ by order natives on lands not occupied by themselves. The result in such cases is, that the pest is now reinvading lands that have already been cleared several times. I would venture to suggest that, in this respect, Act 33 should be altered and extended by some further legislation." Surely this is in every sense a very grave matter. There seems a downright waste of public money occasioned by such extemporising legislation. How can success be achieved if full power be not given to the officers to deal with the pest at whatever part or parts it may present itself, and appear to him or them necessary to tackle it? Such a state of matters is scarcely conceivable in any community of educated men of understanding and common-sense. He adds:—

538. Difficulty in administering Act.—"In dealing with private occupied lands, a wide, troublesome, and delicate series of problems face me constantly. At a first glance it appears a simple matter to put the provisions of the law into force, by requiring farmers and stock-breeders to destroy the pest in their own land, and, failing a ready compliance, to enforce its penalties. An examination of the subject, however, will

speedily demonstrate that difficulties arise which no law can override and no punishment meet."

539. Government must not oppress occupiers of land.—Surely here there is room for comment and advice. The Government in enacting laws for exterminating a plague cannot in that wise endeavour to replace it by imposing something worse than the plague itself. It can exact a willing co-operation to combat the plague from the occupier of the land, and in default of which it may exact a penalty or fine. But no one can do more than he is able to do. If the occupier of private land does give his willing aid to the full extent of his capacity, the law should not attempt to do more, for that would mean oppression and confiscation. If more be necessary to carry out the measures, the excess ought to be provided out of the public funds or through the agency of the Government. If it can be proved that the private occupier is exerting himself in a *bonâ fide* manner to the full capacity of his power or in a fair way, I cannot see any ground for any difficulty; and, if it exists, the law should be reconstructed so as to make it fair and just for all parties. One of the uses of a Government in a case like the present is that it serves as a centre for helping the people to help themselves, and without which they might not succeed in getting concerted action. In a central authority they may meet for a common end.

540. Wise choice of legislators.—The important place the Government on the one side occupies in dealing with a plague such as that under consideration has already been pointed out, and assuredly the position and attitude of the people on the other side are not less important. The one is the counterpart and complement of the other. If it is the duty of the Government to move in the first instance and act with promptitude, it is not less the duty of the people to be quick and reciprocate their efforts. It is the people who are mainly responsible for the Elective Assembly. It is the people who elect their members, and the people ought to know the persons whom they elect. If they elect an unprincipled man to represent them in the Legislature, he will represent them according to his character. If you elect an improper person, he will represent you improperly, and not attend to the requirements of the district. The members of the Government are therefore what the people make them—nothing more and nothing less. The best men ought to be elected, as they will attend most to do what is the best for all the people—the best will legislate, or try to do so, for the poorest, rather than, or at least as well as, for the richest. The people in the case of an election ought to put friendship on one side, and an effort should be made to get the best men to represent the locality and act for the good of the electors.

541. Representatives should possess esprit de corps.—Now,

the best man ought to be patriotic, and think well of his country and the district he represents. He must regard it an honour to represent the general interests of the locality. It seemed a beautiful trait in the history of the Apostle Paul, namely, when the scoffing, ignorant, and jeering crowd asked him, "Who are you? Do you know Hebrew?" Paul rose grandly to the occasion in his answer, "I am of Tarsus, no mean city." He was proud of his town, and so ought everyone to be; make the place what it ought to be, and then we cannot help being proud of it, and this will help every one of us to rise to the occasion. What possibilities, therefore, lie before the people of South Africa! "All work is worship," says Carlyle, meaning of course all work that in motive is pure, good, and beneficent; however menial and servile it may seem, it is not truly so; but if it is honourable, it is worship in the best sense. It is dishonour that degrades work and makes it really menial and servile.

542. Constituencies should be educated.—With some sort of guide or handbook before them, the people ought to get up the subject on which we are treating, meet together to discuss the questions, and resolve as to the best means to combat the plague. By concerted action, and showing the Government the intelligent interest they take in the matter, an impulse will be given, and the Executive themselves will be made more alive to do their duty and see that the means they are adopting are for the best ends.

543. Intelligent public opinion.—In some such manner the hands of both sides, both the Government and also the people, will be strengthened. It is therefore with satisfaction that I see from time to time accounts of meetings reported in the press, in which the people, farmers, etc., have met, discussed subjects pertaining to the pest, and drawn up certain resolutions in regard to what they think should be done. In this way public opinion is being educated and formed. The people have a voice, and they mean to let it be heard. I give the following as a sample, without committing myself as to the correctness of the details, or the exact necessity of all that is stated—all of which may be perfectly good in itself.

544. Meeting in Cape Colony.—"A large meeting of farmers was held the other day in the Cape Colony, to consider the best means to destroy young locusts, now hatching out in the particular district, when A. B. proposed the following resolutions, which were adopted:—

(a) "That Government be asked to supply to each field cornet one spray-pump, and sufficient of any chemical that would destroy the young locusts, also screens for trapping the voetgangers.

(b) "That the field cornet in each ward be appointed inspector for the time being without fee or reward.

(c) "That the field cornet have entire charge of spray-pump, screens, etc.

(d) "That every farmer, as soon as he discovers a hatching place or swarm of young locusts, should report at once to the field cornet.

(e) "That the field cornet immediately proceed to the place indicated, and take what steps he considers necessary to utterly destroy the swarm.

(f) "That the field cornet have the power to engage outside labour when necessary.

(g) "That the field cornet have the power to appoint an assistant or assistants if required."

There can be no doubt that the meeting that drew up these resolutions was in earnest, and so far knew what they were about. Whether the means they suggested were the best or adequate might be a question open for discussion, and which could only be correctly known by ascertaining the true condition of the locality.

545. Taxation necessary.—I need only further in this part of my subject refer to one more topic, namely, in regard to the providing means for carrying on the campaign. Clearly this is a matter for the Government. The money must come from the people in one form or another, and therefore as much voluntary help as can be secured it will be advisable to obtain, as it will be a double saving of expense, and at the same time be a stimulus to the people to work cheerfully and together. To meet the necessary expense it will be requisite to collect money by taxation.

546. Each district to be taxed according to its nature.—There are many ways in which this may be done, and what may suit one district, or rather country, may not exactly suit another so well. In one notable instance the money was raised by means of a special locust-tax; 10 per cent. was charged on the tithes, 1 per cent. on the assumed value of crops, and 1 per cent. on property and incomes not otherwise assessed. It is very necessary that the Government, from whatever source, should have funds in hand sufficient to supply every requirement connected with the campaign—plant and labour. If the exchequer is low, and if matters are gone about in a mean, niggardly way, a bad impression is imparted, and the public lose heart or will-power to continue the battle. They easily get an idea that it is needless to fight, and that it will prove fruitless and a failure. This spreads like an epidemic contagion or "wild-fire," and it is never easy to resuscitate lost or dying energies. The Government, therefore, in this matter ought to bear in mind that half-measures are worse than useless. Farming is the backbone of this, as it is of every country, and it is requisite that the Government should raise funds in the way it deems best to aid the farming industry at a time such as we refer to.

547. Wise economy necessary.—This, however, is far from saying or approving of reckless expenditure and waste of the public money. Bear in mind that no trouble can be too great, or work too expensive, if the extinction can be effected. In too many countries the locust plague is made the excuse for downright robberies of the public funds.

548. State Council.—There are many ways in which the various Governments in South Africa might aid in a more effective way than hitherto has prevailed in trying to exterminate or deal with the pest. Perhaps there is none that would be better than the appointment of a State Council in each of the countries of which South Africa is composed, where locusts abound; and this State Council could, in turn, appoint one or more delegates from its number, who might meet in conference with those from other States.

549. Mr. Bairstow's suggestion.—In this way combined or concerted action might be secured. Without committing myself to the details, I may here give a suggestion of Mr. Bairstow's on the subject or plan of legislation, which I think should be international, if that term is applicable in Africa. He says:—

“(1) Combined action of Cape Colony with neighbouring Governments and States. The necessity of this is surely unmistakably plain.

“(2) Practical sympathy (and if not forthcoming, *compulsion* from Governments) of Divisional Councils or allied organisations with proposed schemes.

“(3) Individual efforts and enforced obligations. I am speaking to intelligent sufferers, and take it that none here is so wanton as to oppose legitimate inimical action against the locusts.

550. “I propose that the meetings of the powers that be—statesmen, farmers, and entomologists—define certain feasible, simple, and powerful modes of attack, and that gangs of natives or men during each yearly locust period be under their control, properly equipped with well-devised implements, to proceed at any given notice to that State Syndicate by Divisional Councils or local public bodies, duly assisted again by farmers, to the fated locality, there wage war on behalf of our country, and supported by this country against the migratory *lowcusses* we have been considering. Say that there are three gangs of twenty natives—each supervised by a man at £150 per annum—one gang for each section of the colony. This is taking a very elaborate example, as probably not so many gangs or individuals would be required. Say that each native costs the country roughly six shillings per diem, that is, Sundays barred, £18 per day for the gang's maintenance, at £108 per week, or £432 per month, add £40 for supervisors, then the united scheme would cost £472, or £2832 for six months' good work—a mere flea-bite on the Estimates, and not likely to call for much electoral growling, even if you double the cost to provide for elaborate

housing or contingencies which always accrue. Say it costs with still greater elaboration £10,000 per annum, and saves a couple of millions, would it be satisfactory? But don't believe it. The cost would be a really trifling set-off against the demolition of millions of locusts in a methodical simple plan.

551. "Bang to Cape Town goes a wire, 'Locusts!' and the nearest gangers at once respond, 'Avengers coming.' You say it would be awkward if they arrived too late—the avengers. Why, certainly! But you must give Government credit for doing things properly. Selah! Any Divisional Council failing to report locust presence should be penalised with the gangers' expenses, and farmers will probably respond by holding themselves liable for individual wilful and criminal neglect. You can drive a horse to the water, you cannot make him drink; but don't you know a horse ain't a man, and a man ain't a donkey? Coming nearer home as a ratepayer, I prefer to pay an extra half-sovereign per annum, for the good of the farmers and myself, than sixty shillings for house-duty, as I used to—a penalty for the Basuto War.

552. "For twenty years I have studied at home, abroad, and in this colony the habits of injurious insects. For twelve years by pen and by mouth I have advocated a State Entomological Council in South Africa. As a simple student for twelve years I have pushed the necessity of Economical Elementary Natural History study. For years my esteemed patroness and colleague (Miss E. A. Ormerod)—whose voluntary work in this country cannot be overestimated—has plodded on arduously and with many obstacles to promote the study of injurious insects. If any reward accrues, it is this: now, others come into the field, and at last an outcry runs through the length and breadth of the land, 'Remedial measures needful.' That is our reward.

553. "I trust none may be so blindly ignorant as to oppose the laudable efforts of the Government in favour of a feasible Locust Bill. Those who do should be hauled up by their constituents. My great hobby is to see a bill passed wide enough to deal with all injurious insects—scab, ostrich worm, locust, potato worm, Australian bug, etc. etc.—and finish the matter for all time; and my great desire is to see Dame Nature herself take up the locust question in default of Government, and settle effectively in her usual subtle manner that which bothers the powerful brain of harassed colonists."

554. **Augmentation of cost, from £10,000 to £200,000.**—I am afraid "the estimate," at least as regards cost, which Mr. Bairstow has sketched out will not bear very close scrutiny. It appears to me that for important work, such as that indicated, it would cost as much as he states for every district contained in the colony. But inasmuch as he leaves so wide a margin, £7168 (*i.e.*, the difference between £2832—the actual estimated cost for the whole colony—and £10,000,

even, as he says, though it should come to that sum), it shows that he is neither sure nor particular, and that the great desideratum should be success, and in this I cordially concur. In saving £2,000,000, what is £2832, or even £10,000? Such is his argument, and a very good and sound one, too. As far as I am concerned, I would extend in this effort his £10,000 to at least £100,000 or £200,000. But would it not be well worth it, if it should cost £500,000 to save £2,000,000, and much more?

555. Niggardliness deprecated.—I think it would be good for the country if, by an expenditure of £100,000, or any such sum, it could save £2,000,000 or thereby. In any case, I am satisfied the expenditure he mentioned is far too little, as proved from the experience in Cyprus and other districts. A great work like this requires funds, and you cannot or ought not to be stingy with the means. The great thing is to see that the ideas are right and expedient. Money must be spent liberally in order to command and carry out the proper ideals. It is the ideas that must govern, and money is requisite so that they may be carried into effect.

556. The influence of the press.—We have now in the anterior part of the subject dealt sufficiently as an indication with the means nature uses to counteract or keep in check the plague, and also the necessity that exists for having a Locust Act in force to empower the responsible Government to take such artificial steps as may be considered requisite from time to time in the affected districts to deal with the calamity. There is one means that occupies quite a unique position and power in this matter, and which we cannot allow to pass without notice. The influence of the press, as we have already seen, is most beneficial, and at the present time is doing a service in this matter that was never done before, to anything like the same extent. From all parts and localities we not only get nowadays facts about the locusts, but also intelligence as to the means that are used for combating their progress. This stimulates *thought*, ideas are formed, and it is ideas that rule. Now these matters are dealt with at present far more clearly and in far more detail than used to be the case previously—say ten or twenty years ago. We therefore now are gaining ground fast in consequence of the present utilitarianism of the press. Facts and evidences are daily increasing, and accumulating to an extent unknown before. The spirit of inquiry and enlightenment is abroad, and will make itself manifest.

557. Form of Act proposed.—In pursuance of the foregoing remarks, I now herewith think it is best to introduce the form of an Act which is necessary to enable the country, through its constituted authorities, to take action. In this case I introduce that operative in Natal, only as a matter of convenience and expediency, and which may

serve as at least some sort of pattern or basis of recommendation in other or similar cases.

"THE NATAL LOCUST EXTERMINATION ACT—(COPY)

(*Paragraphed for convenience.*)

(No. 33, 1895.)

WALTER HELY-HUTCHINSON, *Governor*

V.  R.

ACT

To Provide for the Extermination of Locusts

558. "W HEREAS it is expedient to make provisions for the extermination of locusts :

"BE IT THEREFORE ENACTED by the Queen's Most Excellent Majesty, by and with the advice and consent of the Legislative Assembly of Natal, as follows :—

559. "(1) This Act may be cited as the 'Locust Extermination Act, 1895.'

560. "(2) The Governor may, from time to time, by proclamation, declare any portion of the Colony to be a locust area within the meaning of this Act.

561. "(3) The Governor may, from time to time, require the inhabitants of any locust area, whether Europeans, Natives, Indians, or others, being in occupation of land in such locust area, to concur in steps which may be deemed necessary by the Governor for exterminating locusts.

562. "(4) The Governor in Council may, from time to time, make, repeal, alter, and add to rules and regulations, and may do all things necessary for the extermination of locusts and for carrying out the provisions of this Act.

563. "(5) The Governor in Council may, from time to time, appoint some fit person or persons to carry into effect the purposes of this Act, and may delegate to him or them all or any of the powers and authorities hereby conferred on the Governor, and may, from time to time, remove any person so appointed, and appoint another person in his stead.

564. "(6) The Government shall not be liable, nor shall the Governor be personally liable, for any loss or damage arising from or caused by anything done under the authority of this Act; and every officer or person acting under the authority of the Governor, and any other person acting in aid or under the orders of any such officer or person,

may, from time to time, enter into and upon the land of any person or persons, firm, company, board, society, or corporation, and may cut grass and take brushwood thereon or therefrom, and do all other things necessary for the purpose of carrying out the objects of this Act, and shall not be answerable or chargeable for any act of trespass which they may respectively have committed on such lands for the purpose aforesaid.

565. "(7) Any officer of Government appointed under this Act may set fire to and burn grass and brushwood within any locust area, on Crown lands and lands of the Natal Native Trust, and lands not occupied by Europeans, and also on private lands, having first obtained the consent thereto of the owner or lessee of such private lands or his agent.

566. "(8) If any person is sued or prosecuted for anything done by him in pursuance or execution, or intended execution, of this Act, or of any rules, orders, or regulations made thereunder, he may plead generally that the same was done in pursuance or execution, or intended execution, of this Act, or of rules, orders, or regulations made under authority of this Act, and may give the special matter in evidence.

567. "(9) Where any matter or thing is by this Act, or by any rule, regulation, order, or notice made or published under the authority hereof, directed or forbidden to be done, or where any authority is given by this Act to any person to direct any matter or thing to be done, or to forbid any matter or thing to be done, and such act so directed to be done remains undone, or such act so forbidden to be done is done, in every such case every person offending against such directions or prohibition shall, in the absence of any other special provision of this or any other Act in force, be deemed guilty of an offence against this Act.

568. "(10) Every person guilty of an offence against this Act or any regulation passed hereunder shall, for every such offence, be liable to a penalty not exceeding twenty pounds sterling, and in default of payment thereof shall be imprisoned, with or without hard labour, for any period not exceeding three months.

569. "(11) All penalties or other moneys payable in respect of any offence against this Act, or any rules or regulations made thereunder, may be recovered before the court of the magistrate of the division in which such offence shall have been committed, or in which the offender may be found.

570. "(12) All fines under this Act, or any rules or regulations thereunder shall, when recovered, be paid into the Public Treasury.

"Given at Pietermaritzburg, Natal, this 24th day of August 1895,

"By command of His Excellency the Governor,

"JOHN ROBINSON, *Colonial Secretary*."

571. To enforce the carrying out of the foregoing Act of the Legislature, the following Regulations or Rules were made by the Government:—

“Government Notice, No. 124, 1896

“The Rules and Regulations published under Government Notice, No. 422, 1895, are hereby cancelled, and the following Rules and Regulations made by the Governor in Council, under the provisions of Act No. 33, 1895, are hereby published in lieu thereof.

“JOHN ROBINSON, Colonial Secretary.

“COLONIAL SECRETARY'S OFFICE, NATAL,

“21st February 1896.

“RULES AND REGULATIONS FRAMED UNDER ACT NO. 33, 1895

572. “(1) The officer appointed by the Governor in Council to carry into effect the purposes of Act No. 33, 1895, is called the Chief Locust Officer.

573. “(2) The officer appointed to any special area is called the Locust Officer for *(name of district).*

574. “(3) Every person in occupation of land in a locust area shall at once give notice to the magistrate of the district, or to the nearest Locust Officer, of the appearance of young locusts on his land.

575. “(4) It is the duty of every person in a locust area on whose land young locusts shall appear, to dig trenches and to drive the young locusts into such trenches and there to bury them, or otherwise to destroy such locusts in such manner as may be directed by the Locust Officer.

576. “(5) When lands are occupied in common, it is the joint and several duty of all and each of the occupiers to give the notice, and to dig the trenches, and to bury or otherwise destroy the locusts therein, as required by these Regulations.

577. “(6) Every person in occupation of land in a locust area shall, to the extent of his power, by personal service and by that of all persons in his employment, or occupying the land under him, or by substituted service accepted as sufficient by the Locust Officer, destroy, or assist the Locust Officer in destroying, the locusts on any land within the locust area.

578. “(7) If any person shall obstruct or interfere with any Locust Officer in the discharge of his duty, or shall refuse to such officer the service and assistance demanded of him for the purpose of the destruction of the locusts on such person's land, such person shall be held to have contravened these Regulations.

579. “(8) If any question shall arise as to the sufficiency of the

labour or service supplied, or of the assistance rendered, the person supplying such labour, service, or rendering such assistance, shall be obliged to satisfy the Court that he did all that was reasonably in his power to do, or otherwise he shall be deemed to have refused such service or assistance as aforesaid.

580. "(9) The penalty for a contravention of the Act No. 33, 1895, and of the regulations passed thereunder, may be, but is not to exceed, twenty pounds sterling, and in default of payment imprisonment, with or without hard labour, not exceeding three months."

LOCUST DESTRUCTION

THE STATES CO-OPERATING—SOME DIFFICULTIES

581. **Report.**—The following is the C.L.O.'s Report on locust destruction operations in Natal, for the period ending 29th February 1896 :—

"The operations for the destruction of locusts are now being carried out on an extensive scale throughout the colony, while several of the neighbouring States are co-operating with more or less success.

582. **Success due to foresight and organisation.**—"In the location lands of Natal, owing doubtless to the masses of inhabitants occupying them, the work has met with marked success. The result of the locust-egg purchase system, as carried out against the deposits made by the locusts in November last, has been to thin out and weaken the swarms to such a degree as to render them easier of destruction than those of the last invasion, when the eggs were not purchased. Nothing but this practical test could have so amply demonstrated this fact, and could have justified the amount of public money spent in this manner. The hatchings of the last invasion have been so enormous that, had the hosts of swarms come on the colony when the officers and constables employed in the task of supervision were new to their work, the whole country would most certainly have been overwhelmed. Happily the organisation was in full working order, the officers knew their work and their districts, the native population was prepared, and every known means of destruction was promptly brought to bear whenever and wherever it was possible. The effect of this widespread action has been to minimise in a very great measure the chances of a general short-fall of grain amongst the tribes; that is to say, as far as the effect of locust ravages go to this date. The prevailing drought is doing much to injure the crops on fields that have been saved from the locusts by the energy of their owners.

583. **Hearty response by natives.**—"The reports of these

officers throughout the colony who are stationed amongst the natives, and the observations made by myself while on inspection duty, enable me to state that the natives, though considerably discouraged by the prolonged drought, are freely and loyally responding to the calls made on them, and I find it difficult to express fully my sense of their steady and persevering efforts. Owing to the mountainous nature of some parts of the location, where a foothold is not obtainable, and to the tangled forests of euphorbia and thorn which prevail in certain localities, it has been beyond the power of human effort to utterly exterminate the pest everywhere. A destruction, however, of over two hundred swarms a day, some of them covering many acres, must materially have reduced the almost inconceivable masses which sprang from the ground in every direction. Had no action been taken, the natives themselves frankly admit that famine long ere this would have been upon them. As matters stand at this date, the surplus of grain which is usually consumed in beer-making will not be available, and it is in this direction (not an unhappy one) that the short-fall will be felt.

584. Government organisation to be extended.—“Taking the feeling of the farmers throughout the colony, and I have met many of them at the meetings, where the attendance averaged about twenty-five, I found them almost unanimously in favour of a continuance of the Government organisation, only on a more extensive scale. Naturally up-country landowners, having seen less of the good work done, owing to the scarcity of labour in their own neighbourhood, were more inclined to appeal to Government for help than those on the coast, where more success had been obtained.

585. Sugar crop saved.—“The effect of the operations so far can be best estimated by dividing the country into upland, midland, and coast belts. As already stated, the sparseness of population in the uplands has seriously militated against success. The midlands, with a slightly denser population of agriculturists, had more success; while the result on the coast, despite the heavy masses of the plague, is distinctly encouraging. It has been widely and publicly admitted, by those most deeply interested, that the effect of the Government organisation supporting their individual efforts has resulted so far in practically saving the sugar crop, and as that crop is worth, even in bad seasons, something over half a million sterling, it follows that the action taken by the Government has been abundantly justified.

586. Implements and methods of destruction.—“With regard to the methods of destruction which have proved most successful, it may be interesting and valuable to neighbouring States to learn that in districts where labour is plentiful, and where the grass is short and too green to burn, scourges made from about forty strands of No. 10 or

12 wire, and about two feet in length, are effective. In places where the grass is tall and coarse, similar scourges made of heavier wire, and mounted on handles three feet long, do extensive execution. Where labour is scarce, locust screens made of canvas, or, better still, ten or twenty sheets of galvanised iron, placed longitudinally on edge, in a V shape, the apex being open and leading into a hole, will materially assist destruction. Fire, when grass is plentiful and dry, can be used, but the swarm must be completely surrounded by flames. Many other methods of destruction might be named, but the above have the advantage of being effective, without the danger brought about by the use of poisons. Since my last statement of expenditure, the sum of £3578, 2s. 8d. has been disbursed under the following heads, namely:—

| | | | |
|---|-------|----|----|
| Purchase of eggs, delivered prior to 10th January . | £983 | 11 | 9 |
| All other expenses | 2594 | 10 | 11 |
| | <hr/> | | |
| | £3578 | 2 | 8 |

or a total to date since the beginning of operations of £10,714, 6s. 7d. In conclusion, I have to express the gratitude of the Department to the magistrates, court officials, district officers, and others, for the earnest and oftentimes laborious work which has been entailed on them in helping forward a work as wearisome as it is difficult. By an oversight in my previous Report I omitted to express my thanks, especially to Colonel Vaughan, for the very great assistance he has rendered in his district.

“P.S.—Since writing the above, I have learnt that during the last ten days, owing to the continued drought and constant additions to the masses of the pest by the appearance of the last lot of the new hatchings, certain districts, such as Bulwer, Polela, and Ixopo, have suffered heavily. This information, however, has not been officially confirmed.”

A CHAT WITH THE CHIEF

587. Change of attitude by farmers.—The C.L.O., interviewed by the *Witness*, remarked:—“I cannot say whether it is in answer to prayer or not, but I have received reports that large swarms of young locusts are dying from disease. In most of the coast districts, where labour has been plentiful, the pest has been practically annihilated, and the crops are looking well. The prevailing idea throughout the colony is that the Government did the right thing at the right time. I must admit that the attitude assumed by the farmers up country was for a time decidedly antagonistic; but a better feeling prevails now, and

they are all animated with a spirit of co-operation, and are willing and anxious to assist the Government in every way they can. It is a matter for regret that such a spirit was not exhibited earlier in the day. We have less hesitation in punishing Indians, because we know their expenses are so much less than those of Europeans. To put the law into operation amongst Europeans means that summonses will have to be issued, and this extreme measure is far from pleasant to contemplate. There are not wanting in Natal many negrophilists of the maudlin type, some of whom have endeavoured to raise an outcry at the firm treatment that has been meted out to the various tribes. I hold that the only way to save the natives from the effects of this terrible plague is to rouse them as much as possible from that lethargic state which is characteristic of their disposition. The harder they are pushed now the sooner it will be over. The natives themselves are with us *en masse*.

588. Spraying poison.—"On the subject of spraying I have experimented with nearly every known poison, and in every case have been successful in killing the locusts; but I cannot recommend its use. In the first place, the method is altogether too expensive for extensive operations, and in the second place it is positively dangerous to animal and vegetable life. Mr. Millborrow's scheme is out of the question, as it could only create another danger far more terrible than the locusts themselves. We have a first-class intelligence department. The officers are one and all most enthusiastic in their work, and in this I include the native constables, who are just as keen as the Europeans."

589. Progress made, knowledge increasing.—At the first consideration of the subject of direct artificial means for exterminating the plague one is apt to be dismayed, and not without reason. Whether we look at the fearful numbers of the insects (in fact, we lose all count of numbers) and the ravages they commit, the enormity of the losses, or the small certain headway that the artificial well-directed means used for exterminating them has made in the past, an overwhelming sense of inability and helplessness to cope with the malady creeps over one, almost enough to remove our hope, and we are compelled to approach this part of the subject in an appalling fear. On closer and more minute examination, however, there is some ground for hope, inasmuch as we know that in the last two or three decades more progress in this department has been effected than in as many centuries before. More attention, as has been extensively shown, is being directed to the subject, and the data connected with it have been more accurately recorded and tabulated. The power and influence of the press tell more at the end of the nineteenth century than before. Our knowledge is therefore increasing, and knowledge is power—at least, if it can be anywhere so regarded, it can here in this sphere.

590. One successful case.—There is at least one notable example on record where human agencies exterminated the pest, and what has been done once can or may, in similar circumstances, be done again. This is an age of discovery, and great progress is made in every department. This is the case in all parts of the world. There is therefore ground for hoping and working. Light may arise in the darkness. The command or summons is to "watch," or "be up and doing," always on the alert.

591. Fluctuations in opinion.—One has only to take up some of the leading daily newspapers published in South Africa to see the very peculiar and varied state of the public mind in regard to the locust question. At one time, the record states, it will be the Government who declines to continue spending the money already voted for the purpose of coping with the mischief and exterminating the pest; at another time there will be a report of a meeting of farmers gathered for the purpose of soliciting the Government not to cease their efforts, but continue them, and even with renewed energy; then one finds the Government gives way, and yields to the petition of the farmers. Next we find a meeting of the farmers resolving that the Government should spend no more money, because they think it useless, and that the means used are ineffectual, and so on. There does not seem to be that careful fixedness of purpose and resolution which an impartial outsider would like to see in regard to the carrying out of a great plan and work.

592. Illustration from Natal.—It is not in one colony or state in which the above course of conduct is seen, but it is discoverable in one after the other. It may be in the Cape one week or month, and in Natal the next, and so on. It may be well here to cite one instance out of many, which in this case occurred in Natal.

LOCUST EXTERMINATION

TO THE EDITOR OF THE *Natal Witness*.

593. Mr. Scott's opinion—Number destroyed a mere fraction.
—SIR,—I am sorry to see that my friends, Messrs. Arbuckle and Campbell, are not satisfied that the time has come for the Government to discontinue spending money on attempts at locust destruction. The unanimous vote given at the Farmers' Conference should be enough to settle the matter. As both of the gentlemen mentioned will appreciate figures, I will give them material to digest which, I think, will alter their opinion.

594. First, I will accept Mr. Arbuckle's statement that 27,000,000 have been destroyed. I will allow that more have been destroyed, and not reported—let us suppose in all 100,000,000 have been destroyed. What is that? A mere drop in the bucket. In January last a swarm

passed over this neighbourhood ; it was eight days in passing, travelling about seven hours a day, and on an average travelled quite five miles an hour. The breadth of that swarm was over ten miles ; the density was variously estimated at from 20 to 100 per square yard. Taking, however, only one per square yard, which I think all those who saw the swarm will allow is absurdly low, we have in that one swarm eighty-six times the whole 100,000,000 allowed as destroyed.

595. "Driving" alone successful.—Again, when in Newcastle division a few weeks ago, I rode through swarms of hoppers, several of these covering hundreds of acres ; but let us see what number 100 acres would contain. Suppose 100 hoppers to the square yard (a thousand would often be below the truth), and we have over 48,000,000, nearly double the number claimed as destroyed. I hope when those in favour of spending public money in the destruction of locusts verify and digest these figures, they will see the futility of any attempt to cope in that way with the plague.

To show that I am not theorising on the matter, I may say that for over two months I have had about fifty boys doing little else than driving and killing locusts. I have, I believe, tried every scheme proposed—driving into trenches, beating with wire whips, crushing with heavy rollers, poisoning, burning, and shooting—and I declare one and all of little use. Driving seems to me the only thing of any use, and by that we secured three-fourths of our crops.—Yours, etc.,

JAMES SCOTT.

IMPOLWENI, *April 16th.*

596. Mr. Scott's dictum traversed.—Now let us examine this epistle, which is a characteristically typical one, and one which, at a superficial glance, does seem to strike out "straight from the shoulder," as the saying is, at Messrs. Arbuckle and Campbell's contention in regard to the expediency of the Government's continuing to spend money in view of the inadequate proportion of locusts killed. I hold that the contention of Mr. Scott as set forth in this letter is utterly mistaken and false. Two wrongs can never make one right. Mr. Scott entirely evades the real question, which probably his opponents did not set out correctly in their letter, which letter I have not seen. I take the facts for granted, and will only consider the deductions drawn therefrom. The fact is, that Mr. Scott proves from his own statement, if he would only "digest" it, that the Government would be justified in spending public money if it were possible to secure what he secured, namely, three-fourths of the crop by "driving" the locusts. That is an immense gain ! Usually it is computed that no more than two-thirds of the entire cereal crop is saved ; or, in other words, the locusts devour one-third, and the two-thirds are saved, not in consequence of "driving," but in consequence of opportune circumstances, such as the crop being saved before the hoppers have a chance to get at and eat it.

597. Government grant justified.—The real question that Mr.

Scott and his opponents ought to have tackled is, whether the Government can, by a judicious expenditure of money, supervision, labour, etc., say, amounting to £10,000, help the farmers to save their crops, which would have been eaten up by the locusts to an extent, say, of £500,000 (the exact figures do not matter if the illustration is only approximate)? It would surely be better to spend £10,000 in helping the farmers to save £500,000! That course would surely redound to their credit, and prove the Government to be wise and good and safe.

598. £5000 saves £500,000.—In one instance alone, namely, that of the sugar-cane, it is asserted, I believe, on good authority, through the interest and agency of the same Government, who may not have spent on this crop alone £5000, that £500,000 value has been saved, which would in all probability, without the stimulus, aid, and direction of the Government through its officers, have been lost.

599. Mr. Scott's deduction wrong.—The contention of Messrs. Arbuckle and Campbell, that because 27,000,000 locusts have been destroyed, therefore the Government should continue, is utterly wrong. I agree with Mr. Scott that numbers is practically nothing—no criterion; but then that is beside the real question. If the Government, through its channels, only killed 27,000,000, its channels or means may not have been right, and they might, or should, have used other means in that case. That there were so very many more to kill was surely a reason to persevere rather than discontinue, and Mr. Scott himself proved this contention and set the Government the example, for he went on using an immense number, comparatively speaking, of "boys"—fifty of them—and therefore he saved three-quarters (or 75 per cent.) of his crop!

600. Mr. Scott's admission an argument for Government aid.—The argument is superlative, and comes upon his own head with the weight of a sledge-hammer. This is an exceedingly opportune letter, and one to which I must hereafter refer in some detail in regard to the practical carrying out of the means to be used. It is in regard to the means to be used that I think at once the difficulty and the secret of success lie. He has used no less than six methods in all. His general opinion or verdict is, that "I declare one and all of little use," but he, in the next breath, as it were, adds, "driving seems to me the only thing of any use, and by that we secured three-quarters of our crops." Well, there is something peculiar in all this. It is astonishing that Mr. Scott could continue employing no less than fifty boys for over two months at a thing that was of "little use"! That is worthy of some reflection. The state of mind and of purse of a man who could do this is, to say the least, rather exceptional. Now, if Mr. Scott could do this, how beneficial would Government aid and

encouragement be to poor struggling but honest men perhaps, as Mr. Scott's controversialists were, if attainable; but they and their class are not always good logicians, and often are unable to state their case properly, and hence a clever man like Mr. Scott can throw dust in the eyes of the public—perhaps unintentionally.

601. Government might alter methods in cases of failure.—

The fact is, the Government did enter into co-operation with the farmers to check the plague of locusts; the Government voted money for the purpose of aiding, through their representative officers, and if success does not come so soon as expected, or if money is spent in an absurd and reckless and profitless manner, it does not prove that the Government ought to stop or retire. Quite the reverse. The Government should, as long as the plague is rampant, face it, and help the people to fight it out successfully, and if money has been spent badly and out of all proportion to the success obtained, it should, from the experience gained, correct the abuse, and work on different lines and with different men. The 27,000,000 locusts killed is truly nothing, but the billions alive, and which Mr. Scott points out, even inadequately, is the appalling circumstance, and it is to this that the Government ought to direct its strenuous attention. The methods used are probably flippantly carried out, and hence failure ensues. We shall afterwards have to examine the methods Mr. Scott indicates, when we shall weigh the pros and the cons regarding them *seriatim*.

602. Example of U.S. Government.—Looking, then, critically at Mr. Scott's letter, as stated in the *Witness*, I feel inclined to say of the first paragraph, that I hope the time has not "come for the Government to discontinue spending money on attempts at locust destruction," but that it will go on discreetly and energetically until the pest be finally vanquished and overcome. There is a glorious opportunity for the Government in question, or any other, to do a good and praiseworthy work. The United States Government has acquired an enviable reputation on account of the very strenuous and admirable efforts it put forth to minimise and exterminate the pest there in years gone by. "The unanimous vote given at the Farmers' Conference" (to which we shall allude later on) "should be enough to settle the matter," says Mr. Scott; but it is no proof, I respectfully submit, that Government should discontinue. It is only an expression of opinion upon the manner of spending money, and it is valuable in showing that these thirty practical **representative** men did not approve of the mode adopted by the Government. But the plague remained the same precisely, and the necessity, consequently, for trying to check it was as strong as ever. Experience shows that frequently "unanimous" votes may not be right, and that they may often mislead. I purpose inserting the reported dealing of the

Conference with this matter, so as to illustrate the point, and will not therefore at present refer further to this part of the subject.

603. A "nut" for Mr. Scott.—Mr. Scott's dealing with the figures of his opponents in the argument is rather singular. He not only admits their figures, but adds to them at one bound 300 per cent. ! Intrinsically he must therefore have known that the case he essayed to tackle was essentially weak on that score. With the view of giving such as think with or like Mr. Scott some "material to digest," I, in turn, will take what he himself provides for me in the next two paragraphs and look at the matter from another aspect. He gives an instance of one swarm out of many that pass from time to time. He says, practically, the swarm, at an "absurdly low" reckoning, contained 8,600,000,000, *i.e.* nearly nine billions. Most persons who have any knowledge or idea of the numbers contained in a swarm of flying locusts will regard one locust to the superficial square yard as "absurdly low." I should imagine, judging from the thickness of a regular swarm, that twenty to the square yard would partake of the same "absurd" character, and probably it is much under the mark when he even puts it at "100 to the square yard," for swarms not unfrequently are 300 yards in thickness, or depth, or width, and sometimes more ! Well, now, at the smaller reckoning, we should have in his one swarm 172,000,000,000, or, at the more probable reckoning of 100, we should have 860,000,000,000. Then the rate of speed—five miles an hour—which Mr. Scott correctly states is a slow rate, for when travelling they often go twice as fast, and that would then nearly double the number deducible from his own figures—anyhow, the number he reckons is far too small. They are so close and dense that the sun is prevented from casting shadows ; such density will give an idea of the number a flying swarm contains.

604. Testimony of Major Moor and Mr. Barrow.—Major Moor has reported, "that when at Poonah he was witness to an immense army of locusts which ravaged the Mahratta country. . . . The column they composed, his friend was informed, extended 500 miles, and so compact was it when on the wing, that, like an eclipse, it completely hid the sun, so that no shadow was cast by any object, and some lofty tombs distant from his residence not more than 200 yards were rendered quite invisible." And Barrow, in his *Travels*, says what is still more wonderful, and illustrative of the immense number which a flock contains, namely : "An area in South Africa of nearly 2000 square miles might be said literally to be covered by the locusts.¹ When driven into the sea by a north-west wind, they formed upon the shore for fifty miles a bank three or four feet high, and when

¹ In S. America (Province of Santa Fé) I have seen an area of 200 miles by 200 miles (and more) covered with the flying locusts, *i.e.* over 40,000 square miles.

the wind was south-east, the stench was so powerful as to be smelt at the distance of 150 miles." With data before one like these, the calculation of Mr. Scott must inevitably be much below the actual number contained in a swarm. Of course swarms vary in size.

605. The farmers' vote and policy ignoble.—What, then, about all the many swarms that are scattered over this fine and extensive country? Is it a light matter for these thirty farmers to pass a "unanimous" vote that the Government should cease to spend any more money to check or abate this flood of destruction? Was it wise, even if "unanimous," to pass an ironical vote of thanks at the same time to the Government? How far could the ridicule or contempt at the effort of the Government be carried? To the extent of getting the C.L.O.'s portrait and Reports, framing them, and preserving them as mementoes or curiosities in caricature! Praiseworthy, was it not, of this deliberative Assembly? On the face of it, did not the Government, recognising the awfulness of a visitation of such numbers of destructive animals, act wisely in the attempt to make some provision to cope with the mischief? In view of the data given by Mr. Scott himself, I think there cannot be a shadow of a doubt as to the wisdom of using all means to check the plague. These thirty farmers were unable to suggest any means in place of those used by the Government. They chose the ignoble or "easy-chair" mode—not at all an enviable one, however, for energetic men—namely, ridiculing or caricaturing, instead of earnest action and supporting the Government measures.

