

Department of Agriculture, Bombay.

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1908.

LOCUSTS IN INDIA

BY

H. M. LEFROY, M.A., F.E.S., F.Z.S.,

Imperial Entomologist, Pusa.



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I.—GENERAL DESCRIPTION AND HABITAT.

INDIA is the home of two locusts, which are periodically destructive to the crops and are familiar to agriculturists in the tracts through which they pass. These two species differ in habits and life-history and are checked by diverse methods. In order to facilitate their recognition, we reproduce coloured plates of these insects, and this short article is merely an amplification and explanation of the plates.

For many reasons it is important to be able to recognize a locust and make quite certain which one of the two kinds it is; knowing this, it is possible to predict what will happen whether damage is to be anticipated, whether locusts are likely to lay eggs, and whether any precautions are possible. There are great gaps in our knowledge of locusts which we hope to fill if readers will report every flight of locusts they see. For this, it is absolutely necessary to be able to identify the locusts with perfect certainty, and we hope that this will be possible by means of the plates.

A locust is a grasshopper which multiplies excessively, forms swarms and migrates, passing over long distances and setting here and there to feed. There are authentic records of only two insects in India which behave like this, but there is no reason why any of our common grasshoppers should not do so. If, therefore, the reader finds a swarm of locusts, the individuals of which do not agree with those represented here, we hope he will post specimens to Pusa with a short report. There have been reports of a green locust in Orissa, of curious locusts in Madras, of flights

of the Central Asian Locusts coming into India and so on, and it is desirable that these should be authenticated.

Plate XIX represents the North-West Locust.* This insect extends from Algeria through Northern Africa, into Cyprus, Arabia, Persia, through Baluchistan, into Sind, Kathiawar, Rajputana and the Punjab. From the last four areas it flies in vast swarms over Northern India, into the Western Himalayas, into the United Provinces, Behar, Bengal, and up the Assam Valley to the Eastern Himalayas. Calcutta is visited only occasionally, and is perhaps the Southern limit of its usual wanderings (though swarms have been recorded from the Godelavari Delta), while Assam, which is also only occasionally visited, forms its eastern limit.

In the flying stage this locust occurs in two colours; when it first acquires wing it is pink with a purplish tinge (Plate XIX, Fig. 20); in this stage it flies actively and for great distances; later, when it is about to reproduce, it becomes yellow (Plate XIX, Fig. 21) and, since the females are burdened with eggs, it now flies more slowly and for shorter distances.

When a swarm of yellow locusts is seen, egg-laying may be expected, but, before this occurs, they will settle and mate. A characteristic of this locust is that it lays its eggs in sandy places in fairly dry loose soil; large numbers lay their eggs together in one spot, and one may find as much as a maund of eggs laid in a few suitable spots included in an area of a few acres. A single egg cluster contains about 100 eggs, and weighs about 11 grains; a seer of eggs totals about a lakh, and a maund about 40 lakhs.

Speaking generally, there are in India two broods of this insect yearly; eggs are laid, say, in February—March; they hatch in about six—seven weeks depending on temperature; the hoppers live for about six weeks and undergo six or seven moults; at the last moult the winged insect appears, and after some time flies away. It then lives for about three months, becoming yellow

* This is known to science as *Acridium (Schistocerca) peregrinum* Oliv.

after about two months, as a rule; having mated and laid eggs, it dies.

The essential features of this locust are that it lives in all stages only six months, that its hoppers pack into swarms and move about, and that it is primarily a desert insect, an insect that lives and breeds in dry hot places and not in the moister parts of India where vegetation is abundant. In habits and colouring it is specially adapted to this life, and we might aptly term it the "desert locust" in distinction to the second Indian locust. The fact that the hoppers pack into swarms and move is sufficiently well marked to enable this locust to be immediately recognized in this stage; no one can mistake an army of these little dark coloured insects as they pour along the soil, and there need be no hesitation in identifying such a swarm as the North-West Locust (late XVIII).

The Bombay Locust* is so called as, in its capacity of a locust, it occurs chiefly on the Western Ghats and in neighbouring districts. Its last occurrence on a large scale was in 1903-04, and an account of its habits was published in 1906.† This locust is represented in Plates XVI, XVII. It will be seen that its colouring varies extremely, and this is the principal reason why it has been confused in the past. This locust is first seen in October when swarms are found flying; at this time it has the colouring shown in Plate XVII. Normally the insect retains this colour until death. In almost any part of India that is sufficiently moist and wooded, it will be found singly, in small numbers, just like any ordinary grasshopper. In some years, as in 1903, it becomes abundant, assumes the instincts of a locust, gathers together in loose swarms and migrates; unfortunately we know little of this locust except from the 1903 outbreak; in that year these swarms concentrated on the Western Ghats, as they did in previous recorded outbreaks; the migration to the Ghats took place in November, and it was found that these locusts had

* At present known to Science as *Acridium succinctum*, Linn., with some doubt. The family is undergoing revision at the present time.

