PSYCHE.

# THE INFLUENCE OF METEOROLOGICAL CONDITIONS ON INSECT LIFE.

BY CHARLES GOLDING BARRETT, PEMBROKE, WALES.

[Abstract, by B: Pickman Mann, Washington, D. C., from Entom. mo. mag., June 1882, v. 19, p. 1-8.]

"The means employed by nature to keep species within due bounds—checking their inordinate increase or unnecessary decrease—are so certain and reliable in their results, and yet so obscure and difficult to trace in their modes of action, that almost any observations, however slight, which seem to be reliable as data from which to ascertain these means, are interesting and worthy of being put on record.

"In every district and every climate there are evidently many species so peculiarly fitted to it that none of the periodical changes of weather and temperature materially affect their numbers, and from *these* little evidence can be obtained. It is from those species which only casually and rarely extend themselves from their natural homes into climates unsuitable for them, or from those which are always to be found in a given locality, but sometimes rarely and always varying in numbers, that the most satisfactory evidence must be expected.

"In the first class of cases an example occurred to me a few years ago which seems very much to the point."

From eggs of *Deiopeia pulchella* received from the south of France some moths were, by great care and assiduity, reared to maturity in England, and from these were obtained fertile eggs, which duly hatched. Only about half a dozen of the larvae seemed to possess sufficient vitality to feed. These were fed on potted plants, grown in a sunny window, where they, covered with gauze, "grew rapidly, feeding with especial eagerness when the sun was shining on them. The weather happened to be fine and the sun hot for two or three weeks just at that time, and one larva made such progress that in a fortnight it was full-fed, when it spun a very slight cocoon on the gauze and turned safely to pupa. By this time two more larvae were full-fed and left the food-plant for the gauze, the rest being fully half-grown, when a change of weather came, with wind, heavy rain, and a total absence of sunshine. The larvae were, of course, not exposed to the rain, but the effect of the change was that those full-fed made no attempt to spin up, and the rest ceased to feed, and in a few days they all fell off the gauze or the plants, dead. After a fortnight of wet weather it cleared up and the one pupa produced the moth—a male.

"This seems to supply a key to the whole history of the eccentric casual appearances" in England, "of this and many other inhabitants of warmer climates. In obedience to some singular instinct that impels insects when becoming too numerous in their natural homes to emigrate to 'fresh fields and

pastures new,' they, contrary to their ordinary habits, cross land or sea, arriving, of course, very often, in some inhospitable clime, where — if not at once captured — they very likely soon fall victims to some pitiless storm of wind and rain. But supposing both these risks to be avoided, the moth — if an impregnated female — in due course lays its eggs, which most probably hatch. If the temperature happens to be lower or the weather wetter than the natural constitution of the species is able to endure, the young larvae die without even attempting to feed, but if matters are more favourable, the strongest of them struggle along, and if fairly favoured by the weather a few of them may reach the perfect state; if quite unusually favored by the weather a large proportion of them may do so, producing those remarkable instances of the sudden appearance in numbers of a species usually rare. Such good fortune rarely extends to a second season and the species becomes a rarity again or is even probably exterminated, to be renewed at some future time by the same instinct of migration. In cases such as these it appears to me that sunshine means life, and its absence destruction, to the larvae, and that by this simple and obvious influence the extension of species beyond their assigned limits is practically prohibited.

"It also happens sometimes that the immigrant, following instinctively its inherited habit, attempts to produce *an additional brood* in the year, over what the climate will allow." For instance, pupae of the second brood of *Colias edusa*, in England, showed in December the yellow color of the wings, "which only shows itself when the insect is nearly ready to emerge," thus "following inherited habit so as to hibernate, as they are well known to do [on the continent of Europe] in the perfect state, but from insufficient warmth and sunshine were unable to muster sufficient strength," and died.