606. That Government criminal which holds aloof.—It cannot be too clearly understood or well enforced, that any Government which not only keeps aloof from aiding the work of exterminating the pest, but also does not put the very best means calculated to checkmate the plague in the hands or power of the people it governs (and who are willing to work and carry out well-considered plans for the purpose), incurs very great responsibility indeed. It is surprising to see, now and again, notices in the press to the effect that the Government is doing all it can, but it will not supply this, that, or the other thing, irrespective of whether or not the thing it refuses to supply may be the very best thing for the purpose required.

607. A local council recommended.—What appears to be needed in each country is an independent and impartial council of intelligent and educated men who are conversant with the details of the present state of matters pertaining to the subject, who will decide absolutely from time to time as to what means are the best and what are useless, or what ought to be avoided, acting thus in a capacity similar to what a council of war does to a nation. At present there is no general agreement as to the measures which should be adopted. But if

a council existed, then definite arrangements could and should be made, suitable for special localities, and perhaps also for dealing with special swarms and special crops. Then, again, the nature of the ground has to be considered. What measures may be most adapted for one place may not suit another; obstacles for carrying out a certain plan of campaign may present themselves—one here and another there. Crushing by rollers, for example, may be successful here on account of the surface of the ground and the character of the swarm; but in another place it may fail just because the circumstances do not exist that are adapted for crushing by rollers. It is therefore not the thing that fails, it is the want of knowledge in carrying it out properly as it should be carried out. The law of the fitness of things is not adequately understood and applied. A body of intelligent men would, by their counsel, help the people enormously in tackling the foe with the greatest effect and with the smallest amount of waste of energy.

608. Great diversity of opinion.—In a battle of this kind especially, success may depend on the adaptation of means to circumstances far more than we are disposed to allow at first sight. One cannot on reading the newspapers of the day help being struck at the enormous contrariety in regard to the inability of this, that, and the other detail about the carrying out of the battle. This could only happen in consequence of some link being amissing, the actual details of the special battle not being understood, and this want should be supplied. Following the example of the great Architect of the Universe, who bids us to imitate Him, it ought to be our constant and highest endeavour to bring order out of chaos.

On reading the letter of date April 16th, I wrote as follows:—

JOHANNESBURG, 27th April 1896.

JAMES SCOTT, Esq., Impolweni, Natal.

609. Dr. Munro's letter.—DEAR SIR,—A friend has forwarded to me the *Natal Witness* of Saturday last. I have read your letter therein on locust extermination, and as I am interested in the question, I write to you to ask if you could send to me the account of the Farmers' Conference mentioned in your first paragraph.

610. Details of operations requested.—In the last paragraph you say: "I have, I believe, tried every scheme proposed—driving into trenches, beating with wire whips, crushing under heavy rollers, poisoning, burning, and shooting—and I declare one and all of little use." But you add that you think driving is the best, and by such you have secured three-fourths of your crop. Could you give me the details of these several (in all six) methods which you have yourself tried and seen? I shall be immensely obliged if you would have the goodness to do so. How did you proceed with the rollers, and have you seen them extensively used? An answer at your earliest convenience will oblige, yours faithfully,

Æ. MUNRO, M.D.

611. Misunderstanding as to methods.—Of the six various modes of attacking the locusts which Mr. Scott mentioned, I was anxious to get particulars of how they were carried out, believing that failure had ensued through the want of adaptability. Success depends almost entirely on the adaptability of the means to the end, and I felt sure there must have been some misunderstanding on this point, and, as we shall see hereafter, I differ entirely with Mr. Scott in regard to his mode of carrying out these methods as they should be carried out.

I duly received the following reply:—

4th of May 1896.

Æ. MUNRO, Esq., M.D.

612. Mr. Scott's reply.—DEAR SIR,—Yours of 27th April to hand. I could only get you doings of Farmers' Conference by sending you the paper with an account of proceedings, but I do not think that worth while, as there was nothing said about locusts further than a unanimous vote of some thirty practical farmers, "That all expenditure cease," with an unseconded amendment, or rather rider, "That the C.L.O.'s (Chief Locust Officer's) Reports be got and framed as curiosities."

Now as to particulars of locust destruction:—

613. (1) Digging of trenches and driving into the same and burying.—This was the scheme relied upon at the commencement of the campaign, and in certain conditions is probably the best. The conditions are that the ground in front of the swarm is tolerably soft, that a ditch can be dug in a moderate time, also that the grass is not too long, for if the grass is very long it is impossible to drive, and this I may say is the great difficulty in Natal. The grass is generally long, and when the grass is long the locusts will not drive, they simply hide under the grass and escape from wire whips and everything else. Perhaps you will say, Why not burn the grass? The grass in Natal is too green, and will not burn from November to March, and that is the locust breeding-time. The first attempt I made at driving I got a swarm on bare ground and fairly soft. We dug a trench in front of the swarm, placed corrugated iron sheets to prevent them jumping out, and in an hour's time we buried a considerable swarm. But that once and once only; whenever we tried it again, they hid in the long grass.

614. (2) Wire whips.—The wire whips are undoubtedly of some use, but if a swarm is large the labour is long and heavy. I believe we might have done more with the whips if we had commenced earlier, but trusting to the burying, which is best done when they are six or seven weeks old, we did not use the wire whips or scourge till perhaps it was too late. When once you attack a swarm with scourges, it is really amazing to see how cunning they get; the moment they see you coming they are down out of sight in the long grass.

615. (3) Crushing with a roller.—If the ground is hard, level, and bare, no doubt a great many could be killed this way; but the long grass protected them. My roller is a block of concrete about two tons

in weight, requires ten oxen to draw it, and when I passed this over them in the long grass, the majority were none the worse. They simply crept into the roots of the long grass.

616. (4) Poisoning.—Treacle and arsenic were laid about in tins for the young hoppers. A good many were drowned in the treacle, but I saw no sign of their being attracted to it. Where treacle is very cheap, spreading it on sheets of iron and catching them, as recommended by one planter, might be of use, but it would be simply as a trap.

617. (5) Burning.—Burning, when the grass will permit, is fairly effective, but if the grass has to be hand-cut it is too expensive to do much good, and most of our ground is too rough for the mowing machine.

618. (6) Tramping with cattle.—What ought to be the sixth method, and one that I tried, was tramping with cattle. I found the same objection to this, they merely crept out of the way into the grass.

Shooting, I merely added that as a joke. . . . My experience of shooting was an experiment by a young friend, who fired a charge of dust-shot into a large swarm and killed two!

619. Wire scourges.—The wire scourges are made in different ways. The first way was a wooden handle two to three feet long, a loop of strong wire, say No. 6, passed through a hole in the end of it, then pieces of a finer wire, No. 10 or 12, passed through the loop. But the best kinds are made by cutting ordinary lightning conductors into suitable lengths, say three to four feet, and untwisting, say two feet, the remainder being the handle.

620. The locusts die off simultaneously.—I have before me a letter from my friend, Mr. Arbuckle, who tells me that the numbers reported as killed by the C.L.O. was 24,772,600,000, not 27,000,000, as by my letter. The mistake was not mine. I quoted from the *Witness* report. I do not lay much stress on the numbers given. What I do go by is, that where the utmost has been done no impression has been made, so that what has been done in Natal has been of no use. I do not, however, much fear their continuance. I remember them in 1851 and 1852, and they disappeared. They are dying in thousands and millions in this neighbourhood.

621. Climate in Natal, etc., destructive of locusts.—I believe our climate is too moist for them. I send you to-day's *Witness*, in which you will see the other side, but I would tell you that Malton is close to me, and we all know they have had no locusts worth speaking of, and as for the inch deep over 800 acres, that is mere tall talk. I don't believe that with eight boys, inch deep over an acre could be destroyed. The fifty boys I employed are schoolboys in our native institution. I am a missionary of the Free Church of Scotland, and Impolweni is a mission station, so that I have a command of native labour which few farmers have.

622. Driving successful.—The driving I refer to is the driving first of the flying swarms or mature locusts. We had often to give up school for the day and drive from 10 a.m. to 5 p.m., by which time they settled for the night. Four boys, if active, could manage about twenty acres, as fortunately the locust does not, unless very hungry, begin to eat until he has had a few minutes' rest. Secondly, with patience a

swarm of young hoppers may be driven out of a field, but it requires great patience to do this. It is better, however, to watch them, and when they are making for a field guide them away from it. They can generally with patient driving be guided downwards towards a river, which they will cross even if twenty or thirty yards wide. There is a good deal of truth in what the farmers say (*Witness* of to-day) that the natives get tired unless kept up to it by a European; they generally give over just when a little patience would have gained the day.

623. If you ask any questions I will do my best to answer them; but, as you may suppose, with two native training institutions and a native membership of six hundred, I am pretty busy. You will excuse me if I have omitted anything you would like to know.—Yours very truly,
JAMES SCOTT.

624. **More information requested.**—Leaving out “shooting,” which is evidently not seriously meant, of the six modes mentioned, which embrace “every scheme proposed” (a statement very far short of the fact, as we shall hereafter see), I am not at all certain that Mr. Scott or his practical farmers and myself are agreed as to how even these methods should be carried out. In my subsequent letter I begged him to favour me with details—for example, as to how he used the rollers, the number of cattle used for tramping, the manner and time, etc., for burning, and so on, because it would be useless going round about the bush; unless we know and are agreed about the premises, we can have no certainty as to drawing a right conclusion from them. As he omitted to supply me, I am not in a position to give an opinion as to his conclusion. He may have no fear of their continuing because of unsuitability of climate, but that is a lame ground, I very much fear, and can only say, “Great is thy faith.”

Wishing to still get the detailed manner of Mr. Scott's working, so as to clear up this matter, I therefore more fully wrote:—

67 BREE STREET, 7th May 1896.

REV. JAMES SCOTT, Impolweni, Albert, Natal.

625. **Dr. Munro's fresh appeal.**—MY DEAR SIR,—I have this morning received your letter of the 4th inst., which is so good in expressing certain views or phases of the great locust question that I hope you have no objection to my using it publicly for illustrating the many questions that crop up in connection therewith; and I could suppress your name or not, as you may wish. I should be glad still to have the newspaper account of the proceedings of the Farmers' Conference, if you could conveniently send it to me.

626. As the subject is a worthy one, and as you kindly offer to answer any points that appear to me requiring elucidation, I beg to ask details of your views on the following, suggested by reading your account of the seven methods referred to.

627. **Tramping by cattle.**—Have you personally seen this carried

out in practice in Natal or elsewhere? How many cattle were used? and generally with what result?

628. Burning.—How did you burn them? How old were the locusts at the time? Do you mean setting fire to the dry grass, or did you use any other means?

629. Killing by whips or scourges.—As you come from “bonnie” Scotland, you will no doubt remember and be familiar with the old instrument, the “flail,” used in the olden times before mills were put up for threshing the corn crop. A whip made like a “flail” should suit the purpose well—supposing the handle (that of an ordinary broom) about 4 ft. long, and the wires like the “souple” about 3 ft. long, and the thickness to vary with the nature of the swarm and ground. The action in killing locusts (the hoppers) with the whip or scourge would be pretty much the same as that of using the “flail” in threshing corn. Or is the form you describe more convenient still? However, I suppose the precise kind or form is a matter of expediency.

630. Killing by rollers.—When did you hear first of this plan? Have you personally seen it tried in other places than on your own land, and was it then tried as you now describe?

631. Cunning of the locusts.—I quite understand the difficulty you have so well described in regard to the “cunning” and obstinate qualities of the insects. But I would be glad to have your views amplified in regard to the carrying out of the practice used for exterminating them.

632. Points on which more light is wanted.—Have you seen the “hoppers” cross a stream or river 20 to 30 yards in width? How did they manage it? I have no doubt of the fact, but I would be glad of an accurate description of it by one who has himself seen and observed it—an eye-witness. About what rate of speed would the water be passing in the said stream? How, again, could you drive the flying locusts, seeing that usually they are so afraid that when one claps the hands in the midst of a large flock, they rise with surprising rapidity? At certain times they are not so very frightened, but it is rather difficult to picture driving the company of flying locusts. A few words on this might be useful and certainly welcome. I quite agree with all you say in regard to *numbers*, and that up to the present no great impression has here been made in reducing or arresting the plague. The “treacle” mode seems poor. Do you find that the hoppers don’t walk or march till they are six or seven weeks old? I am of opinion they usually do so much earlier. Do you not find that the hoppers take wings and begin to fly about a week or so after that time?—Thanking you for your letter, and in anticipation of more, I remain, Rev. and dear Sir, yours faithfully,

Æ. MUNRO.

633. Mr. Scott’s reply.—On the 26th of May Mr. Scott wrote to me in answer to my last, and after excusing himself for the necessary delay, and that in consequence of his having mislaid my letter he was able only to reply from memory as to what I desired, he adds thus:—

634. The methods and implements Mr. Scott used.—I send

you herewith *Witness* with account of Farmers' Conference.¹ In regard to any information I gave you, you are at perfect liberty to use it in any way you choose. You asked if I had seen rollers used other than

¹ In order to show the importance of Mr. Scott's letter and position, and that it was useful to answer and explain his views, I herewith give the notice of the Conference as reported in the newspaper press at the time, as well as the leader from the *Natal Witness*, bearing on the matter—however remotely.

"NATAL FARMERS' CONFERENCE"

"The sixth annual meeting of the Natal Farmers' Conference was opened yesterday in the Town Hall, the proceedings starting at ten o'clock in the forenoon. There was at that time an attendance of about thirty delegates from various associations, including Messrs. W. T. Wood, J. W. Moor (Weenen Agricultural Society), E. Snell, W. Adams (Durban and Coast), A. Stone (Ixopo), M. A. Smuts, Jas. Henwood (Howick), T. Hyslop and Jesse Parker (Lion's River), G. L. Coventry, J.P., W. H. Roberts (U. Tugela), Thos. Fleming, Edward H. Poole (Boston), P. D. Simmons (Mooi River), T. Stead, J. Mapstone (Richmond Road and Camperdown), C. Hammond, A. W. Cooper (Richmond's Farm Association), H. Nicholson, P. Flett, Jno. Marwick (Richmond Agricultural Society), E. Peckham, Rev. J. Scott (New Hanover Agricultural Society), F. J. De Waal, Fr. Bloy (Ladysmith Farmers' Association), G. Forder, J. F. Alexander (Poela Agricultural Society), G. Ross, E. M. Greene (Maritzburg Agricultural Society).

"The President, Mr. Philip Norton, J.P. (Riet Vlei), occupied the chair, and, after the roll call, formally opened the proceedings by expressing his pleasure at meeting with them all, and the hope that their business would be worthy of the occasion.

"PRESIDENT'S ADDRESS"

"The minutes of last Conference having been adopted,

"The President delivered the customary presidential address. He said he had pleasure in being able to congratulate the members of the Conference upon the satisfactory results of the last annual general meeting, and to make a few suggestions on matters of importance to the farming community. Their late Secretary left the papers in connection with the Conference with Mr. Herhensohnn, jun., but it did not appear to him from those documents that any proper accounts had been kept as to the receipts and disbursements. So far as they had been able to base the accuracy of the moneys actually received, he thought it was fairly correct, and left them with a cash balance of £17, 6s. 6d. That included £1, 2s. of arrears, recovered by the present Secretary. Reference was made to the provisional appointment by the Executive Committee of Mr. Herhensohnn as Secretary.

"Referring to the deputation which waited upon the Attorney-General as to the reason of a non-conviction in a case of sheep-stealing, in which mutton was found in the hut, the President remarked that the deputation was not courteously received, but the explanation given by the Attorney-General satisfied the deputation. In the Attorney-General's written reply great stress was laid upon the farmers, as owners of sheep, in keeping correct count of their flocks, and to inform the police directly sheep are missing, the Attorney-General stating that should the number of the police be insufficient to cope with the crime, the Government were prepared to strengthen the force. The President also wished to impress upon his fellow-farmers how essential it was that proper and regular counting of these flocks should be more

my own. I have not. The one I used was a very heavy cement one, made to my order, over 2 tons in weight. On hard bare ground it would have been effective, but was of little use where the grass was

systematically adopted. If stock-stealing was to be suppressed it would require the strenuous efforts of every farmer of the colony to unite and assist the powers that be in every possible way, and the most important feature to put into action was regular and correct counting. In connection with this subject, he thought it desirable for the Conference to bring to the notice of the Government the practice which was now made a custom of abuse by natives, in giving and demanding extensive presents in addition to the ten head of cattle paid as lobola fee. He knew from personal inquiries that presents were demanded in the shape of a horse, saddle and bridle, pots, blankets, and clothing, as well as money. These presents often amounted in round sums to £20 or £30, and no bridegroom could tell how much he might be called upon to pay in the shape of presents, and he was afraid that these demands from the bride's father often acted as an incentive to steal. He considered a limit should be fixed by Government, or the practice of presents abolished, to debar parents of betrothed girls from demanding presents, which was fast becoming an abuse.

"The matter of organising and fixing dates for the stock fairs throughout the country had been dropped, only two associations having responded to the Secretary's circular.

"In regard to the question of obtaining statistics showing the number of deaths occurring annually throughout the colony of horses, cattle, sheep, regret was expressed that so much indifference was shown by farmers in regard to supplying the information desired. The police collected 1338 replies out of 3000 circulars distributed. From these it appeared that, during the year 1895, 1150 horses, 12,683 cattle, and 40,314 sheep died. An analysis of these returns, compiled by the Secretary, showed that amongst horses there were 28 causes of mortality at work, amongst cattle 41, and amongst sheep 28. The total loss to the colony shown by these returns, imperfect as they were, was something like £58,774, 12s. That showed the necessity for the early creation of an efficient Veterinary Department.

"Up to the present there had been no replies from the Governments of the two adjoining States in connection with a resolution passed, soliciting united action in carrying a general Scab Law for South Africa, which was so much to be desired as a progressive pastoral movement for the improvement of their principal staple, wool.

"On the subject of outspans, the President said he would suggest that some steps should be taken by the Conference to apply to the Government to introduce a retrospective Fencing Law, compelling farmers to comply with the outspan law of the colony before the fencing off both sides of the road, and also pressing upon the Government the necessity of calling the Surveyor-General's attention to the non-passing of surveys on subdivisions before these subdivisions had contributed their quota of land as provided by the outspan law of the colony. It was probably late in the day, but better late than never.

"It was, he thought, imperative that the Conference should bring the matter of the rate demanded for goods and stock passing in transit through the Transvaal to the notice of the powers that be, in making the matter a public question, to ascertain whether the custom officers at Volksrust were not exceeding their instructions.

"The locust plague was also a subject upon which the Government would like an expression from the members of the Conference. Personally, he did not think that any good whatever had been accomplished under the Locust Extermination Act, and whatever zeal and energy the officers under the Act had adopted had proved

long and tufty. Since I last wrote you I have seen an account of mowing grass with a machine, and burning. No doubt where the grass was suitable that would be useful, but I am fully persuaded no

futile, as far as the extermination of the pest was concerned. If all the various Governments of South Africa had amalgamated under the Act, he did not think any practical benefit would have been derived, as far as his observations had served him, and the £10,714 expended had been so much waste for the purpose it was intended for. The only satisfaction that had been derived was, that the Government had done its utmost, and further, there did not appear to have been any serious damage done, so far as he had been able to gather. The crops throughout the upper districts, he had seen, would be a fair average crop, in spite of the locusts and drought, the latter being, in his opinion, the most formidable element to contend with. He was under the impression, if they had the usual rainfall, there would not have been much to complain of, as far as damage from locusts was concerned, especially where a little energy had been displayed by the various landowners or occupiers, by protecting their crops.

"While expressing satisfaction with the Masters and Servants Act, No. 40, 1894, the President suggested alterations, which he deemed necessary. He also thought that Hottentots should be brought under its provisions, as they were in no way superior to the natives.

"The last season had been a record year as far as successful shows were concerned, and upon the success of the various exhibitions, or otherwise, they naturally looked in order to gauge the prosperity of agricultural and pastoral pursuits throughout the colony.

"Last, but not least, a great deal had been said with regard to a free interchange of colonial products, and too much could not be said in favour of such a move throughout South Africa. It therefore behoved the Conference to agitate consistently and persistently for the cultivation of such a measure, and place themselves in communication with every organised body of farmers in all parts of South Africa for united action, in view of bringing the question prominently before the various Governments, and endeavour, as a subordinate body, to set their superior powers an example in not advocating a cut-throat policy to the detriment and dishonour of two British colonies who had done their utmost to outstrip each other in the matter of trade, and thus played into the hands of foreign powers in anything but a generous and consistent spirit, for the monopoly of trade, the farmers being the greatest sufferers.

"They should therefore, as a farming community, endeavour to persuade by united action the various Governments in South Africa as to the necessity of free trade in all colonial industries, and thus strengthen their hands. Nothing would tend more to bring about good fellowship betwixt the various nationalities. Their interests ought to be one, as upon the success or otherwise of one colony or state depended the prosperity of another; and so *vice versa*, with the non-progress of one part of South Africa the other also suffered. The time had come when they should set aside all provincial feelings, and aim at one object and purpose, namely, to endeavour to amalgamate the various Farmers' Conferences throughout South Africa, no matter of what nationality, for the weal and welfare of their country, and for the free interchange of their colonial products. He had to thank the Government for the considerate and the conciliatory manner in which they had endeavoured to assist the Conference in furthering the various resolutions which were brought before them. In conclusion, he thanked them for the honour conferred upon him in electing him chairman, and pointed out that their first duty would be to elect a chairman for the ensuing year. (Applause.)

human power can deal with a large swarm. We have still a few about, but I think they are dying out. I do not think our climate suits them.

"President re-elected.

"At the conclusion of the address, Mr. Wm. Woods proposed that Mr. Norton be re-elected President for the ensuing year, which was seconded by Mr. Scott, and agreed to. The President briefly returned thanks for his election.

"LOCUST EXTERMINATION

"MR. MARWICK, for the Richmond Association, moved: 'That this Conference is of opinion that the present law and organisation for the extermination of locusts should be suspended.' They were all agreed that the law had been a failure.

"MR. HENWOOD seconded. At the same time, he thought their thanks were due to the Government for the effort they had made.

"The REV. J. SCOTT agreed.

"The CHAIRMAN declared the motion unanimously carried.

"MR. MARWICK.—Mr. Hammond wishes to move that the C.L.O.'s Reports be collected and framed. (Laughter.)

"MR. HYSLOP moved: 'That this Conference begs to convey to the Government sincere thanks for their efforts towards locust extermination.'

"MR. HENWOOD seconded.

"The CHAIRMAN declared it carried.

"MR. BLOY.—No fear. (Laughter.) He complained that the farmers had not been assisted, the officers going only to the locations and farms worked by Kaffirs. If the Governor, as Supreme Chief, had called out the whole native population at a certain time, some good might have been done. A locust officer told him that he had only instructions with regard to Kaffir land.

"The REV. JAS. SCOTT said that in his district officers went to both location and other lands.

"MR. MARWICK said he had never seen a locust officer at work.

"The CHAIRMAN.—The motion has been carried.

"MR. ALEXANDER.—No discussion was asked.

"The CHAIRMAN.—It was carried by a large majority.

"EDITORIAL ARTICLE FROM THE NATAL WITNESS

"MARITZBURG, SATURDAY, 11th April 1896.

"The proceedings of the annual Natal Farmers' Parliament are never uninteresting, and this year they have been of more than usual interest. The propriety of publishing the Bills to be submitted to the Legislature, before its meeting, though highly 'unconstitutional,' has been shown, by the opportunity it has afforded of discussing measures to be brought forward in relation to agriculture, when the collective opinion of those who live by the land is obtainable; and Parliament and the Government have hereby not to grope their way more or less in the dark, or run the risk of being misled by giving too great consideration to merely individual views or those of a district here or there.

"Parliament will have been materially assisted in dealing with the Lung Sickness and the Outspan Bills, and the hands of the Government will have been strengthened in any action they may propose to take, in order effectually to deal with the rinderpest, towards prevention of which at present the issue of a proclamation is all that has been done. The proceedings of the Farmers' Conference were eminently of a practical and business-like character, but then, as some of the delegates observed when complimented thereon, they are not in receipt of a pound a day.

The scourges or whips are exactly like flails with wire for the one end.
—In haste, yours very truly,

JAMES SCOTT."

"The President dwelt at some length on the thefts of stock, referring particularly to the unbusiness-like habit, which obtains with a good many owners, of not making a practice of counting their sheep. He attributes a good deal of the sheep-stealing to the demands made by the parents for presents over and above the regulation gift of ten oxen for lobola, to meet which the intended husband draws upon the farmers' flocks. We scarcely follow Mr. Norton here, because the extra presents claimed are, he says, such things as saddlery, blankets, and clothing, and we fail to see how stolen sheep can readily purchase such articles. The thief could not well dispose of them as meat, and to offer them to a butcher of any repute would be to risk his liberty. We fail also to see how the Legislature could stop or limit these presents, or a knowledge of them be arrived at, except through the persons who would be the least likely to inform. Even with natives, allowance must be made for the greater power of purchase by one than by another. It might certainly do much to stop the sale of girls to old men and promote the happiness of young people, but whilst there continues to be an open marriage market amongst ourselves, we should lay ourselves open to being reminded that we live in glass houses. Anyone who is in the habit of reading the English law reports will frequently have come across suits by jewellers for debts due for expensive articles as marriage presents, which are quite beyond the means of the giver. Strictly speaking, the white donor as much robs the jeweller as the native does his employer or other person, whilst in regard to the native the motive for the theft might be accepted by a soft-hearted jury as an extenuating circumstance. According to the report of the Magistrates' Commission, the existing laws are quite sufficient to suppress stock thefts, if only they were vigorously enforced, and that they are not is, in no slight degree, due to indifference or delay on the part of the farmer.

"The Conference appears to have anticipated the Ministry in attempting to move the Republics to attempt eradication of scab. Neither of their Governments has even replied. It is at the course that their own Government is pursuing that the progressive sheep farmer in Natal should direct his attention. It is of little use to talk of making laws, and when they are broken, the very officer whose duty it is to see the law carried out is disposed to step in between the offender and his punishment if his sympathies can be aroused.

"Another measure indicated by Mr. Norton is a retrospective Fencing Law, but retrospective legislation has never met with favour, is generally more or less harsh in its incidence, and in this case might be extremely so where the fencing has been put up for the purpose of raising plantations. The whole outspan question is one of great difficulty, and is none the less difficult because encroachments have been permitted, and therefore, as it were, condoned for a series of years by the past Government as well as the present. Neither could possibly have been aware that the law was not being complied with. Further, as was pointed out by Mr. Greene, the Government is going farther than permitting or condoning avoidance of the law, in 'offering something to which the farmers are not entitled, as there is no right of redemption whatever.' We express no further opinion to-day, but will recur to the subject at an early date.

"Turning his attention to the locust plague, and regarding the effort at extermination as futile, Mr. Norton was of opinion that, but for the short rainfall, there would not have been much to complain of in damage from the locusts wherever a little energy was displayed in the protection of crops. He says that the crops throughout the upper districts will be fairly average ones, and that generally, as far

as he has been able to gather, no serious damage has been done. In that belief he is entirely at variance with the Government, who have been considering how best to meet a dearth of foodstuffs, and whose information must naturally be much more extensive than Mr. Norton's. We happen to have had ocular evidence in the last few days of the ravages of the locusts, and can scarcely treat as no 'serious damage' the complete destruction of hundreds of acres of mealies and forage on one farm alone, where the labourers and the oxen had to be taken off from all other work to try and save the crops. Many of the smaller farmers have seen everything swept away, with no provision made to tide over the calamity, and the bulk of the natives are similarly circumstanced. It is a matter upon which only the Government can speak with any authority, as was shown by the great diversity of opinion when the subject came to be discussed by the Conference in relation to the grain duties. In the upper districts, where the President averred that there will be fair average crops, Mr. Moor says that most of the grain has been destroyed, compelling the Weenen Agricultural Society to ask for relaxation of duties for a year. Other delegates, too, spoke of large districts in which there is not a single mealie left, and where the natives have already had to sell their stock to get food. As in Ireland, where, if the potato crop fails, the cottier is simply without resource, and the pig that pays the rent must be sold, so it is with the native and his mealie crop.

"We are inclined to think that provision for a dearth of food is amongst the 'unforeseen contingencies' for which the Government is about to ask for borrowing powers; that is to say, that it is unforeseen so far that the extent of the provision to be made has not been estimated; but that should not be, and the Ministry should be able to inform the Assembly, with a tolerable approach to accuracy, of what will be needed to tide over the failure of the crops.

"Another unforeseen contingency has already turned up in the rinderpest. What may be needed to guard against an invasion of that disease is not so easy to calculate; in fact, it is beyond the bounds of calculation. Considering that the disease was on the Zambesi and Nyassa flats four years ago, the extreme rapidity with which it has moved south in a couple of months is astonishing. The Cape Government has been exerting itself to the utmost in keeping it out of that colony, and cattle have been slaughtered wholesale in Bechuanaland, and compensation made to the owners. The Cape has adopted the only method possible of stamping the disease out, and the same course must be followed in Natal. Mr. Parker is mistaken in thinking that so far there have only been a few cases south of the Zambesi. The disease had shown itself before the insurrection of the Matabeles, and the vigorous steps then taken by the Chartered Company are said to have been amongst the causes which led to the rising. Numerous cases have been met with on the borders of Bechuanaland and the Transvaal, and desperate attempts have been made by transport riders to get past the cordon of police to the Cape Colony. No effort whatever to stop its entry into the Transvaal has yet been made, and possibly the same view may be taken of the rinderpest plague as of locust invasions and scab—that it is a visitation of the Almighty, and not to be fought against. And if it is in the Transvaal, as there is reason to believe, and the Boers lose their cattle, it will be another item in the bill to be paid by the reformers, and the Boer will look upon it as a blessing specially sent his way.

"There were some remarkable suggestions during the Conference discussion, but Mr. Bloy's idea was simply preposterous—that this colony should offer a premium to the two Republics if they would stamp out the disease. It was satisfactory that the Conference ultimately resolved to request Government to allow of no cattle coming in from the Free State, Transvaal, or Zululand, and it will be a serious neglect of duty if they should hesitate to comply, for if they show the least lukewarmness it will not fail to be attributed to political considerations."

635. Reply unsatisfactory.—Of course I acknowledged the above letter with thanks, but clearly the information I specially desired was not there, or at most only a very small part of it. The manner of using rollers (information which was ample on that point, and just as I thought) and mode of burning are not, I submit, understood properly by Mr. Scott, or, at all events, as I understand these means to be suitable for combating the locust pest. He reasserts his pet theory about the climate not suiting the locusts, and that artificial human means are of no avail! "Human" power, however, I affirm, extinguished them, and Mr. Scott ought to have known this.

The following letter, after a lapse of six months, was sent, to further elicit Mr. Scott's views:—

JOHANNESBURG, S.A.R., 10th Dec. 1896.

THE REV. J. SCOTT, Impolweni, Albert, Natal.

636. A further appeal to Mr. Scott.—DEAR SIR,—On the 26th May you wrote to me on locusts in answer to mine of the 7th May, but in consequence of the said letter having been mislaid, you were unable to answer the details I then desired. I had intended then publishing something on the locust, but through a delay on the part of the person into whose hands I placed the matter, it was deferred. I am now resuscitating the matter, and beg to send you more or less a copy of my said letter, and I should be glad if you would kindly still look it over, and favour me with your views on the subject.

637. Newspaper testimony.—I saw a notice in the *Mercury* (Durban), June 13th, that after making careful inquiry it was found then that the locusts were hatching by millions in the neighbourhood of Port Shepstone. The notice ran—

"From information the *Mercury* has received, it would appear that locusts are hatching by millions about ten miles from Port Shepstone."

638. Has public opinion in Natal undergone any change?—Is this information consistent with what you know to be the case in other parts of the colony? Are your opinions, from what you were able to gather, pretty much the same regarding the question as they were when you wrote to me in May? Do you think that there is any sign of abatement in the plague? Of course, from your kindly allowing me to make free use of your letters, you will not, I presume, mind my giving a criticism of your views. What I wish and hope to do, is to produce an educative work. I find that there are really only a few who have a thorough knowledge of the insect or plague. The opinions in regard to dealing with it are very varied and crude, and there is no concerted action. I shall be glad if you will favour me with any special or representative views you yourself may have, or those of practical farmers, or men you know, who have sound ideas, and are shrewd men of the world.—I remain, yours faithfully, Æ. MUNRO.

639. The following excellent letter was duly received in answer to the foregoing. It is representative in the ideas mentioned, and I shall therefore have something to say on several points contained in it:—

IMPOLWENI, ALBERT, Dec. 12, 1896.

To E. MUNRO, Esq., M.D.

640. Mr. Scott's reply.—DEAR SIR,—Yours of the 10th to hand. After writing you I found your last letter, of which you have sent me a copy. I have no objection whatever to your criticising my views on the locust question. I have no doubt we have one aim—to elucidate the truth, and see if anything can be done to mitigate the plague. The present state of matters in Natal is more hopeful than this time last year.

641. The plague diminishing.—I do not think our climate agrees with them, and unless large swarms come from without, I believe we will suffer less than last year, and probably in a while they will disappear from the colony. I suppose you are aware that the last visitation we had of them came to an end in 1852. It is difficult to get the facts, but from native accounts it is supposed *that they had been fourteen years in the country at that time*, but the numbers must have been small, as they did not do nearly so much harm as last year.

642. My own opinion is, that all our endeavours to destroy by mechanical means are utterly useless. This opinion has been confirmed by more recent experiences, and is shared by the most practical men in this neighbourhood: *not one sane man has proposed the continuance of the attempts to destroy either the eggs or the grown insects.* Some letters have appeared advocating the spread of disease amongst the swarms, and I believe a Mr. Cooper, near Richmond, Natal, is carrying on investigations. I consider that this is the only plan that gives a ray of hope for anything being done by human efforts.

643. A plantation needed.—I saw the notice in the *Mercury* about millions hatching on the coast in this neighbourhood. There has been no hatching for the last eight months. I am sorry to see a good many pairing at present, so we may have young ones before our crops are ripe. I had a new experience some three months ago; a swarm passed over Impolweni, from what cause I cannot say, but they came on in such masses that driving was useless. They would not drive; they settled on the trees, and ate up the leaves of a wattle plantation; on gum trees they settled in such masses that they broke the trees down; trees and branches four inches in diameter were crashing every moment; the noise was as if a thousand men were felling the trees. The plantation is quite a wreck.

I will now proceed to give you a detailed answer to questions asked in yours of 7th May.

644. Tramping by cattle.—Of very little use, as the locusts escape under tufts of grass and weeds. I tried it on swarms of half-grown locusts; about fifty head of cattle were used. On bare ground it would be more effectual, but on the whole not of much effect.

645. Burning.—When young locusts are in old, dry grass which will burn, something may be done, but with us the grass is too green at the hatching seasons. I tried cutting and drying the grass, and spreading it over the locusts. Where good hay grass could be cut by a mower, something might be done, but not very much where the swarms

are large. The younger the locusts the more successful the attack is likely to be. The great difficulty is that the locusts breed in inaccessible and stony places. Also the fact that the swarms which do the mischief are probably bred thousands of miles away, so that any labour in destroying young locusts, except amongst or near growing crops, is, as far as the labour is concerned, mere waste of strength.

646. Killing by whips.—The "flail" with the striking end made of fine wire would suit exactly. What we find the simplest form was to take about $4\frac{1}{2}$ feet of lightning conductors, and unwind one half, retaining the other half for the handle. The numbers killed were too small to be of much use, though small swarms may be exterminated, especially in short grass. The sooner the attack is made the better—the younger, the tenderer, and more easily destroyed is the locust.

647. Killing by roller.—I used a three-ton roller on half-grown locusts, but with no effect. Doubtless on hard bare ground and young locusts the effect would have been better.

Driving into ditches and burying.—Where the ground is suitable this seems to me the best method of attacking the hoppers, but where the grass is long it is impossible to drive.

648. Mr. Scott reiterates his preference for "driving."—*The conclusion that I have come to, and this is shared by the best farmers in this neighbourhood, is—drive the hoppers past your crops, always heading them downhill; but don't attempt to destroy, it is not worth while.* A few boys patiently working a swarm can get them past a field in a few days, while any attempt to destroy only scatters them, and makes it impossible to move them. For the flying locusts, scare them away as best you can; with noise and smoke sometimes they can be got off, at other times it is impossible, especially when they move at night, as I have seen them do once. I think they had been driven by a storm on that occasion.

I shall be glad to see whatever you publish on the locust question.
—I am, yours very truly, JAMES SCOTT.

649. It is not often that one gets such a pleasant correspondent on a popular subject like this, as I have had the privilege of having in Mr. Scott, who, though I do not agree with his ideas, yet has the power to express them well. The italics in the foregoing letter are mine. I felt before concluding that I should like to have his description, as an eye-witness, of the locusts crossing a stream. I therefore wrote:—

JOHANNESBURG, 18th Dec. 1896.

THE REV. JAMES SCOTT.

650. The swimming power of hoppers.—MY DEAR SIR,—I have your favour of the 12th Dec., for which I am greatly obliged and indebted. I think I have now got your views pretty well, and in concluding for the present a correspondence which I have found interesting, and which I hope to put to profit, I would crave a few lines from you on the *swimming power of hoppers*. I have never actually seen the process of swimming across a river. I should be glad of a short description from an eye-witness, and would insert it.

651. If I manage to publish anything on the subject, which I hope to do, I shall not fail to ask your acceptance of a copy. Your ideas are considerably at variance with mine, but I have no doubt our aims are the same, namely, to elucidate the truth, and try to exterminate or lessen the plague. Our differences are so great that it would be useless for me to enter on the subject in a letter, for I could not hope to move you. I am not without hope, however, that upon examining the subject when fully exposed and dealt with, you will, if you approach it with an open and impartial mind, see your way at least to modify your views.

Again thanking you, I remain, dear sir, yours faithfully,

Æ. MUNRO.

652. **Mr. Scott's opinions representative.**—I have previously stated that owing to the views of Mr. Scott being in a sense representative of those of a good many in the country, I should have something to say regarding them. Mr. Scott is evidently in touch with his practical neighbours.

653. **The "climate" argument untenable.**—I would then first deal with his pet theory that the climate of South Africa, more especially Natal, is so ill-suited for the locusts that much damage is not likely to result, and that after a while the insect will of its own accord depart from here, and seek better quarters elsewhere. Mr. Scott bases his opinion for this on the fact that the climate is too moist. Now, there is room here, I think, for a difference of opinion, and I can, I think, show from Mr. Scott's own words that there is no good ground at least for his view. The surface of the ground in Natal is typically "broken," that is, there is high and low ground—ups and downs; it is full of undulations, which impart beauty, variety, and richness to it. This being the case, there is an adaptability from the variety of surface of the land in which the locust may breed. Then there is the requisite warmth; and "moisture," *per se*, is not inimical unless it is in the form of copious rains on level ground—a proof of which we can furnish from other countries, and also Natal. The South American Republics bordering on the River Plate more than answer Mr. Scott's description, and therefore his contention regarding the unsuitability of the Natal and the Cape Colonies for the locust, on account of the heat and moisture, is completely untenable and disproved. Then, in addition, Mr. Scott says that the locusts were here for fourteen years consecutively, previous to their leaving in 1852! Is any further proof of the fallacy of his views requisite?