† Memoirs of the Agricultural Department, Entomology, Vol. 1, No. 1.

become a vivid red, as shown in Plate XVI, Fig. 12; we may call this the "Swarming Colour," and we surmise its object to be simply to facilitate swarming, the stragglers being able to see from a long distance and regain the swarm. From November to March, these locusts moved about the forests in great swarms, defoliating the trees; in March they commenced to move out and they spread as far north as Ahmedabad and Udaipur, as far east as Nagpur, and south-east into Madras districts. The swarms then broke up, the locusts spread out singly and were widely distributed over a great area. In some the red colouring gave place to a "dry grass colour," the dull yellow brown of dry grass, but in the majority the red colouring remained more or less vividly until this second migration was over; in May the colouring of all changed to the dark colour shown in Plate XVI, Fig. 13, and when the rains came, egg-laying commenced. The colouring was then of extreme value, as the locust settling on the wet ground was very difficult to see. We call this the "wet ground colour," since it served the purpose of concealing the insect when settled on the wet soil. An egg-laying locust has many enemies, especially birds, and just as the North-West Locust turns to the colour of sand, so this locust assumed the hues that best enabled it to remain unseen on the earth when laying eggs. Egg-laying takes place after the first fall of rain in June—July, the eggs hatch in six to seven weeks to hoppers and the original locusts were by this time all dead. The hoppers were found to be green, did not pack into swarms, but remained singly in the long green grass just as ordinary grasshoppers do. In Plates XIV, XV we figure the hoppers in all stages. These figures were painted from specimens very carefully reared during the outbreak of 1903-04. Had not specimens been reared in cages and kept alive from stage to stage, it would have been impossible to tell which of all the hoppers caught were really of this locust. A great variety of insects were caught and sent in as being the hoppers of this insect. The senders would have avoided this confusion if coloured figures of the hoppers had been available at the time. These plates will enable

them to be immediately recognized when this locust occurs again. The hoppers moult as a rule seven times and then are winged, emerging in October.

The essential features of this locust are :—

(1) It is normally a grasshopper, but when excessively abundant behaves as a locust.

(2) It breeds normally in forest areas, and most abundantly in the forests of Kanara and Goa.

(3) Its total life is one year.

(4) Hoppers do not pack into swarms.

(5) The eggs are not laid in one place by a number of locusts but, as a rule, are scattered, each locust laying in any spot it finds suitable.

(6) The locust changes colour twice.

(7) Eggs are always laid in wet soil, not in dry earth or sand.

(8) Hoppers die in a dry atmosphere and can live only in very moist places.

The description given above shows how great is the distinction between these two insects and how important it is to be able to distinguish the habits and appearances of each. In the dry areas of Northern India, from Sind to the Punjab, in Kathiawar, and in Northern Rajputana, the North-West Locust alone occurs very commonly. The Bombay Locust may be found in forested areas, such as Kulu (and is doubtfully recorded as occurring there in vast swarms), but will not be found, as a rule, where the North-West Locust breeds.

From Ahmedabad southwards, through Gujarat, Central India, the Central Provinces and Berar, both locusts occur, and it is in these areas particularly that it is all-important to be able to distinguish which locust composes the swarm. There has been the greatest confusion in the past, and in 1903, when swarms of the Bombay Locust were flying south to the Ghats, swarms of the North-West Locust flew over from Kathiawar to Surat, crossing the path of the former, and passed on eastwards into India, giving rise to the belief that the locusts were moving east.

So far as the scanty records go, the locusts, south of a line drawn from Bombay to Calcutta, should be the Bombay Locust as a rule, but what the Locusts of Madras really are, does not seem to be certain. In Bengal and Assam, either locust might occur, but we believe that the Bombay Locust is not there known in swarms, but that the locusts are the North-West Locusts *which do not breed in so moist a climate.*

A great deal has been written about these two locusts, and we have indicated the salient points in the lives of each; but there are some points on which we are still ignorant. This is particularly the case with regard to the movements of these swarms of locusts, and unless far more full and accurate records can be obtained, we shall not be able to trace individual swarms across India. The peculiar migrations of the North-West Locust are still largely shrouded in mystery; when these locusts penetrate into the moist areas of Lower Bengal and Assam, what do they do? Do they seek a hot dry area in which to lay eggs? Do they turn back towards North-West India, or do they push on in the vain hope of finding sandy deserts? These and other questions remain unanswered to this day and much remains to be learnt.

The North-West Locust is also the locust of other countries but, so far as we know, the Bombay Locust is not known to occur in swarms elsewhere than in India. The Central Asian locust occurs in India, but we believe never in swarms. One of our commonest insects is the Black Spotted Grasshopper, figured in Plate XX; in 1903-04 this was constantly sent in as a locust; there is no *definite authentic* case of this insect having been found in a swarm; it has been found attached to swarms of the Bombay Locust, but no swarm composed of this grasshopper has been recorded. We figure it here because it is the insect most likely to be taken for a locust; it is the nearest in structure and appearance to the Bombay Locust of all our common grasshoppers, but it *never changes colour*, is common throughout the cultivated parts of India and normally feeds on cotton leaves.