Again, in the autumn of 1880, in which year there had been a wonderful immigration of *Vanessa cardui* into England, evidently a portion of the vast army that migrated across Europe, larvae were found tolerably common, feeding, at the beginning of October, on young thistle plants, close to the ground, making their nests among the radical leaves, all the tall thistles being dead. From some of these larvae two pupae were obtained, in doors, 17 and 20 October, and one imago, 20 November. "The rest died. This failure of instinct on the part of the immigrants surely explains, in some degree, the fact that last year [1881] the insect was more than usually scarce, hardly any appearing to have hibernated, and also why an insect with such power of increase in a suitable climate is so uncertain and variable in its appearances in one that is unfavorable.

"With reference to the second class of cases — those in which a species always present is periodically common or scarce — much has been written, excessive *rain* being usually assigned as the cause of diminution in numbers, sunshine as the cause of increase. Without doubt these causes act to a

very large extent, large numbers of larvae being actually *drowned* by continued heavy rain, and others rendered liable to disease, but a little evidence has come under my notice, pointing so distinctly to another influence of equal potency, that I think it well worth recording in detail."

For many years previous to 1878 there had been little or no intense cold in Pembrokeshire, owing to the predominance "through each winter of winds from the southeast, south and west, and especially the southwest, all coming off a sea kept constantly warm by the gulf stream. In many places fuchsias standing out of doors had never been cut down by frost within the memory of the inhabitants." Some of these plants had become trees five or six metres high, with trunks of the size of a man's leg. Plants usually grown in greenhouses here flourished in the open air. "During these years, very many insects of general distribution [in Great Britain] continued to be either very scarce, or confined to exceedingly restricted localities in this district." [Particulars given.] "*Noctuae* (except a few universally abundant species) appeared to be almost absent; such a dearth of ordinary night flying species I never knew anywhere before.

"But in the winter of 1878, there was a great change. Persistent north or northeast winds, intensely cold, froze everything up hard, the warm sea air was completely expelled, or if a slight change of wind permitted a few clouds to come over, the rain from them was nistantly converted into ice, with which the high roads were coated to a thickness of three or four inches [7.6 to 10.2 cm.], for weeks.

"The winters of 1879 and 1880 were equally cold, indeed, the latter was said to be the coldest known here for fifty years, even the sea sands along the tide line were covered ankle deep with ice and frozen snow, a sight very rarely seen on this coast. The first of these three winters [1878-1879] killed all the shrubby veronicas and some of the sumachs, and the tree fuchsias and myrtles above the ground.

"And now I will give the results as regards insects."

Lepidoptera which before were exceedingly rare became more and more abundant in 1879, 1880, and 1881, until in the last year they actually abounded. Species previously restricted to a few favorite spots spread all along the coast or over the country. Many *Geometrae* turned up which had hardly been seen before.

"But in *Noctuae*, the improvement was the most remarkable, as in that group the scarcity had been most marked." [Mentions numerous species which became abundant.]

"Here we seem to have a direct example of cause and effect, but I am not prepared to say that the effect always arises in the same way. I think there can be no doubt that in the case of those insects, whose mode of life includes the capacity for hibernation, their constitution is greatly strengthened and their chance of arriving at maturity increased, if the cold of winter is sufficiently severe to induce *complete* tor-

pidity, undisturbed by warm and spring-like weather at unseasonable times, and this may account for the vast increase in numbers in species which hibernate in the egg state; it also probably has a strengthening effect on those which pass the winter as small social larvae under a silken tent on the ground, or which, like the *Noctuae*, hibernate in the larva state on the ground or among dead leaves, and are tempted out to feed by every warm and genial evening.