654. **Native testimony untrustworthy.**—He throws out the hint that they were not so numerous then as they are now, or that they could have done as much damage then as now. But he acknowledged that he has very little ground indeed upon which to form any trustworthy comparison. In fact, I should imagine he, like any "sane" man, would consider the data absolutely worthless as a groundwork

for making a trustworthy comparison—it might serve as a conjecture. Hearsay stories from natives, etc., can scarcely be relied on. The memory is very treacherous in such matters, and half a century is a long time, and especially in a country such as South Africa, where in a short time so many changes take place. Moreover, forty or fifty years ago there was not much grown in South Africa to destroy as compared with the present time, nor was there the press then to tell us all about the ravages done, etc. Even in a decade (far less fifty years) there are notable differences. No, we must have some more satisfactory data to guide us in forming such conclusions. Our present opinions may be right or wrong, but they cannot be said to be moved one way or the other as a consequence of or dependent upon such data as these. From the following letter it does not appear evident that Natal and the Cape are so unsuitable.

THE LOCUST PLAGUE IN UITENHAGE

655. No diminution in numbers.—Countless multitudes of locusts are still to be seen in this district. They have caused enormous destruction. In many parts the fruit trees have been stripped of their leaves, and what I fear is, that the locusts will now attack the bark. Mealies, Kaffir corn, in fact all growing crops, have been completely destroyed.

656. Farming seriously injured.—The worst feature of the invasion is, that the locusts are depositing their eggs, and that they have evidently come to remain with us. I am afraid that until nature provides an enemy to destroy them, they will make successful farming in this part of the country next to impossible.

657. The locust-bird.—Darwin supports the theory that there are periods when the locusts have the upper hand, lasting until the great increase of the locust-bird (due to an abundant supply of food) gives the latter the advantage. When locusts become scarce, large numbers of these birds die off, and in time the locusts swarm over the country. Now, if Darwin had been acquainted with the Cape Colony, he might have gone a step farther, and mentioned the great destruction of locusts by gregarious and other birds, a strong auxiliary force to the locust-bird. At least, such was the case when he wrote on the subject, but, what with reckless shooting, the destruction of eggs, and above all the throwing of poisoned meal throughout the greater part of the country, only a small remnant of the auxiliary force remains.

658. Disappearance of destroyers.—I remember the time when the bonte and ring-hals crows, many species of the sparrowhawk and owl, vultures, bustards, etc., were very common birds; when the dikkop, keiwieje, plover, etc. etc., were found in large flocks in many parts of the colony; when the large locust-bird came annually, living on small insects, while the locusts did not show themselves. All these locusts and locust-egg destroying birds have almost disappeared.

659. Poison prohibited.—We have clearly disturbed the balance

of nature, and we have nothing to meet the enemy in the gate. It is surely high time that all useful birds were protected. The first step should be the prohibition of the sowing of poison broadcast throughout the land. Fox-terriers and traps, judiciously used, would as effectively destroy the jackal, as the reckless use of poison now so common.

660. Auxiliary force.—When we have recruited the auxiliary force and restored the balance of nature, we will still have to put up with the periodical invasion of swarms of locusts from the North, but they will no longer threaten to become one of our permanent institutions.

ARTHUR GARCIA.

UITENHAGE, 6th February 1896.

661. Proof as to improvement in Natal not conclusive.—

I will not deal with his view in regard to Natal being in a better state now as compared with what it was this time a year ago, so far as the plague of locusts goes. I do not know upon what grounds Mr. Scott bases his facts for forming this opinion. But supposing his data to be correct, which I think would require other and stronger proof, and that the fact deduced therefrom is true (that is, putting it on the best possible basis), does this bring us any nearer a solution in regard to the correctness of his pet theory? I do not think so. Wherever the locusts make their temporary homes, one season or year differs, or may do so, from another in the degree of the severity of the visitation. History proves this beyond dispute. We thus find it recorded that such and such a year was noted for its terrible locust visitation. Therefore, if Mr. Scott's opinion as to the present alleviated state of the colony of Natal as compared with a year ago be true, it amounts to nothing as far as proving that the plague is now diminishing owing to unsuitability of climate from moisture. Further, was not Natal pretty much the same as regards climate when they remained, as he says, on a former occasion for fourteen years? Practically, I believe, it will more or less remain the same. Proof of the contention I have here advanced will be found in the records of the locust visitation in Cyprus, where the data are of the most authentic and trustworthy kind. Years differed there in severity, and even it was found that when they used the greatest exertion to check the plague, the next year the plague was more aggravated than ever, but by persistence it was finally extinguished. I am credibly informed that locusts have visited the colony of Natal at intervals between 1852 and the present invasion. Thus, for example, in 1856-57, and at later dates.

662. Mr. Scott stultifies himself.—In the next place, let us on the other hand suppose that there are others pretty reliable and well-informed in the colony who take an opposite view to that which Mr. Scott espouses in regard to the more satisfactory present locust condition this year, as compared with last year—there are persons who

have the greatest fear that the visitation will be equally severe this year as compared with the last. I have such views in my possession. It would not be seemly to be pitting one man's opinion against that of another equally good, so I will refrain. Such a course would tend to excite ill-feeling, and without any real good resulting. There is one point, however, in Mr. Scott's letter which tells heavily against himself and in favour of those who take a contrary view to him, and that is, that the pest is probably likely to be as bad this year or in years to come as it was in the last. "There came such a tremendous swarm under his observation three months ago" that its numbers gave him quite a new experience. He is then in a state of learning or being trained. They settled on and destroyed both a wattle and also a gum (eucalyptus) plantation, breaking by their weight trees and branches of 4 in. in diameter! Unfortunately, he adds, the locusts "are pairing in great numbers"! That evidence does not look as if the locusts were finding the climate unsuitable for their prosperity, or that the loss this year will of necessity be much less than last year. "Time" is always on the side of the winning party. We shall see.

663. Mechanical methods still satisfactory.—I next come to Mr. Scott's view as to the inutility of even attempting to check the plague by "mechanical" means, or in other words, it is useless to employ human agency. He says: "My own opinion is that all our endeavours to destroy by mechanical means are utterly useless. This opinion has been confirmed by more recent experiences, and is shared by the most practical men in this neighbourhood. *Not one sane man has proposed the continuance of the attempts to destroy either the eggs or the grown insects.*" Inasmuch as no proposal to resuscitate the warfare against the locusts is put forward, one is so far bound to corroborate Mr. Scott's view of the farmers in his neighbourhood, namely, that they agree with him. In fact, to a certain extent at least, his statement represents the views of his farmer friends around him. Now let us examine carefully what all this means. In order to bring out the force of the words italicised we might put it in the inverse way, namely, "Every man who uses mechanical agencies to check the plague is insane"! If this were really true, I am not quite certain but I should be obliged to embrace in this category Mr. Scott himself and all his practical farmers. I think all of them have used mechanical means, and will use them again. I therefore should be sorry to make any such sweeping charge in regard to anyone who used, or directed, means against the advancement of a plague, although I might take another view as to the wisdom and expediency of adopting even the same methods. Will Mr. Scott and his friends venture to assert that those in charge of the operations against the pest of locusts in Algiers have been and are still not "sane" men? Will or can the same be seriously

urged against the U.S. Government, which so combated the plague by mechanical means of human invention as to reduce the temporary homes of the locusts by hundreds of thousands of square miles? Then what of the crushing answer to this sneer, when we look at the data with which Cyprus has furnished us? There the British extinguished in the space of a year or two the pest which infested it unceasingly hundreds of years, and that by the purest mechanical means that can be possible to conceive. What is *mechanical* if the "screen and trap" system is not? Is there any ground whatever for the contention that Mr. Scott and his friends urge? I hold there cannot be. Encouragement and hope lie quite in the opposite direction.

664. Mr. Scott's special means.—I now wish to address myself to the *special* "means" which Mr. Scott and his friends relied on and used. I have a special reason for entering into details, as I have no doubt whatever the great diversity that exists is due mainly to this—that we are not at all at one as to the meaning or ways or modes of carrying out the plans. As I do not know of any common accurate description of the means whereby Tom, Dick, and Harry can come to the same understanding, if living apart or in different countries or continents, I will try to supply the deficiency. Titles or names do not always convey in them the description of the method. Thus "tramping" is a term for a definite plan, but Tom, Dick, or Harry may have different ideas as to how it should be done, or done to the best advantage. My object, therefore, in dealing with this matter is to show that great confusion has arisen because nothing explicit has been described by which a common understanding can be reached. He tells us the methods used were—(1) Tramping with cattle, (2) killing with rollers, (3) burning, (4) poisoning with arsenic and treacle, (5) killing with whips and scourges, (6) driving into trenches and burying.

665. Failure courted.—Now, I may say in regard to the four modes (out of the entire six) at the top of the list, so far as I can understand Mr. Scott's methods of procedure, that I am at considerable variance with him as to the manner of conducting and carrying them out. If I courted failure in such a fight, I could not do much more than adopt what he said he did. True, he does not tell enough about it, but, from what he gives in outline, it may be easy to fill in and complete the picture.

666. (1) Killing by tramping with cattle.—Instead of there being only about 50 head, let us suppose there was a swarm of young hoppers, which was tolerably well circumscribed, and that he had from 500 to three or four times that number (or, say, from 1000 to 2000 head—Fig. 28), and kept them running—galloping round and round—on the locust ground time after time, I am certain they could and would kill the swarm completely. It has been done over and over again, and there

can be no doubt about it. Failure follows in Mr. Scott's exceptional case, in consequence of the inadequacy of the number of cattle and his not knowing how to lead the warfare. In this case he neither had "soldiers," nor was he capable as a "General" to lead the few "soldiers" he had. The enemy finessed and outdid or outwitted him completely. If he had not sufficient cattle, perhaps he could gather together 300 or 400 mares or horses or mules, or the law could be so enacted as to enable this to be done, and these would do equally well, and, after a little training, they would go round and round, covering every inch of ground and demolishing every one of the locusts, so that not one would escape. If it were easier to procure a flock of 1000 or 2000 sheep than cattle or horses, then the sheep would do, if properly managed. But of course sheep are not so good as cattle, and experience has proved that their feet might become affected and sore. When the locusts are very young, sheep might suit very well. But cattle or mares are best. In well-selected, suitable cases there is not a shadow of doubt that a swarm of hoppers can be completely vanquished by the "tramping" of stock, if properly managed. Anyone who has had the requisite experience can easily see that Mr. Scott's was no real test or trial. But, like everything else, some perseverance and knowledge of the nature of the battle is necessary.

667. (2) Killing by means of rollers.—Here again I think Mr. Scott is "at sea." His own roller is over two tons, or indeed it is three tons in weight, specially made of cement, and requiring ten oxen to draw it! He has only used it *once*, then on dry hardish ground, with the grass growing in strong tufts, and he avows he never saw it used elsewhere! Should the weight be two or four times even what his roller was, I should not expect a very different result from what he obtained under the circumstances, namely, failure. Therefore, he thinks, "killing with rollers is of no use"! The principle on which killing by the roller system is conducted, is not here understood, I submit; and the practice is consequently complete failure. To kill the army on the march with rollers, a space of, say, 30 ft., the entire breadth of the swarm, ought to be prepared for the attack. The hoppers *in this case* are, or must be, "on the march," and the rollers employed for the attack only used for the vanguard of the enemy and on the prepared ground. As we have already seen, when the voetgangers are on the "march," they advance in one direction and in line, irrespective of obstacles and obstructions that may be in their way. The rollers need not be so frightfully heavy; the hoppers are not so terribly strong, or difficult to smash or crush—they are softish creatures. Any light cheap ordinary roller, drawn by one horse, will do as well as one as heavy as to require to be drawn by ten or twenty oxen! If the ground be uneven, the rollers, as we shall afterwards see, may be adapted to that

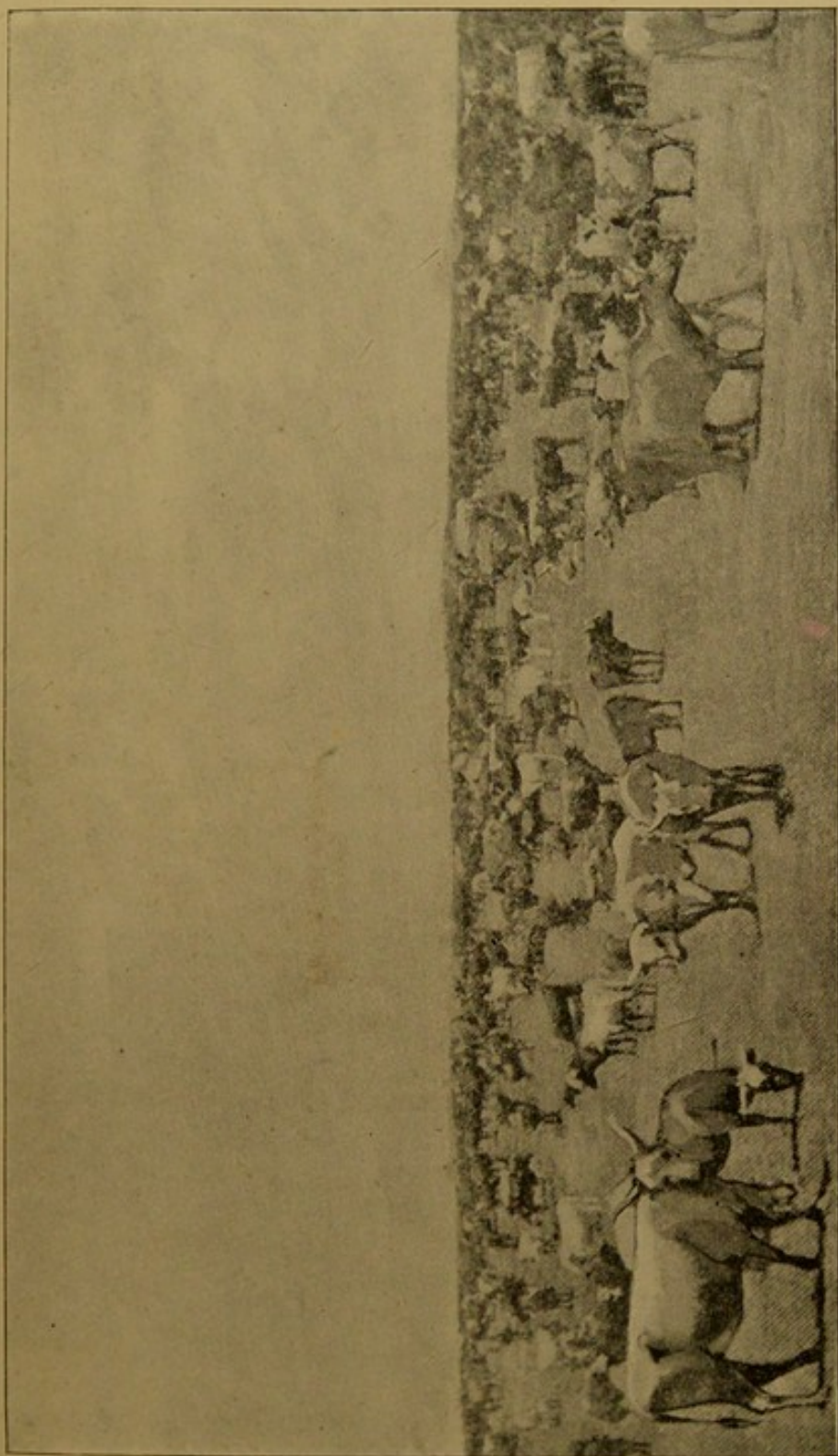


FIG. 28.—A "cut" from a flock of cattle, to show that for a work of the kind required a large number of cattle is requisite, if success can be expected.



condition. In any case, the person with the roller should wait until the voetgangers "march" on to the battlefield. Now, if Mr. Scott and his friends would only try the rollers on this plan, to combat any given swarm, he might meet with very different success to what he has done. Probably neither he nor his friends, practical as they may be, ever heard of conducting the battle on these lines. Nevertheless, I beg very respectfully to recommend it to their careful attention, when the conditions are favourable for the rollers, and these we shall point out afterwards.

668. Here again is proof that Nature is beautiful in her workings and dealings and order, when properly and fairly interpreted and understood. Instinct is furnished to the whole animal creation—in some instances more, and in others less. The "cunning" of the locusts, by which they adopt means whereby they evade death by concealing themselves beneath the tufts of strong coarse grass, the roots of which with the earth gathered around are so constructed as to resist effectively the great weight of heavy rollers, need not so much surprise us as excite our wonder that they are endowed with qualities akin to our own. An ordinary house-fly does the same, for it does not permit you to catch or injure it, if it can, when it annoys you by getting on your nose or other sensitive part. Does not a mosquito or even a flea teach us the same? Self-preservation is an instinct of our nature, so it is of theirs. When we bear in mind that many spiders, moths, and beetles counterfeit death itself when in danger, and no torture will make them show signs of life while the danger continues, we need not much wonder at the locusts trying to secrete themselves. It would be a wonder if they did not.

669. (3) Killing the hoppers by burning.—Now, here again I am perfectly willing to accept all that Mr. Scott says on his method, as far as he goes; but then, so far as I can conceive the mode of burning put forward as a great means for combating the plague, it is best done during the first week after hatching, and not, as he indicates, when they are spread out on the green pastures. During the first week or two the young twisters or hoppers aggregate together at night, form themselves into heaps, and this is one of the times only when burning will prove of great efficacy as a means of destruction. When thus aggregated into heaps at sunset, or in the early morning before the heat of the sun induces them to open out or segregate and assume their extremely active habits, spray kerosene on each heap and set fire to them. In this way swarms can be perfectly well vanquished and annihilated. Now, this is only one of the methods that I understand by "burning." But when neglected, then there are other modes which may be used—one is mentioned by Mr. Scott, namely, when the grass is dry and will burn; or, if possible, cut the grass, and when sufficiently dry set

fire to it. This could no doubt get at some. But the best times for burning are during the early days, when they gather into heaps; or, spread dry hay on the ground, and when the hoppers go there for shelter, as they do, set fire to it. Here again Mr. Scott and his practical friends have not tried the process when at its best for the purpose. There is therefore another opportunity open for them!

670. (4) Poisoning with arsenic and treacle.—Now, as far as I understand the process of those who advocate this plan, of which I have no experience, I do not think, from what Mr. Scott says, that he has given it a *fair* trial. To lay about this "poison" in a few tins for the hoppers is scarcely operating in the spirit of those who advocate this method on a large scale, if they desire to attain success. Mr. Scott, however, may have done enough to satisfy himself that this plan did not realise sufficient success to warrant his pursuing it further. His trial appears to me, from the way in which it is stated, to have been meagre and not carried out on a scale sufficiently extensive to ensure success. Then, in addition to all this, "arsenic and treacle" is only one among many poisons. Millborrow has another which he pledges his word is effectual and safe. Therefore, without enlarging meanwhile, I say here again, there is incompleteness in Mr. Scott's mode of action in this as well as the preceding three plans of combat.

671. (5) Killing by whips or scourges.—In some very well-defined and limited circumstances this method may be applicable, but I confess, on the whole, that it is not a means of killing likely to be greatly in demand on a large scale. It may be useful, for example, in the early stage after hatching, when gathered in heaps, and when burning cannot be practised, or when the flying locusts settle for the night. As a rule, there are other methods which I believe will take its place and prove an advantage under most circumstances. Scourges are also useful in getting the swarm into a certain *shape* or *form*, into which it is possible by this means to drive or force them, or keep them together for slaughtering purposes.

672. (6) Making trenches, driving the hoppers into them, and burying them.—This I may at once say is an antiquated, and on the whole a useless method to trust to, except in exceptional cases. It is a plan which is almost as old as the locusts themselves. It is still much used, but I am opposed to this somewhat effete measure, almost as much so as I think Mr. Scott fell short in his carrying out the other plans in the way they should be carried out, to be effective in my opinion. There are two or three observations I should like to make upon it. The trench in itself is comparatively a somewhat costly thing, and involves some time in the making. Mr. Scott says, then, that they must drive the locusts (hoppers) into these trenches. This seems singular. Why not leave the hoppers alone until they march into the

ditch? They certainly will do so, but they will march out of it, unless care be taken to keep them in it by putting tin, projecting a couple of inches over the margin, on each side. When full of the hoppers, the ditch must be filled in again, and a fresh or new one made to receive another cargo. But all this means much labour and money, and Mr. Scott does not give sufficient details, so as to enable one to judge as to his mode of working from an economic point of view. The trench system, as done by the Latin and Egyptian races, I have seen in operation extensively used in South America and also here, and I am decidedly not in favour of trusting to it. It is not a plan that I think can equal many of the others which are more modern and effective. It may in exceptional cases be tried, when other methods are unavailable. In limited places, such as gardens, or along roads and in groves of fruit trees, it might suit.

673. It ought to be borne in mind with regard to Mr. Scott's remark as to the impossibility of *driving* locusts (hoppers) in long grass, that in this, like everything else, there is a right and a wrong way. The insects have not only an instinctive cunning, but they are easily confused and discouraged, and sometimes feign inability to move, and remain motionless so as to escape further torment. Then, again, it is perhaps the case that their drivers drive them on more rapidly than the creatures care or can manage to go. The driving, therefore, requires some management and coaxing. Experienced drivers have found in South America (and what suits there will probably suit elsewhere) that bright-coloured flags, not green, waved a couple of metres or 6 ft. behind them, with a forward movement at regular intervals every few seconds, so that the insects may not be unduly hurried, but coaxed, and thus perceive what is wanted, will cause the entire body to advance as directed. If these precautions are not observed, the insects will make violent efforts to dash about in different directions irregularly, or hide in the grass and refuse to move, or make a stampede in an opposite direction, after the nature of pigs or sheep. The method above described has been found to answer perfectly well in long grass, as well as in short vegetation or bare ground. I wonder how the above method tallies with that actually adopted by Mr. Scott.

674. Mr. Scott's plan selfish and unchristian.—There is one more point in Mr. Scott's letter, and which grieves and surprises me more than all the others. He goes so far as to say that the farmers—the “best farmers,” even—in his neighbourhood share the same views. The plan or advice, it is said, is, “Drive the hoppers past your crops, always heading them downhill; but don't attempt to destroy, it is not worth while. . . . For the flying locusts, scare them away as best you can with noise and smoke.” This is the necessary or natural sequence or climax of all that went before. The principle underlying this is

completely antagonistic to that of co-operation or union. The conduct is selfish in the extreme, and love of self alone is antichristian and wrong. Here it is in essence "Every man for himself." It is the exact opposite of that taught by the Perfect Man. It is a repetition of Cain's saying, "Am I my brother's keeper?"—the same in effect as saying, "I shall try to save my own crop; lead them quietly down the hill; let them go by to my neighbour, and let them take their fill out of his crop, if he cannot take care of his own, for they must be fed somewhere." This is the worldly view of the commercial spirit, but ideally it is not so. Commerce is business conducted by an association for the welfare of the community at large, and therefore cannot be selfish in itself.

675. I have dealt with this aspect of the case in a previous part, and it is too horrible to believe that any intelligent body of men belonging to the greatest industry in this or any other country—far less the Rev. Mr. Scott, for whose profession and work I have the profoundest esteem and respect, for it is second to none—could be partisans of such doctrines. I cannot believe it, and I say there is only one cure for this, namely, that the Government of the country should put forward well-concerted methods to try to protect the weak and to check the plague, and that all the people should facilitate the operations of the same in the most cordial and sympathetic manner.

676. True happiness can only come in vicarious service—that is, in helping others as well as ourselves. We must do what is right to others as well as to ourselves, and we cannot do this or be just to others unless in our hearts we love and sympathise with them. This, in fact, is righteousness itself. Love of self springs from a different motive. A selfish man has no *true* love to himself, and he is altogether on the wrong line.

677. A new and equitable idea.—There should be measures contrived or adopted whereby the sufferer from the locust pest should bear a share only of the loss, just as is done in the case of insurance (life or fire), or when an infectious disease attacks a herd of cattle, and when the herd has to be slaughtered to prevent the disease from spreading farther. So here, suppose an industrious farmer aids and abets the Government—and every good farmer will in such a case as this—it surely is expedient and possible to devise means whereby the loss, for example, when the flight of flying locusts swoop down on his ground in that locality and devour his crop, and then fly away, may be spread over a number, or all, in the locality, and so not press heavily upon one good man. Surely he ought not to be allowed to bear the entire loss of the damage in such a case. Means ought to be devised to prevent such a calamity.

LOCUSTS DYING

678. Report of "Witness" representative.—Meeting the C.L.O. (Mr. J. F. Ingram) yesterday (April 12, 1896), a *Witness* representative gathered that reports were coming in from the coast and elsewhere to the effect that the locusts attacked by the parasite were dying in millions. Fresh armies, however, are entering the colony from Basutoland and Griqualand, but even these had been attacked by parasites.

679. Mr. Heroldt's testimony.—Opinions may be cited as to the fact that swarms can be vanquished and overcome. Thus—

The Hon. Mr. Heroldt, M.L.C., says:—"I have destroyed whole swarms of voetgangers. When a swarm was discovered making its way on to my lands, I ordered the labourers to go to the lands and cut fodder. This fodder was strewed along in front of the advancing swarm. Those in the van immediately settled upon this fodder, and their progress was arrested. Strips of corrugated iron and other impediments were then placed around the swarm, forming a sort of three-sided kraal. Within a few minutes this kraal was filled with a seething mass of jumping creatures, and the work of destruction began. By those means we destroyed entire swarms."

680. Now, it is not here said (and it is a pity it was not stated) what the "means" were; but, whatever they were, the hon. gentleman says the voetgangers were destroyed. That is the best, perhaps (as the proverb says), which lieth nearest or within reach—do it in any way that it can be done, by beating with whips or scourges, by chemicals, etc., according to the expediency or exigency of the case.

Then, again, to quote another who gives similar testimony. The case is noted by the *Argus*.

Mr. J. U. Orpen, M.L.D., says:—

681. Sheep attacking the locusts.—All are now looking to our Government to take the initiative. Let it now do its utmost in this way. Let it publish an appeal to the public. Let it mention now the different modes of operation which have been successful in South Africa. . . . Let civil commissioners be directed to press on such attempts and experiments, and report results periodically for publication. Let Government encourage the neighbouring Governments to do the same, and keep up active consultations with them, and publish the progress of the general campaign in all parts of South Africa. . . . In some parts farmers have with ease exterminated in the early mornings countless millions of swarming young locusts by beating them to death with branches of trees. Elsewhere a heavy cat-of-nine-tails has been used, or skins, or wet sacks; or an implement known as a stamper, like a churn-stick, entered into a heavy piece of wood at the end; or they

have been crushed with a sort of bush harrow, or tramped to death with stock or driven between movable converging walls of tin or oil-cloth, 30 ft. long and a few inches high, into a pit about a yard square and deep, with a strip of tin sloping downwards round the edges. In Barkley East it is recorded that sheep are eating up the hopping locusts as fast as they are hatched out some places.

Natal Witness, MARCH 3, 1896—THE LOCUST CAMPAIGN

682. Meeting at Richmond Road.—"A public meeting under the auspices of the Richmond Road and Camperdown Farmers' Association was held in the Richmond Road Schoolroom on Thursday last, to organise the farmers and consider the best method to kill the locusts. There were present Messrs. T. Stead, Chairman; C. B. Lloyd, Commissioner of Agriculture; Ingram, Chief Locust Officer; W. Comrie, Richmond Locust Officer; J. Moon, M. F. Phipson, J. Brunyate, J. Sinclair, Johnstone, J. Baynes, M.L.A., H. L. Stead, F. Mapstone, S. Phipson, A. Brunyate, W. Crouch, J. Mapstone, Malcolm, W. Keytel, B. Crough, J. Mapstone, W. Sinclair, W. Oldfield, G. Demount, J. Dalgarno, W. Mapstone, S. Curran, W. L. Stead.

683. Selfishness at work again.—"The Chairman opened the meeting by reading the circular from the Government, notifying the farmers that the operations for killing the locusts were to be continued. The Chairman also remarked that there could be no two opinions on the matter, that the farmers had their crops in, and they depended on them for their living, and therefore they must kill the locusts to protect themselves, whether the Government helped or not; and he was of opinion that if the country was cut up into small divisions, and a responsible man put over each one, it would but be a matter of time. As it was at present, some men worked hard at killing locusts, spending time and money, while the next man on the adjoining farm never so much as raised a hand. The consequence was, that the hard-working man no sooner finished killing the locusts on his own farm than it was invaded by the locusts from his neighbours, which was most disheartening, to say the least of it. He thought that the Locust Law ought to be enforced, and every man made to do his share, and, to show what could be done by perseverance, he read a report from the newspapers of the Umzinto doings.

684. The Government Commissioner.—"Mr. Lloyd, Commissioner of Agriculture, said that the Government was willing to give the farmers all the help possible to help them to kill the young locusts, but the Government would not supply individual farmers with screens, etc. He thought that they should, for the present, direct their attention to the protection of their crops, as it was utterly impossible to kill all the

locusts. They would have a far better chance of exterminating them later on, when they could get to burn the grass. He was there to listen to any suggestions which they might have to make on the subject.

685. The Chief Locust Officer's opinion.—"Mr. Ingram, C.L.O., said the law was that the Government looked after and exterminated all the locusts on its own land, as far as possible. He had found that the natives were very willing to work and help ; but he had found it far more difficult to awake the white population to the danger that threatened them, and induce them to bestir themselves. When he had first started, public opinion was so dead against the movement that he could have hardly raised half a dozen to discuss the locusts, even in Maritzburg. He was thankful for any support such as might be given by committees in the country districts, but unless they all tried to work together for their mutual good it would be useless. If they kept on killing and continually harassing the locusts, whenever they got wings they would go away. There were certain country places that had not awakened yet, and made it difficult to organise ; but if, as the Chairman remarked, the country was cut up into small divisions it would facilitate matters.

686. Mr. Baynes' "scourge."—"Mr. Baynes thanked Messrs. Lloyd and Ingram for coming to the meeting, and said it showed that the Government sympathised with them, and were willing to help all they could. But it was very disheartening to know that while they were straining every nerve to fight the locusts that were swarming all over the country, there were just now millions of young locusts hatching in the fields. They might fight them in the veldt, but what could they do with them when they are in the crops? It was thought that the young locusts were very evenly distributed, and some soils were more suitable for locust eggs hatching than others ; but however disheartening the prospects might be, he was ready to help and fight to the end, and should be glad to hear of any method or suggestion. He then gave a description of the scourge which he used.

687. The red-light soil.—"Mr. Phipson said he entirely agreed with Mr. Baynes about the different soils being more suitable for hatching, and had observed that a red-light soil seemed to be the favourite.

688. Locusts don't "lay" in a newly ploughed field.—"Mr. Comrie, Richmond Locust Officer, said that his experience was that the locusts would lay in any soil ; he had come upon them in the main road (where the ground was as hard as a stone, laying in scores), but he had not yet seen them laying in a newly ploughed field. He had found the natives quite willing to work, and was sure that with energy the farmers could succeed in clearing the country. He had no sympathy with men who had large farms stocked with natives and did not come and help in a time of trouble like the present.

689. Personal energy.—"Mr. Dalgarno said that he thought it was not a case where the Government could do much good; all that was needed was personal energy. It was proposed and carried that a committee be formed.

690. Black list.—"Mr. Ingram explained that a committee man could report a man who did not co-operate, and he would be simply doing his duty.

691. Pattern screens.—"Some of the gentlemen wanted to know how the screens were made, and Mr. Lloyd kindly consented to lend the committee a couple as patterns.

692. "The meeting closed with a vote of thanks to the gentlemen from Maritzburg."

"WATCHMAN, WHAT OF THE NIGHT?"

TO THE EDITOR OF THE *Natal Witness*.

693. "J. M.'s" question.—SIR,—I feel constrained to put the above question to you in regard to Clause 6 of Law No. 33, 1895, known as the Locust Act. I have only just seen the law, and as no reference is made to it in the agenda paper of the coming Conference, it is quite possible the majority of farmers are unacquainted with its provisions.

694. A grievance.—According to Clause 6, although a man may be doing his utmost to clear his own lands, he may be called upon, with every other person in his employment, to proceed to any part of the locust area (without compensation), not for a day or two, but until released by the Locust Officer, under a penalty of £20, or three months.

695. Forced labour.—Some few days ago, sir, in one of your able articles, you applauded the beneficent rule of the British in Egypt, and it is known that one of the great curses the subjects of that country had to endure was forced labour. I may be dense, but I cannot see that the principle involved in this clause is one whit better than that which existed twenty-five years ago in that unhappy country, and under which the Egyptians had groaned for centuries.

696. A question.—How is it, Mr. Editor, that you allowed such a principle to go forth unchallenged? Allow me to cite a parallel case to make my argument clear.

697. An analogy.—Suppose that on account of immense traffic on the N.G.R., the line was blocked, all the stations and sheds were filled with goods, and trade brought almost to a standstill, the commercial community, you yourself included, appeal to the Government to do something to save them from serious loss, if not from ruin. They respond readily enough, and pass an Act similar to No. 33, 1895, and Clause No. 6 reads as follows: "Every merchant, importer, or person who uses the N.G.R. for the conveyance of goods, shall, to the extent of his power, by personal service, and by that of all persons in his employment, or by substituted service accepted as sufficient by the General Manager, load, off-load, and clear any part of the line within

the congested area, under a penalty of £20, or three months' imprisonment"!

698. The application.—That, of course, is a horse of another complexion, and in that case it would be considered a very serious invasion of constitutional and individual liberty. But that, sir, is the position of the Natal farmer to-day.

699. Farmers invoking the evil genii.—Hitherto the officials have been shy to enforce the law, but now we are informed it is to be carried out to the utmost. Surely some of those farmers who have been calling loudly for the application of this law hardly comprehend the force and scope of Clause No. 6.

Our watchmen were asleep when that clause was allowed to see the light.—Yours, etc., J. M.

700. A word to the D.L.O.—The D.L.O. should report all farmers to the magistrate, at least those who do not do their best in the matter. He must be more determined, and do his duty without fear, favour, or affection. If the D.L.O. does not do so, the sooner he is superseded the better.

701. Gum-tree poles.—I find that a good way to destroy the locusts is to have two straight gum-tree poles, 12 ft. long and 12 in. in diameter, one fastened behind the other, about 18 in. apart. A chain is fastened at each end of the front pole, and six oxen pull it from the centre. Two Kaffirs can destroy any quantity in a short time. The poles must be dragged along the grass.—Yours, etc.,

GEO. CURRY.

THE APPROACHING FAMINE: FROM TWO POINTS OF VIEW

NO. I.—THE FARMER'S

702. "W. L. S.'s" advocacy for protection.—SIR,—Having noticed in the papers various letters upon the coming famine, and that the newspapers themselves advocate the Government removing the duties on imported grain, and taking steps to supply the poor dear natives with corn at cost price, I should like to give a farmer's side of the question, and lay before you a few facts which, I think, have been overlooked.

703. Majority of farmers have saved their crops.—In the first place, I will admit that we are constantly hearing of the terrible devastation which the locusts are committing. I believe that the Wilgefontein and Richmond districts have had the greater part of their crops destroyed, but you know the Richmond people are stock farmers, and only grow mealies, and send natives to the Gold Fields for amusement. In the principal agricultural districts there are occasional farmers who lost all their crops, but the majority of the farmers in the Cato Ridge, Camperdown, Umlass, New Leeds, Malton, and York districts have managed to save the greater part of their crops; and the remainder looks exceptionally well, and promises a larger yield per acre than we have had for some years.

704. An invitation.—Sir, these are facts which you or anybody

can see for yourselves, if you will take a ride round into the districts which I have mentioned ; and if you should think of doing so, I think I can promise you, on behalf of my fellow-farmers, "a cup o' tea and a bit o' sum't to eat." For the last two or three weeks most of the farmers have been able to do little else than prevent the locusts from going into their crops, which, as you know, means expense, and people want the duty taken off ! Why ? and this just at the very time when the farmer needs helping ! With the present duties on, mealies can be imported and sold in Durban at about 14s. per 200 lbs., and the Natal farmer can hardly expect to get 2s. more than that for the mealies—is that not cheap enough ? It can hardly be called a famine price.

705. Protection necessary.—Have the farmers not enough difficulties to contend against that they are to have what little protection they have taken away ? If the duty is taken off, it is the merchants who will reap the principal benefit, and they have enough interest in the House to prevent it ever being put on again if once removed. How can we expect to compete against the South American farmers, who have large plains of rich soil, which they simply have to plough and sow, and when the season comes round reap a good crop ? Do we not allow the adjoining States to send their produce over our border free of duty, and carry it on the railways to the markets at a cheaper rate than we take our own produce to their border ? Do the Government not encourage and afford our native labour, a reliable supply of which is so necessary to the farmer, every facility to go and work in a foreign State ?

706. Government interference resented.—I maintain that there is sufficient grain in the colony for our home consumption, and that mealies can be imported at a reasonable price, so there is no necessity for Government to interfere.

707. The "poor starving blacks."—As for the natives, if every mealie they had was eaten off, it would be the best that could happen to them, for then they would need to work, and learn that time is money. When I see the number of able-bodied men and big, strong native girls loafing about the countryside—like independent ladies and gentlemen that they are—and know how hard the poorer white population have to struggle to make a living, I feel indignant when I hear people talking about the "poor starving blacks." There is plenty of work both in the town and country ; let them work, as a white man has to.

708. Natives won't work.—Mr. Editor, just try to imagine the farmer's feelings who has a large crop of forage spoiling for the want of labour to reap it, and he goes round to the Kaffir kraals, and offers the natives good wages if they will come and work ; but they simply laugh, and say they don't want to work ; it is too hard work cutting forage. If all the people that are able go and work, the natives will have ample money to supply their kraals with food.—Yours, etc. W. L. S.

NO. 2.—THE CONSUMER'S

709. "N." advocates Free Trade.—SIR,—It seems incredible our Government hesitates to temporarily remove the import duty on mealies and reduce rail carriage to the South African produce rate.

There can now be no doubt as to the almost entire destruction of the mealie crop throughout the colony. Districts where at first the locusts had not put in an appearance are now simply swarming, and others where, with indefatigable energy and perseverance, farmers had guarded the crops for weeks, these poor fellows have been hopelessly beaten by the scourge in their fight, and their fields occupied and mealies destroyed by the enemy; and yet no action is taken by the Government to prepare for the inevitable famine that must accrue. Why, even that stultified Constitution, called a Government, in the Transvaal were more prompt in meeting a similar crisis by the removal of duty. What is the reason, Mr. Editor? Surely not to bolster up a few isolated farmers who have saved, or hope they have saved, a few acres of mealies, for they would suffer no loss; in fact, they will realise more than in ordinary years, for even with duty off and the keen competition of importing merchants, mealies cannot be sold under 11s. per muid.

710. No loss of revenue can follow.—Anyway, they are not to be considered in comparison with the vast majority of people in the colony, both white and coloured, who must suffer. It cannot be anticipated loss of revenue, for it is quite certain no receipts were expected from this source when the year's estimates were made, while the daily increasing income from customs and Overberg traffic cannot fail to leave the Government a handsome surplus.

711. A plea for the native.—The natives, again, have a strong claim for the removal of "duty," if not, other provision should be made for them. It is all very well for people to say, let them come out and work. They will have to do that, but will with difficulty be able to earn enough to keep their women and children from starving, with dear mealies and low wages, with little or no farm work doing. Not only this: there are thousands of kraals with only one adult male, with one or two wives and a lot of children, who cannot be left, but must be fed. These people are entitled to every consideration from Government. In fact, sir, there is no class in the colony who will not be benefited by the removal of duty, which I hope this letter may in some way help to effect.—Yours, etc.,
N.

March 25th, 1896.

"THE MEALIE CROP

"CHATS WITH THE FARMERS.

712. The farmers shaken up.—'Much has been written of late about the prospective mealie yield this season, some prognosticating a famine and others a fairly good crop, but the contemplated removal by the Government of the import duty has brought farmers to their bearings, and they are only too willing now to show their hands rather than allow the consumer to remain any longer in ignorance of real facts.