In all cases of a doubtful locust, compare the specimen with this plate ; open the wings and note if the large delicate lower wing is yellow.

Unfortunately there is no single structural feature that separates a locust from a grasshopper, and the reader will find large insects that look like locusts, but do not agree in appearance with the insects portrayed here. Unless they are in swarms, they are not locusts ; if they are in swarms, care is required to make sure that one gets the real insect composing the swarm. It is a surprising fact that grasshoppers often attach themselves to the fringe of a locust swarm, and it is very easy to assume that one of these insects, which one finds after a swarm has passed or which settles near a swarm, is the real article, when it is only a chance straggler or a hanger-on.

We do not propose to say anything in detail about remedies. To deal with locusts is not a matter for an individual, but a question of co-operation and effort on a large scale. The North-West Locust is dealt with successfully by simple means in Northern India, and an account of the measures adopted against the Bombay Locust is on record. (*Vide* Memoirs of the Agricultural Department, Entomology, Vol. 1, No. 1.)

We trust that any reader who sees a swarm of locusts and finds that it is the Bombay Locust will help by reporting it *wherever he may be* ; that anyone finding a swarm of the North-West Locust anywhere *outside the drier areas of the Punjab, Sind, Rajputana and Kathiawar* will report the fact and state the colour of the locust ; and that anyone so lucky as to find a swarm of locusts not agreeing with those figured here will send as many as possible with full details ; and finally, should anyone be so fortunate as only to *see* in a swarm of locusts that are green or any other colour than yellow, red or pink, he will render valuable assistance by reporting the matter by wire specifying the exact locality.

II.—THE LOCUST PROBLEM.

THE Bombay Locust in September 1903 probably occupied an area of not less than 25,000 square miles: during the winter months it was concentrated in an area of 12,000 square miles and it then dispersed over an area which cannot be less than 140,000 square miles. To deal with a migratory insect that moves over such areas of country is not a light matter, and the experience of this outbreak will be of great value when the next commences.

In all probability, there will be no warning of the next outbreak until the flying locusts emerge as they did in September 1903. During the rains of 1903, there must have been numbers of hoppers throughout the area in which the swarms originated and there is no more likelihood that the hoppers will be seen in another year than they were in 1903. In discussing the general measures possible against the locusts in another year, it is convenient to commence with the flying locusts as they come out of the crops. Wherever locusts are found in September or October, whether in Bombay, Central Provinces, Madras or Central India, the most accurate information possible should be obtained as to the size of the swarms and their movements. During 1903, the swarms came largely from South Gujarat, with a contingent from Goa and Khandesh; in 1904, the eggs were laid and the swarms would have started over a far wider area, if the climatic conditions had been favourable to the eggs hatching. It is, therefore, not possible to say that the swarms will originate in any particular part of the country; their natural and normal breeding place appears to be the forest region of the Ghâts and that neighbourhood; in exceptional years they spread over a larger area, as they did in the early part of 1903, and again in 1904. If the swarms return, as they did in 1903, into the Ghât forest region, they have to be attacked there; whatever their movements, it will be important to know where they are and in what direction they move.

During September and October, little can be done ; the villagers should be induced to come out and beat the swarms from the crops. Continual harrying may drive the locusts from place to place, till they reach the forest regions, where at least they will not destroy the crops. They cannot be destroyed in these months on any large scale, and the one thing possible is to keep them moving, to drive them into waste lands, and worry them till they leave the fertile areas for the forests. During the cold weather, the method of destroying them at night can be followed wherever the locusts are accessible. Places like Mahableswar and Satara form centres for this work and in every village efforts should be made towards killing the locusts under the stimulus of a proper reward and an active officer. There are at least four months during which this can be done, when the locusts are concentrated in a smaller area and are perfectly helpless at night. After this comes the migrating period, during which nothing can be done except to attack them at night as before. The coupling season offers the last hope of destroying them before eggs are laid ; there is little difficulty in collecting them by day and every pair of locusts then killed means one egg cluster less laid in the ground. The utmost care should be taken to compile accurate records of the places where the locusts lay eggs, that is, of the districts where locusts are at the coupling and egg-laying season. Though it is not generally possible to destroy eggs, it is possible to destroy hoppers, and no better or easier method offers itself of checking the locusts than that of destroying the hoppers. If large swarms of locusts are known to live till the coupling period and are then marked down, it may be possible to destroy hoppers on a large scale when they emerge later in the season and so check every outbreak at the commencement. The action necessary amounts to—

- (1) Note the movements and size of the swarms during the first migrating period.
- (2) Urge the villagers to drive them out of the crops.

- (3) Destroy them at night during the cold weather.
- (4) Destroy them during the coupling season.
- (5) Mark down the localities in which they couple and lay eggs.
- (6) Destroy the emerging hoppers.

In view of the many printed papers issued by the Government of Bombay during the year, comment on these points and on their execution is not much needed. The experience of 1903-1904 has elucidated much, and notably certain practical points which would have been of great value had they been known before the outbreak of locusts.

