PSYCHE.

THE ENTOMOCECIDIA.

Introduction.

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[Translated by B : Pickman Mann, from *Entomologische nachrichten*, July 1884, jahrg. 10, p. 205-209.]

I propose to offer, under the above title, within the next few years, a list, arranged by families according to a zoological system, of the galls (cecidia) which are produced on plants by insects (entoma), so far as such a list will serve to fill up gaps now existing. The category "plant-galls" is to be taken in the widest sense of the word, i. e., it is to embrace all those modifications which lie outside of the normal methods of development of the plant, and which are presumed to be due to the influence of a definite insect in any stage whatever of its development, from the egg to the imago. Usually only those vegetal formations are designated by the term "galls," which, while they do lie outside of the normal structure of the plant under consideration, yet show forms so definite and so perfect in themselves that they might rather be spoken of as an ornament than as a pathological phenomenon of growth. Of this kind are the well-known puff-balls of our oaks, the bedeguars of our roses, and the spirally twisted petioles of our poplars. But a wider knowledge of such forms, and the observation that anomalies which are far less obvious, and therefore are usually overlooked by the laity,

are due to exactly the same formative impulses (such, for instance, as the crumpling of the leaves of trees by the suction of certain *aphididae*), make it necessary to broaden the category "galls," and now every creative reaction of a part of a plant against an irritation which affects it, whether proceeding from an animal or a plant, is conceived of as a gall-making activity, and the resultant structure (cecidium) is termed a *mycocecidium* if a fungus figures as the impulse of the pathological formation, and as a *zoocecidium* if it is due to an animal.

If a coleopterous larva devour the parenchyma of a leaf, or a caterpillar spin together the margins of the leaves in order to make itself a shelter and to prepare itself a closed storehouse for food, the inhabited part of the plant opposes no obstacle to the doings of the animal, and the "miners" are very well to be distinguished from the cecidozoa. Bladder-galls, on the contrary, arise in another way, when the parenchyma of the leaf increases instead of becoming less, and the affected place thickens; and cecidia arise when leaves of trees expand in a direction other than the usual one, solely because of the irrita-

tion resulting from the sucking action of an animal, without being cemented by threads. In this sense some of the insects included among the gall-makers (cecidozoa) by F. Rudow (Uebersicht der gallenbildungen, welche an Tilia, Salix, Populus, Artemisia vorkommen, nebst bemerkungen zu einigen anderen gallen: Zeitschr. für d. ges. naturwissensch., 1875, v. 46, p. 237-287) [p. 269] cannot be considered as such, but *Trachys minuta* Fabr. and *Phyllostoma microcephala* Klug must rather be designated as miners. The resinous galls* also, which are included among the galls by Haimhoffen, in his Beobachtungen über die menge und das vorkommen der pflanzengallen und ihre specielle vertheilung auf die verschiedenen pflanzengattungen und arten (Verh. K.-k. zool.-bot. ges. in Wien, 1858, v. 8, p. 285-294), cannot be placed there without a distinction, if their method of formation presumes no real reaction on the part of the plant against the attacks of the enemy. There belongs, for example, the "mannatihal," which, a saccharine secretion, serves as an abode and for the transformations of some coleopterous larvae, the *Larinus mellificus* Jeckel and *L. maculatus* Falderm., and which occurs not uncommonly in Persia, on species of *Echinops*.†

It is another matter, however, when such formations arise only accessorially, as for instance they are connected with

the swelling of the wood in the case of the effect of *Tortrix zebeana* Ratz. On the other hand, since the recently published exhaustive investigations of Graf zu Solms-Laubach and P. Mayer, it can no longer be questioned, as it has been repeatedly in the past, that the caprificators belong to the cecidozoa.

It has been asserted that the cecidozoa preferably or solely attack diseased plants or parts of plants; indeed Ratzeburg goes so far as to set up the view that *tenthredinidae* are purposed to clear away diseased vegetal matter. Every day observation teaches that little weight is to be attached to general statements of this kind; the branches of oaks and elms, while loaded with galls, show forth in autumn in the most luxuriant green!

The list which I have planned is not alone to comprise the palearctic entomocecidia and their producers, but is to take into consideration also those of the rest of the regions, so far as attainable. At the same time the number of plant-galls as yet made known, which are produced by exotic insects, from all the rest of the geographical regions, is a relatively very small one—with the single exception of some of those of the antarctic region, whose entomocecidia have already been partly described in numerous North American periodicals hard to get at.

By the gradual publication of a complete codex of entomocecidia I believe I shall partially supply the need of a codex of zoocecidia in general, which need has long been greatly felt, and has

* Cf. Kirchner, Leop. Ant. Die harzgallen der nadelhölzer um Kaplitz. (Lotos, Jan. 1865, v. 6, p. 9-12.)

† Cf. Hanbury, Daniel. Note on two insect products from Persia. (Journ. proc. Linn. soc. Lond., 1859, v. 3, p. 173-185, fig.)

constantly become more pressing. The existence of such a need is sufficiently shown by the circumstance that single parts of this codex have already been worked out by illustrious men. Thus, in regard to insects, Julius elder von Bergenstamm and Paul Loew have compiled a "Synopsis cecidomyidarum," Wien, 1876. (Published by the authors. From Verh. K.-k. zool.-bot. ges. in Wein, 1876, v. 26, p. 1-104.)