713. A conversation.—"Meeting a couple of sturdy young farmers (Messrs. W. B. Turner and H. Baker) from Camperdown district on a

Saturday, a representative of this paper drew them into a discussion on the subject, with the following result:—

“‘Never a better crop grown in Camperdown,’ said Mr. Turner. ‘I have about 60 acres, and, roughly speaking, I should reap between 700 and 800 muids.’

714. “‘You haven’t been bothered with the locusts, then?’

“‘Oh, haven’t I just? I’ve fought with the pests tooth and nail—killed every swarm hatched on my farm, and several swarms that visited me from my neighbours, that ought to have been served by them as I served those that came to life on my place.’

715. “‘Did you employ many natives to assist you in the extermination of the pest?’

“‘Only eight, my own staff of boys. The natives living in the neighbourhood refused either to assist me or themselves either. They came to me with a tale about the destruction the locusts were doing amongst their mealies, but never as much as raised a hand to kill them. When all their mealies were eaten, I said to them, “Now come and assist me to kill the locusts in my mealies, and I’ll pay your hut taxes for you.” They refused point blank, and even refused to turn out at a togt wage to help me. Someone had told them that if their crops were eaten up by the locusts the Government would be bound to supply them with food. So now they are quite satisfied, waiting until the time comes when they will be fed for nothing.’

716. “Mr. Baker here interpolated a few remarks bearing out Mr. Turner’s statement as to the disinclination shown by the natives to destroy locusts amongst their own crops, or assist European farmers to save theirs. However, by dint of sticking to it with the labour available, he had managed to beat, burn, and harass the creatures from his fields, with the result that his crop would exceed 1000 muids this year—the heaviest crop he had ever reaped.

717. “‘But is there not still time and opportunity for the “flyers” to injure the standing crop?’

“‘No,’ replied both farmers. Mr. Baker, continuing, said that the locusts were ‘fluffing’ the cobs, but owing to the corn being practically ripe they could do no damage, except to very late mealies. In answer to a question as to the probable yield for the whole of Camperdown district, Mr. Baker estimated it at 30,000 muids. He blamed the Government for the fact that so many locusts were still in existence. They had a Chief Locust Officer who did practically nothing. He knew a landowner in the Camperdown district who owned, he believed, 6000 acres, and who never lifted a finger to destroy a locust, albeit his whole farm swarmed with hoppers, two-thirds of which had ultimately paid him (the speaker) a visit, and had been killed. He calculated that he had killed sufficient locusts in the hopper stage on his place to

have covered the whole of his land—800 acres—with a layer of them an inch thick—and yet he had saved the whole of his mealie crop. He had offered natives residing in the locality a sum amounting to over 50 sovereigns in hut taxes, that he promised to pay for them if they would turn out and assist him to destroy the locusts in his mealies, but they refused to do so.

718. "Mr. W. Smith, of Malton, happening to pass at the time, chimed in, on hearing the last remark, with, 'The lazy brutes! I saved as many mealies with seven or eight hands, under my personal supervision and assistance, as ninety-two of them did living on lands adjacent to my place.'

719. "After ascertaining from Mr. Smith that the mealie crop in the Malton district was an exceptionally good one this year, and from Mr. Baker that a very large quantity of forage had been planted and was looking well in the Camperdown districts—though the farmers could hardly hope in the face of the swarms of locusts hovering about the locality to reap it—our representative thanked them for their information, and left."

TO THE EDITOR OF THE *Natal Witness*.

720. SIR,—In your issue of April 29th I notice a letter headed "The Mealie Crop," from which I beg to differ. Being a farmer in the Howick district, I can say that the mealie crop, on the whole, is a very good one; of course, in some instances, the locusts have done little damage.

721. Mr. Ross sends three mealie cobs eaten by locusts as a sample, from a field of 60 acres. Could he find fifty cobs eaten in the same manner from the said field? From my experience I find the mealies are too hard for the locusts now.

722. Anyone reading Mr. Ross's letter would infer he agreed with the free importation of mealies (as I notice he quotes Mr. Stead's letter), which would mean ruination to the mealie-farming community generally.
—Yours, etc.,

HOWICK FARMER.

723. **A new subject for the newspapers.**—The following appeared in the *Transvaal Independent* of 17th July 1896. The newspapers of Johannesburg do not as a rule trouble themselves with such "disinteresting" subjects as the locusts. Probably their readers are more interested in gold and the share-market, which the locusts cannot directly affect. Assuredly they can indirectly. Those in charge of the newspapers are, however, chiefly responsible for the supply of mental food to their readers.

724. **Ruskin's gospel reiterated.**—The gospel according to the great Ruskin is that "Food can only be got out of the earth, and happiness out of honesty." It might not be amiss were the newspapers of the day to direct the attention of their readers to the two parts of

this gospel, the first as well as the last. If report speaks truly, it is doubtful if their preaching has had much effect in improving the grumbling propensity on the Exchange. Let them return to first principles and see what the effect will be. I am glad to insert the following as an example. The subject demands greater notice.

725. The eighth plague.—"Of all the ten plagues that Pharaoh of old endured, none of them appeals so forcibly to the feelings of the farming community in South Africa as that of the eighth, the plague of locusts. We have periodical visitations, such as hail, drought, and latterly 'rinderpest,' but the name of locusts brings dismay into the hearts of the toiling, struggling farmer, and fills him with a despair so deep that it forces from him the self-same word wrung from that monarch of old, 'Entreat the Lord God that He may take away from us this dearth.'

726. The locust's pedigree.—"The locust proper belongs to the Orthoptera family, though different nations apply the name of locust to any insect of the grasshopper species. In some of the English counties, the cockchafer even bears the name of locust; still, the locust proper is a distinct species.

727. The "Locustidæ."—"The *Locustidæ*, to which the English grasshopper belongs, may be easily distinguished by the long thread-like antennæ; it also has a four-jointed 'tarsi,' whilst the *Acrydidæ*, to which our South African species belong, has a short stout antennæ, and only a three-jointed 'tarsi.' Whilst in the Rocky Mountains I saw swarms of an insignificant little insect, which, although the same species, they looked like pigmies alongside its often 3-inch African cousin.

728. The "Acrydidæ."—"The chief species we have to contend against here is that belonging to the family of the *Acrydidæ*. The nurseries of the locusts are generally the barren plains found on elevated plateaux, with a loose sandy soil covering a rocky foundation, and in such a position as to catch the warm rays of the sun, and so form a natural incubator for the purpose of hatching the eggs.

729. Laying eggs.—"The operation of laying the eggs is a most interesting one to watch. The female excavates a hole in the earth by digging with its front legs and burrowing her head in the sand; then the eggs are deposited, and regularly arranged in a cylindrical form, which are then covered with a kind of glutinous secretion, which in time hardens, and forms a kind of case; each of these cases or cocoons contains from twenty to twenty-five eggs, and as each female makes from two to three of these cocoons, some idea of the number of eggs in a breeding ground can be imagined.

730. Born with teeth and claws.—"The young are never in a quiescent state, so that their destructive powers are in continual

activity from the moment they are hatched until they die. When hatched they are not much larger than a white ant, and rapidly increase in size, and, though still unprovided with wings, their powers of locomotion are very great, and by means of their long black legs they cover a large surface of ground in a day. When they approach the perfect stage wings appear, and consequently their sphere of destruction is considerably increased.

731. Their "ways" not yet known.—"The laws regulating the migratory instinct of the locust are not yet properly understood, though various suggestions have been put forward. No doubt food is the chief factor, for in dry sandy soil, such as the breeding grounds consist of, no vegetation will grow, and so the hordes are compelled to wander farther afield in search of food.

732. Distance they can travel.—"The direction of flight depends a great deal on the aspect and formation of the ground, and there is no doubt but that each swarm has its own area of constant migration. The distance travelled depends on a variety of circumstances, the quantity of food met with, and especially the impulse of the prevalent wind. One thousand miles is by no means an uncommon distance for a swarm to travel. Specimens of the South African locust were caught in England in 1869, and these must have travelled right across the South Atlantic Ocean. The same species was met with by a ship 1200 miles from any land in the Atlantic; so large was the swarm that for three hours the sun was obscured, and the deck, sails, and rigging a living mass of these ubiquitous insects.

733. Their voracity.—"The voracity of the locust is phenomenal. Miles and miles of country, bright with all the varied foliage of flowers, cereals, and fruits, are in a few hours turned into black bare spaces. Not a blade of grass or vestige of any vegetable is to be seen. So great is their voracity that, in the absence of green meat, they have been known to attack dry animal matter, and even turn cannibal where they fail to find any food. Not only are the farmers affected, but the poor transport rider is often in despair. Mile after mile nothing but endless wastes, no food for his cattle, which daily become weaker and weaker, and sometimes even die before the area of this desolation is passed through.

734. The locusts' foes.—"Luckily locusts have enemies, like all other things, who help in some way to keep down their numbers. I've seen a flock followed by flocks of kites, hawks, and locust-birds, who for the time live entirely on them. Insect parasites, too, wage a deadly warfare against them, some attacking the fully developed, but the larger number preying on the eggs. A certain beetle of the *Cantharidæ* family is responsible for great destruction of the ova, and especially a small two-winged fly.

735. The locusts an Australian delicacy.—"To man, too, in certain parts, the locust is not an unmixed evil, for in some parts of South Africa some tribes look eagerly for the locust season, and consider them a delicacy, and make a kind of bread with them. In Australia, too, the aborigines make a cake of pounded locust, first stripping off the wings and legs, which they call 'bugoog,' and I have eaten it with great relish, and it is by no means to be despised.

736. Cypriote method best.—"Various and ingenious methods have been used to keep down and destroy the pest, but the Cyprus expedient seems to be the most successfully used in Australia, and I see no reason that it should not be equally efficacious here.

737. "The flight of the swarm is carefully watched beforehand, the point from where the prevailing wind is blowing being one of the main features carefully studied. As soon as the eggs are hatched, the living mass of locusts, sometimes so deep as to reach above the knees, are surrounded by canvas screens, kept upright by means of ropes and stakes driven into the ground. These screens are generally 3 ft. high, and in lengths from 30 to 40 yds., and so made as to be readily attached to each other. On the top of the screen is a strip of oil-cloth fastened at such an angle as to prevent the locust from creeping out when once in. Long trenches are dug parallel with the screens, from 6 to 7 ft. long, 2 ft. wide at the top end, and 4 ft. deep, the width at the bottom being greater than at the top, and so making it more difficult for the locust to escape. On the top of the trench a ledge of tin is placed, so fixed as to hang over the edge some 6 in., thereby making escape still more difficult. A swarm travelling will hit the screen and fall into the trench beneath; and, as always the same line is followed by the whole swarm, the trenches soon fill, and the pests are easily destroyed, either by burning, or covering them up with earth. Should the one line of screens be insufficient to cope with the swarm, others are erected behind in the same way.

738. Locusts bring rinderpest an unproved and hypothetical theory.—"But what, to my mind, is of greatest interest, and of the highest importance at the present time, is the fact that, from observations I have made, and the opinions of others who have taken a very great interest in this matter, I am perfectly convinced that the locusts are mainly responsible for the spread of 'rinderpest.' I have noticed that in most cases of an outbreak of this terrible disease in a district it has nearly always been heralded by a visitation of locusts."

BOOK III (*continued*)

SECTION II

ARTIFICIAL AND MECHANICAL INVENTIONS
FOR CHECKING THE PLAGUE

SUB-SECTION II

MECHANICAL AND ARTIFICIAL REMEDIES

“In every rank or great or small,
’Tis industry supports us all.”

BOOK III (*continued*)

SECTION II

ARTIFICIAL AND MECHANICAL INVENTIONS FOR CHECKING THE PLAGUE

SUB-SECTION II

MECHANICAL AND ARTIFICIAL REMEDIES

739. The locust on the increase in Argentina.—No doubt if the permanent home or wintering quarters of the locusts were known, it would be best, for conquering the pest, to make a campaign on them there, as they are then more congregated together, in consequence of the cold and other reasons. It would or should probably be the duty of the various countries in which the plague exists to offer some reward to anyone likely to discover their more permanent habitats, if not directly to undertake a search on the part of the Government itself. It is remarkable, from reports in the press, etc., that have reached me, to note the headway the insects have made in the Argentine. The present visitation appeared slightly first in the end of 1889, but certainly they cleared away for six months in each of the following successive years, with the approaching cold of winter, out of each of the fourteen provinces of the Republic, and so far as is known out of the national territory of the Gran Chaco also, to reappear with the approaching heat of summer.

740. Now an annual visitor.—Many of the best informed and educated Argentines had a theory that the locusts only came or visited the country for three successive years, when, in the natural course, they ceased to trouble for a number of years — till the next visitation; a theory which is utterly wrong, inasmuch as they have visited increasingly the country for the last nine years, and, as already indicated, have so augmented in these later years as to call for special effort and attention to combat them. It will be seen that whereas five years ago they fled from the Argentine in the winter, now recent reports demonstrate that they took up their habitat for the last two or more winters in several of its provinces, particularly Santiago del

Estero, Cordoba, Santa Fé, and partly also in Catamarca, Tucuman and Entre Rios.

741. Beard the locust in his winter quarters.—Unless, therefore, effective means to check the plague are adopted, it would appear to be moving on somewhat parallel lines, or similar to what happened centuries ago in Cyprus, where the pest took up its permanent habitation instead of its former temporary visitations. It would be well to make at least one or if necessary more expeditions to discover where their hibernating quarters exist, and ascertain their habits, and if possible give them battle there. This would be most effective.

742. The press now taking matters seriously.—Some of the newspapers are alive to the urgent necessity of directing public attention as forcibly as possible to all matters pertaining to the pest, while a large section of the press seemed, and still seem, more or less callous in this matter. During the early years of the present visitation the Buenos Ayres *Herald* readily opened its columns and did valiant and excellent service in the cause, and so may the *Natal Witness* in South Africa be mentioned in a similar way. "Better late than never," is an old and trite saying, and so we find is the experience of the Buenos Ayres *Standard*, which in 1891, in its editorial items, said: "We are very much obliged for a tremendously long article about locusts sent to us yesterday, but have no space for it. Our editorial instinct tells us that nineteen-twentieths of our readers do not care a straw about locusts, and much prefer Lomas Harriers, gold or paper salaried clerks, tramway badgering, railway backsliding, and other lively persons and things to the goings-on of such insects." In 1897 and 1898 we find its principal editor is obliged to come out from amongst the "nineteen-twentieths"—his "instinct" as to what his readers and the country require has quite changed in eight years—and taken another turn! He sees it now pays to join the merchant princes of that great and fine town, who have been now compelled to form themselves into a "Locust Investigation Commission," for the purpose of trying to save themselves and the country from disaster and ruin in consequence of the devastation of the plague. He forms one of the committee, and a very useful and active one. The *Standard*, *La Nacion* (the *Times* of Buenos Ayres), *El Diario*, *La Prensa*, as well as the *Herald*, and all others, have now minute details daily regarding the locusts and what is being done respecting the pest. Columns—actually columns—are not grudged in the cause.

743. The "Standard" on the pest.—To show the immense interest now taken in the insect I here subjoin extracts from some of the numbers of the *Standard*, taken pretty much at random, but all more or less useful and suggestive in our present object of instruction as to ways and means, etc. The locust pest is talked of in the Exchange, and the share-market is affected by it.

"ON 'CHANGE

"Thursday, December 31st, 1896

"Gold Premium,

"First Ring, 183: 50.

"The month and year closed to-day on a very quiet, dull market. The liquidation apparently passes off very quietly, as no failures were spoken of at the first hour, nor does it seem at all likely that there will be any now, in view of the narrow speculative margins that have ruled during the month. There is, in fact, only one ugly feature in the outlook, and that is the failure of the harvests in Santa Fé and Entre Rios, but though undoubtedly this is a grim reality, it may not prove so sweeping a collapse as is anticipated. However, things are bad, very bad, in the agricultural districts, and Congress will have to rack its brains and resources to tide over the bad times. It is satisfactory to note that fresh emissions are not spoken of in this regard. The country seems to have realised at long and last that such a remedy would be a fell one, infinitely worse than the disease, and whatever shape the relief may take it will not be an emission."

744. "Stay or fly."—"The locusts all over the district are beginning to fly, so it will soon be seen whether they are going to fly away or remain with us throughout the winter. The hoppers are doing more and more damage to crops week by week, efforts to keep them out proving quite unavailing. The wet days we have been having are making them go in thick swarms at night. In one of my fields I have found a good many dead and dying ones, and a good many look black and queer, but there are not enough dead to make any difference to the size of the swarm. Whether it is the fungus or whether it is the cold weather just at moulting-time I cannot say. I have not heard or seen a description of the fungus."

745. The storm helps the enemy.—"Poor Entre Rios! The storm on Tuesday night destroyed the remnant of the crops left by the hail and the locusts, so the farmers of the Argentine Mesopotamia are now in as bad a plight as their fellows in Santa Fé, and will, no doubt, soon be knocking also at the doors of Congress with their hats in their right hands, held crown downwards.

746. The crops devoured.—"Great havoc as the locusts have caused in Santa Fé and Entre Rios, their ravages in the Banda Oriental¹ are far worse. The hoppers are eating everything all over the Republic. Nothing could be done to check them, as Borda's press-gangs snapped

¹ Republic of Uruguay.

up the peons just at the moment when they would have been better employed in fighting the locust than in fighting Saravia. The result is that the wheat, maize, vines, and vegetable crops have been destroyed to an average of from 20 to 50 per cent., rather a severe blow for Banda Oriental farmers, who expect quite the reverse of a happy New Year."

747. The water turned off.—"Our Montevidean friends are in a bit of a fright. The river Santa Lucia is choked with dead locusts, at the very point from which the pipe water is taken. The reservoirs only hold a provision of water for eight days."

748. A "frozen fact."—"The locusts seem to be awfully bad on the other side of the river, as they say that Colonia is like Birnam Wood, a moving mass. The locusts have eaten up everything, even to the 'paja' on the ranches, and so bad is it that the people are afraid to put out their clothes to dry. At Captain Manton's place a gentleman put his collar out in the sun to stiffen, and lost it—clean eaten up. This would seem like exaggeration, but that is what Cousin Jonathan styles a *frozen fact*. And to think after this that wheat or linseed or maize can be too far advanced for the locust's molars! It is absurd.

749. A conjuring feat.—"We understand that President Uriburu has promised the Santa Fé Distress Commission to lay their petition before Congress, in a message setting forth the urgency of the need, the ardent desire of the Executive that Congress should take prompt and decisive measures to conjure the crisis that is menacing the agricultural interest. This may be very commendable on the part of the President, but as yet how the 'conjuring' is to be done is not explained, and perhaps Congress, who is a good hand at conjuring, will be asked to evolve the means; it is to be hoped that this will not centre round an emission."

750. A voice from Pampa.—A general subscriber in the Pampa Central lets his pen go thus: "It is quite astonishing the way you ignore the Pampa Central, rarely referring to it, although we have better wool this year than most provinces in the Republic, considerably over the average number of murders, robberies (under arms), and general abuse of power. The civil Government being a military one—that sounds good—we are not yet supposed to be competent to elect a Jefe de Paz, etc., which in part accounts for the peculiar kind of government enjoyed by the inhabitants of national territories. You will be surprised to hear that no commission has been named to tackle the locusts, which are present in large numbers, and yet Mr. Parish accuses the Argentines of not being an economical race."

Referring in its own pleasant bantering fashion to the "Firm"—Weather, Locusts, and Eventualities—the *Standard* says, respecting the second member of the firm:—

751. Not much damage apprehended.—"As to the locusts, the news that arrives daily is very satisfactory, showing that the extermination work is being carried on very energetically in the districts invaded by the plague. The enormous amount of the winged *Acridium* already destroyed, and what undoubtedly will be in their embryo and saltona period with better results, leads us to the well-founded hope that the harm we may expect from the insect this year to our crops generally will not be much; for, if reports are true, what may be lost in quantity will be counterbalanced and gained by the quality of the grain, which promises to be exceptionally good this year."

OPINION OF THE CHIEF OF THE ARGENTINE AGRICULTURAL DEPARTMENT ON THE HOME AND BREEDING SCOPE OF THE LOCUST

THE LOCUST

752. The locusts come from the Chaco.—"Mr. Richard Huergo, the energetic Chief of the National Agricultural Department, has, after a series of observations and studies on the habits, etc., of the obnoxious locust, come to the conclusion that the locusts come into the central and southern parts of the Republic from a fixed point located in the Chaco. The direction from which the locusts come is, according to Mr. Huergo, north and north-west, and they fly south and south-east in the provinces of Santa Fé and Entre Rios, while in the central provinces the insects fly from north to south. This shows that the locusts come from some spot in the Chaco.¹ It has been proved that the locusts

¹ Mr. Huergo being Chief of a National Department, presumably knew what he was writing about, yet such is the want of reliable knowledge on the matter pertaining to this subject, that in the recent Report we find Professor Bruner (p. 24) stating as follows: "The region frequented by this insect during winter seems to be that bordering on the Rio Salado, in south-eastern Santiago del Estero, north-eastern Cordova, and northern Santa Fé, and not the Chaco, as we might be led to believe from many published statements to that effect. According to the reports of correspondents and personal observations, there are also a few other localities where the insect has been known to winter in small numbers. These seem to be confined to the provinces of Catamarca, Tucuman, and Entre Rios. All of these latter points, however, as well as the former, lie between the latitudes of 28° and 32° south, while the principal district seems to be along the 30th degree parallel, and at a comparatively low altitude." There is therefore considerable difference between the views of Mr. Bruner and Mr. Huergo. In any case it would be highly satisfactory and commendable if Mr. Huergo could succeed in despatching three commissions, for there would not only be a chance of settling the point in dispute, but also of elucidating several other obscure matters in the life and history of the insect.

that invaded Uruguay came from Entre Rios, and in returning passed through Entre Rios and Santa Fé, always flying in a north-west direction. Meanwhile the locusts bred in the provinces of Buenos Ayres and Córdoba go north through Rioja, Catamarca, and Santiago del Estero. Mr. Huergo finally sums up his observations as follows: The general directions taken by locusts in their flight to the interior of the Republic and their return to the northern parts of the country are N.N.W. to S.S.E., and from S.S.E. to N.N.E. to N.N.W. respectively.

753. Their breeding ground.—"The invasion of the locusts in 1854 to 1876-1877-1888 confirms the existence of a permanent breeding ground in the Republic, and this ground lies towards the N.W. of the country, near the valleys at the foot of the Andes.

754. Influence of climate.—"There is not the slightest doubt that the climate exercises its changes over the female locusts, and therefore a prolonged summer or early winter enables the plague to breed twice in the first case, and disappear sooner in the second. The first case occurred during the summer which is dying out, as the heat began to be felt before its time, and the locusts therefore laid their eggs very early. The prolonged summer enabled the female locusts to breed again.

755. The Chaco also their breeding ground.—"That a subpermanent breeding ground exists there is not the slightest doubt, as Mr. Huergo says, and this ground must be in the Chaco. In order to prove this, Mr. Huergo cites a case of locusts appearing in the "Cielo" camps, on the frontier of Santiago del Estero, during the months of June and July.

756. A travelling commission recommended.—"Mr. Huergo winds up his report on this important question by dwelling on the advisability of three commissions exploring the regions where the locusts are supposed to have their permanent and subpermanent breeding grounds."

757. The Cordilleras swarm with locusts.—A proof that locusts can thrive in temperate parts is furnished by the following account, which appeared in the Buenos Ayres *Standard* of 1st March 1897. Nearly 5000 ft. in height, in immediate proximity to Aconcagua, the highest peak of the Andes range is not by any means warm. "Mr. Wilhelm Behr was welcomed on his return from Mendoza and Puente del Inca, where he visited the Fitzgerald encampment of Aconcagua climbers. Zurbriggen was the only one of the party who got to the top; from the last encampment it took him twelve hours to reach the summit; he came down in an hour. The top of Aconcagua is flat, and you might build a house on the spot were it not for the eternal hurricane ever blowing. Fitzgerald could not ascend owing to

the 'puna.' Mr. Behr informs us that he found the Cordilleras, at a height of 1500 metres, swarming with locusts in the vicinity of Blanco Encalada. At Puente del Inca all dress in picturesque Swiss and Tyrolese costume since the advent of the Alpine climbers. Aconcagua is the topic of conversation—it is, according to Zurbriggen, exactly 24,500 ft. high. The vineyards of Mendoza cover 15,000 hectareas, and promise a splendid crop, in spite of losses in Maypu and Lujan through hail and locusts."

FROM THE *Standard*

1st March 1897

758. I copy in full an account of the following machine, which I shall have to notice fully later on.

The Carcaraña Machine—(Destruction of Locusts)

"This important problem must be discussed in two separate chapters, as the methods for destroying the plague are totally different from one another.

759. Two methods—"First, to use elements at hand to cut short the damage these insects cause; and, secondly, to profit by the experience taught by other countries which have had similar plagues to combat.

760. Eggs to be destroyed.—"The swarms of flying locusts on settling down on a certain spot immediately seek a clean patch of land on which to lay their eggs. Now, the first really practicable way in which to combat the plague is, therefore, the destruction of their eggs, as little can be done against the full-grown flying locusts.

761. No time to be lost.—"The destruction of the eggs should commence at once. This can be done by digging up the soil to the depth of three inches, and exposing the eggs to the sun and air. An important fact must be borne in mind: that although the eggs be ploughed, if they be again covered with earth, they will germinate in almost their entirety. Each pod or germ contains from sixty to seventy eggs.

762. The "net" and "box."—"The young locusts come out of the eggs between forty and forty-five days after these are laid, and it is an easy matter to destroy them while in this state by crushing them, or sprinkling a solution of kerosene and water on them; soap and water will also kill the insects. The young insects, similar in appearance to mosquitoes, creep up the long grass or weeds during the afternoon, and there they remain until the next day, when the rays of the sun begin to scorch them, then they retire until the afternoon. The locusts at this stage can be destroyed by means of a net attached to a stick as a

handle (Fig. 42, p. 329). A gentle movement easily knocks them into the net. They can be then destroyed by being buried or crushed. As days go by the young locusts gradually develop and become harmful, but they can be killed by means of a simple apparatus, consisting of an open box 4 metres long. This box is dragged along by horses (Fig. 39, p. 322). When the box is full, the contents can be emptied into ditches, and the operation renewed again. These ditches should be 5 metres long and 2 wide. The insects can be prevented from leaving the ditch by the placing of four pieces of wood slightly inclined towards the opening of the ditch and covered with zinc.

763. Lime as a destroyer.—"It will be noticed that the volume of the locusts filling a ditch decreases after a certain period. Only the live insects are on the very top, and these can be destroyed by earth being strewn on them. Lime is a better destructive still.

764. Cost.—"The total cost of this useful apparatus is \$22. The best boxes are those made of iron sheeting, 1 m. 80 cm. wide, and 4 m. long. The cost of a box like this, made by a blacksmith, is between \$14 and \$15. The apparatus made of strong tarpaulin is rather expensive, as the tarpaulin requires to be changed every eight days, and costs more.

765. Success of Carcaraña.—"Those who have had occasion to handle the Carcaraña (Fig. 35) machine in camp under alfalfa, noticed that locusts constantly pursued become stupid and finally come to a standstill. The importance of carrying out the destruction of the locusts thoroughly may be gauged from the fact that six square leagues of camp in the province of Santa Fé were thoroughly cleared of the insects, and this after the flying locusts had laid eggs four times in succeeding epochs! Thirty per cent. of the crops were lost in this district, and the whole lot would have been destroyed had it not been for the hard work and perseverance of those engaged in the task of destroying the plague.

766. Two hundred tons destroyed.—"The crops on another camp, measuring three-quarters of a league, were totally saved by only twelve men engaged with five Carcaraña machines. These twelve peons buried no less than 200 tons of locusts. H. B. COFFIN."

THE LOCUST INVESTIGATION: A COMPLAINT

767. Mr. Arribalzaga's letter.—"In a lengthy letter to the *Semana Rural*, addressed to Mr. J. F. Roberts, Chairman of the Merchants' Locust Investigation Committee, Mr. Enrique Lynch Arribalzaga advises the committee to undo all that it has done, give up the idea of searching for the habitat or breeding zone of the locusts, desist from enjoying the services of a foreign specialist to study the question, appoint some local

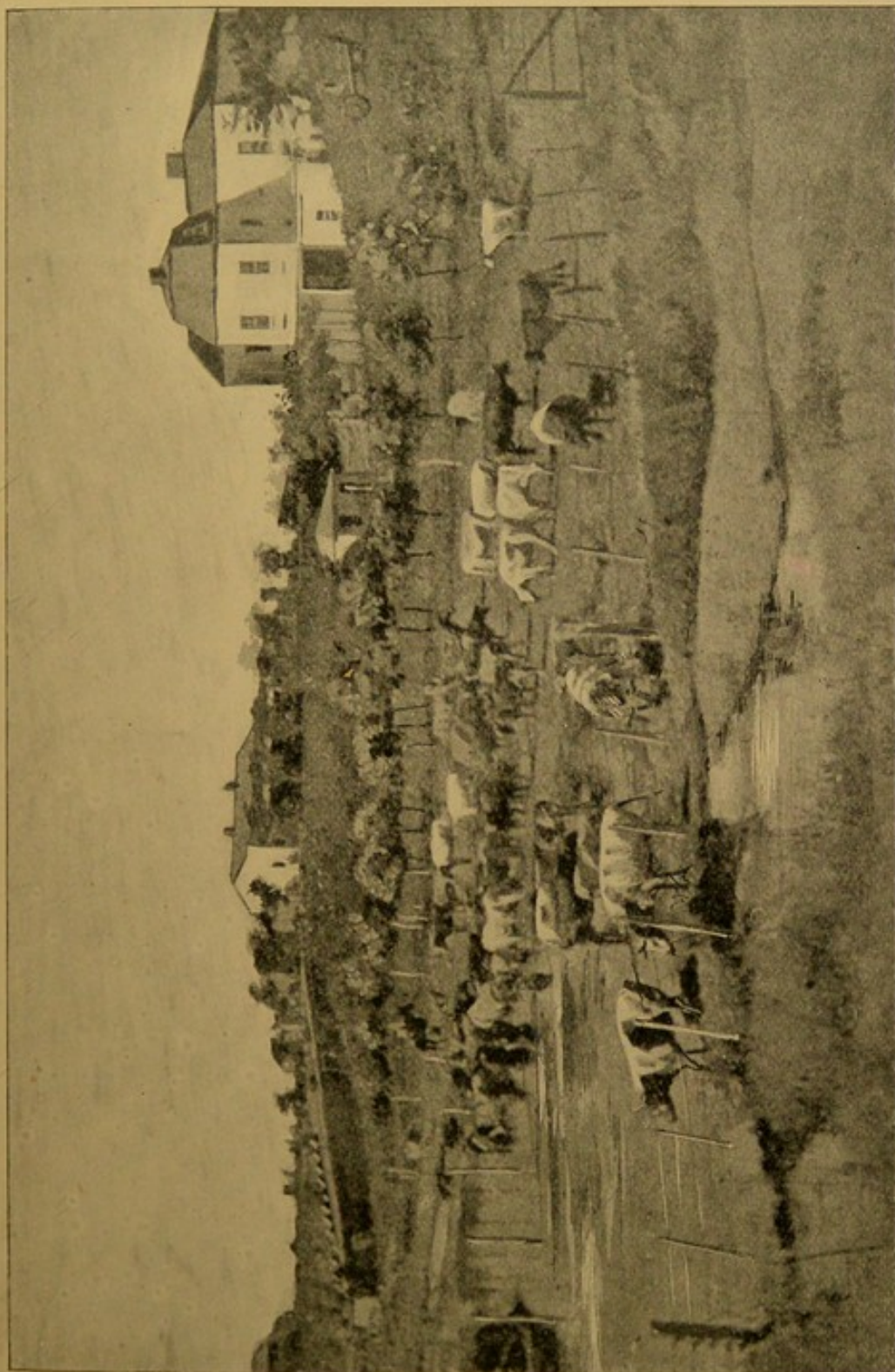


FIG. 29.—A view of Carcaraña, province of Santa Fé, Argentine Republic,—a centre of industry, having a "creamery" (dairy), flour mills, stock-raising, great tracts under cultivation of wheat, maize, alfalfa (lucerne), etc.,—directly very useful in this locust inquiry.



naturalist for the task, enlist the material and moral support of Government and individuals, buy zinc and canvas for active operations, and, last and not least, organise a special department *under some experienced and well-paid official* to superintend the study and destruction of locusts. Mr. Lynch Arribalzaga, like many others, is evidently ignorant of the antecedents that led to the formation of the Merchants' Locust Investigation Committee. Mr. J. F. Roberts, Chairman of the Merchants' Committee, has answered Mr. Lynch Arribalzaga in the following terms :—

30th March 1897.

ENRIQUE LYNCH ARRIBALZAGA, Esq.,
Valparaiso.

768. Mr. Roberts' reply.—DEAR SIR,—I have received and read your interesting letter, dated 28th February ult., referring to the important question, Extermination of the Locust, and which appeared in the 97th number of the *Semana Rural*, published here. In answering your letter, I may state that the committee appointed by Buenos Ayres merchants, banks, and railway companies, for the purpose of discussing this vital matter, and over which I have the honour to preside, adopted the following resolutions in their general meeting of 28th ult. :—

(1) Consult the Governments of the different countries which have suffered losses through the invasions of locusts, and open a series of correspondence with scientific societies and persons who have made the method of exterminating the locusts a special study.

(2) Take the necessary steps to obtain the services of one or more well-known authorities on the matter, in order that they may devote special attention to the invasion of the Argentine Republic by locusts, and propose the best means of getting rid of the plague.

(3) Raise funds, through subscriptions or other means, in order to attain the object in view.

769. Evidence being gleaned in America.—The United States solved the difficult problem of getting rid of locusts, and this has led the committee to communicate with North American experts, through the medium of the United States Minister here, in order to obtain the services of an entomologist who will take the matter in hand. The committee hope to receive a favourable reply in a short time. A sub-commission, composed of gentlemen who devoted some time to the study of the question, has also been appointed. This commission is at present engaged in receiving data referring to locusts from all parts of the Republic, and the information received will be given to the entomologist, who is shortly expected. Once this gentleman has perused the documents, the committee will send a report of the work done to the National Government, and at the same time advise the best means of getting rid of the plague.—I beg to remain, yours truly,

J. F. ROBERTS, *President*.

770. Local talent has failed.—"Our colleague, *El Tiempo*, vents its ire on the Locust Investigation Committee for engaging the services

of an American entomologist to study the locust invasions in Argentina: this appointment, it adds, is a slight to the nation, and to the naturalists who live in our midst, and are quite equal to the task. We join issue with our colleague. First and foremost, the Merchants' Committee has to obey the instruction of the body of merchants who named that committee, so there is no use attacking the committee. Secondly, if there is local talent able to combat the evil, ten years have elapsed with locust invasions and losses to our crops, but no practical evidence of that local talent coping with the evil has been forthcoming. Our colleague says that Dr. Berg should not have been overlooked. We might add that Dr. Berg is Director of the National Museum, and that it is none of his business. Furthermore, the committee have always consulted Dr. Berg and other naturalists in our midst.

771. A foreign specialist imperatively wanted.—"It was not the wish or the intention of the Buenos Ayres merchants to hurt the feelings our colleague refers to; the wish to engage the services of a foreign specialist, when the resolutions and instructions were framed for the guidance of the Locust Committee, sprang from the solemn fact that in a rotation of years, with periodical locust invasions and colossal losses, no scientist, nobody in the country, had done anything practical to check an enemy that threatens to kill our agricultural industry, and plunge thousands of people into misery. The merchants were guided by the earnest desire to do something practical on their own account, and they are still of opinion that nothing could be more practical than to engage the services of some specialist, who combined with the science of the entomologist the valuable experience of locust destruction acquired by years of practical training in the United States. . . . This sounds practical enough to business men, and we think that the public at large will approve the experiment. No matter what the results, the merchants of Buenos Ayres deserve national thanks for trying this practical experiment."

772. Omissions from committee.—Not having seen the reputed "lengthy" letter of Mr. Arribalzaga in the *Semana Rural*, one is unable to hazard an opinion on its merits, but from the condensed report of it given above, and the opinion of *El Tiempo*, one is inclined, after examining the list of members in the Report who formed the Investigation Committee, to wonder how such prominent names in the Zoological Department of the country as Dr. Berg, Mr. Pennington, and others, have not been included and associated with Mr. Bruner in his work. One cannot admire the spirit evinced at the beginning of Mr. Arribalzaga's letter. If his advice were followed it would be a retrograde movement altogether.

773. Argentine entomologists should have been associated

with American specialist.—The arguments underlying the notice immediately preceding do not appear to me sound. "Local talent" might be spurned if volunteered, and at all events it should be solicited. If a thing is worth having, it is worth asking for. Proof of this will readily occur to the reader. The argument proceeds on the assumption that because the "local talent" had not come out and saved the country, therefore it did not exist, and if it existed the blame for having the plague or the necessity to cope with it now lies at the doors of those possessing the local talent. This contention is absurd. Mr. Bruner may have been the right man, but to say that Dr. Berg was not chosen because he was the Director of the National Museum, does not prove that Mr. Bruner should be chosen over him because he (Mr. Bruner) was professor of a university in Nebraska, North America, and far removed from the Argentine. Undoubtedly the Argentine entomologists should have been associated officially with the movement, and *El Tiempo* has some right in demurring as it has done. At least, so it would appear to an outsider, and one removed from the irritation and strife which springs from close personal and local contact.

LOCUSTS IN SEPTEMBER

774. State of matters during September and October.—“After careful perusal of our files in September, we come to the conclusion that the locusts made only slight progress during the month, although there can be no doubt that considerable damage was done to the crops by the voracious invaders in several colonies. In some localities they began to deposit eggs on a small scale, and showed signs of doing so shortly in other parts. The letter from our Gran Chaco correspondent which we published yesterday shows, however, that in some quarters of that territory the swarms are larger than last year, which looks threatening for the Santa Fé colonies in this month of October.

775. Swarms of locusts in Paraguay and Argentine Republic.—“From all the telegrams of the Postmaster-General and the information collected by the Central Locust Extinction Committee, we gather in general that the locusts swarm in the south of Paraguay and in the Argentine Republic, principally in the provinces of Santa Fé, Córdoba, and Entre Rios. Thus in a region of 2° latitude in width, and an equal extent in length, the locusts appear to have settled down to work in swarms of various magnitudes. Some of these swarms, we see, are reported ‘inactive,’ as containing none or but few eggs, or as blessed with very small appetites, or as dying in large quantities. This is only relatively satisfactory, as in other parts they have done considerable injury, and according

to last accounts are now threatening to advance farther south in large numbers.

776. Egg-laying deficient.—"During September some mangas crossed the Paraná; some dropped into the river and succumbed to fish, birds, etc. In Paraguay there were small swarms in the south, and they had begun laying eggs. On the whole, the egg-laying was pronounced deficient, and according to some reports the locusts laid from 6 to 30 eggs; few anything near the average, from 70 to 100.

777. Co-operation.—"The work of destruction by the Central Locust Extinction Committee continued with vigour in the principal districts of Santa Fé, and this campaign against the flyers can be still carried on for a few days longer this month. In some parts enormous quantities of locusts were destroyed by the local sub-committees, thus helping the work of destruction so industriously carried on by the innumerable birds of the field.