In regard to the first point, the very practical caution of ascertaining the identity of the locust may be impressed. In 1903 the migratory locust was also passing through Gujarat and was confused with the Bombay locust. The past records bristle with difficulties and misconceptions due to the impossibility of accurately identifying the locusts or to the chance assumption that the locust in question was "Acridium so and so."

Various methods of carrying out the third point were advocated and tried. The use of fire in any form was eventually abandoned, as also the use of kerosene torches. Insecticides are extremely valuable when they can be applied, but the expenditure of large sums on machinery and insecticides, while useful for the protection of stations such as Mahableshwer, is not likely to solve the general problem. It has been shown that twelve men with insecticides destroyed ten times the number of locusts killed by hand with a large gang of labourers in far less time, and at far less cost ; but the difficulties of transport and of water-supply, and the absence of men fit to carry out this work, put this method beyond consideration. The method of killing locusts at night was fully successful at Mahableshwar, and was largely adopted during subsequent operations in many parts of the Bombay Presidency.

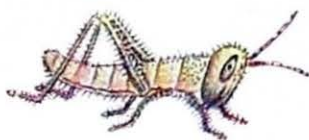
During the coupling season, no special methods are needed. The offer of rewards, and the encouragement by village officers and mamlatdars, should stimulate the people to collect the locusts and the only thing needed is a supply of bags in which to bring in the locusts.

The destruction of hoppers by means of bags and frames was tested on a sufficiently large scale to demonstrate its fitness for general use, and more complicated methods are not likely to offer any advantages.

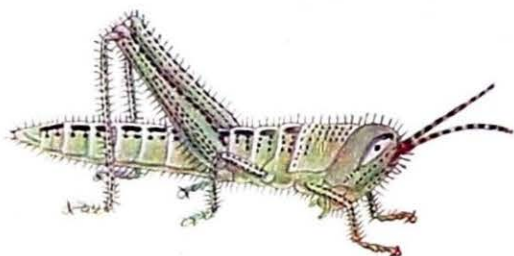
EXPLANATION OF THE PLATES.

- Fig. 1. (Plate XIV.) Bombay Locust Hopper, just hatched from the egg ; magnified five times.
- " 2. " Bombay Locust Hopper, after first moult (in second stage), magnified five times.
- " 3. " Hopper after second moult (in third stage), magnified five times.
- " 4. (Plate XV.) Hopper after third moult (in fourth stage), magnified five times.
- " 5. " Hopper after fourth moult (in fifth stage), magnified three times.
- " 6. " Hopper after fifth moult (in sixth stage), magnified twice. The wing lobes are turned up.
- " 7. " Hopper after sixth moult (in seventh stage), magnified twice.
- " 8. (Plate XIV.) Hopper in the same stage, but just before the last moult, the colour of the Locust now developing. Natural size.
- " 9. " The Locust just emerged.
- " 10. (Plate XVI.) The same, a darker variety.
- " 11. " The red Migrating colour.
- " 12. " The Wet-Ground colour.
- " 13, 14. (Plate XVII.) The Bombay Locust as ordinarily found when it does not swarm and change colour.
- " 15. (Plate XVIII.) Migratory Locust Hopper, in first stage, magnified five times.
- " 16. " Migratory Locust Hopper, in second stage, magnified four times.
- " 17. " Migratory Locust Hopper, in third stage, magnified three times.
- " 18. " Migratory Locust Hopper, in fourth stage, magnified $2\frac{1}{2}$ times.
- " 19. (Plate XIX.) Migratory Locust in swarming colouration.
- " 20. " The same in egg-laying colouration.
- " 21, 22. (Plate XX.) The Black Spotted Grasshopper.

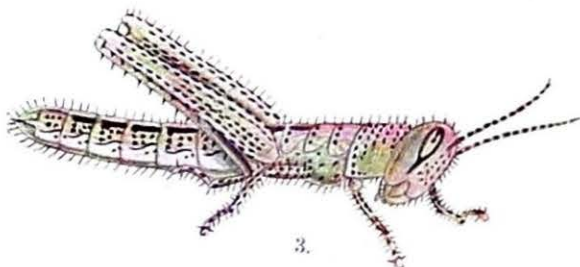
PLATE XIV.



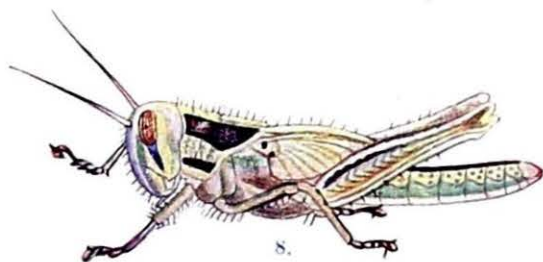
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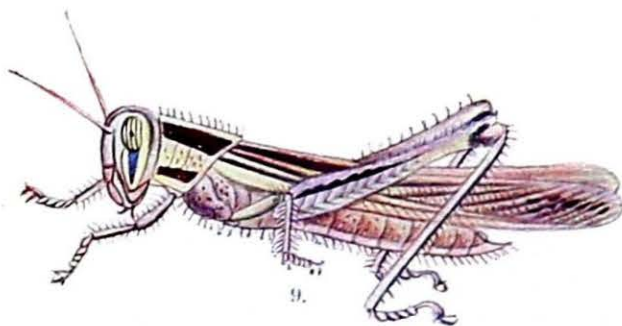
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3.