"On the other hand there can be no doubt that mild winters act directly to cause the destruction of both hibernating larvae and pupae, in two ways. One is by encouraging the growth of mould, which we know attacks them as soon as, from excess of rain or humidity, they become sickly; the other by permitting the continued activity of predaceous creatures. These are very numerous. Moles continue at work in mild winters, instead of burying themselves deep in the ground; and mice are constantly active. These small mammalia destroy great numbers of Lepidopterous pupae, and they abound in this district, as also do birds during the winter in an extraordinary degree. As soon as severe cold sets in to the north and east, the birds come down in swarms to the open fields and sheltered hillsides of this district, and it is hardly necessary to point them out as most industrious and persevering destroyers of larvae. Predaceous beetles and earwigs are generally on the alert all through very mild winters, and although they probably do not eat much at that time, and, indeed, are not very plentiful in Pembrokeshire, they must destroy many larvae and pupae, having little else to subsist upon. But I believe that the mischief done by all these added together does not equal that done by the Onisci.

"During mild winters these crustaceous vermin increase and multiply, and feed, and grow without check, till in so mild a climate they become a perfect nuisance, pervading everything indoors and out. It was hardly possible to keep them even out of the breeding cages, where they would get introduced when very small and unnoticed — or perhaps in the egg state — hunt out and destroy every larva and pupa, and grow large and plump without ever showing themselves above the leaves and rubbish. Doubtless, their industry out of doors was in the same proportion, and my impression is that they approached very near to completely exterminating many species that would naturally be common here. Severe cold seems to destroy some of them, for they are not nearly so numerous now, and it certainly puts a complete stop to their destructive operations during a time when larvae are most especially helpless and liable to attack. To this, with other causes already mentioned, I am inclined to attribute the extraordinary increase in numbers of so many species during the last three seasons, divided by severe winters. The winter now past has been mild, and, therefore, a further progressive increase cannot reasonably be expected; but I hope that the mischief done in one mild winter may not be

serious. It is the progressive increase of destroyers with the decrease of victims through successive mild seasons that is really to be dreaded.

"As a slight corroboration of this view, I may mention, that while this district of country is comparatively poor in all the species of which the larvae feed and hibernate in any exposed situation, several species of Noctuae, of which the larvae live underground, are always abundant, and the country is actually rather rich in those species of Tortricina which feed and hibernate entirely within the stalks or roots of plants.

"It is worthy of notice, that there are a very few species which have appeared unable to cope with severe cold. *Lobophora viretata* was tolerably common here during the first three or four years of which I have been writing, but after the first cold winter it became scarce, and has since almost disappeared."

## SALIVARY GLANDS IN BEES.

[Abstract of a dissertation by Paulus Schiemenz.]

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Paulus Schiemenz' dissertation "Über das herkommen des futtersaftes und die speicheldrüsen der biene" . . . [Rec., no. 3337] gives many interesting facts in the anatomy of the honey-bee and of other bees. The beginning of this paper is a historical consideration of the subject, with a description of the digestive tract of *Apis mellifica*, in which the author follows Plateau's view that the proventriculus serves to arrest the too rapid flow of the contents of the crop (or honey-stomach, as Schiemenz here terms it) into the ventricle. Following the views of Leuckart, in whose laboratory Schiemenz prepared this paper, the author considers that the ileum of the bees, as of insects in general, has no other function than that of furnishing a suitable connection between ventricle and rectum, and he decides that the nutrient fluid used by bees to feed their queen, larvae and drones surely does not come from the ventricle, as has been often supposed. The salivary glands are next described, and their secretions and histological structure discussed, in the order introduced for them by Siebold, i. e., as "system I, II, III, IV and V."

The gland of system I (Meckel's supramaxillary gland) is provided with a reservoir and discharges its strongly acid secretion by openings, one on each side of the "Schlundblättchen" [hypopharynx of Savigny]. This gland is absent in queens and drones. In six species of *Bombus* this system is well developed, and the author describes various modifications in other bees.

The glands of system II (Meckel's glandula sublingualis) are in the head, just above its lower or posterior chitinous walls, and are easiest prepared by first removing system I, and then the brain. The different efferent ducts of the parts