778. Where the locusts camped in September.—"At the end of September we find that the locusts were located as follows: one swarm in the vicinity of the Paraguayan capital, another in South Corrientes and north of Entre Rios, another in the zone of Santa Fé, Mar Chiquita, Villa Maria, and Tortugas. At the end of September a swarm passed over Cruz del Eje. Small swarms were reported south of the main bodies, having advanced south of the Central Argentine and pushed southward towards the province of Buenos Ayres; some were marching on Villa Mercedes. This was more or less the state of the locust situation in September. With the advent of the warm weather we may expect them soon on their journey toward this province. Meantime, the Central Committee is not idle, and lots of money is going forward to check their advance."

EDITOR'S TABLE

779. Caught napping again.—"The clerk of the weather seemed depressed yesterday, but he didn't burst into tears. Everybody attributed his low spirits to the thundering locust news, which put our friends interested in bucolic matters into a terrible stew. The dreaded invaders are now in Santa Fé, Entre Rios, Córdoba, Buenos Ayres, and Tucuman provinces in enormous flights.¹ What specially makes the news so bad is the appearance of the plague in the gardens of the Republic, as the flight there is evidently the advanced guard of the new-comers of the season, young healthy insects, and not dying and decrepit old chappies left behind as stragglers from last year's hosts. Some say we have the old, old story repeated again—the winter frittered away in frothy scientific talk and newspaper articles, but nothing done. And now the *Acridium* is in the bowels of the land again between

night and morning, and there is wild fuss and alarm, and rushing to and fro in hot haste, and yells of 'The foe! the foe! They come! they come!' It raises a 'triste sonrisa' and mild grin to read that Friend Frommel has been ordered to Santa Fé by the Agricultural Department to 'at once destroy the mangas in that province'! 'Destroy' them? Easier said than done, gentlemen. It's too late, and Congress is too late, and all the 'Comisiones' are too late, and the locusts are too early, though what could have been done is hard to say. All that can be hoped for now is that Professor Bruner will start some epidemic amongst the foe at once, and that it will be as successful as in Nebraska."

780. Mr. Frommel's report.—"Mr. Frommel, who has just arrived from Santa Fé, reports that the crops in the province are saved, and a good harvest may be expected if Government will only provide the funds to enable colonists to destroy the locust eggs. Up to the present 1500 tons of insects have been killed. The swarms in some parts of the province were very thick, but fortunately did not do much damage. The colonists who most suffered were those in Vila and San Ramon. The locusts are in present possession of a strip of land stretching from Nueve de Julio in Monteros to Sastre. The insect appears to be a new species, of a deep red colour. Swarms of locusts have appeared north of San Cristobal. They come from the woods in the Chaco, and will probably lay their eggs in San Luis or Mendoza, as they are flying in a south-western direction. Commissions for destroying locusts are at present hard at work in Brinkmaan, Porteña, Freyre, San Francisco, and Zenon Pereyra. Mr. Frommel will shortly return to Santa Fé, where he will organise more commissions to destroy locusts. The purchase of dead locusts at three cents per kilo. is giving splendid results. Hundreds of families are engaged killing the insect by thousands."

781. Conflicting testimony.—"How the world is given to lying!' said the greatest liar fact or fiction has ever known, and when telegrams were received to-day from Santa Fé announcing that there was hardly a live locust left in the province, the idea that someone was playing pranks with truth took shape. Yesterday the telegrams proclaimed battalions of locusts on the march in; to-day's wires announced the direct contrary. Which are correct? Dr. Pellegrini has received a telegram to the effect that there is not a locust left in Santa Fé, all wiped out by the cold."

782. Locusts arrive at San Francisco and Arrecifes.—"The appearance of the locusts at San Francisco, an important colony on the borders of Santa Fé and Córdoba, and at Arrecifes, in the province of

Buenos Ayres, was much commented on in the Bolsa to-day, though it is stated that the pest is worn out with disease and not likely to do much damage. Still, its appearance has caused much alarm and dismay, especially at the places affected, which are important centres of cultivation. It is very necessary that vigorous measures be speedily adopted to crush this plague, which is a menace not only to the farmers but to the whole country."

783. A manga covering twenty-five kilometers.— "The most serious item about the locusts yet come to hand is a despatch received from Tucuman, district of Trancas, in which the inroad of a tremendous manga is announced. It covered an area of twenty-five kilometers, the whole stretch from Trancas to Colatao, and was passing from north to south. This is the first serious news of the plague. The isolated flights hitherto reported fade into insignificance alongside this gigantic cloud, and unless there comes another spell of hard weather to check the advance the outlook is very gloomy. It would be a great pity, with everything looking so well, if the plague were to again set the farmers aback. . . . However, moralising will do little good. The authorities must pull themselves together and proceed to the task of extinction, **cost what it may.**"

784. Report from Santa Fé.—"The telegrams from Santa Fé report a big manga of locusts passing over Ombu Colony, the mild weather inviting incursions. At Monteros Colony the farmers and peons collected 1800 quintales, or, say, 70,000,000 locusts, for which they were paid at the rate of 2 dols. per 5 kilos."

785. Organisation and determination do their work.—"The locust advices are not very alarming, though a big manga is reported to have passed over Empedrado yesterday in a south-easterly direction. But in Santa Fé splendid work has been done in extinguishing the mangas; at San Francisco the 'vecinos' have disposed of 2000 tons of locusts, and have still plenty of work in hand. At Amelia, Santa Clara, San Geronimo, Armstrong, Diaz Moeril, and Firmat Colonies there are no signs of the plague as yet, the crops being in splendid order, and a much larger area cultivated than in previous years. Things, in fact, are looking so extremely satisfactory that the colonists expect to be beyond all danger from locusts and their ravages if there are no incursions within eighty days. There is, of course, always danger from hail, and until the wheat is up and in, the harvest cannot be counted upon as certain, but it is at least consoling to reflect that if the conditions only continue favourable the production will be immense, far ahead of anything we have ever seen in this country."

THE LOCUST INVESTIGATION COMMITTEE

" 23rd February.

786. Meeting of Committee.—"The above committee, appointed by the leading merchants of the city, met yesterday in the offices of Messrs. Toso, Crane, & Co. The minutes of the previous meeting, the letters sent to the several Governments and heads of agricultural departments in the United States, were approved. It was resolved that the Chairman, Mr. J. F. Roberts, should see Dr. Carles, the Postmaster-General, in order to forward to all the postmasters in the country circulars with queries as to the movements of the locusts in the respective districts; also that he should undertake the forwarding of circulars to the railways in the Banda Oriental and Entre Rios. The committee, acting on the suggestion of the *Deutsche La Plata Zeitung*, resolved to print circulars in German, as well as Spanish and English. The circulars are as follows:—

" 'BUENOS AYRES, 17th February 1897.

787. Circular.—"DEAR SIR,—Inclosed you will find several copies of the preliminary circular of the Committee of Inquiry of the Locust Investigation Committee recently formed in the capital, embodying a series of questions regarding the appearance of the locusts in your vicinity, which we hope you will find time and opportunity to reply to in the blank lines under the questions.

788. "It will aid the committee if, after sending your replies to the first and second interrogations, and adding such other information as you may think of use, you will immediately mail the copy containing the record to Oliver C. James, Sub-Commission Estadística Carcaraña, F.C.C.A., Santa Fé, without delay, retaining the remaining copies of the circular to record your further observations. As this is a matter affecting not only the interests of the agriculturist, but of everyone living in the country, we have no doubt our appeal for this information will lead to your active and earnest co-operation.—Yours, etc.,

" J. F. ROBERTS, *President*.

" WILLIAM GOODWIN, *Hon. Sec.*

789. Replies.—"Approximate replies to the questions are all that is required, though, when possible, exact information regarding date of first appearance, course of flight, direction of wind, and particularly their course when making their final disappearance, will be appreciated—

" 1. When did the locusts make their appearance in your neighbourhood?

" (a) Did they come in mangas as voladoras?

- "(b) Or, were they developed from the saltonas hatched in the vicinity?
- "2. If as voladoras, from what point did they appear?
- "(a) Did they fly with wind, head first?
- "(b) Or, were they carried backward by the wind, while apparently flying against it?
- "(c) Or, did they fly at right angles to the direction of the wind?
- "3. Note when they began to mate.
- "4. Note when they began to deposit eggs.
- "(a) Note if any subsequent deposit was made by subsequent flights.
- "5. Note whether the eggs appear sound and healthy; whether enemies of any kind prey on them—beetles, flies, wasp-like insects, grubs, etc.
- "6. Note when the eggs hatch, and about what proportion are hatched.
- "7. Note whether any large numbers die in course of development from the young saltona to the imago or voladora.
- "8. Note whether, at any time, the saltona or voladora is infested with parasites, such as the long white thread-like worms, small white grubs, etc.
- "9. Note carefully direction of flight and course of wind when they finally leave as migrating locusts.
- "10. Do the adults generally die after depositing their eggs?
- "11. Record the course of flight, direction of wind, with date of passing mangas.

790. "The committee earnestly hope that all those who have made observations on the locusts, and may not have received circulars, will communicate with the Secretary, Mr. William Goodwin, 268 Calle Reconquista, who will immediately forward the formulas.

"Letters were then read from Mr. Stuart Pennington, announcing that he was getting ready his manuscript for print; and from Mr. Davis, of the Córdoba Observatory, accepting his appointment on the sub-committee of inquiry. It was decided to request Mr. Kenyon, near Rosario, to act also on the sub-committee of inquiry.

791. "The principal business of the committee at present is sending out circulars to all parts and preparing all the information that can be got for the entomologist who is expected to arrive here before May. All that information will be compiled and published in pamphlets.

"*Standard*, March 1, 1897."

792. PRESENT ARTIFICIAL MEANS OF COMBATING THE LOCUST PLAGUE

I. INGENUITY OR FINESSING.

II. DESTRUCTION OF THE EGGS.

- (1) Machines—ploughs, harrows, grubbers ;
- (2) Eating by pigs ;
- (3) Tramping the ground ;
- (4) Irrigation ;
- (5) Chemicals ;
- (6) Collecting the eggs.

III. DESTRUCTION OF HOPPERS, SALTONAS, VOETGANGERS.

- (1) Maiming ;
- (2) Tramping with stock ;
- (3) Crushing ;
- (4) Diverting ;
- (5) Catching and bagging ;
- (6) Trapping ;
- (7) Burning ;
- (8) Chemicals ;
- (9) Fungi.

IV. DESTRUCTION OF THE WINGED OR FULLY-FLEDGED LOCUSTS —VOLADORAS.

- (1) Diverting a flock ;
- (2) By shooting ;
- (3) Maiming ;
- (4) Chemicals ;
- (5) Tramping ;
- (6) Crushing ;
- (7) Burning ;
- (8) Catching and bagging ;
- (9) Fungi.

I. INGENUITY OR FINESSING

793. Introductory.—Having attempted to make ourselves as well acquainted with the characteristics of the locust and the plague as our present knowledge will permit, and having, I trust, proved the fallaciousness, as well as the wickedness, of not adopting measures of an active kind to combat or exterminate the pest, it is requisite to proceed to examine the current aggressive methods now in vogue for checking the ravages of the pest. The foremost among these is what may be termed strategy, or finessing; although it cannot, from a certain point of view, be said to be a direct means of warfare, yet it may be equal to these and of great advantage.

794. Every faculty should be pressed into the service.—There may be circumstances which might prevent the putting into active operation any of the recognised combative means, and the faculty of ingenuity or forethought has been bestowed on man by his Creator, who requires of us to use all our talents, and not to leave any one of them buried "in the earth," or not to put the same to usury. All the parts of a man—the whole man—ought to be exercised. Every part is of use and has its own special avocation, some more and some less: "But now hath God set the members every one of them in the body, as it has pleased Him. And if they were all one member, where were the body? But now are they many members, yet but one body. And the eye cannot say to the hand, I have no need of thee; nor, again, the head to the feet, I have no need of you. Nay, much more those members which seem to be more feeble are necessary, and those members of the body which we think to be less honourable, upon these we bestow more abundant honour. . . . Whether one member suffers all the members suffer with it, or one member be honoured all the members rejoice with it." By all means, therefore, adopt any measure likely to foil the destructive effect of the insect, for this is the chief end in view.

795. Sowing should be timed to elude the pest.—Experience during these years of locust visitations has shown to us clearly that when wheat is far advanced in growth the locusts do not choose to eat it. They will pass it by, if there is a chance to get anything else to eat. Not so, however, with the maize (mealie) crop, linseed, etc., which, though far advanced towards maturity, they will attack and ruin; for it so happens that when the covering of the cob of maize is eaten or destroyed, the grains are injured and do not fill properly as in Fig. 30. Potatoes come under the same category as the maize crop. If the bloom or flowers be destroyed, the bulbs or potatoes are injured—witness the disastrous effect of an untimely early frost or biting wind, which nips off the bloom. These are unlike wheat, which if the locusts eat when

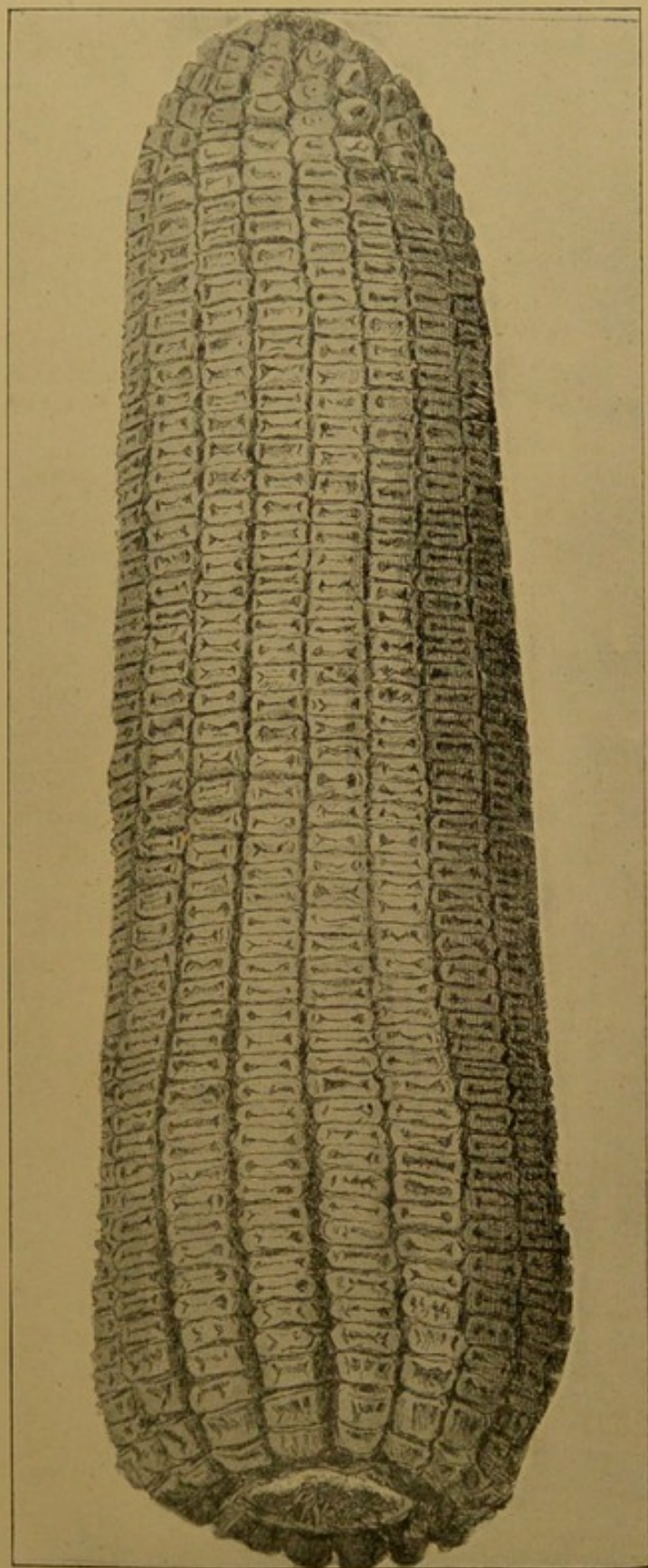


FIG. 30.—A full, healthy, and typical cob of maize—departures from this type indicate impairment of growth.



young and tender, it springs up again and is not permanently injured thereby. Therefore it is well that the farmer should sow wheat early, so that before the locusts make their appearance in the spring following—even when they come early—it may be far advanced, and hence rather tougher than they care for; and, similarly, such crops as maize and potatoes should *not* be put down until the voetgangers or hoppers are due to undertake their “march,” while these crops are as yet *under* the surface of the ground. This period in both cases is generally pretty well known or may be ascertained. The march does not begin until the larvæ are from twenty to twenty-eight days old. The time—about fourteen days—required for the seed to sprout and appear above ground is also well known, or can be estimated with some nicety—it occupies about fourteen days after being sown. The choice also, in respect of the sort of crops to grow during locust visitations, is extremely important.

796. A crop that can't be destroyed.—Lucerne or alfalfa is convenient to grow during locust visitations, if the ground or soil and other circumstances are suitable; not because the locusts will not eat it, as some suppose,—they do eat it, and eat it readily,—but the crop can be cut down by “reapers” at any time previous to the “army” marching on it. The lucerne so cut down, dried, and removed for preservation, is not lost. Though it has not attained its full growth, it will still be profitable if cut down, and the plant being a perennial it will grow immediately after being so reaped, and reach maturity again sooner than if the hoppers had eaten it.

797. Strategy emphasised.—By giving careful attention to matters of this kind, it is possible, nay probable, that by ingenuity or strategy of this kind, you may “dodge,” or foil, or outwit the locusts; at all events, to a certain extent one may, by guile and skill, succeed in conquering and checking them. The advanced wheat crop is beyond the *taste* of the marching army, and if the precautions indicated are taken, the young maize ought not yet to be above ground when the army is on the march, and therefore the crop cannot be spoiled. As soon as the army passes, all is safe. In the flying state the locusts may settle down, levy toll here and there, and of course it is necessary to have the combined action of the entire community, so that all may be done to combat the pest in all forms and stages.

798. “Prevention better than cure.”—This brings to mind a well-known story on parallel lines, namely, that of a gentleman who, requiring a coachman, had to make a choice between three candidates who presented themselves for the post. From the experience he had had, he thought it was his duty to be specially on his guard so as to secure a servant to whom he might with confidence entrust himself. No. 1 candidate, in the course of the interview, was accordingly

asked how far, in driving a carriage and pair of horses past a certain given dangerous point—a great precipice—did he think it was safe and compatible with his duties as an expert coachman to keep away from or clear of it? The answer was, that he thought he could safely drive to within a yard or two of the said danger. No. 2 candidate, in turn and in answer to the same question, replied, he could drive to within one foot. No. 3 candidate protested, *that he would keep away from it as far as possible*. The employer unhesitatingly replied that the last (No. 3) was the coachman for him; but the coachmen, on comparing notes afterwards, and before Nos. 1 and 2 knew the result, were surprised, and Nos. 1 and 2 thought No. 3 was a long way inferior (according to his answer) in horsemanship or skill. To their great chagrin they, however, learnt that the employer thought it was worth his while to entrust himself to such a careful and considerate man. So it may be in this plague. There is a personal or individual duty to do, as well as one to the community at large. It is our obligation and privilege to discharge faithfully both of these services—"Prevention is better than cure."

II. DESTRUCTION OF THE EGGS

799. Prospecting.—It must be borne in mind that the space of time in which the eggs can be destroyed is limited, as has already been pointed out, to about forty days. Therefore, as soon as the swarm have finished their work of egg-laying in the couple of days in which they are engaged in it, no time ought to be lost if this plan is decided on as the most convenient and best to adopt. Consequently, one of the first things to do is, to decide as to the characteristics and conditions of the locality, size, and nature of the affected ground, and which of the several modes of destruction of the eggs would be best if all of them are at our command, or as many of them as may be at our disposal. In coming to this decision, ample scope for exercising the tact and judgment which come from experience will be afforded.

(1) MACHINES

800. Ploughing.—It is very generally considered that when the nest, or cartucho, as it is termed in Spanish, is interfered with, after the female finishes it, fertility and fecundity of the eggs, to a greater or lesser extent, is also interrupted. So far as I know, we have not data enough to permit us to speak on this point absolutely or affirmatively. Some say that when even the spuma which covers the eggs is interfered with, that it is enough to impede or injure the fertility of the eggs; others say that a greater derangement of the nest is required before such a result

can be obtained; others, again, say that a similar result can only be hoped for if the ground be completely dugged up and overturned; while others still say that the eggs remain fertile and may do so for a long uncertain period, so long as the individual egg is not broken or injured, although turned or covered up by the earth. There is therefore here a field for much conjecture. The probability, however, is, that if the nest is broken up and interfered with, its fertility is not only impeded, but also stopped. When possible, the wisest plan, therefore, after noting the average depth of the nests, is to plough deeper, and give the soil a good turn over. If a roller is then passed over the surface, it is quite probable that this process would injure and break up, not only the nest as a whole, but also the individual eggs in it. It would, moreover, have this advantage, that it would reverse the mode of exit of the young, if they lived to be hatched. They might never get to the surface. As on a field the laying ground is very often the "headrig," which is the hardest of the whole field, it alone might be ploughed up, if the eggs were deposited there or chiefly there. But no matter where they are deposited in the field, if at all defined, it will be better to destroy them (and the crop) than leave them, should this be the most convenient and selected method and the one decided on to give the enemy battle, and so prevent further loss than that in this field only.

801. Harrowing, instead of ploughing, may also answer the same purpose, if the ground is looser where the nests exist. The teeth, if sharp, and the harrow heavy, will go down perhaps a couple of inches, and so undoubtedly would succeed in tearing up or destroying the cartuchos as a whole, which especially in rainy weather would do much to addle the eggs. The implement called *grubber* being between the plough and the harrow, would in all probability have a proportionately beneficial effect. The *grubber*, of course, would get over the ground quicker than a plough, though not so speedily as a pair of harrows. Another good plan is to plough the ground where the eggs are laid, and harrow it after. In this way the nest would be torn up pretty completely and injured. It might then be rolled so as to make the destruction as complete as possible. Of course it is needless to say that, if the eggs are to be collected, this mode of destruction is out of the question. The means now mentioned are had recourse to when the nest and the eggs are to be destroyed and left in the ground. Hoeing or like modes with hand instruments (spade), if the only thing available, and if the laying ground is limited in extent, may also be called into aid. (See pars. 331, 378, etc.)

(2) EATING BY PIGS

802. Where available, should be compulsory.—When a large herd of pigs are available, or in the neighbourhood, there is perhaps no

better mode of exterminating the pest through the eggs than this. By confining the pigs by means of a special netted wire fence, made for the purpose, to the locality where the eggs are deposited, good work will be effected by the pigs. By means of their snouts they will root up the cartuchos and eat up all the eggs. It may not happen often that pigs are available in the district; but when available, and it is decided to attack the plague by destroying the eggs, then by law it should be made obligatory to use pigs for the purpose—at least it is one, and a good one, of the available avenues of destruction.

(3) TRAMPING THE GROUND

803. Cattle should be driven at the gallop.—Now this excellent method has to be studied or seen before its full value can be realised and appreciated. The word *tramping* is capable of a deeper significance than would at first appear. It does not mean the driving of a *few* mares, cattle, or sheep over the ground where the locusts have nested, but, so driven in such numbers and at such speed, that the land over which the flock has “tramped,” bears evidence, by what is left on the surface, of the very marked results of the stampede. It will thus be patent to anyone that there is “tramping” and “tramping.” To drive fifty head of cattle, *e.g.*, over a field slowly may be so done as scarcely to perceive that they had passed over it at all; but to drive 500 or 5000 at a smart trot or gallop would have a very different effect. This latter process would leave evident indentations on the surface, and when driven back again, and the same frequently repeated, it would no doubt not only injure the tapping spuma which lies over the eggs, or between them and the surface, but effectually injure the eggs themselves.

804. Drivers to be mounted.—Tramping to be effective must be well directed, the animals more or less trained; and the speed and compactness of the herd are important factors in the successful issue—a result which can only be obtained according to the effect produced. When the ground is soft and wet, the effect is more speedily attained, and nearly all the eggs may thus be crushed, or so crushed and injured that none will be hatched. Such interference with the eggs and nests, it will be readily perceived, is in direct opposition to nature's plan, and as such it is as effectual as removing the eggs by the ordinary collection or otherwise. It may be here indicated generally that for effective tramping it will be necessary that those who drive or manage the flock should be mounted on horseback, and that the work has to be done in a spirited fashion—“walking” is dawdling and fatiguing and ineffectual. The animals must be driven in such a way as that their feet shall be made to sink into the soil.



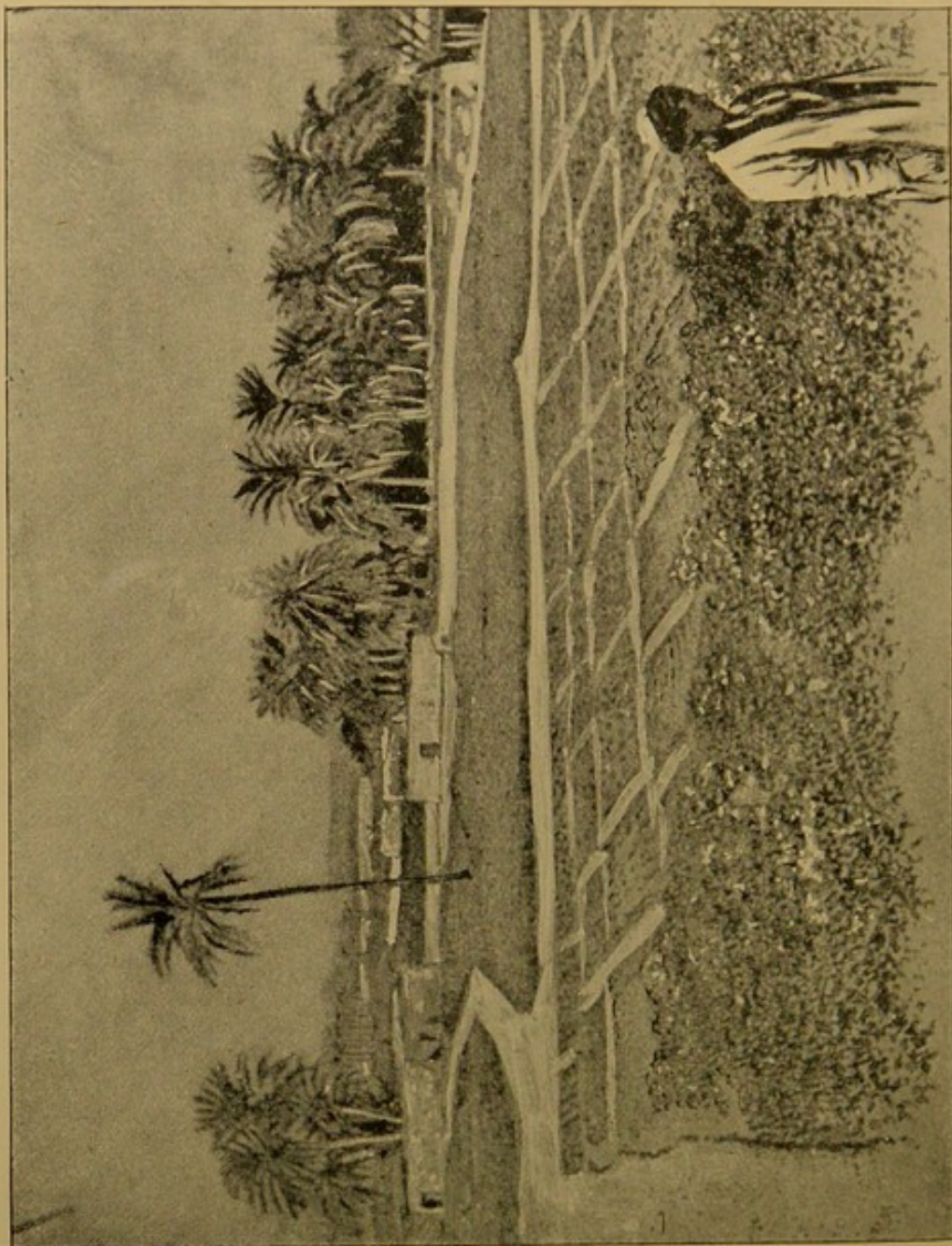


FIG. 31.--Cultivation in north of Africa (Egypt), with the aid of irrigation, and when free from the plague of locusts.

(4) IRRIGATION

805. Harrowing to precede watering.—Here again nature, when interpreted correctly, gives us a sure and certain indication. The insect chooses dry, arid land in which to deposit carefully her eggs, and wet weather or wet land is inimical to the fertilisation of the eggs. Consequently, where the land can be freely irrigated (Fig. 31), after the eggs are deposited therein, plenty of water is certain to destroy them, if managed properly. If possible, it might be well to harrow lightly the land first, and then let the water run freely on it at intervals, and by a judicious administration of this process no doubt the eggs would perish. Like most of the work connected with the destruction of the plague, accurate data require to be noted and registered, and comparisons carefully made out as to the best modes of irrigation to adopt, as to frequency, time, and quantity.

(5) USE OF CHEMICALS

806. To be applied to the eggs.—If chemicals are of use anywhere in this warfare, I believe more benefit would follow from well-directed means or applications directly to the eggs or cartuchos than anywhere else. I am not aware that this has been tried or even thought of, but on *a priori* grounds the action of chemicals directly applied to the eggs in the nest should probably prove more effective, and less would be required for the purpose than for the hoppers or flying locusts. There is room here for well-directed experiments.

(6) COLLECTING OF THE EGGS

807. "Bounty" system tends to official corruption.—This method is one of the most generally used and oldest for checking the plague. It is used by all the Latin races (in Europe), and the East—Asia, North of Africa (Egypt, Algeria), South Africa, United States, and South America. In Cyprus it used to be practised for hundreds of years; but in 1882 the British collected there 1330 tons of eggs (the largest recorded amount at least up till then—computed to represent 70,000,000,000 locusts; or, as in Natal, reckoning 550 nests of 80 eggs each, *i.e.* 44,000 to the pound, or 117,000,000,000 to the 1330 tons at 2000 lbs. to the ton—ever collected, without experiencing any abatement then of the plague), and next year discarding that system, entirely exterminated the plague by another and totally different one. Inseparably connected with this egg-collecting plan is, that the Government must support it, and so induce the people to engage in it as a source of pecuniary revenue. A bounty or so much money is offered

if a certain number of pounds, or kilos, or a certain measure, as a bushel, or quintal, or muid, is presented, according to the place in which this system is carried out. In Natal sixpence a pound is given for the eggs. From the experience gained in the case of Cyprus, it was manifest that abuses became inseparable from a plan in which there was such a pecuniary emolument concerned. Corruption became rampant, and egg-collecting became the harvest to the chief officials and the very poor. In reality the egg-collecting did not lessen the plague.

808. Method of collecting.—At the same time there may be places and circumstances in which the ordinary means may be unavailable and useless, or at least cannot be employed. However, if the people entered into the plan with a true sense of public spirit, there cannot be a doubt that the method is an excellent one, given certain well-marked circumstances and conditions. This may be proved from the work done in Algeria by the French, who relied mainly on this system, and came very near in 1888 to exterminate the visitation which then prevailed. When considered best, it may be expedient, after the people of the district have carefully considered the advisability of enforcing it, to pay so much in food to the people employed, and if successful in clearing the district of the eggs, then, and then only, so much more according to weight or measure produced. The first thing in all cases ought to be to summon a meeting of the people of the district, whose aim ought to be to exterminate the pest, and they should discuss in the abstract as to the wisest measures to adopt for this purpose. As to the method or manner of collecting the eggs, a few words may be said.

809. By hand.—The nesting ground may be observed by its peculiar greyish aspect, dotted over, here and there, as if the surface were sprinkled with a solution of salt which dried or was acted on by the air. If any doubt exists, by removing with a spade a slice of the surface of about 1 in., you will make the character of it clear. In order to do the work expeditiously, it is best to have a sharp spade to remove the superficial layer of the soil, to the extent of about $\frac{3}{4}$ of an inch in thickness over several square yards at one time, and before commencing to dig up the clusters of eggs. When thus made free, you are ready to dig up, and not more than from 3 to 4 in. in depth is requisite. The eggs adhere to each other as a rule,—there is no special covering or cocoon, as those who have never seen the nest describe,—and they are therefore easily separated and gathered by the hand and put into a vessel for the purpose. It is computed that every bushel so saved preserves from destruction a hundred acres of corn. But this is, in my humble opinion, a somewhat high estimate; and if it is realised that the soil or land is literally sown or full of these nests, it will not be difficult to estimate the hundreds of

acres that a few persons at this rate could save from destruction in the course of a day or week. To dig out the nests one by one by means of a knife or trowel is a slow and lazy way—so indolent and slothful that those indulging in it are only playing and using it as a pastime, and are not in earnest.

810. Eggs may be gathered in various other ways.—Thus the earth may be turned over or dug up, and, when dry and exposed to the sun, the part containing the eggs, nests, or cartuchos may be put into a sieve specially prepared for the purpose, in which the soil may be passed through and the eggs retained. This, however, can only be carried out successfully by experience acquired by trial. At other times, when the nature of the soil and the cohesive character of the cartuchos permit the use of a small closely-toothed handrake passed over the upturned dried earth, it may help one to gather speedily a large quantity of eggs, or, again, the egg-laden earth may be carted away to another locality, and so acted on there as to render the eggs sterile. There is here abundant room for the exercise of ingenuity. The eggs that are so collected can easily be destroyed—buried in pits, acted on by various chemicals, broken up in a mortar, etc. etc.

811. Hand-rake only suitable in small countries.—In a thickly-peopled small country, where labour is cheap, this method may present certain features which might induce the people and the authorities to give it a trial with a fair prospect of success, under well-regulated conditions; but in a large extent of country, such as the Republics bordering on the River Plate, South America, and South Africa, Algeria, etc., where, generally speaking, the population is sparse and labour scarce and dear, such a system does not appear to me likely to have the elements of success in it for exterminating the pest. In 1891 and 1892 I put my reasons forward (pars. 217–221) in justification of my opinion, and in December 1895, Mr. W. F. H. Blandford, Lecturer on Entomology in the Forestry Branch of the Indian Civil Engineering College at Cooper's Hill, London, delivered in a very careful and exhaustive paper his opinion to a similar effect. From the value I attach to this last opinion, I have copied it in full, and it deserves to be carefully studied—every word of it. It will be found in pars. 469 to 510, pp. 187–195.

III. DESTRUCTION OF YOUNG UNWINGED LOCUSTS— HOPPERS, SALTONAS, VOETGANGERS

812. Reasons for "dealing" with the young.—Many circumstances point out and mark this period in the life of the insect as *the best* for giving battle to it, in the hope of exterminating it as a plague. When we look at the insect itself, in the first place, we shall readily

perceive a notable advantage in dealing with it at this period. It is above ground and can be seen, and therefore very different from the eggs. It has no power to move quickly from our reach, as is the case when the insect is winged and fully fledged. From its habits of bunching or gathering together in a heap at night, it is somewhat amenable to approach, and as the *heaps* are large, the insects can without difficult or tedious work be secured. It has at certain stages well-marked and known features which may help us in the fight, as, *e.g.*, it marches in a given direction, and marches fearless of the obstacles or *traps* that may be set in its way. And, further, there is a longer space of time in which to give battle to it in this stage than in any other, from seven to nine weeks. But in the same period there are certain well-marked divisions or epochs; thus in the first week the habits of the locust are different from those in the next two or three weeks, especially is this marked in their manner of bunching or heaping themselves together at night in the first few days or weeks after being hatched, as compared with their after life. From the fourth to the sixth week another propensity indicating a marked difference presents itself, namely, they *march*, and this march is such that it is likened to an *army on the march*.

813. District, soil, and condition of crops to be considered.

—In addition to what I have said regarding the insects themselves, experience proves that the measures for combating them in this stage will vary according to the nature of the place and soil, the condition of the crops, and the general inherent characteristics of the local grasses and vegetation in which they exist. Another consideration of importance, apart from the insect and the field of battle, is the soldiers themselves and the armaments they have at command. The chief utility of this work is to arouse an interest and prepare for the warfare, assured that the conclusion is a foregone one, if all be properly arranged and ready for the fight.

814. Remedies to be adapted to local peculiarities.—It may be said that for the first few days or a week, the twisters or very young hoppers may be best encountered by the maiming process—wire flails, twig whips, scourges of various kinds, shovels, wooden paddles, heavy weights, rollers of various kinds to suit the battlefield, and tramping with stock—cattle, horses, or sheep. Or, chemicals—especially solution of petroleum—through a spray producer or engine, would also be indicated while they lie in these heaps, or kerosene might be sprinkled over them and a light set to the heap—set it on fire and burn it. In this way, no doubt, complete mangas or district broods can be and have been destroyed. Each locality must be adjudged according to its own characteristics and intrinsic conditions—no two places are alike. The selection of the remedy will depend on the circumstances already fully

enumerated. If each district undertook to give battle in this way, I have no hesitation in saying that, so far as the inhabited or peopled portion of the affected country or countries were concerned, little harm would accrue from the hoppers. When the insects are further advanced, say two or three weeks old, and before evincing their well-known propensity to "march," then maiming by the wire flail, or whip, or scourge, or tramping with stock, or burning the grass, may be had recourse to as the most probable means, according to the resources at command in that particular locality and existing conditions.

815. When, again, the hoppers advance farther and betake themselves to "marching," then recourse must be had to one or other (separately or combined) of the four following methods: *Trapping, catching, crushing with rollers, or tramping with stock.* When the insect is still farther advanced, and just before getting its wings, perhaps burning will suit best at this stage, as their jumping propensity is now considerable, and this characteristic might impede the efficiency of the other methods. Burning will also depend on the condition of the grass and other circumstances.

816. Strike early.—From what has, however, been said, it will be clear that one man can in all probability kill more of the insects if he can get at them properly during the first week, when they cluster so closely together at night, or on a cold day, than twelve men could equally do at other times, or than can be done with large machines afterwards. Then, when on the "march," I believe most profit will be derived by attacking the vanguard with the roller on specially prepared ground, and that by this means the whole "army" may be annihilated. I am firmly of opinion that the old system of making trenches, *i.e.* ditches, in which to catch or trap them is not good, and is a useless waste. The "screen and trap" system when practicable is best and most perfect of all. Having now generally indicated the battle, it is requisite to give details under each head.

(1) MAIMING

817. Growth of insect and nature of ground to be considered.—There are various devices by means of which "maiming" the insect may be so effected as to greatly lessen if not absolutely prevent its power to destroy. These means will require to be adapted to the growth and condition of the insect and the nature and dimensions of the ground.

818. "Scourges."—During the first week after hatching, or when very young, they gather together in heaps at night, and great havoc in killing or maiming them can then be made by the use of wire flails (the most serviceable for continuous effective work will be the form described in

pars. 629 and 646) (Fig. 32), shovels, wooden paddles, weighted bags, or an undried hide (made heavy with sand, stones, earth, etc., to give the requisite weight), barrels or boxes weighted with stones, etc., a hand or horse roller, or anything in the shape of a scourge which can be speedily got together and made ready for effective use to draw or drag over these heaps towards the evening or early morning, or on a cold, dull, or cheerless day before they spread out to eat with the heat of the sun. Common means, readily at hand, may be the best for attacking them.

819. The wire flail preferable.—A whip made of tough twigs from a tree is often used for "maiming" purposes; but in my opinion it is not so serviceable as the wire flail mentioned, if the latter can be made or obtained. The use of the wire flail would be more destructive when the insects are gathered together in these heaps, than the twig whips, which, from their more extended sweep and branches, are more indicated than the wire flail when the insects are older and more spread out on the surface. Perhaps they (the twig whips) would suit rather better for "driving" purposes. The wire flail is an invaluable implement for "maiming" purposes, both in the heaps as well as when the locusts are older, among the winged ones, when they settle down for the night, or on a cold, cheerless day; great execution and slaughter may be effected by this means.