8.



9.

THE BOMBAY LOCUST.

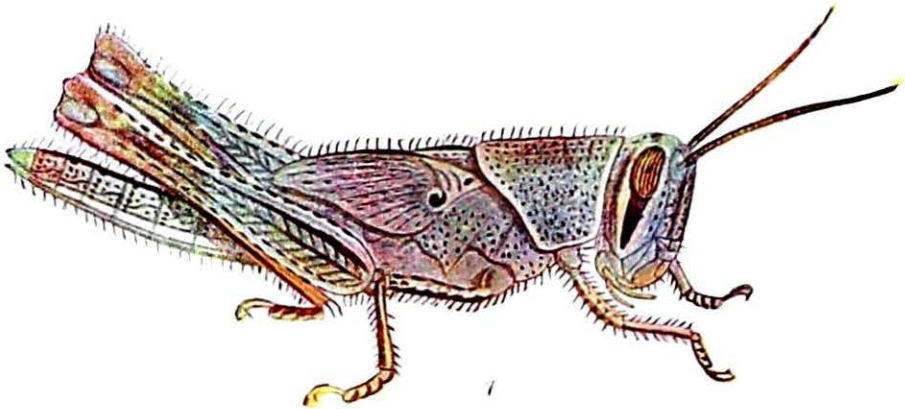
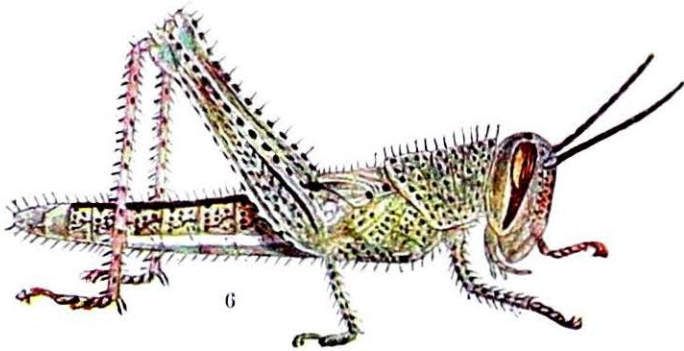
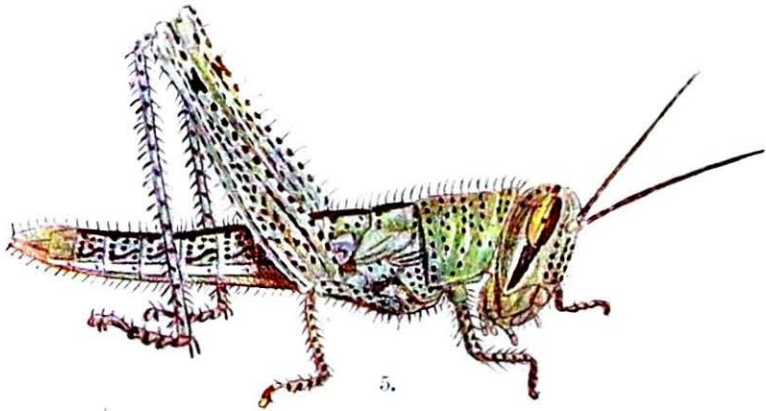
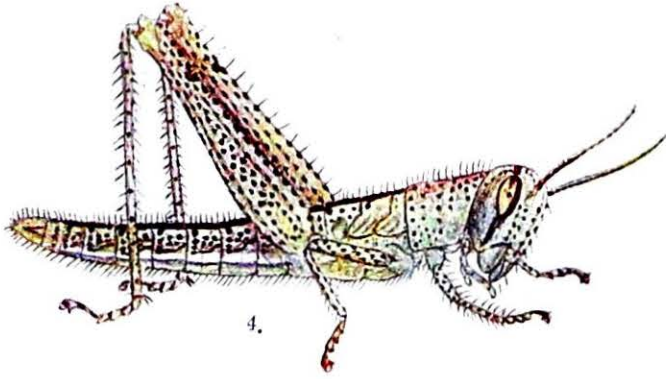