Among all the animals (cecidozoa) which produce cecidia, the insects form decidedly by far the greater majority. Almost all the orders furnish at least one or another representative, and often from systematically very distant families. The number of species of cecidozoa among the lepidoptera, coleoptera and hemiptera is small; it is far greater among the hymenoptera and diptera; among the rest of the animals, gall-makers are found only among the minute *acarida*, among the microscopic *rotatoria* (living beings usually subordinated to the crustacea), and finally among the *nematoda*. Among the *acarida* it is exclusively the genus *Phytoptus* Duj. (which has been very imperfectly investigated as yet in regard to its species) which gives rise to plant-galls (phytoptocecidia, the *erinea*, *phylleriaceae*, *cephaloneae* of the old botanists) of the most manifold configuration of shape. The plant-galls of Europe, produced by *Phytoptus*, have been worked up rather exhaustively, especially by their most distinguished connoisseur, Friedrich Thomas, in Ohrdruf near Gotha, who has published the results of his investigations in nu-

merous works (namely, in the Zeitschrift f. d. ges. naturwiss... Giebel, and the Nova acta d. Kais. leop.-carol.-deutschen acad. der naturforscher) during a long series of years, and by several articles by Franz Loew in the Verh. K.-k. zool.-bot. ges. in Wien). Of the rotatoria solely *Notommata werneckii* Ehrenb. has been made known as a cecidozoon in algae, species of *Vaucheria*,* and the cecidozoa among the nematoda belong to some dozen species of the two genera of *anguillulidae*, *Tylenchus* Bastian and *Heterodera* Schmidt. Interesting material regarding these two genera of cecidozoa may be found compiled by Karl Mueller: Neue helminthocecidien und deren erzeuger (in Thiel's landwirthschaftliche jahrbücher, 1883, 50 p., 4 pl., and as a Berlin doctorate-dissertation).

A great part of the material with which we have to deal was arranged ten years ago in J. H. Kaltenbach's "Die pflanzenfeinde aus der klasse der insecten," Stuttgart, J. Hoffmann, 1874; 8+848 p. Yet this otherwise very useful handbook, besides being very incomplete in a cecidological regard, suffers in the lack of any reference to sources, which is however an indispensable requisite to a critical appreciation of the accumulated material.

In spite of the large number of facts already made known, the study of the entomocecidia and their producers still continues to offer a wide field for new

*cf. Ehrenberg. Notommata werneckii. (Mittheil. der Gesells. naturf. freunde zu Berlin, July 1836, p. 30-33.)

investigations, and it is not only of great importance from a purely entomological point of view, inasmuch as the rearing of galls yields insects which belong to the parasites and inquilines, which could not probably be obtained in any other way, but it is so also because it binds together inseparably two great

fields of human investigation, botany and entomology. But the study of plant-galls has moreover a deep practical interest in two other directions, in an industrial and agricultural regard. An all-sided consideration of the subject should not leave these sides of it unattended to.

ON THE RELATIONS OF FUNGI TO GALLS AND TO LARVAE OF CECIDOMYIA LIVING IN GALLS.

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[Reprint, with slight amendment, of an abstract with the same title, by Hermann August Hagen (Canadian entom., July 1885, v. 17, p. 136-137), of a review, by Friedrich August Wilhelm Thomas (Irmischia, 1885, v. 5, p. 4-), based on a record by Fritz Ludwig (Botan. centralblatt, v. 20, p. 356-) of W. Trelease's "Notes on the relations of two cecidomyiids to fungi" (Psyche, Aug-Sep. 1884, v. 4, p. 195-200), Trelease's paper not having been seen by Thomas.]

Larvae of *Cecidomyia* living in the spore-layers of *uredineae* are also found in Thuringia, Germany. In fact the discovery of the community in the same layer of two otherwise very different parasites is at first somewhat wonderful and startling. The right explanation will be a double symbiosis of a phanerogamous plant and a fungus, and of a fungus and an entomozoon. Years ago I received from Gotha such larvae out of the rust-fungus of *Rosa*. A similar manner of living is known in Germany for *Diplosis coniophaga* Winnertz and for *D. caeomatis* Winn. Their larvae were found by F. Loew in the rust-fungus of several plants (cf. Verh. Zool.-bot. ges. Wien, 1874, p. 155-). I am able to add two new facts. I found larvae of *Cecidomyia* on *Vaccinium uliginosum* in the spore-layers of *Thecospora myrtillina* Karsten (*Melampsora vaccinii* Alb. et Schn.), on the Beerberg in the Thuringerwald. The other one was sent to me by Dr. E. Levier, from Florence,

Italy. The leaves of *Tanacetum balsamita* L. (Erba di Santa Maria) had, in the *Puccinia tanacetii balsamitae* D C., many small red larvae of *Cecidomyia*. I am not of opinion that this guard is of prominent advantage for the plant. The enormous numbers of the spores of the rust-fungus will scarcely be diminished by these larvae to any extent, that the guard may be considered to be a practical advantage for the plant.

The second point of interest in Mr. Trelease's paper is that the larvae open the way for the fungus in the plants. I may state as an analogous fact, that here the pustulae and pocks on the leaves of *pomaceae*, made by *Phytoptus*, are not rarely filled by fungi, especially by the carbonized ones. The last plant I received by the late Alex. Braun, in 1877, from Blankenburg, Harz, was a leaf of *Sorbus aucuparia*, with fungus immigrated in the galls of the mites.