820. Weighted bags.—It is not difficult also to perceive that weighted bags drawn along a heap of these tiny insects at a tender age would so maim them as to render them defective, sickly, or powerless to do much damage. By dragging the bag over them again, no doubt most of them would be killed or much wounded.

821. Means to be adapted to existing conditions.—Where suitable, again, rollers would be powerful in the period now under consideration, but as we shall have to deal with this under head (3) following, nothing more need be said of it at present. Likewise maiming may be carried out by means of tramping with stock, with which we shall presently have to deal. Therefore much depends on the means at our disposal—adaptability of the means to the existing conditions is the thing that requires the greatest consideration and judgment. Maiming them by means of scourges is best done when the young hoppers are gathered in heaps during the first week, or when the winged locusts are gathered at night in convenient places, on walls of houses, or on trees or posts, or other parts where other means or machines are not so accessible or manageable.

(2) TRAMPING

822. Not applicable to "army on the march."—For the purpose of destroying circumscribed flocks or mangas of the unfledged



FIG. 32.—Showing locusts on the wing as well as the shape and structure of the two pairs of wings.
A at left-hand corner indicates the wire scourge or flail for maiming.



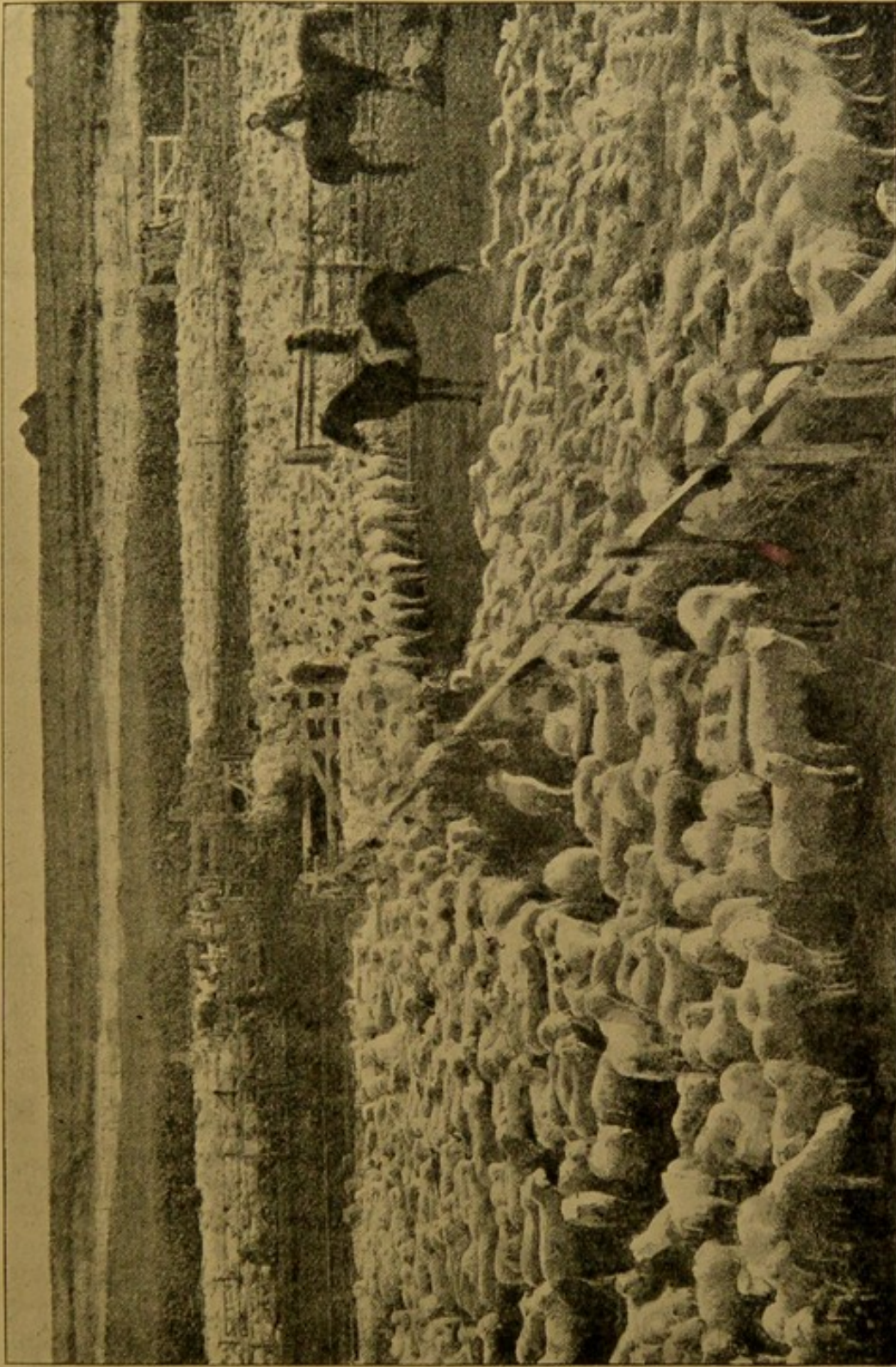


FIG. 33.—Represents flocks of sheep, which may be very useful and necessary if the process of "tramping" is the means of combat selected as the most appropriate one.



insects in almost any stage there can scarcely be a better means of doing so than tramping with stock. I purposely exclude from this consideration the "army on the march," as here the hoppers are too much spread out for cattle-tramping, and other means are far better adapted at that period. The great desideratum here is to know what tramping really is.

823. Animals should be mobilised and drilled.—In the first place, a *large number* of animals—mares, cattle, or sheep (Fig. 33)—are required, and one must from practice or experience know how to move or manœuvre the flock (Fig. 28, p. 249, par. 666, p. 247). They must be driven *rapidly*, and more or less closely packed together, and repeatedly kept going backwards and forwards over the same ground. If this plan be carried out as it ought, the swarm of insects cannot have a chance to survive or escape serious or permanent damage. I have very great confidence in this method, if there be enough stock in the neighbourhood and any person sufficiently skilful and courageous enough to handle them for this purpose. Undoubtedly an Act should be passed entitling the animals in the district or neighbourhood to be so mobilised and utilised for the purpose, if required. A "large number" is itself indefinite, and might mean 50 or 5000. If the locust brood is large, 1000 or 2000 cattle would be necessary, the more the better. It is useless for me to set any limit to the number. Suffice it to say that a few animals driven slowly—walking—over the ground on which a large company of locusts exist will be useless and inefficacious, and *vice versa*.

(3) CRUSHING

824. A more drastic method.—By crushing of the hoppers is meant a more determined and systematic destruction of the insects than perhaps can be absolutely conveyed by the term, or managed under the two former headings—maiming and tramping. For the purpose of technically "crushing" the brood, probably the most effectual means is the use of *rollers*.

825. Rollers to be propelled, not drawn.—Rollers may be made of many kinds, both as regards form and material. It is therefore not necessary to repeat what has been so fully stated on this subject on pp. 102–122. A suggestion may, however, be made, as it may be of value in conducting the battle. In making new rollers it would certainly be of great advantage so to construct the roller or cylinder that it will be forward, and the propelling power—the horse or steam gear—behind or after; the roller or rollers to go in front of the horses or oxen or motive power. To those who have had experience in killing the hoppers, the reason for adopting this plan will be obvious. If the horse is first and *pulling* the roller behind him, the hoppers

very often get instinctively frightened, and when the horse moves

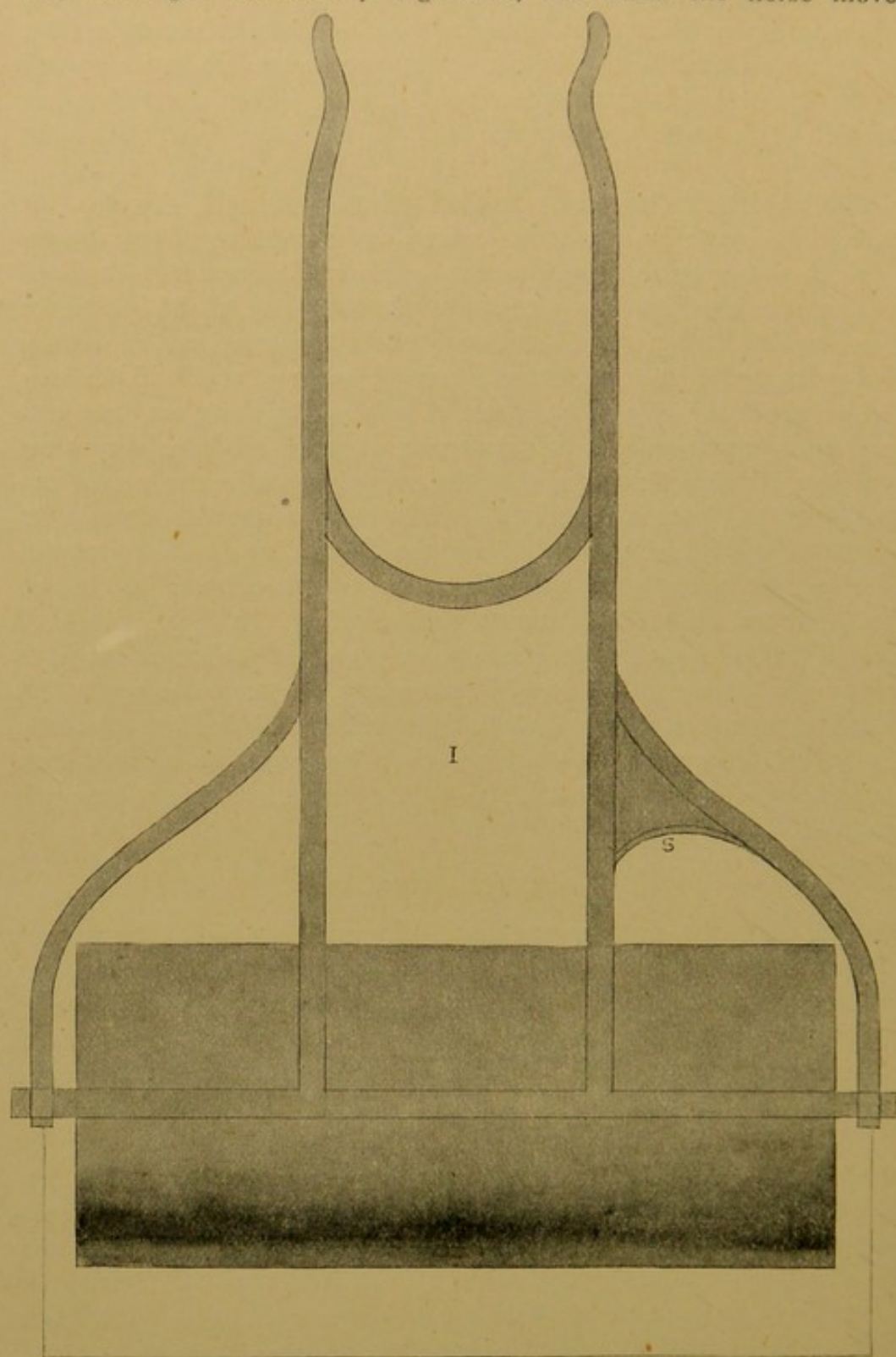


FIG. 34.—Showing general plan or bearing of roller. (*Protection for this machine and method has been secured.*)

among them they spread out quickly, get out of his way, and so escape to a very considerable extent the full effect of the roller. Whereas if

the roller is *pushed* ahead by the horse or other animal behind it, the effect would be markedly greater. The roller would be on the insects in a quiet, speedy, and effective way before they saw or heard the noise of the animal or propelling power, or knew from what direction it came, and as likely as not they would move in front of the roller rather than, or as soon as, run away from it in a fright.

II

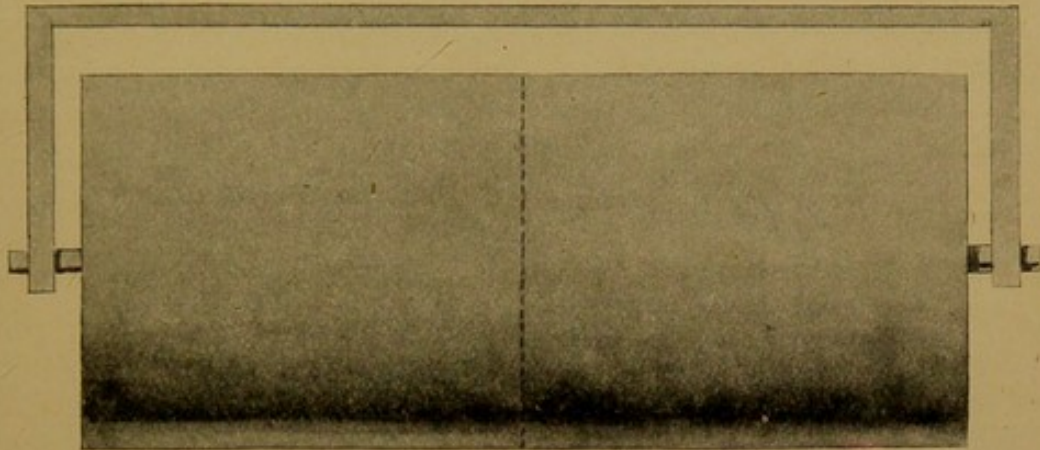


FIG. 34a.—Showing cylinder entire, or it may be divided into two or more sections.

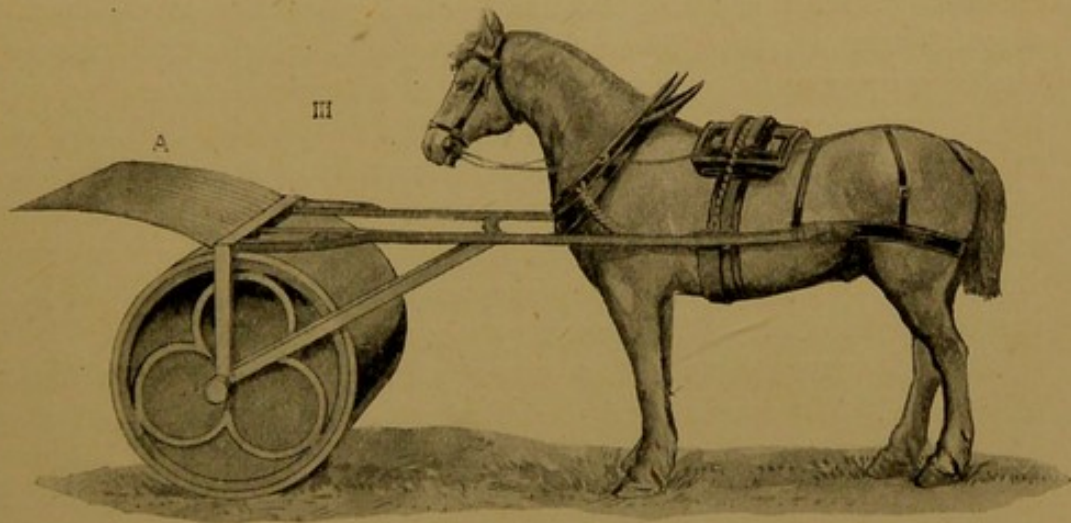


FIG. 34b.—Showing roller before the horse or motor. A, Shield to prevent hoppers jumping over or on the cylinder. (*Protection secured.*)

826. The two periods most suitable for rolling.—Rollers for crushing the hoppers may be used at various stages of their growth, but as far as I can judge there are two periods specially indicated or marked out when they may be used to more signal purpose and advantage than at any other time, namely, during the first week or ten days after the young are hatched, and when (some weeks after) they are

on the march. If the ground is suitable—that is, if level, smooth, and clear or free from indentations or thick hard tufts of coarse grass—there is no means at the command of the agriculturist so efficacious as the roller for killing the locusts.

827. A one-horse roller sufficient.—Not only may the rollers be of many kinds, but certainly they need not be heavy. The weight of the roller ought to be left to the person in charge. Should he deem a heavy roller best, by all means have it, and *vice versâ*. The animals are not difficult to crush. The difficulty consists in getting at them. Unless, therefore, in my opinion, there are clods of earth to be broken, it is needless and a great waste to have heavy rollers—three tons, pulled by ten oxen, such as that mentioned on p. 248. Where the field of operation is suitable for a roller, an ordinary one-horse roller is sufficient.

828. The Carcaraña machine recommended.—Then, again, sometimes it will be convenient to have the roller in sections, so that there may be more play and scope permitted in the operation. Also, as in the accompanying figure, an ingenious contrivance may be secured, as in the Carcaraña machine (Fig. 35), whereby there is an arrangement for receiving or catching the hoppers that jump much, into a sort of trough, and at the inner and lower part or angle there are two cylinders revolving reversely—one against the other—which effectually crush them. The author is pleased to find that the principle (crushing by means of rollers as a means of extermination or checking the plague), so strenuously advocated by him in 1891, is the chief or prominent idea or object derived by the ingenious if somewhat complicated machinery now used for the purpose in the Carcaraña centre; and, if in Carcaraña, then throughout the locust area in the Argentine Republic. The efficacy of this apparatus depends chiefly on the fact that it kills by crushing the insects by means of rollers.

829. Carcaraña machine more adapted to catching than killing.—If this machine can be obtained or easily made, and if it be found (as turned out to be the case in that centre of industry in the Argentine from which it derives its name), by all means use it, and show its action abroad, so that a knowledge of it may be extensively spread, and used whenever possible. But if it cannot be got, then use ordinary rollers, or anything to crush and so wound the insects that they shall be powerless to move away or destroy the crop. It appears to me, though I may be mistaken, that the Carcaraña machine is more suitable for going on or over the field to catch the hoppers and then kill them, than to attack the army on the march. For then, in the latter case, they do not so much hop as walk.

830. Plan of colonisation at Lehman.—That there may be no ambiguity or doubt as to the mode of using the roller, I will here sketch

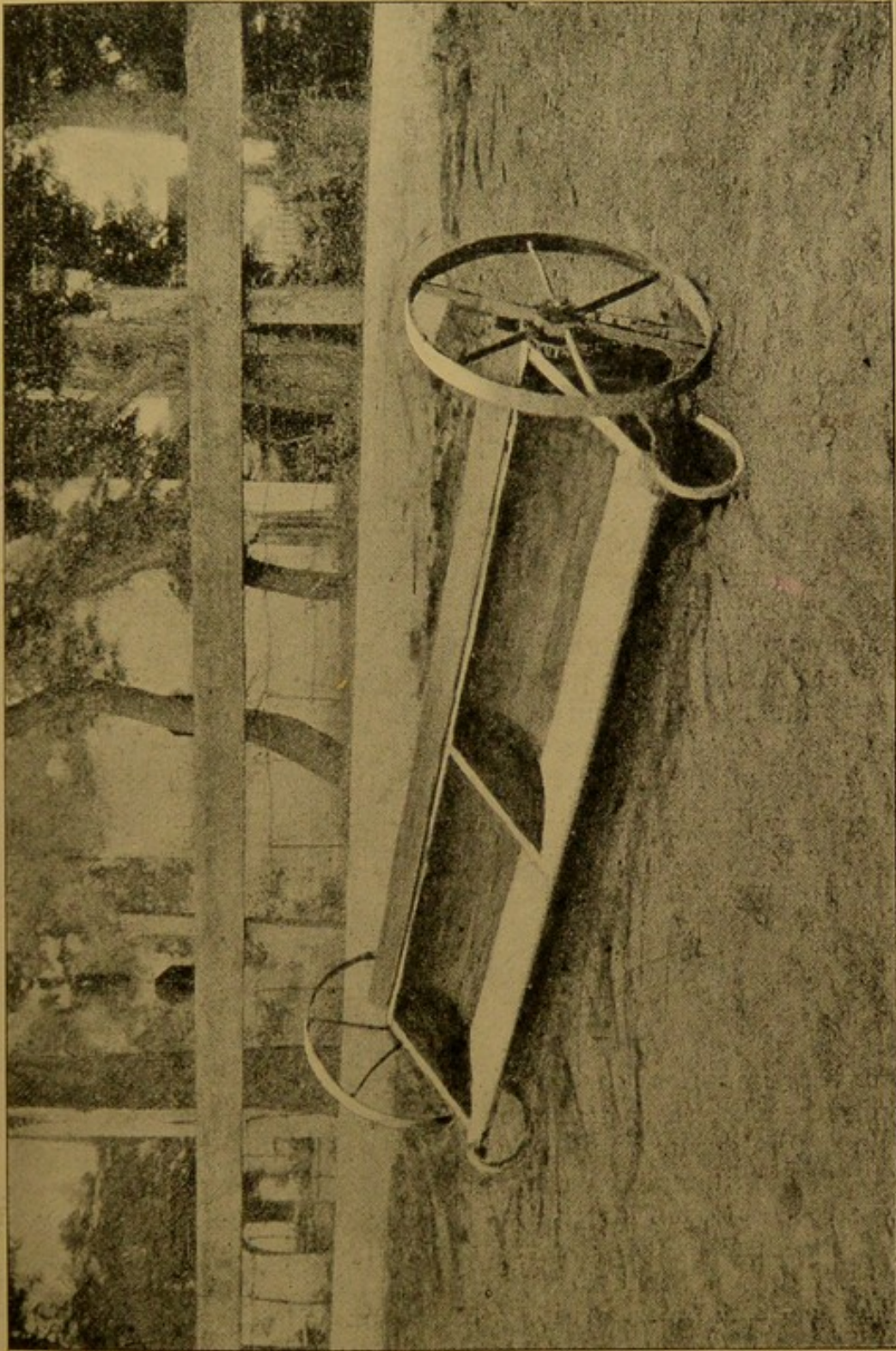


FIG. 35.—One of the Carcaraña machines invented for killing locusts. It appears to be constructed of one trough, divided in the centre, and at the inner and lower angle or level a roller may be detected, and from the wheel arrangement at the end here would appear to be two rollers with a reversible action.



out what I conceive the best or typical way for using the roller, of course to be improved or adapted to particular cases as circumstances alone may indicate. The accompanying plan (Fig. 36) is that of an agricultural colony (Lehman), in the province of Santa Fé—the mother colonising province of the Argentine Republic, and the province particularly referred to in the description given in President Pellegrini's

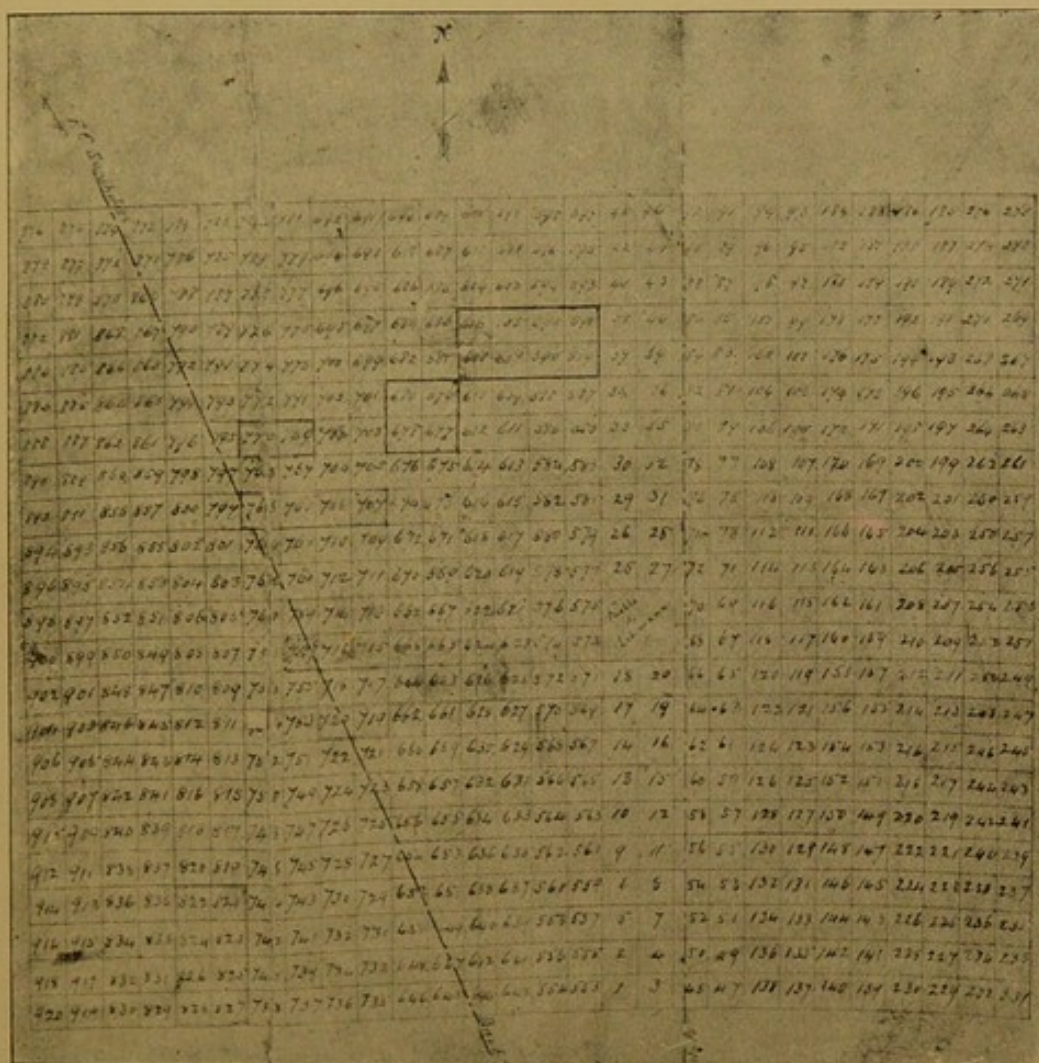


FIG. 36.—Miniature plan of a colony (Lehman, province of Santa Fé, Argentine Republic), showing mode of colonisation—concessions of eighty acres, each marked separately, and two railway lines running right through it.

famous telegram (commencement of Book II., par. 192), and the province that has suffered most and longest from the locusts in the Argentine Republic. It is not amiss to give the scene from that country, as the plan and system of laying out land and colonisation adopted there may be suggestive and useful if adopted in other parts. In explanation of the plan, it may be well to say that each square or number represents a "concession," and a "concession" contains

twenty "squares" (5×4), or 80 acres. A colonist (the majority of colonists in that country are Italians, who make there the best working agriculturists) usually takes four concessions, or 320 acres. There are 80 concessions in a square league, or 6400 acres, or 10 square miles. In some parts of the country land is divided by the "hectarea," which represents one-half of a square, or roughly, two acres, or a morgen. A colony varies in size; it may be three square leagues (thirty square miles), or ten square leagues, or twenty. But each colony has its name, and well-marked boundaries and regulations pertaining to itself.

831. Extent and location of nesting ground to be correctly ascertained.—When locusts lay their eggs inside the colony, they usually select the hardest (waste) clean land, or the "headrig" of a field, or along the margins. In such cases it will probably be best to deal with the eggs by ploughing, harrowing, irrigating, or chemical spray, or egg-collecting, or with the young when bunching during the first week. But, as often happens in a colony, there is some untilled or uncultivated land of considerable extent in some part or other of it. Let us suppose that such exists to the north of the colony, and that the flying locusts have there deposited their eggs as their custom is, or made their nests in it. Those who occupy the land, or the occupiers of the concessions contiguous thereto, are acquainted with the fact that in about two months after the eggs have been laid, "the army" will march into their land and devour their entire crop. The nesting ground, as has already been pointed out, may be reconnoitred and ascertained, and consequently it is the duty of the people to gauge as accurately as possible the extent of superficies containing the locusts' eggs, so as to make the necessary arrangements for the battle.

832. Size, number, and kind of rollers to be used.—Let us, as previously indicated, suppose the marching army are located to the north of the cultivated land, and that they are bent on coming southwards,—preparations have therefore to be made. About ten to twenty yards in width have to be cleared of all obstructions and made as level and smooth as possible, to obtain the full effect of the rollers. If this extent can be got immediately to the north of the cultivated land, *i.e.* the southernmost boundary of the camp or veldt land by the full length or breadth of the manga or swarm of the marching hoppers, so much the better. But if it cannot be got, or got so suitably as elsewhere, then the same extent must be cleared in the cultivated land (Fig. 37). It has to be prepared, and all obstacles in the line or sphere of the rollers have to be removed completely, such as fences, crops, trees, etc.; all must be removed or cut down, and the surface made as smooth and level as possible. For about sixty days after the locusts have laid their eggs, or until the hoppers are from three to four weeks old, there is nothing to do but prepare the rollers and the ground, if this be the kind of

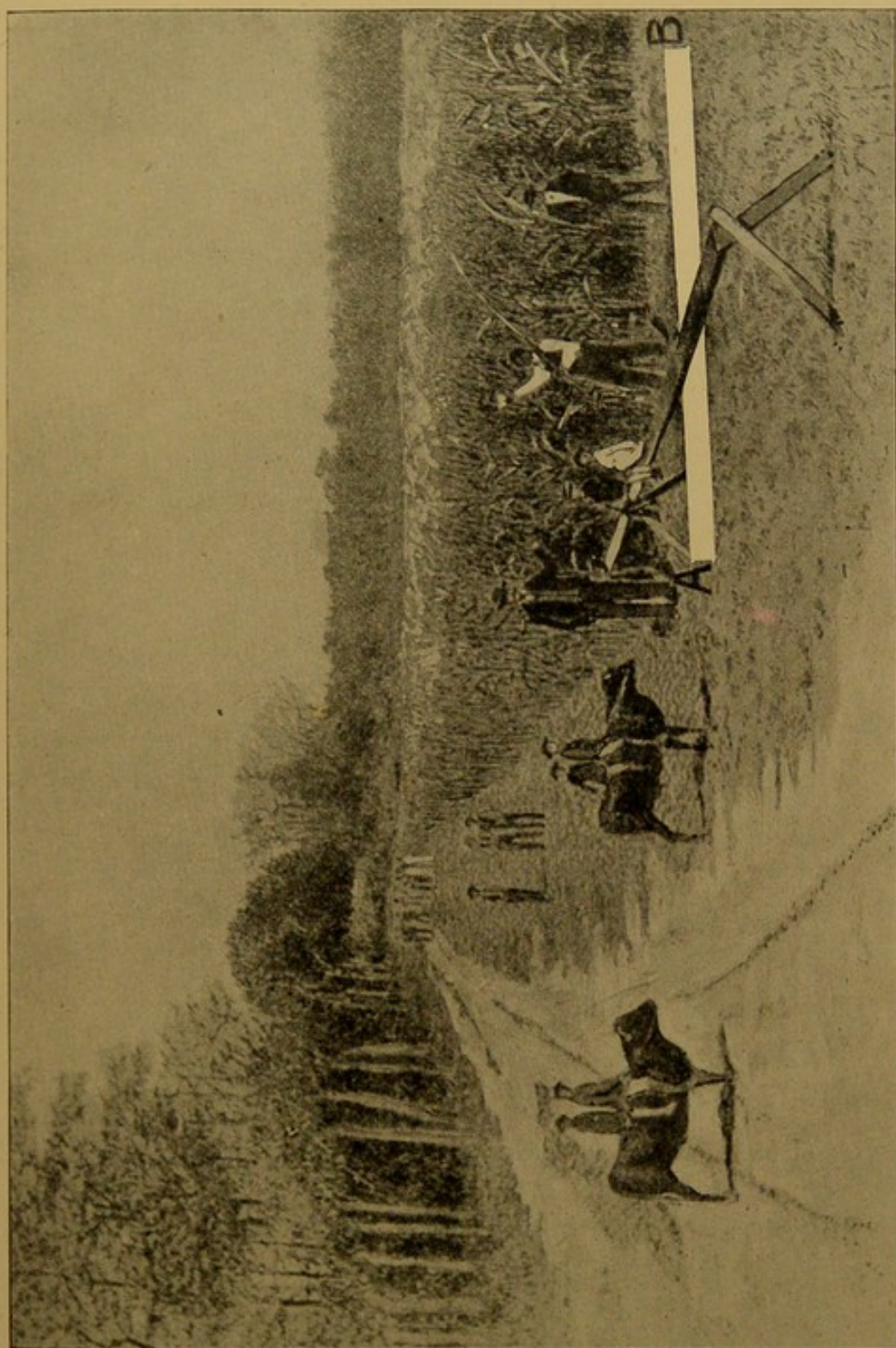


FIG. 37.—Cultivated land about to be attacked by the "army on the march," and prepared for the battle by the "rollers," as at A, B.



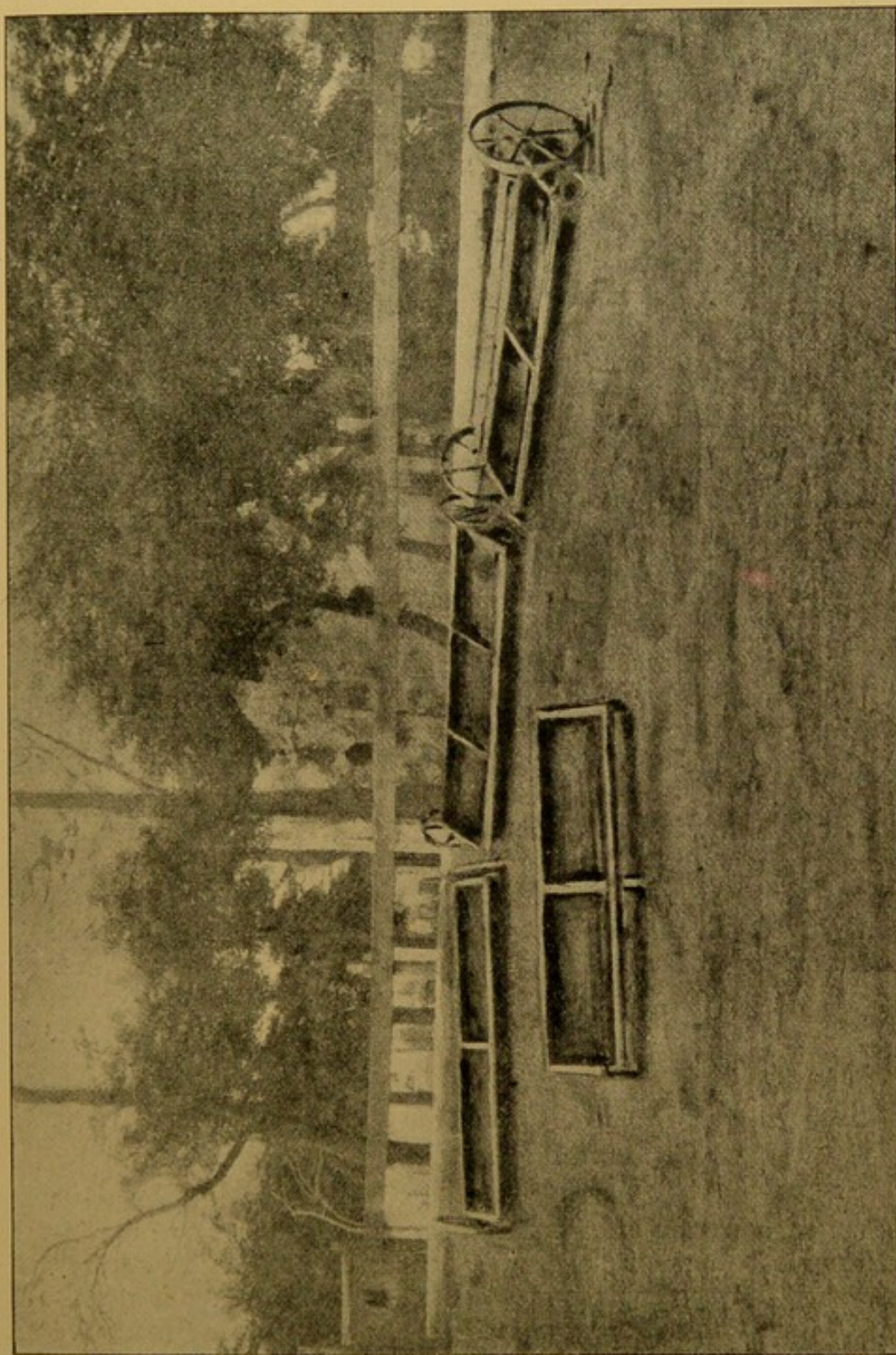


FIG. 38.—Four machines for killing locusts on the Carcaraña principle, or rather plan, as in Fig. 35.



encounter that is deemed advisable in the circumstances. The size and number of the rollers will depend on the size of the army to be overcome and the resources at command. It is always better in such cases to have a few in excess than the opposite, in case of a breakdown. Ordinary wooden one-horse rollers should be about 8 or 10 ft. long by about 2 ft. in diameter. Where trees are plentiful, suitable stems of the required length should be cut, made round and smooth, and the two ends bound with iron hoops fitted with an axle. This roller is inexpensive, and would cost 30s. or 40s., though of course much would depend on local circumstances. If it could be arranged to have the roller in front of the horse, and on its frame a seat for the driver, it would be still better. If necessary, the roller could be weighted with stones, earth, or other material. Rollers may also be rapidly made from sheet iron, and the axles made to project sufficiently from the ends in order to fasten the shafts and frame with a seat thereon for the driver. Then, again, metal rollers may be made in halves or **sections**, so as to allow each part to move more freely—to give more play—on its axle. This plan might suit better in ground that is not so very even. Or, rollers could be made cheaply and readily from large iron pipes. There is no end to the modes (pars. 230–232). Then, if these ordinary rollers are not enough, there is room for invention. Then we have the series of Carcaraña machines, as given in Fig. 38. The simpler but more perfect the contrivance the better.

833. Field of battle to be prepared beforehand.—Inasmuch as the work will be a tiring and arduous one, from its length and continuity, it would be well to make the work as easy as possible for the labourers, in order to save fatigue and store energy. It would be well to draw the rollers over the field of battle for several hours previous to the engagement, and, if possible or necessary, wet or dampen the “course,” so as to make it as smooth as possible. Time will not be wasted in making complete preparations.

834. How the fight is to be conducted.—As soon as the vanguard of the army come on to the prepared battlefield, the first roller should be used, then a second, and so on. Care must be taken to extend as far as the complete width of the army or company, and when at the limit the rollers return precisely on the same path. They must go backward and forward in this way as long as the army continue advancing. The chief thing to be careful about is the speed of the army and the possibility of the column spreading in width. Nothing but experience and tact can supply the requisite knowledge on these points. The fight well begun must be continued till the whole army is demolished. The plan I therefore advocate as likely to be most successful, when the “screen and trap” system as used in Cyprus is unavailable, is to attack the army on the march with rollers on

specially prepared ground, and not to move away from that field, but wait and slay them there, and there only. It may be well to refer to what has been said on this matter in Book II. for further details, so that it is not necessary to enlarge on the subject here.

(4) DIVERTING THE ARMY WHILE ON THEIR MARCH

835. A smooth, glassy, upright barrier better than a high stone wall.—As the reader will have seen, one of the most pronounced characteristics of this larval stage of the insect is its persistent obstinacy. When the insects as a body move, they go in one direction, regardless of all danger or obstacles ahead, until they destroy themselves. There is only one exception, or insurmountable obstacle, that can be put in their way, namely, they cannot climb or fasten themselves on any smooth hard surface, such as tin, glass, smooth wet metals, or surfaces of any kind. Therefore they cannot surmount a fence, such as that in Fig. 43, p. 335, 14 inches in height, made of zinc or corrugated iron. You can with this divert a whole army with a few inches, whereas they easily surmount any ordinary wall, though 30 ft. or more in height, yet if you place a strip of smooth material at any point on the said wall, of three inches in width, they cannot climb over that and pass higher.