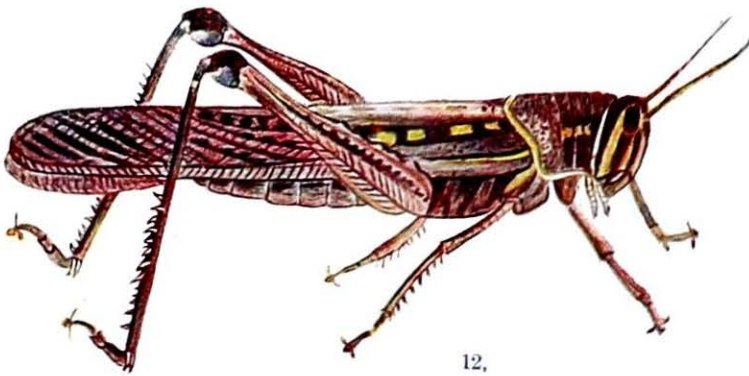
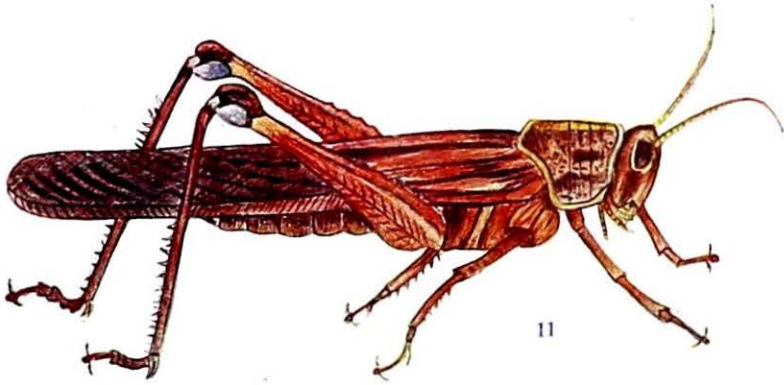
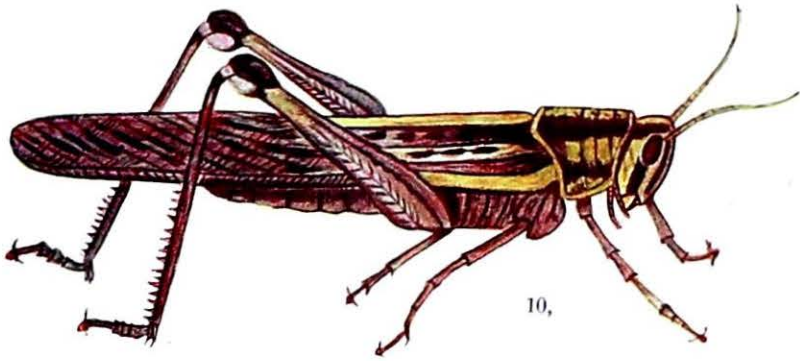
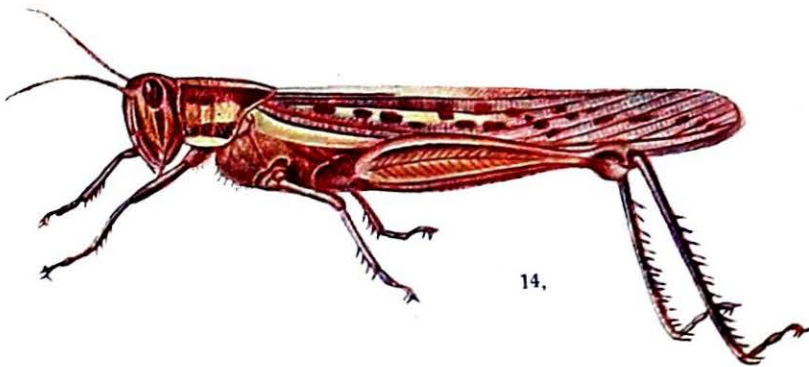
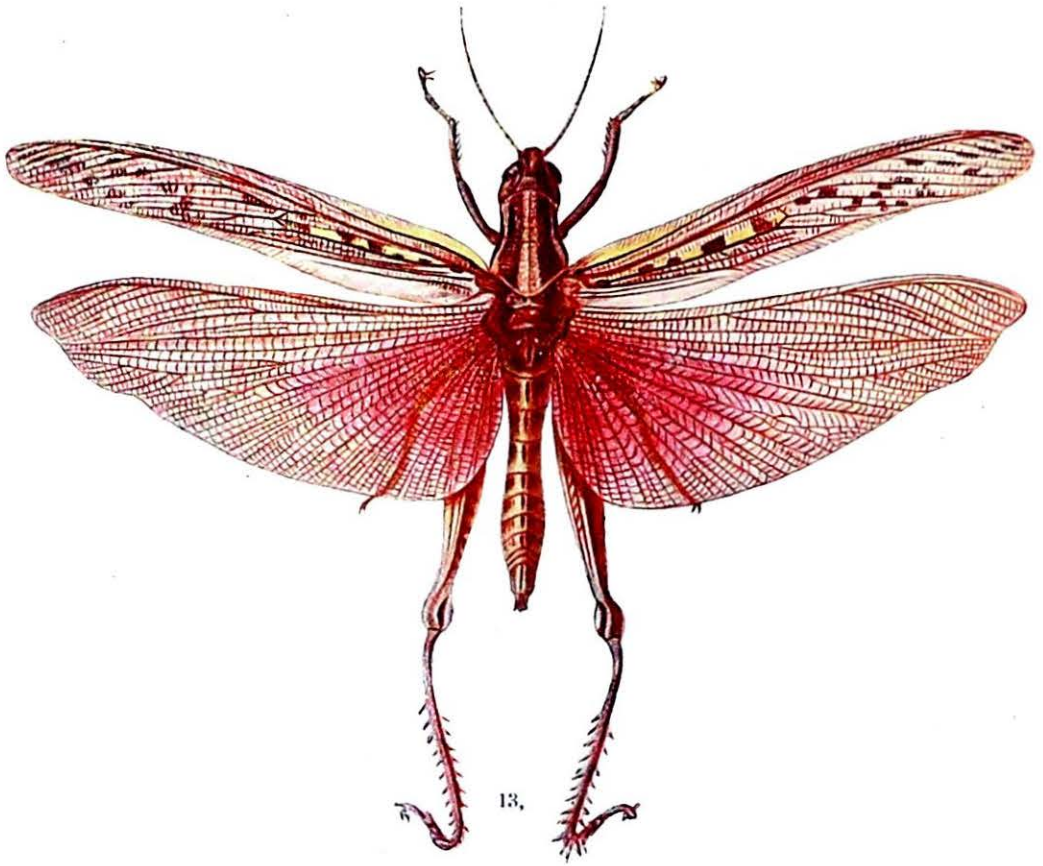


PLATE XVI.



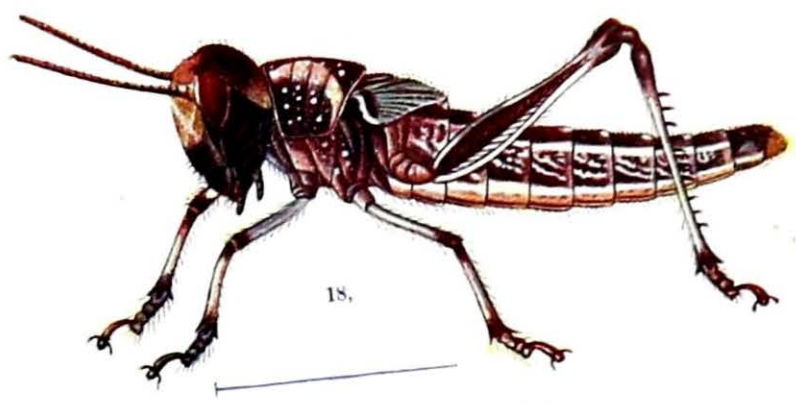
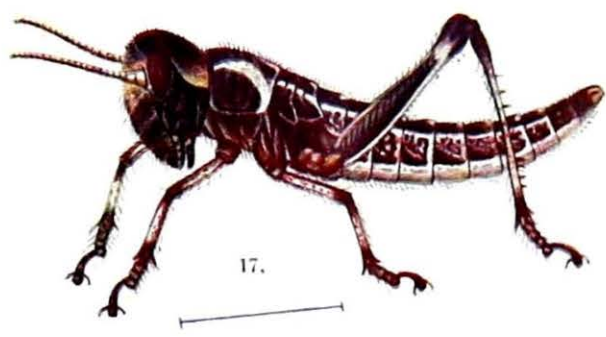
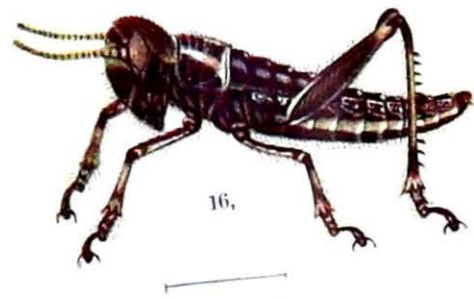
THE BOMBAY LOCUST.

PLATE XVII



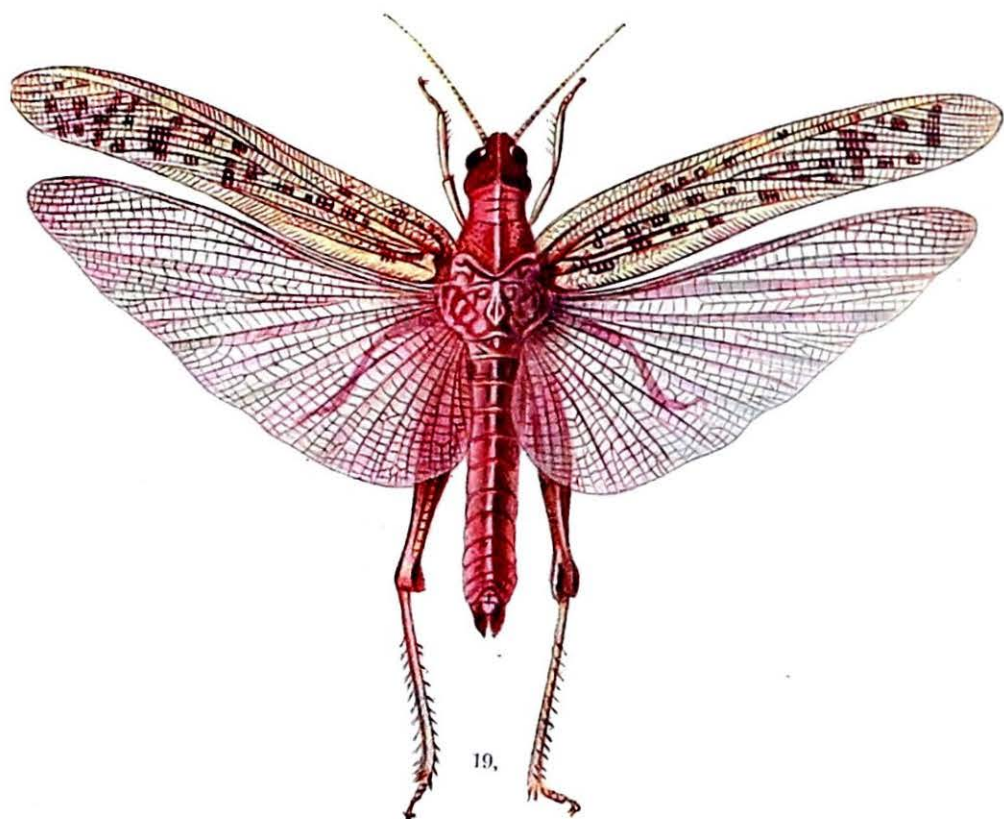
THE BOMBAY LOCUST.