(5) CATCHING AND BAGGING

836. The compound Carcaraña catcher and bagger the premier machine.—In addition to the methods indicated (pars. 353, 354, 357, 358), to which I ask the reader's very special attention, and to which I need not refer to further here, I give in the first place the catcher known as the Carcaraña machine, as in Fig. 39, p. 322. As may be seen, this machine (see par. 762, p. 275) is drawn by two horses in the way not uncommon in the Argentine camp, by what is termed "zinging" (cincha). The horse draws by the belly, and not by the chest or shoulder. The rope, a lasso, is made of hide, and fastened to a ring connected with the native saddle. The machine apparently must be placed on low wheels, and its front so placed as to be drawn close to the ground. The field in view is apparently a lucerne or alfalfa one; the insects stick to the stems of the pasture and are caught into the machine, and so long as it is kept in motion they cannot get out. When full, it is emptied into that shown in Fig. 40, p. 323, after the fashion shown in the next figure, 41, p. 325, being drawn up over the incline by the horses to where it is placed, and the men are turning it over to empty their cargo into the tank, to begin again. When in the tank, from its make, the insects cannot escape.

As these Argentine machines only are given in this last Report, and as Mr. Bruner must be well acquainted with the ten North American

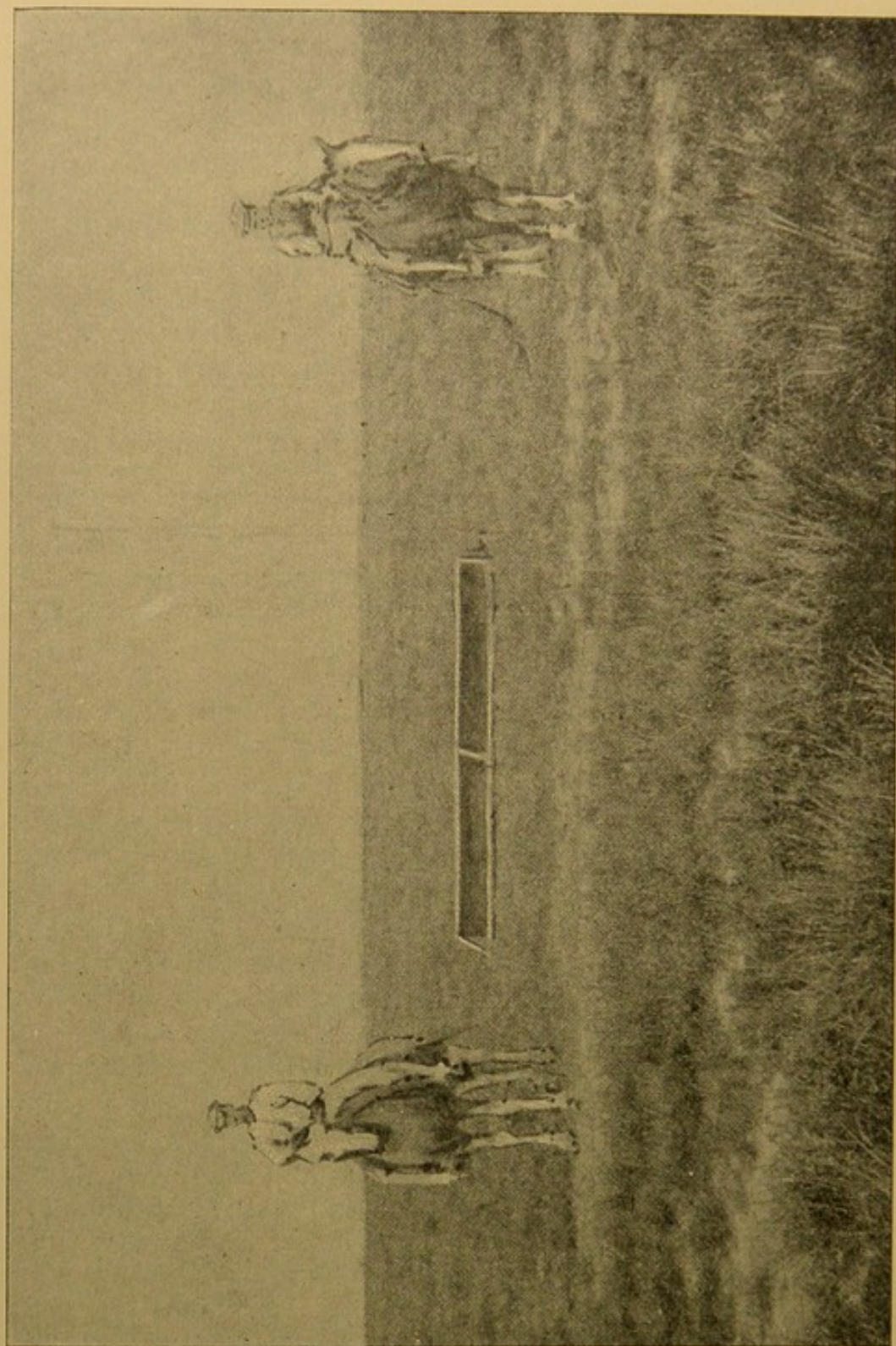


FIG. 39.—Carcaraña machine, for catching hoppers, drawn by horses (zingeing). The field is evidently a large alfalfa or lucerne one, and the hoppers have taken their places on the top part of the pasture, and when the machine is drawn along they are tipped into the receptacle. (See par. 762, p. 275.)

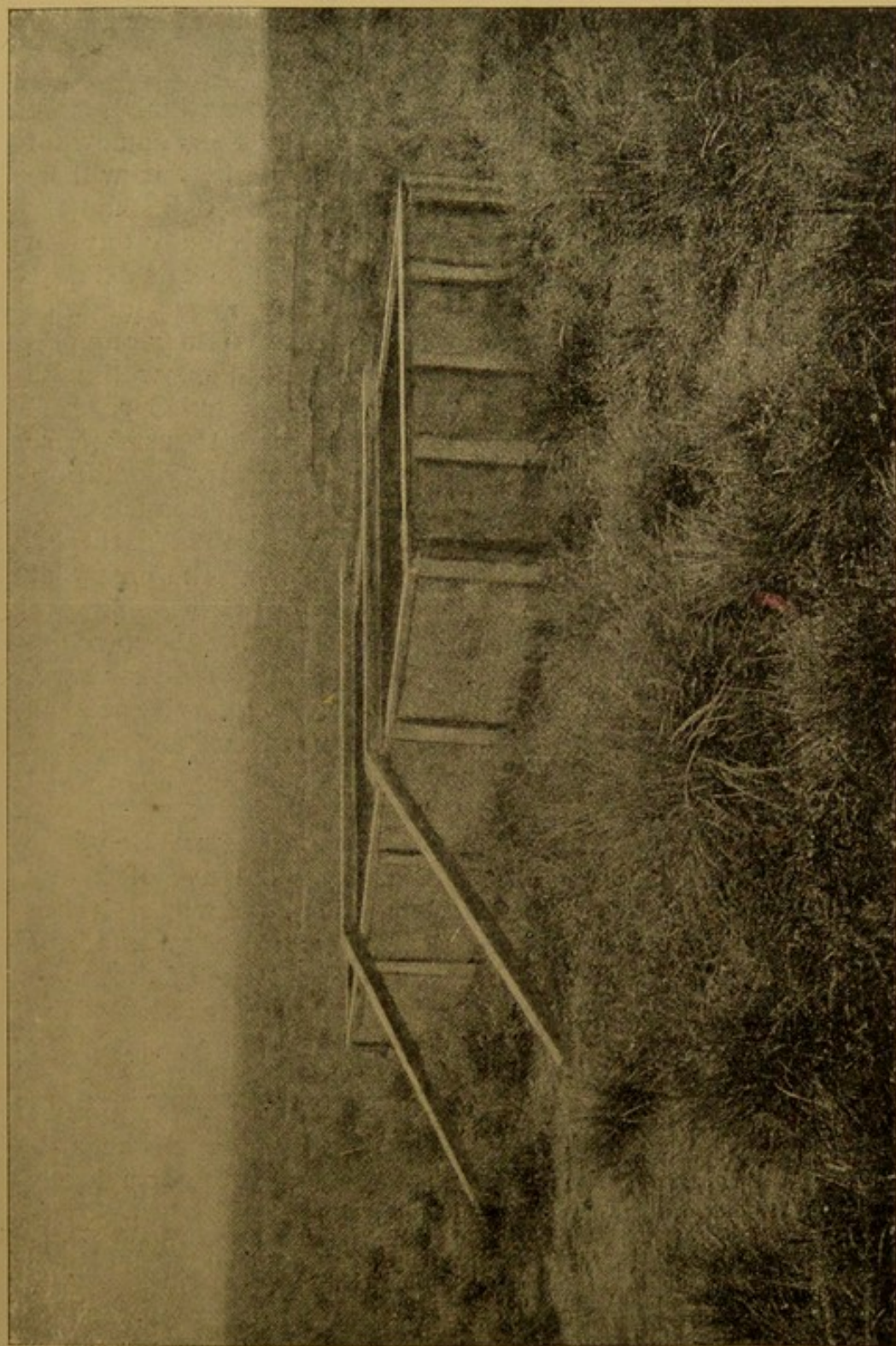


FIG. 40.—Tank for the reception and retention of the hoppers which are caught by the machine described in Fig. 39. On the top margin there is an overlapping projection of from 2 to 3 inches, and this effectually stops them from climbing up and getting out.



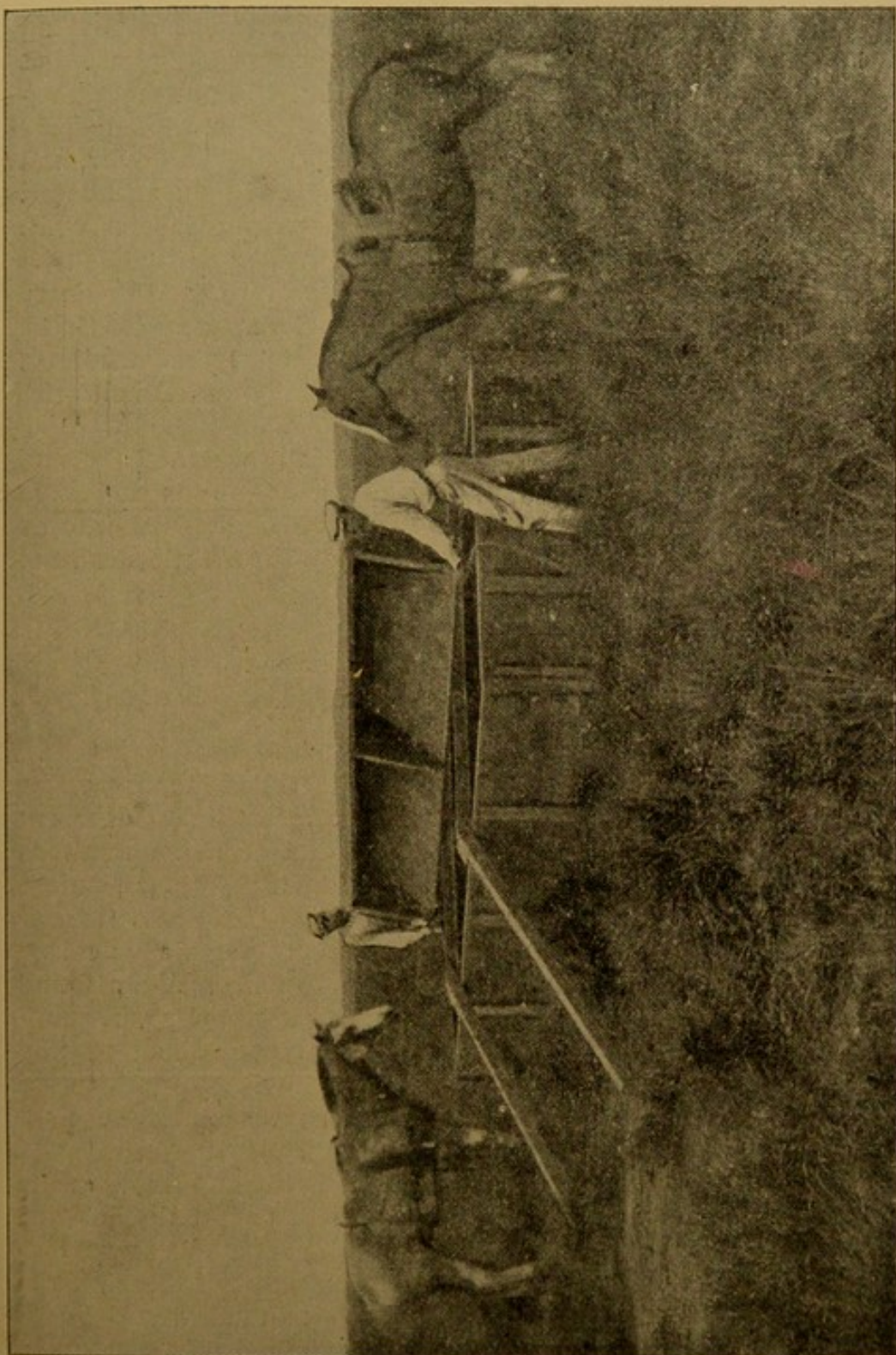


FIG. 41.—Showing method of working. When machine, as in Fig. 39, is full, it is taken to the top of the tank right away, by the horses, to where it is here seen; the riders then dismount, and overturn the locusts into the tank, as seen.



machines for locust-catching (par. 263, p. 113), it is reasonable to presume the Carcaraña machine was considered the best. Fig. 35 (p. 311) shows a compound machine; although there is no description accompanying the figure, I believe it contains a double roller for crushing and an ordinary catcher. By the arrangement of the small chain at the right-hand end, it will be seen that probably there are two rollers with reverse movements; there are two large wheels, and the hoop sort of support is for drawing it near the ground. Fig. 38 shows various types of the same for crushing the captured locusts. Fig. 42 shows a collection of eight machines, which is inserted more for suggestive purposes than anything else.¹

837. Other machines.—As already said, the ways for catching and bagging hoppers are simply *innumerable*, and there are any number of mechanical contrivances for the purpose. In par. 383, p. 146, and following, you have a description of an automatic machine, drawn by one horse, that simply sweeps the ground and bags the hoppers right away. Again, another description (pars. 387, 388, pp. 146, 147) is given of a Balloon Hopper-Catcher. Other kinds are represented by I., II., and III., Figs. 34, 34*a*, 34*b*, pp. 308, 309. All these are given so that ideas may be gathered and thinking generated. In several places bounties are offered for the insects by measure or weight, and although I do not advise the low level which seems expedient in certain places to induce or excite the energies of the people, still I suppose until a better and more public spirit pervades the community it must be tolerated. The price should be as moderate as possible. I thoroughly agree and endorse the view on this point of the author of *On Veldt and Farm*, when it is said: "On the other hand, it is precisely a subject which ought to be a point of honour with all men, to do their level best for the destruction of every locust within their reach, whether on the wing or not."²

¹ Under the head "Catching" the saltonas Mr. Bruner says: "A very neat contrivance for this purpose was used on the estancia of Mr. Greenwood, at Canada de Gomez, in the province of Santa Fé, during the past spring. It consisted of a box made of boards and tin, from the hind end of which branched wings to concentrate the insects and direct them forwards. The box was set at an incline, with the front end resting over a barrel or box to hold the locusts that might be trapped. The device for securing the insects consisted of a pane of glass set in front of a hole in the bottom of the inclined narrow box. Coming to the hole, the locusts naturally tried to jump across, and, on striking the glass, fell into the receptacle below." I happen to have met Mr. Greenwood, and believe his ingenuity is of a high and useful order, but from the description here given, and which is given in full, I fail to construct the said machine or see the beauty or general utility of the invention. I have also given it to clever mechanics to see what they could make of it, but with a similar result. I give it here because I appreciate Mr. Greenwood's mechanical ability, and it may lead others in this part of the world to invent one on similar and more practical lines.

² Referring to cost of "catching" saltonas, Mr. Bruner says: "Experiments which were made at Carcaraña show that under ordinarily favourable conditions the

(6) TRAPPING

838. The most successful plan.—Of all the artificial means that can be used to check or exterminate the plague of locusts none deserves greater attention than those measures to be considered under this heading, for up to the present no other plan of human ingenuity has been so successful.

839. The locust's cunning must be met with superior guile.—We have seen that the locust, especially in its hopper state, is instinctively possessed of some cunning, and is very obstinate and not easily thwarted or turned aside from its purpose; that it pursues its course irrespective of ordinary obstructions that may be placed in its way; that it will run up a wall thirty or more feet high, and it will cross rivers. This is best evidenced or seen when the "army" is on the march. No other proof except what they manifest when on the *march* is required to show us that they are possessed of such indomitable qualities. If driven, they know how to be coaxed or refuse to be driven, as evidenced from pars. 613, 622, 648. Therefore to give battle to them by laying a "trap" or "snare," or to succeed in diverting their march by strategy, or so deceive them, is one of the means most advisable in this stage of the plague that can be open to us. As a matter of course this "trapping" has been used in all countries for centuries in one form or another. To do it anything like justice I must attempt to classify the modes or divide up the subject. I shall do so under the following heads:—

- (a) Ditches or trenches, with simple or under-sloping sides.
- (b) " " with water.
- (c) " " with water and coal-tar or coal-oil.
- (d) " " with overlapping flap of tin.
- (e) Pits—various forms.
- (f) Laying down prepared grasses, pastures, or other substances, to entice them to partake and then destroy them.
- (g) Barriers—various.
 - (1) Fences made from branches or hedges.
 - (2) Fences made of wood, simple or specially prepared.
 - (3) Fences made of corrugated iron, zinc, or tin.
- (h) The "screen and trap," or "Cypriote," system.

840. (a) Ditches or trenches.—As already stated, this means as saltonas in their fourth and fifth stages can be caught by driving into trenches for, not to exceed, seven paper dollars per ton [*i.e.* about 12s.], and with the Carcaraña machine one and a half dollars per thousand kilos. [*i.e.* about 2s. 6d. per ton]. Of course these figures represent cases where everything was done in accordance with the insect's habits, and where the work progressed smoothly under proper instructions and supervision. The insects were also present in very large numbers, but were not more numerous than is often the case."

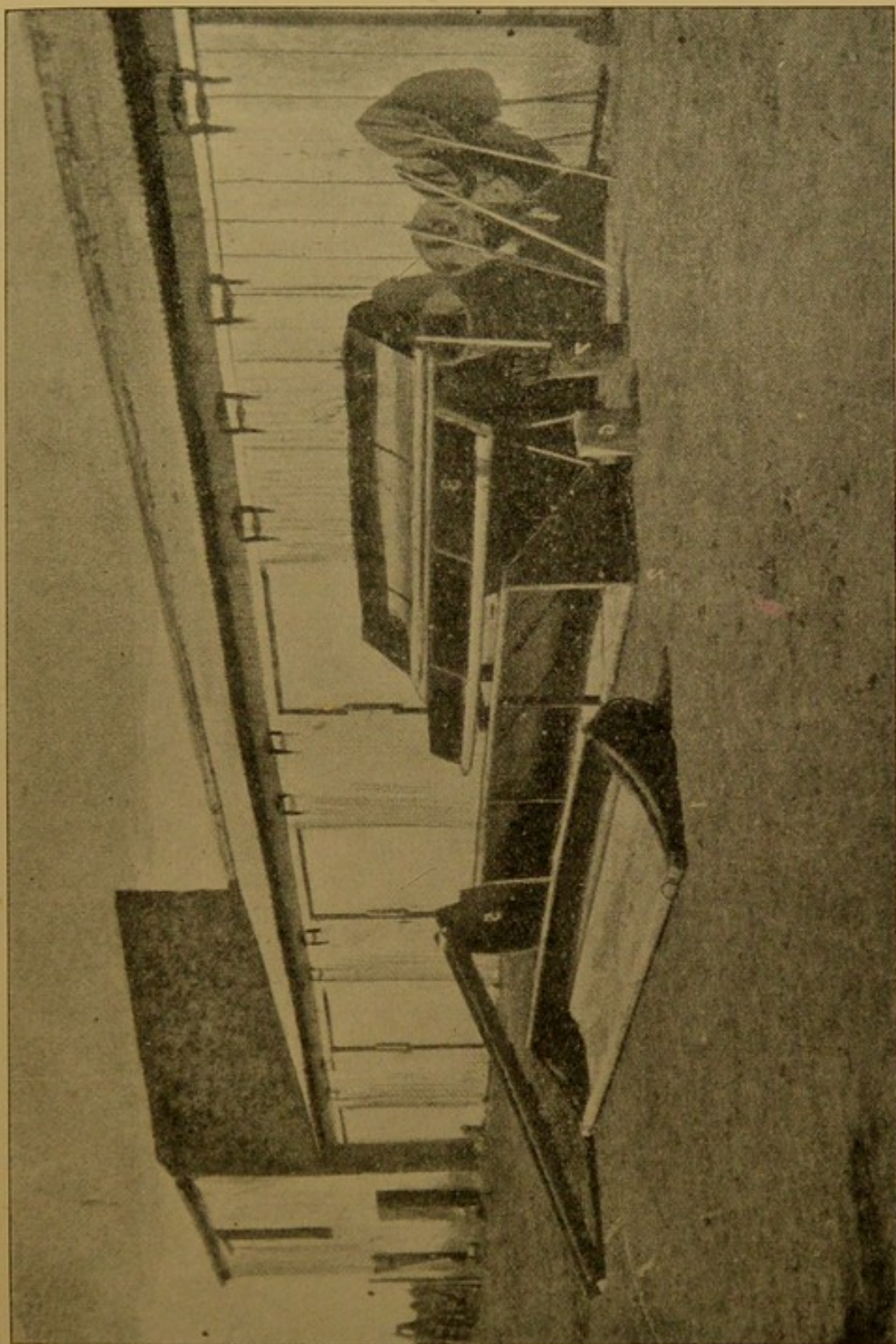


FIG. 42.—A collection of eight instruments, all useful in their way, and references to which will be found in the text.



an obstacle to the progress of the "army," is one if not the most used by all the Latin and Eastern races—in North and South Africa, in Europe, in South America, in India, and in China. The Italian colonists use it largely in the Argentine, and it is common in South Africa—I have seen it in the neighbourhood of Johannesburg. Notwithstanding what is in par. 222, I am surprised that the people have not taken the trouble to examine what history says, and says distinctly, in regard to the experience of this method. In the first place, I will point out the want of unanimity in regard to the dimensions of the ditch or trench. Some advise 18 in. wide by 1 ft. deep, others 18 in. by 18 in., others 2 ft. wide by 18 in. deep, and others 2 ft. by 2 ft. And so on, according as the parties believe in the jumping capacities of the "army" for which the trap is formed. But there is a fundamental error underlying this method, and I do not wonder that it has failed under every age. The test of the success of the plan is not to be measured by the distance or height the insect can jump at this time, but by its power to climb. If, then, it can climb over a wall or run in any direction upon it, although 30 ft. high, why on *a priori* grounds should it not climb the side of a ditch or trench 2 ft. in depth? So it *has always* done it, without an exception. I have never been able to discover the advantage of having recourse to this means—at all events pure and simple. It serves only as an impediment to the progress of the insects without a doubt, and when in the ditch or trench they may more easily be got at and killed or mangled.

841. The **ditch** should be about 2×2 ft., and if the locusts are travelling from the north towards the south, the south side should be as perpendicular as possible; better still, if under-sloping, and certainly not slanting so as to render it easy for them to crawl or creep up. It can be easily perceived that if the soil is dry and hard it will cost a considerable sum to make a ditch or trench of the kind. The point to be judged is, whether or not advantages proportioned with the cost can be obtained from this method? I am bound to say that, from what I have seen, the enlightened portion of farmers do not think so. There is something catching in the idea, but it is far from satisfactory. The usual plan is that when the hoppers fall into the trench, a man walks therein and kills them with a scourge. This goes on until the army thins away, or the ditch is filling up, or the stench is so bad that another has to be made and the earth thrown into the old one, and the locusts therein covered up and buried.

842. It is rather difficult and costly to make an under-sloping side, and if made, the falling portions will require considerable attention and repairs. Therefore, while the "under-sloping" cut would be better, it will be found in practice, when this plan is decided on, that the perpendicular side will be that most expedient and adopted. There

may be small limited localities or circumstances when this method may be useful, but on a large scale for the extermination of the pest I am totally opposed to it, and believe it will, as always hitherto, result in a waste of energy and effort.

843. (b) Ditches or trenches with water.—Where it is expedient to have water in the ditches or trenches referred to above, the matter is *slightly* altered. Undoubtedly to have water stagnant, or better still, running, would be an aid or advantage. But, nevertheless, such would all the same be only an "impediment." The "army" in its march crosses streams or rivers of water, therefore a small ditch or trench such as that described, even with water in it, cannot be expected to be an effective barrier to their progress. However, opportune means could be taken to effect greater destruction, if the ditches did contain water. This, as a rule, can only be got where irrigation is possible, and in this it is safe to leave it under the surveillance of the farmer or person who has charge of that district, to devise means whereby the water can be utilised to aid in the destruction of the pest. The ditch could be stemmed at various and convenient points, the locusts mutilated, removed, bagged, and disposed of.

844. (c) Ditches or trenches with water into which has been dropped some coal-tar or coal-oil.—It would seem that the toxic effect of coal-tar or coal-oil on locusts has the most powerful influence, and kills them right away. The great thing is that a little seems to go a long way. Various contrivances can be invented whereby, in a ditch with running water, the coal-oil could be sparingly introduced by, say, a drop falling into the water every minute, or every five minutes, as the case may be. A drop spreads in the water, and its toxic effect has great influence. Bushels upon bushels and sacks upon sacks of hoppers may thus be caught or trapped and destroyed.

845. (d) Ditch or trench with overlapping flap of tin.—Count Mattei, of Cyprus, by accident, in 1860-61, observed that the hoppers or saltonas could creep up or scale the wall that surrounded his residence, although 30 ft. in height, which he erected in part to keep the "army" out, and so save his crop of fruit, etc.; but he could not do so until he effected his purpose by making a perfectly smooth strip right along the wall, to the extent of a few inches in width, such as is or may be done with cement. He therefore surrounded the top of his wall outside for 4 to 6 in. in width with a perfectly hard, smooth surface, and established the fact in this year and the next that locusts (the hoppers) could not attach themselves to smooth surfaces, like flies to glass, for example. The claws on the front and middle feet especially are short and weak, and unfit them to affix themselves to such surfaces. This observation of the Count, simple as it was and is, has changed all our chief notions

of combat with the insect, although the Turks in Cyprus paid no heed to Mattei's proclamation, and it lay in abeyance for over twenty years, until the British took it up successfully in 1883 (through Engineer S. Brown), since which time it underlies in one way or another in principle the artificial mechanical combative means in vogue.

846. If the artificial propagation of nature's remedy by the spread of fungi can be under our command, it will undoubtedly occupy a first or chief place, but the principle underlying the observation of Mattei is of the very greatest importance, looking at the combat from an artificial human point of view. It is at once seen that their capture is thus safe and easy, for when once taken they can neither crawl nor jump out. It is clear that if a few inches (three, or even two) of tin or any smooth-surfaced material were projected and fastened all along the margin of the ditch or trench, and if on both margins, an effectual trap would thus be made until it was completely full. None could escape. If, then, it were found as cheap to make a large ditch, say a metre or yard wide, by the same depth, and place a narrow strip of tin or zinc or corrugated iron along both margins, covering the upper or superior surface with earth, and allowing the under surface to project 3 in. from the margin on each side; I say, if it were found as cheap to do this as to erect an upright "screen" or barrier, this would be an excellent and efficacious plan undoubtedly. Suppose you had 100 miles of such a trench, it would be the means of burying an immense number of the insects. If the one ditch were not enough, then another could be opened, and the earth of the new one cast above the dead and dying hoppers in the old one. And so on. I need not further enlarge upon this; if found easy to work, and as economic as the "screen" to be afterwards described, it would certainly be efficacious as a trap. Undoubtedly the "army" would *march* into it, or they could be *driven* into it. In regard to "*driving*," I shall deal with it presently.

847. (e) Pits—various forms of traps.—Pits as traps for the hoppers may assume various forms according to the ingenuity and capability of the person who employs it. We have to deal with walking visible insects, and the object is to entrap them into a pit. The plate (Fig. 43) shows several things connected with the combat. Clearly there are two fences or barriers visible converging at a point. Now let us suppose that the saltonas are marching from the direction we ourselves stand in when looking at the picture, they will then go against the fence, and if the fence be of corrugated iron they cannot get over it, but will walk towards the converging point. If, then, a zinc barrel or large tank be placed there, whether buried in the ground so that its margin is level with the surface by which the hoppers had nothing to do but walk in and perish by means of some poison (for

which Sr. Sicaire asked for no less than thirty or forty square miles of land!), or if raised as in No. 5, Fig. 42, the principle is exactly the same—the marching “army” are entrapped as much as if they entered into a pit of such depth as you can imagine or make convenient.

848. *Driving.*—Incidentally something has been said on the subject of “driving,” and all who have any experimental knowledge will realise that some acquaintance with this practice may be at any moment in requisition. Now three things ought, in attempting to “drive” the hoppers, be borne in mind, namely, (1) that the insects are easily confused and discouraged; (2) that while somewhat cunning, they *can* be “driven” or coaxed onwards slowly, but not rapidly; and (3) that they are not great jumpers at this stage—they can jump much higher and farther in proportion when they are fully fledged. Bearing these things in mind, those “driving,” having bright-coloured flags or banners, should not approach too near them nor go too quickly, but coax them onwards by moving the flag in their direction every few seconds, more or less regularly, as they may respond to the call, being distant five or six feet from them. Fig. 43 will show how this can best be done. If worked irregularly, they become obstinate, cluster together, refuse to move at all, or go in an opposite direction to that desired, after the nature of pigs. You must then withdraw from them, allow them to recover themselves, and proceed systematically as described above. When in circumscribed places, such as gardens, orchards, small paddocks, or certain roads, as the railroad, they may be directed by a barrier, such as in the figure; or “driven” towards it, and trapped in a *pit*, as already described.

849. *Dead locusts as a manure.*—It has been mooted that accumulations of dead locusts generate sickness, and in this opinion no doubt the general rule will prevail. But from the following extract it will be seen that excellent use can be made of the dead as a first-class manure.

850. *Locusts and sickness.*—A work on Algeria describes the treatment of dead locusts. They were buried in trenches, with a layer of lime, and then about a foot of gravel on top. In about three months they were dug up, and it was then found they made first-class manure, 300 per cent. better than guano! The same work mentions that the coast for about ten miles was covered with locusts, from which there was great stench, to which an outbreak of typhoid fever was attributed. It will be remembered that a few weeks ago a large quantity of dead locusts were found on this coast (Natal), and along the side of the Bay. Is there any connection between this and the outbreak in Durban of Dengue fever, or what is commonly known as German measles?

851. (f) *Laying down prepared grasses, pastures, or other substances to entice the locusts to eat or take shelter, and then destroy them.*—When the saltonas or hoppers have no disposi-

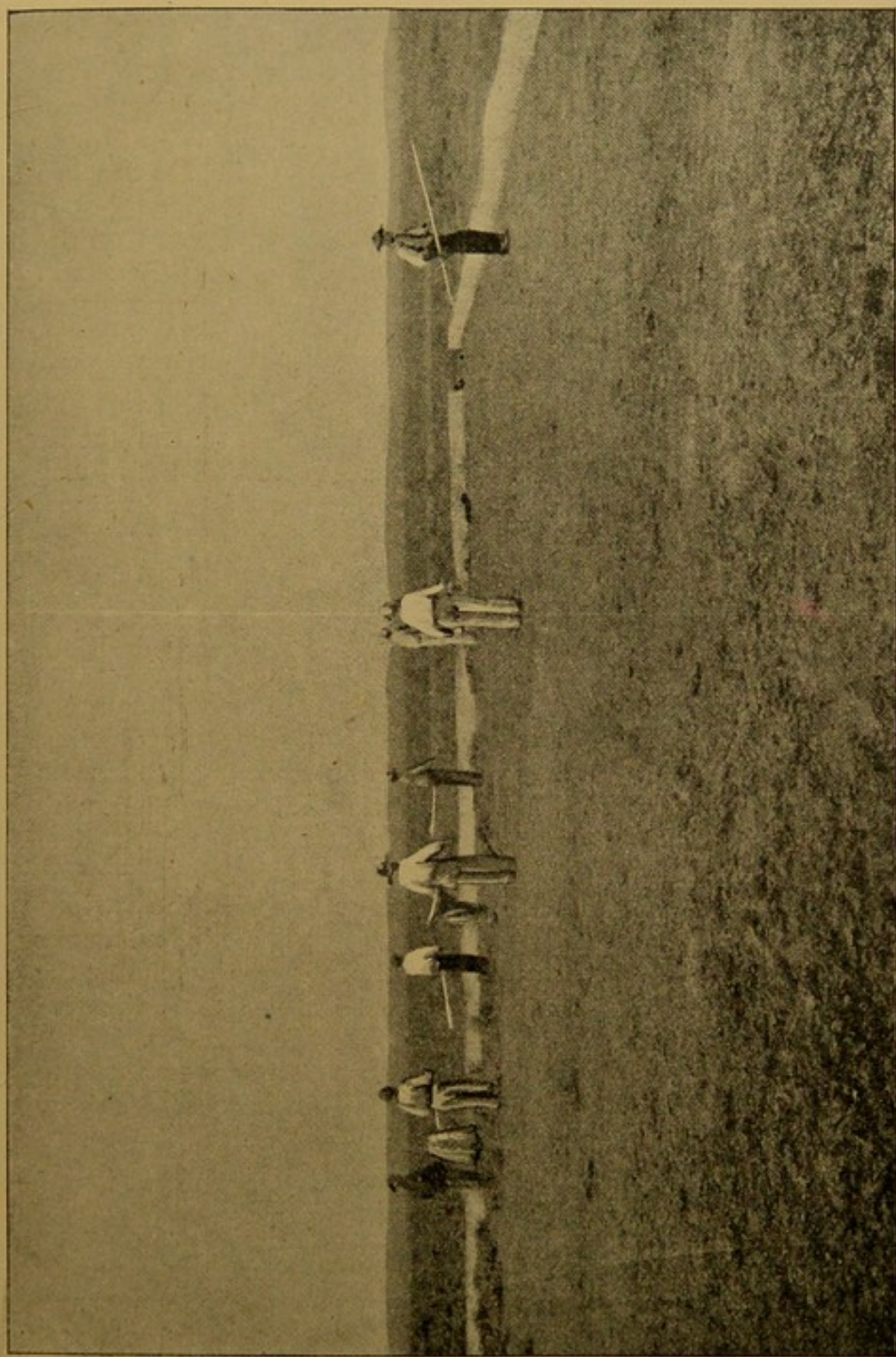


FIG. 43.—Showing a plan of fencing by which the hoppers may be caught or otherwise managed. It will also be seen from this how the hoppers can be "driven" and got into a tank at the junction of the two fences and secured in tubs, either sunk into the ground or quite above it, as represented by 5, 6, 7, in Fig. 42.



tion to march, either before their proper time to commence, or after they have finished it, and previous to the final moulting, it may be deemed wise to kill them. If the natural grass in which they live is very dry, fire may be set to it, which may destroy all of them. But if the natural grass is very green it will not burn; then it may be cut, dried, and set on fire; or, if this be impossible or inexpedient, then dried pasture may be *laid* down, and the insects "driven" to it, and then when under cover of this at night, or in the early morning, or on a cold day, fire may be set to this, and the brood destroyed. They may be trapped in this way by means of other substances than pastures, such as by spreading poisonous compounds on sheets of tin or in pans, which seem to have an attraction for the insects; but this matter will be dealt with under another head—poison.

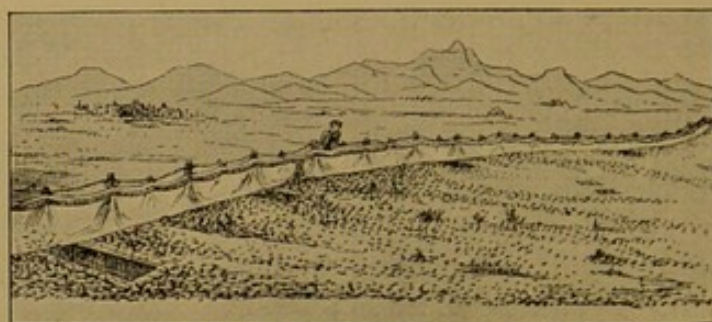
852. (g) Barriers.—(1) *Fences made from branches of trees or hedges.*—This class of barrier may be dismissed in a line or so. It is of no use (see par. 134), and only acts at best as an impediment, or slight obstacle, or cover to shelter them. The only use would be to set it on fire, if dry, and many underneath it.

853. (2) Fences made of wood.—When made of wood simply it is of no use as an effective barrier, for the insects can crawl up on the wood and get over the top. But if the top be well coated for a few inches with coal-tar, or with a strip of three or four inches of tin or American oil-cloth, or anything with a smooth surface, it will prove an effectual barrier. The only thing in the case is to consider whether or not it is expedient, from the cost it would entail. If the board were one foot high, and from two to three inches of its top quite smooth, it would be ample. My impression, however, is that ordinary canvas or zinc would be cheaper, and more handy to move about from place to place. At the same time, if there is wood at hand, and the more suitable material be not expedient, then by all means use the board fence, prepared as above, and fasten them perpendicularly in the ground. By such means the "army" may be conducted to a trap, as above narrated.

854. (3) Fences made of corrugated iron, zinc, or tin.—Undoubtedly, if fences of either of these three materials could be got readily, they would be far better than wood (Fig. 43). They need not be more than about one foot or fourteen inches in height. If ordered from home, the ordinary corrugated sheets might be split lengthways in the middle, and they could be easily fastened to uprights. Plain smooth zinc or tin may be equally well used, and perhaps the latter might come out cheapest, if ordered from home. Tin would be very light in weight, and very durable. These little trifles are sometimes worth attending to when hundreds of miles on end may be required. The special "trap" for the insects may be set in the usual way as before. It is easy to see how vast may be the massacre if fences and traps are laid down properly.

855. (h) The "screen and trap," or "Cypriote," system.—This is a combination of an adaptation of the three forms—*a*, *e*, and *g* (3)—par. 839. Undoubtedly it is the most marked and successful in the extermination of the insects. Its use in Cyprus "marked an epoch" in the battle against the locust plague. Taking advantage of Mattei's simple discovery, as already stated, the British being baffled in their attempts by the other modes, in 1883 erected no less than about 318 miles of a screen (Fig. 44) of calico one yard wide, putting about three inches of American cloth at the upper margin facing the marching

A.



B.

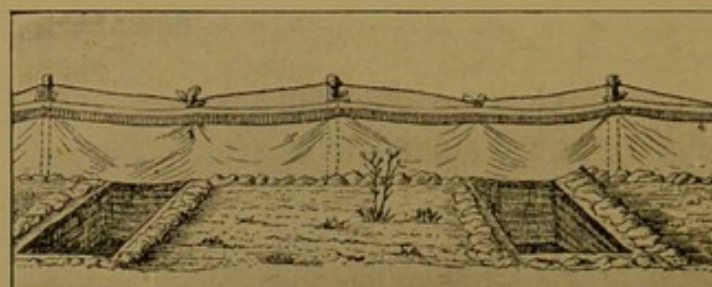


FIG. 44.—Illustrating the "screen and trap" method. *A* gives a view of the continuous extended screen *in situ*. *B* shows the "screen" and the "trap" or pit in front of and at right angles to the screen.

army, and fastening it to uprights by means of tapes to keep it up and even; and, covering the other or lower margin for a couple of inches with earth, so that the insects could not pass below, they were enabled effectually to stop the march. They at the same time made 65,000 small traps or pits, about a metre (or 3 feet 3 inches) deep, at right angles to the screen, and about 7 yards or metres apart from each other. These pits were surrounded by a piece of tin, which projected into the pit some 3 inches. On the top it was covered by earth. As the insects could not pass the screen, they became confused, and, wandering about, fell into the pit or trap, and they could not get out. They were, of course, killed when the pits were sufficiently full. In this way 55,000

of these traps were used and filled, and it was supposed, or roughly calculated, that from the locust area of about 1400 square miles (out of the total of 4000 square miles which the island contains) no less than 195,000,000,000 (195 billions) of locusts must have been destroyed by this means in this one year. It was repeated next year, but little was left to be done, and for the first time the locust plague was exterminated by human agency in the history of the world. In 1882 the British authorities paid for egg-collecting £12,262, and there was no appreciable improvement, whereas in 1883 there was spent altogether on the "screen and trap" system £12,511, with the result that the plague was entirely exterminated.