PLATE XVIII.

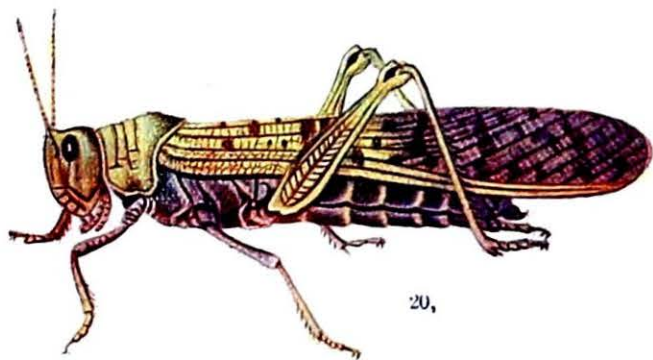


THE NORTH-WEST LOCUST.

PLATE XIX



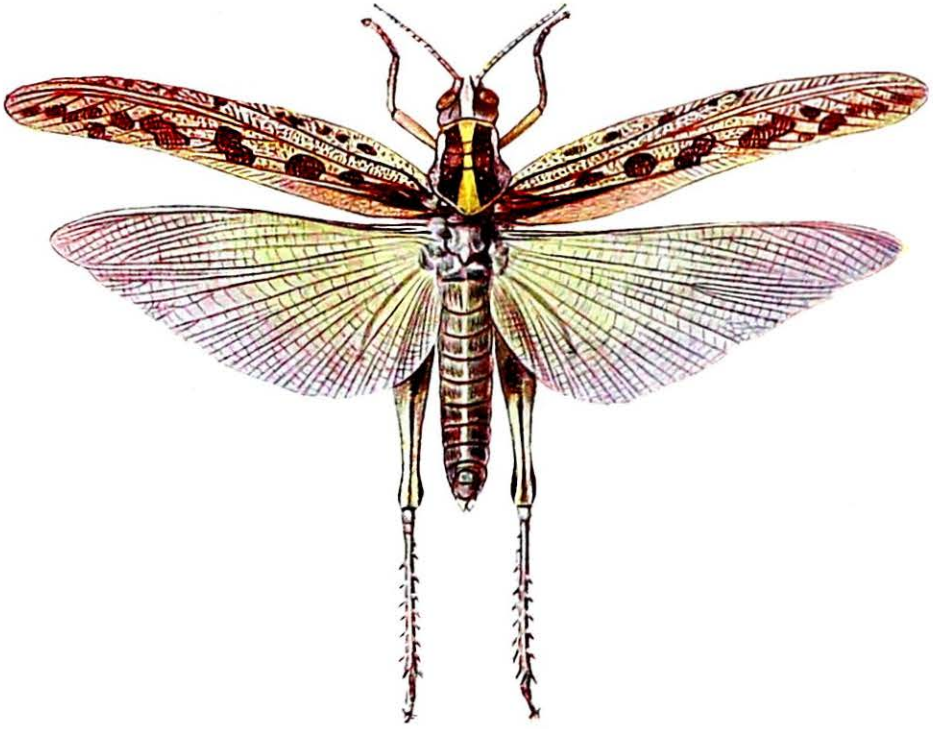
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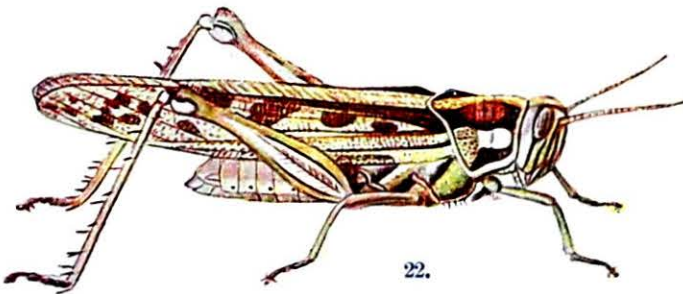
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THE NORTH-WEST LOCUST

PLATE XX



21.



22.

THE BLACK-SPOTTED GRASSHOPPER.