856. More economy possible.—But the "screen and trap" system may be much cheapened from what it was then. We now know that there was no occasion to have the screen one yard high. Experience has since taught us that one-half would be ample. Suppose, then, that the yard width were divided in the centre, and that the American cloth was economically arranged, so that by inserting some padding by which it might be bulged out, not more than two inches at the top or upper margin would be required. Take then a roll of iron wire (Nos. 7, 8, or 9), fasten the ends, and strain well, having a few intermediate posts to keep it up in the centre, arrange lower margin as before, with sufficient earth to prevent the insects passing through, fasten the upper margin to wire by tape or light fine wire or cord, and the screen is complete. Economy could also be effected in regard to the pits or traps. Make them somewhat deeper and larger. The cubic space in this way would be much larger, whereas the expense of tin round the margin would not be proportionally so great. The pit or trap should not be very far from the screen.

857. In my opinion this mode or plan is far and away the best and most effectual in combating and exterminating the plague wherever it is expedient to have it, and the best in this as in other cases is the cheapest. There is no other equal to it. The most effectual exterminating means will probably be found cheapest and most economical in the end. A rough idea may be obtained from the sketch plan (Fig. 44).

(7) BURNING

858. The saltonas or hoppers may be burned at two periods—when gathered in heaps during the first eight or ten days after being hatched and spread out on the pasture, either before or after "marching." If burning be the mode decided on during the first of these two periods, it will be necessary to have recourse to placing inflammable material amongst or over them. Kerosene, paraffin, petroleum, coal-tar, coal-oil, and various other oils or substances may be sprinkled over the heap or

bunch,' and a light set to it. Great execution can be effected in this way in the course of a few hours at night, or in the early morning. If dry old hay or straw be lying about, place it here and there; the young will gather there for cover at night, and when so gathered, set fire to the straw or hay, and all will be destroyed. Torches made of tow or any sort of rags dipped in kerosene, petroleum, or paraffin, and lit, will answer the purpose for burning them very well. Other methods will be found in pars. 339-341.

. 859. When the hoppers are spread out on the camp, and if the season be far advanced and the grass dry and burnable, fire may be set to it, and in this way most of the insects will perish. But this must not be tried if early in the season, as nests, birds, and other useful insects at such a time might be injured at the same time as the locusts. In dealing with fire in the camp great care is required lest any forest should be set on fire, as thereby much damage might accrue. Pans heated by fires inside them may be drawn over the hoppers by means of horses, and much injury done. Of course so much depends on the resources of the locality and the ingenuity of the people who live therein. Naturally following the plan of burning the insects comes that of

SCALDING BY MEANS OF STEAM

860. A well-known and expert man in most matters thus writes on the plan:—

Anent the destruction of the locusts . . . my plan is to have an engine on wheels, made on a peculiar principle and simple, for the generation of steam in a large tank at a high pressure. From this tank would run a leather pipe with a brass nozzle, to be worked like the tube of a fire-engine. I would make the engine high, so as to be easily drawn by a pair of horses or a yoke of oxen, so as to reserve all the steam generated for the one purpose of exterminating the locusts. It would not be difficult for a mechanical engineer to draw out the plans for such an engine; I can only furnish the idea. The engine, with the steam at high pressure, would be drawn slowly across the line of march of a manga of saltonas, and a man walking alongside would play the steam into their ranks with instantaneous and deadly effect. The destruction would be thorough and complete; the insects would not have time to say their prayers. It would be the duty of the colonists to keep the engine continually supplied with fuel and water, but the engine itself should be supplied by Government. I calculate that one such engine would amply suffice for a colony of eight square leagues. I do not know what such an engine would cost, but that is a secondary question; if it turns out effective, as I think it would, it does not matter if it cost two, four, or ten thousand dollars. I suppose it would cost about three thousand, for the machine would have to be well made, capable of rapidly generating steam and retaining it at the

highest pressure. After all, my idea may not be new. In my opinion, steam is *the* means for the destruction of the locust. W. P.

861. This writer was well known as the special correspondent of the newspaper in the Argentine from which the cutting is taken—his initials will be recognised by many—and it is inserted as illustrative of the difficult and stultifying influences that surround the subject. Although a mere detail or trifle, it is not easy to see that a "leather pipe" would long be serviceable in the presence of such heat as required, and yet a light, flexible, and movable pipe was necessary to carry out the fundamental expediency of the idea; but perhaps this could be got over. It shows how careless even clever people are about trifles, which in this case would vitiate the entire process. The great Michael Angelo said, "Trifles make perfection, and perfection is no trifle."

(8) CHEMICALS AND POISONS, ETC.

862. It is not surprising that chemical substances should have been resorted to in order to get rid of such a pest. However repugnant it may appear to some to lay a trap for the insects, anything would be justifiable that would prove effectual. Experience, however, has proved that poisonous chemical substances may be eaten when laid down for the locusts by other creatures not intended to be hurt or jeopardised in the smallest way. Therefore there is a strong current of feeling against the laying down promiscuously of poisonous substances on the off chance that the locusts only will eat of the same. For example, fowls and many kinds of wild birds and insects—allies in the campaign—have been known to have died from these poisonous chemical substances in numbers far more than the locusts, and these in greater numbers would be killed by the former if not poisoned. It would be an error to infer or suppose that such instances are exceptional. On the contrary, it is so much considered the rule that few are now bold enough to advise its use promiscuously.

863. But it may be well here to give a list of the poisonous chemical substances in ordinary use.

Chemical Substances or Combinations ordinarily used for Poisoning Locusts

1. Bran and arsenic.
2. Arsenic solution (arsenic and water).
3. Arsenic and treacle.
4. Paris green { Ordinary of } 1 lb. to
5. London purple { commerce } 200 gals. water.

6. MacDougall's Fluid (Sheep) Dip.
7. Millborrow's Exterminator.
8. Coal-tar.
9. Coal-oil.
10. Petroleum.
11. Kerosene.
12. Creasote.
13. Paraffin.
14. Carbolic acid.

Various Chemical Combinations and Patents

864. Two divisions.—Among the ways in which these chemical agents act on the insect, it is easy to make two manifest divisions—
(1) Those that kill the insect by their partaking of and eating the poison ;
(2) those that kill the insect when it touches them from without.

865. Care to be exercised in placing the poison.—It may be expedient, therefore, to pay great attention to this matter, as if the latter is sufficient to kill, it is unnecessary to leave the poison about here and there, and the risk of injuring birds and other animals and insects is completely avoided so far as leaving the poison in bulk is concerned. Of course great care and attention must be used to see, while using the "Contact" preparations (as the latter of the two divisions above mentioned is termed), that the poisonous substances should not accumulate on the pasture or vegetation or fruit, and so produce injurious effects in this way. It is needless almost to say that the insecticide which also kills the vegetation as well as the insect should be laid aside, and another at least tried. Now, there is another element that ought to be considered, and that is the expense. As a rule chemicals are cheap, but whether or not, it springs from a desire to be speedily rich—patents are procured, or secrets are made of the combination. What then might be, and really is cheap, is made dear, and the country is injured. Public spirit is wanting, and the spirit of selfishness shows its head at every turn of the stile. Not to divulge what is within one's knowledge, and which makes undoubtedly for the country's welfare and the public weal, is unworthy of an honourable man. To keep important information as a secret to oneself for the sake of pecuniary gain and aggrandisement by filthy lucre, is mean and contemptible in the extreme. "He who gives gets, and he who keeps loses." There is a generosity that enriches and ennobles, while the reverse impoverishes and dwarfs the character.

866. A "spray producer."—In the list of chemical poisons for administration to the insects, I have placed references whereby the subjects may be studied directly from the words of those who have

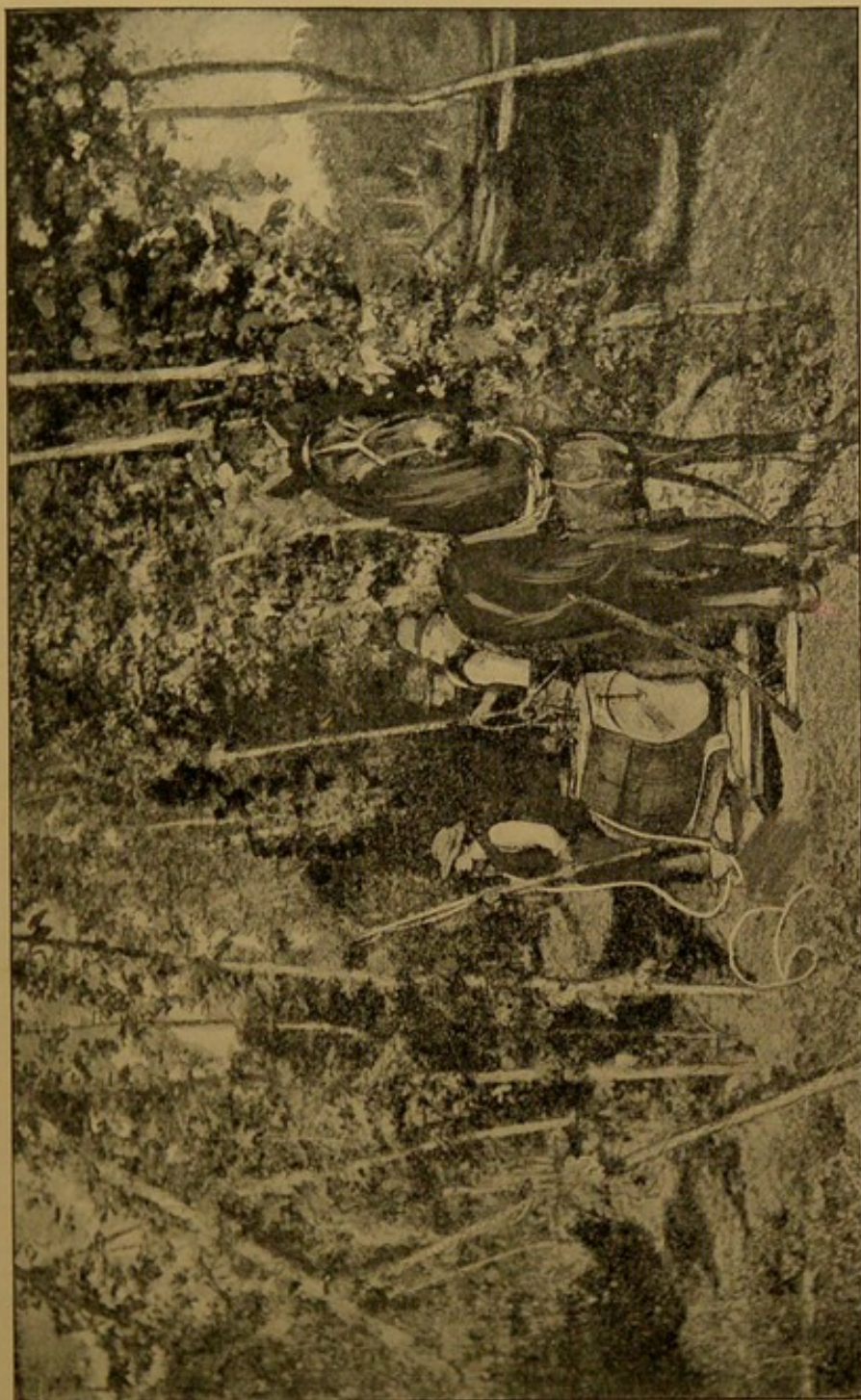


FIG. 45.—Showing specimen of spray producer by which the hoppers, or full-fledged locusts (when roosting), may be killed by one or other of the "Contact" poisonous preparations in vogue.



used the substances. I will therefore merely here give a plate showing a useful spray producer (Fig. 45), which ought to be the most suitable way for applying the "Contact" preparations direct to the locusts, whether saltonas or voladoras. The use of petroleum, which is not injurious to grass or plants, by the spray, when the hoppers are gathered into bunches or heaps, would produce a great massacre. From the accompanying advertisement from a Buenos Ayres paper it would seem that MacDougall's Fluid Dip is safe, and if purchased at a conveniently moderate price, which in this matter is a great desideratum in view of the large area to be operated on, it could be tried, as it does not injure the grass or stock.

"Locusts, Locusts"

867. "By using MacDougall's Fluid Dip at 1 to 70 of water, you can kill thousands per minute.

"This fluid does not poison or damage the grass, being the original non-poisonous dip."

868. I now append a note that appeared in the *Natal Witness* from Mr. Millborrow on his "Exterminator," and thereafter one from Mr. Wilkinson on arsenic and treacle.

Millborrow's Exterminator

Mr. Millborrow writes to the *Witness*:—

Since it has been determined by the Government to continue for the present the services of the Locust Officer, I, as a veterinary surgeon to a large extent dependent on the prosperity of the farmer in this colony, have resolved to give the Government the recipe for my Locust Exterminator, to be used, if they will, for the benefit of the farmers at large. After a number of experiments, I have come to the conclusion that "spraying" is the most effective form of destruction of the insects, and I have lately disposed of several thousand gallons of the Exterminator, which has been used in this way with the best results. The constituents of the Exterminator are cheap and easily obtainable in the colony, and two men could make up as much as a thousand gallons in a day, and, notwithstanding its deadliness as far as the locusts are concerned, it is non-injurious to stock of all kinds. I have heard from various parts of the colony of various swarms of young locusts, which will be on the wing in the next two or three weeks, and now is the time that vigorous steps should be taken to stop them from arriving at maturity, and I trust therefore that the Government, on taking advantage of this offer, will, without delay, place supplies of the Exterminator in the hands of their officers, so that every means in their power may be used for the destruction of the insects. I feel confident that the swarms now maturing are more numerous than those we have just

experienced, and unless they are promptly dealt with it will be quite useless for farmers to put in any winter crops.

Arsenic and Treacle a Success

869. Mr. Gilbert Wilkinson, of Ottawa, Victoria County, writes :—

Having experimented in various ways to destroy the locusts by poison, I find the above the cheapest and best method. Locusts are very fond of treacle, and smell it a long way off, and come down to it from the cane to the small tins placed every ten yards along the roads. They eat it greedily, and don't eat any more cane-tops after, one fill being enough, and soon takes all the jump out of them ; you find the dead next day. Locusts, being cannibals, eat the dead, and should also die. One pound of arsenic costs under sixpence, and makes about three gallons of solution, enough for 80 to 100 gallons of treacle. About 2 or 3 oz. is sufficient for each tin along the roads. Eight coolies with the above do more execution than 120 coolies with cats and screens, this being the number lately employed daily. This remedy also applies to the flying locusts, who hitherto went scatheless. It is now only a question of treacle and arsenic, and a liberal feeding, to keep an estate clear of locusts in all stages. It can be seen in full operation on Ottawa estate, where further information can be obtained.

(9) FUNGI

As the hoppers may be infected equally in an artificial or mechanical manner by fungi with the flying locusts, the reader is referred to the process among the latter class—pars. 882 and following.

IV. DESTRUCTION OF THE WINGED OR FULLY-FLEDGED
LOCUSTS—VOLADORAS

870. **Preliminary—Science should be subsidised.**—Two preliminary observations seem to me likely to be of use if made at the commencement of this subject. One, the flying locusts can only, as far as we know or can judge at present, be effectually destroyed in its wintering or hibernating quarters, where the cold compels them to aggregate or cluster together in considerable numbers, that they may be easily approached and easily caught in great quantities. This inference is fair from what we know of the life-history of the insect, although we do not certainly yet know their permanent home or winter quarters. There is room here for any Government to give encouragement to any courageous and enterprising young scientist to tempt him to find out the regions where they winter ; or, the same is open to any rich private man with a hobby. Money may be well spent in such a pursuit as this, and it is difficult to perceive a better avenue, whether belonging to public or private funds, for laying it out to such excellent purpose, than

in the cause of philanthropy, research, humanity, and progress. If, then, we could with absolute assurance ascertain the permanent wintering quarters of the flying locusts, the battle against them would be an easy and successful one. There is, however, no use till then discussing how to attack them there. When we get that information, suggestions as to the ways and means and plans of attack will not be wanting.

871. Battle to be given while in flying stage.—The other remark I think it well to make here is, that although where the locusts make their appearance in a flying cloud of immense dimensions and swoop down as they list here and there, they seem, and then really are, unmanageable,—man is more or less powerless in face of such countless numbers over large areas of country,—yet there are many opportunities when they may be met in battle and vanquished in appreciable numbers in the flying stage.

872. The locusts' powers of flight.—At the same time it would be futile to shut our eyes to the fact that *their* being endowed with winged motion, whereby they may quickly get away quite beyond our reach and sphere of influence, does not give *us* such a good chance to overcome them as when they are minus this power. At the same time, the fact that they use their wings for the purpose of soaring to enormous heights and distances is of considerable advantage; for in one way they can and do pierce strata or currents of air which carry them in vast numbers far away beyond their own power and ours, and they perish in the sea; and in another way they carry seeds of the fungus or other disease, which naturally affect them over a large area over which we can have no influence to attack them or other flocks there.

Now, in dealing with this department of the subject, it is not necessary to repeat processes already detailed. The reader can refer to the description given in a former part. I must say a few words in regard to

(1) DIVERTING AND DRIVING AWAY AN ORDINARY FLIGHT OF FLYING LOCUSTS

873. Altruism again pressed.—From what has been said throughout the text in Books I. and II., it will be evident to the reader that the flying clouds that visit us dislike smoke, noise, and disturbance or molestation. Therefore from time immemorial it has been usual and customary to use such means as these to prevent them settling on the crop. It is reasonable and right to adopt everything possible to save the crop, but what I think is wrong is the selfishness of the person who only tries to save his own and gives no aid to his weak neighbour to save his also.

874. A plague like this should be the means of stirring up and

strengthening the best part of our natures. I strongly urge on the authorities the propriety and duty of steps or means being enacted to prevent the entire loss caused by a flock of flying locusts to be borne by one or a few persons in a locality. It must or ought to be moderated or graduated in a somewhat similar way to what is done in the case of the cattle plague, in which we have something that approaches an analogy. One would have no sympathy with the idle man—the sluggard who did little or nothing for the welfare of the community, his family or himself; but when we find the industrious, hard-working, and honest man striving for all that he is worth, with might and main, for hearth, home, and country, so that he may make a competency and owe “not any man,” it is enough, if a catastrophe strikes him and causes his ruin, to touch the heart of any true man, and the thought of it makes the unbidden tears trickle down the cheeks. By all means, then, let there be made as much union and alleviation as possible in combating this plague and saving from ruin the best material of our manhood, which forms the backbone of any country. References will be found (in pars. 83, 134, etc.) as to the ways that are most in vogue for frightening or keeping the flying cloud away, so that they may not settle and eat what we hold so dear and (up till this visitation) have guarded and nurtured with attention and care.

(2) BY SHOOTING

875. Plans on which I pronounce no judgment.—From pars. 295 and following will be observed how this may be attempted. I present the plan to the reader by the advocates themselves of the methods, and though I confess that I do not believe in these plans, as at present devised likely to succeed, at the same time I have not seen them, and it would be unfair for me to condemn or sit as a censor in judgment upon them. To me they would not be advisable or expedient.

(3) MAIMING

876. Attack at night, or on cheerless mornings.—The best opportunity afforded for maiming the flying locusts is when the invading and local hosts settle to roost for the night, or when they do not rise on a cheerless, sunless, cold, windy, or rainy day. From sunset until the sun is well up next morning, and warms the earth, they do not move. They roost wherever they can—clinging to long, strong grass, vegetation, posts, pillars, walls of houses—anything and everything—and the implement or scourge for maiming them should be what you can find most convenient and expedient under the circumstances. Great injury can be done to them at this time, if people were only alive to the fact and not put it off in the hope that a more convenient time or oppor-

tunity should come. It is this procrastination that spoils everything. The different kinds of scourges have already been mentioned and a selection has to be made.

(4) CHEMICALS

877. The spray producer, with a solution of petroleum or coal-oil, or any of the "Contact" preparations, presents one of the very best means for killing the flying locusts, when they roost especially, or at pairing or nesting times. Chemical substances of a poisonous nature (pars. 863 and 294) from contact would then, I feel certain, have a marvellously good effect, and would repay the trial and the expense. I do not approve of laying poison down in pans, such as bran and arsenic, etc., on the off-chance that the flying locusts will be attracted thereby and condescend to partake of the compound.

(5) TRAMPING

878. Times suitable for this plan.—In convenient places, when the flying locusts roost in the camp or veldt, tramping by means of a large flock of cattle after sunset, or until the sun is well up in the morning, would be useful. Also when they pair and nest, if managed properly. It should not be forgotten that for every female locust killed before it deposits its eggs an equivalent of eighty young ones are killed, or forty for each of the pair. (See pars. 823, 666, 224-226, 288, 292.)

(6) CRUSHING

879. Rollers to be used at "pairing" period or when they settle.—Crushing the flying locusts is best done in open camp in suitable places by means of rollers at the pairing period, or when they settle to roost, as already indicated. As the female locusts can jump when "paired" very high (from six to eight feet), it would undoubtedly be of great advantage in this case, as already detailed under their respective heads, if the roller precede the horse, and means were extemporised to gather and keep them in front of the roller, as the moment you attempt to walk *amongst them* they jump away out of reach.

(7) BURNING

880. By means of mops made of tow dipped in kerosene or paraffin, or other oil, and fastened on a long wire, the mops set alight, and arranged to be drawn along the surface of the ground by horses, a large quantity may be injured or killed when roosting for the night. It will, in the early season, when the invading army come, be

impossible to set fire to the grass. If we find their wintering quarters when the grass is dry and in a fit state to burn, no doubt this period would of all times be the one to massacre them by the billion and with ease.

(8) CATCHING AND BAGGING

881. The locusts to be captured while roosting.—There is no limit to the number of flying locusts that may be caught when roosting alongside a house, or on posts, or on the veldt, if a suitable handy implement be selected to wound them; then bag them, or scoop them up and pop them into bags, tie them up, and destroy them in a poisonous solution in a tank. They may also be caught in a similar way by the Carcaraña machine, as shown in Figs. 35, 38, 39 (pars. 828, 832, and 836).

(9) BY MEANS OF LOCUST FUNGI

882. Mr. Edington's report.—The Director (Mr. A. Edington, M.B., etc.) of the Bacteriological Institute at Grahamstown, Cape Colony, has very kindly offered any help he can to me, saying, "I certainly think you would do well to prosecute the work you have taken up," and places his last Report at my disposal, from which, on this specific subject, I make the following important extracts:—

"Six years ago the Secretary for Agriculture directed my attention to the enormous depredations which were being caused by locusts, and asked if I could suggest or attempt any method for their destruction. From my experience with disease-producing fungi . . . I felt convinced that in this country, where the conditions for the growth of fungi are existent in a high degree, we should find, sooner or later, that locusts would be attacked by some low form of vegetable life, and I accordingly directed the attention of the Secretary for Agriculture to such a probability, and advised that instruction should be sent out to all districts, asking that, wherever locusts were found to be dying, samples should be forwarded to me, and that if I found any depredatory fungus, I would attempt its cultivation in a state of purity, so as to admit of its dissemination in areas visited by locusts, provided that such fungus should be proved to be harmless to farm stock.

883. Preparation of cultures for transmission abroad.—"On the 14th March 1896, I received a telegram from the Under-Secretary for Agriculture, asking if arrangements could be made to assist the Government of Natal in regard to the isolation and propagation of a fungus which was destroying locusts in that country. I replied that I should be glad to give all the assistance in my power, the more so since I had been in anticipation that such a fungus would be found sooner or

later. The work and experiments . . . enabled us, in the first instance, to prepare the fungus in such a manner, as regards purity and quantity, as admitted of its being made use of on a considerable scale in the field. Since then I have endeavoured to find on what medium it can grow with greatest celerity, and in what manner it can be transmitted to great distances for use in the field. So far I have preferred the use of a saccharine agar whose reaction is faintly acid. Small tubes containing such medium are inoculated, plugged with cotton-wool, and incubated up to the moment at which visible growth is to be recognised by the naked eye. As soon as this occurs, the plugged end is immersed in liquefied hard paraffin, and when cooled such tubes are ready for transmission to distant parts.

884. Tube to be either broken on the ground or placed in a tank along with locusts.—"For the purpose of affecting an area it suffices to break such a tube on the ground, either in high grass or in a suitable shade. It is, however, of the first importance to have a certain amount of moisture present, and hence its use is always most likely to be successful after rain. It is not advisable to use it after a drought, unless the place where it is deposited is kept damp. Various persons who have used it prefer to break a tube in water and to place some living locusts therein, which are subsequently released among a swarm. In Buluwayo the authorities are highly pleased with the success which has attended its use, but they insist on the greater advantage which follows if it is used during the voetganger stage.

885. Parts where transmitted.—"Quantities of the fungus have been sent to various parts of South Africa, to North America, the United States, India, Australia, and to Buenos Ayres. In various parts where it has been used, most successful results have followed.

886. The fungus is that of the "*Empusa grylli*."—"I regret that, owing to the urgent nature of the work in other departments, time has not admitted of the full study of its life-history, which I am desirous of having made, the more especially since its growth on artificial media gives such results as render the question of a symbiosis, as occurring in its life-history, deserving of some attention. It is, however, probable that the fungus is the *Empusa grylli* of the *Entomophthorea*, a group of fungi which for the most part live on or in the bodies of insects—into the cavities of the bodies of which they usually penetrate during life. After penetrating into the body cavity, they develop hyphæ, or filaments on branches of which are borne gonidiphores, *e.g.*, carriers of brood cells. These hyphæ penetrate from within outwards in the body of the insect after death, and upon the outer surface the final stages of development are completed. The *Entomophthorea* do not live exclusively on insects. One species,

according to the observations which have been made by Lietget, exists as a parasitic fungus in the cells of the prothallia of ferns.

887. Another locust-attacking fungus.—"Quite recently it had been reported that a different fungus from the *Empusa* found in South Africa has been recognised as attacking locusts in Buenos Ayres, and I am now endeavouring to procure some of the infected locusts from that country. It seems to me that only by the maintenance of a warfare against them, carried out by the dissemination of parasites, either vegetable or animal, can we hope to overcome them."

888. Reports from Cape Colony.—On the 7th November 1898, Dr. Edington wrote me, saying that he was then "making a large series of practical field experiments in Lower Albany," and in the *Standard and Diggers' News* of Johannesburg, of date 21st November, the following short notice appeared:—

"The Colonial Bacteriological Institute at Grahamstown has been making experiments with locust fungus. In Lower Albany the results were most successful, locusts dying in thousands."¹

889. Mr. Bruner's report.—Mr. Bruner, in his Report on the subject of locust-killing fungi, says:—"At least two, and possibly

¹ The fungus has been, as may be gathered from various parts in the text, used in several localities in South Africa—not only, as above, in Lower Albany, Cape Colony, but in Buluwayo and several parts in Natal, such as Durban, Richmond, Umzinto—and with gratifying results. Mr. E. W. Hawksworth (as would appear from a report in the *Johannesburg Star* of February 6, 1899, copying from the *Mercury* of Durban) sent an account of an experiment at Umzinto with the fungus. The following is an extract:—

"The pests having again visited us, I treated probably about 1000 fliers, according to instructions, and about ten days afterwards found considerable numbers of dead locusts about a mile away, which, upon examination, proved to have died of fungus disease. A short time after this I found several large swarms of young locusts infested with the fungus disease, a number of which, when dead, were collected by one of my brothers, dried, reduced to powder, mixed with water, and applied to a healthy swarm. Four days afterwards the 'hoppers' had unmistakably contracted the disease, and soon began to die off rapidly.

"Having now clearly proved, to my mind, the efficacy of infection by fungus, I am of opinion that, by the united action on the part of the Government and people, the colony could be rid of the pests in little, if anything, over a month, if systematic and prompt action be taken. Where no dead diseased locusts can be procured, a few swarms can be infected from the tubes, carefully watched, and when dead be collected, dried, reduced to powder, and used to infect other swarms. The dead could be collected and used as before, and by this means, within, say, from three to four weeks, by systematic and united action, the whole of the swarms in the colony could be got rid of at a very small cost. So successful have the experiments proved about here, that numbers of the dead diseased locusts are being collected and dried for stock."

The opinion of Mr. Hawksworth is extremely optimistic, and surpasses that of all who have been working with the fungi. This, however, need not detract from the direct evidence given.

three, distinct species of locust-attacking fungi have been especially brought before the public in different parts of the world during the past few years. Not that they are the only ones of these plants which select the bodies of the Acridians as proper places for development, but because they, among the others, have been most persistent and active in their results. Not being a specialist in the study of insect-attacking fungi, and not having the necessary books of reference before him, the writer is unable to give a satisfactory history of these plants at this time. For the same reason, anything like a complete classification is impossible.

890. "The North American locust-killing fungus which has been most noticeable is the one known to botanists as the *Empusa grylli*. It is the cause of the disease that frequently attacks and destroys myriads of both 'native' grasshoppers and the migratory ones. It works best during rather wet, warm weather in midsummer, and seems to attack the mature insects rather than the young ones. At anyrate, it is much oftener the case that the winged insects are killed by it than are the jumpers. When an insect has been once attacked by the fungus, it becomes rather sluggish in its movements, and shortly before death climbs up the stem of some weed or other plant, and securely attaches itself by tightly hugging the plant with its front and middle pairs of legs. In this position it dies, and remains clinging for some time after death. The bodies of the insects that die from the attacks of this fungus become somewhat swollen, and quite soft and brittle. A few days after death the body cracks open at the joints, thereby permitting the brown dust-like spores to escape and be blown about by the winds. Other locusts, upon eating vegetation on which such spores may be resting, if the weather and other conditions are favourable, likewise become attacked and die from the disease. It is most prevalent in the more humid parts of the United States, and also occurs to a considerable extent in the irrigated districts of the arid regions. Not unfrequently does it happen that the disease becomes so prevalent towards the close of summer that two dozen or more dead locusts may be found clinging to a single small plant. The *Empusa grylli* also occurs to some extent in this Republic (Argentina), where locusts killed by it have, on two or three different occasions, been found and sent to the Commission. Other quarters of the earth are its home also.

891. The Carcaraña or Argentine locust fungus.—"Early in his investigations the writer discovered at Carcaraña, in the province of Santa Fé, specimens of full-grown saltonas that had apparently died from one of the fungus diseases. A first glance at the specimens indicated that the fungus which had caused this death was quite distinct from the *Empusa grylli* described above. Having had some

experience with a fungus of similar appearance in the destruction of quite another kind of insect in the United States, he suggested that possibly the find was a *Sporotrichum*. To obtain a verification of this surmise, or to learn just where it belonged, specimens of the fungus-killed locusts were sent to Professor C. E. Bessey, of the University of Nebraska, a specialist in this line. He replied that the fungus without doubt was a *Sporotrichum*, but as to the species he could not tell till he had grown it to learn its spore-formation. He also wrote that he considered a 'great find' had been made, and that he hoped experiments would show it to be a valuable locust-destroying medium. No later information concerning the identity of this fungus has been received to date. Locusts which have been attacked by this native fungus, instead of climbing to the top of various plants, so as to get as much open air as possible, creep away from the light and seek for dark, moist places in which to die. Consequently they are most often found hidden away among the roots of bunches of grass, in the midst of dense, juicy foliage, etc. Here, after death, their bodies become entirely filled with mycelial threads and spores of the fungus. In many cases, under certain conditions, the spores cover the outside of the body also. In breeding-cage experiments this *Sporotrichum* gave very good results in a number of cases, while on the open camp, soon after the arrival of the voladoras from the north, many were seen to succumb and turn bright pink. These upon examination gave large quantities of the same kind of spores and threads as were found in the fungus-covered saltonas mentioned above. They also imparted the same disease to other locusts when powdered and sprinkled in the food of sound insects. At present the fungus is working nicely in the vicinity of Carcaraña, where it has already exterminated a good-sized manga of the insects. Here a very large supply of the dead bodies of the insects can be obtained with which to spread the disease to other mangas of the voladoras.

892. Fungi not the sole means of destruction.—"Although the experiments with locust-killing fungi have proven the uselessness of them as a sole means of destroying the locust pest, it is recommended that a sufficient supply of the *Sporotrichum* or Carcaraña locust fungus be kept on hand to use against it when conditions are favourable and necessity demands it.

893. "Allow also the assertion to be made here that no one remedy—disease, or mechanical, natural, or artificial—can be recommended to the exclusion of all others when it comes to dealing with so formidable a pest as is *Schistocerca paranensis*."

894. South African locust fungus.—Mr. Bruner says with regard to it: "Quite early in these investigations specimen tubes of the South African fungus were obtained and careful experiments were

also made on our locust with it. The results obtained were less satisfactory, however, than those with the native species. In the breeding cages, where all the conditions were under the control of the experimenter, the locusts exposed died. Outside no such favourable result followed its use. Just what this African fungus is has not been determined. It may be, and very likely is, quite another thing from both of the species referred to above.

895. Peculiarities of fungus growth.—"In the application of these fungus diseases it must be remembered that each fungus has its peculiar habits, and therefore requires certain conditions for its growth. *If a cow or ox be attacked by a disease like 'tristeza,' it does not necessarily follow that a sheep will also be subject to the same disease, though both are ruminants*; just as like as not, the South African locust fungus gave the smallest results on *Pachytylus migratorius*, the most common of the destructive locusts in that region. To expect the fungus to take hold of and kill *Schistocerca paranensis*, which belongs to an entirely distinct sub-family of locusts, is hardly scientific, to say the least. *That such results might occur* is possible, but not probable.

896. Native species the most deadly to its hosts.—"If any of these fungi are to be relied upon, why not the native species, that is already acclimatised, and was discovered as an actual enemy of the very insect whose destruction is sought? Besides, the various species of *Sporotrichum* are recognised by both botanists and entomologists as the easiest of insect-attacking fungi to propagate and to preserve, besides being the most deadly in their effects on the hosts which they attack.

897. Fungi inoperative unless the climate favour.—"Experiments made during the past spring and early summer tend to show the inefficiency of this mode of locust-fighting to the exclusion of all others. Both at headquarters and at other points in the Republic careful lists were made of the different fungi mentioned, and with practically the same negative results, save where climatic conditions happened to be favourable at the time. But by always keeping a good supply of the fungus-killed locusts on hand, and using them where the opportunity occurs and the conditions are favourable, much good may and undoubtedly will result."

898. A logical fallacy.—There is much in the above quotation, referring to the South African locust fungus, that one would like an opportunity to thresh out; but, in passing, I might call attention to the mode of reasoning employed especially in one of the paragraphs (which for convenience I have put in italics). The reasoning partakes of a well-known fallacy in logic, and, though catching, is very erroneous. Let us bring it out. If a cow or ox be attacked in consequence of some known cause, then it is probable that any cow or ox, no matter

to what species or sub-family they may belong, whether Cross-bred, Shorthorn, Hereford, Devon, Polled-Angus, Jersey, Kerry, Ayrshire, or Highland, would be similarly attacked if exposed in the same way to the same cause. The species of locust in the Argentine as well as that found in Africa bear pretty much the same relationship to the parent genus locust as the different breeds of cattle mentioned above do to the parent ox or cow. So the simile, to be of any parallel use, ought to be restricted to cattle and not to sheep; otherwise, it would be more "scientific" and accurate to say that because the fungus produced excellent results on *Pachytylus migratorius* it might or might not have the same effect on *bees*—an insect that is of a totally different and distinct family. They are not related. I think the concluding sentence in the paragraph referred to might be very safely and well put if the terms were *reversed*, namely: "That such results might occur is probable, but that they might not is possible."

899. The matter should be scientifically and exhaustively considered.—Note further the wording of the next paragraph: "If any of these fungi are to be relied upon, why not the native species," etc. This savours of incredulity in the first place and partisanship in the next place. It is the business of the scientist to find out the fittest without fear or favour or partiality of any kind. Both varieties or species of fungi *may* answer the purpose equally well. The man of science only arrives as a rule at the result after long and laborious work and careful observation and many failures.

900. Principles enunciated at "Tuberculosis" meeting identical with those of this work.—A copy of the *Edinburgh Scotsman* of Wednesday, 21st December 1898, has been sent to me in consequence of the similarity of the principles it manifested in the report of the meeting on the previous night at Marlborough House, London, and convened by H.R.H. the Prince of Wales, who presided on the occasion. The object of the meeting was the formation of "The New National Association for the Prevention of Consumption," and convened at the instigation of Sir William Broadbent, who, after stating the details as to the number of deaths annually and the modes as to the ways the disease spreads, said—

"But the adoption of the necessary measures has, as we know from abundant experience, been very slow, and would require many years, and if 70,000 persons die every year from tuberculous disease, which for Great Britain and Ireland is a very moderate computation, at least 200 new persons must catch the disease every day. It is the realisation of this fact that has called into existence "The National Association for the Prevention of Consumption and Other Forms of Tuberculosis." The mission of the Association is to carry into every dwelling in the land an

elementary knowledge of the modes in which consumption is propagated, and of the means by which its spread may be prevented, and thus to strengthen the hands of medical men throughout the country who are dealing with this disease. To this end the public attention must be captured, the public imagination must be impressed, the defensive instincts of the general public must be aroused, and we do not hesitate to express our belief that your Royal Highness will, by the single gracious act of calling together and presiding over this meeting, save thousands of lives. The objects of the Association can be stated in a few words. They are—(1) To educate the public as to the means of preventing the spread of consumption from those already suffering from the disease; (2) to extinguish tuberculosis in cattle; (3) to promote the erection of sanatoria for the open-air treatment of tuberculous disease.

"In supporting the objects proposed, the Marquis of Salisbury, who was present with other nobles and gentlemen, said—

"I believe this Association will be of great value in spreading both full knowledge and correct ideas on this matter. As one gentleman

said in the course of the discussion, it is the public only who can effect a change, and it is only by public knowledge that any real good will be done. Nothing has seemed to me more striking in the luminous statement of Sir Wm. Broadbent, or in the discussion following, than the absence of all desire that the powers of the law should be brought into operation to carry out the objects of the Association. It is a snare which they should carefully avoid. They must be content with preaching the salutary doctrine which they hold, and must not think of applying to the secular arm. . . . It must be taught, it cannot be enforced.' And among these avenues his lordship mentioned 'literature' as one of the chief.

"The Prince of Wales, who thus made his first public appearance after his accident, was cordially welcomed, and said—

"The points which Sir Wm. Broadbent alluded to were, first, educating the public to prevent the spread of consumption from those already suffering . . . and the way in which much can be done is to extinguish tubercle in cattle."

It will thus be clearly perceived that the lines and arguments used throughout the foregoing text are precisely the same as those promulgated at the meeting presided over by H.R.H. the Prince of Wales.

"Blow the trumpet in Zion, sanctify a fast, call a solemn assembly. . . . I will restore to you the years that the locust hath eaten."



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