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ON THE HABITS AND ECONOMY OF SOME SPECIES OF SPHINGIDÆ.

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The Sphinges are of those types that have attracted consider able attention even in the dawn of our science.

It is quite astonishing what a number of exotic Sphinges are figured in Cramer, Stoll and other ancient iconographs, and the very names given by the immortal Linné to the European species bear testimony how well their habits were known at the beginning of entomological study, because they refer either to the food plant of the larva, or to some peculiarity in its shape (*Porcellus*) and that is one of the strongest proofs of their having attracted the attention even of the non-scientists to a superstition the name of the fatal Goddess, *Atropos*, referring to the popular belief, that the appearance of this insect foreboded epidemics, famine or war. The name *Elpenor* is an allusion to the companion of Ulysses of that name, who met with a fatal accident when under the influence of wine. Linné evidently has chosen this name to indicate that the grapevine is the favorite food plant of the species. Nevertheless these powerful and active insects, whose peculiarities strike even the imagination of the common observer, do not play that part in the economy of nature that could be expected from their enormous locomotive powers, their spasmodic activity, and their formidable looking larvæ.

In fact, with very few exceptions their influence on other provinces of creation is limited, they rarely become injurious to vegetation and even then they are never an endemic pest, but only sweep a district like an epidemic not to reappear for more than a decennium.

The State of California as far as its fauna is known, is poor in Sphinges. Most of our species are too rare to play a part anywhere but in collections and cabinets of scientists.

Deilephila Lineata var. Daucus, is common throughout the State. It is also found in the Atlantic States and in the slightly aberrant form described by Linne, in Mediterranean Europe. It seems to be nowhere so common as on the Pacific slope. The larva prefers plants of the natural order *Onagraceæ*, viz: *Epilobium*, *Boisduvalia*, *Clarkiæ*, *Eucharidium*, *Godetia*, *Ænothera*, and since the introduction of the *Fuchsia* species into our gardens it has taken very kindly to the different varieties of these exotics.

The larva but rarely suffers here from *Ichneumon*, *Ophion* or other parasites. It has a strong vitality and the power to adapt itself to plants of different orders for instance *Rumex* and *Portulaca*. Occasionally, but rarely it is met with on the grape-vine.

This species is known to have multiplied under favorable circumstances to an alarming extent. In a report published in the year 1877 I find a notice of such an instanee, of which I give the particulars.

In that year the neighborhood of Manhattan, in Kansas, was devastated by swarms of Locusts (*Caloptenus*) to a degree that all grass had entirely disappeared. Before the seeds of the destroyed grasses had a chance to germinate, their place was occupied by a herbaceous vegetation, chiefly consisting of *Portulaca oleracea*. Scarcely was this new vegetation started when numerous larvæ of *D. Lineata* made their appearance spreading even to some of the neighboring vineyards. This last circumstance roused the apprehensions of the people, when the cause of their fears disappeared as suddenly as it had made its appearance.

I read that *Philampelus Achæmon*, *Philampelus Satellitia*, and *Chærocampa Myron* are injurious to the grapevines of the Atlantic States. I do not know to what degree they are injurious, *i. e.* if they are dangerous, or merely troublesome and annoying.

Ph. Achæmon is the only one of these species as yet found in California. Like most insects, feeding on plants cultivated exclusively on large tracts of land, this species will multiply in favorable seasons to an alarming extent. Nevertheless, I do not know of any instance of material damage done by this species. The larva looks more formidable than it is in reality. It is of quick growth and soon transforms. The powerful flight of the imago carries the female to localities very distant from her birth place. Besides this, *Ph. Achæmon* partakes largely of the well known peculiarity of many Sphingides; namely, the undeveloped sexual character of the individuals that transform the same year and do not hybernate in the chrysalis state, so that the propagation depends mainly on the hybernating individuals.

From these circumstances it becomes evident that this species, although it may interfere to a certain extent with the production of a vineyard, is not capable of inflicting serious injury to the vines themselves, as is the case with endemic insect pests, or such epidemics as repeat more frequently.

I have no data as to what extent the injuries inflicted on vineyards by this species have been carried in the Atlantic States, nor am I in possession of exact statements in relation to *Ph. Satellitia* and *D. Myron.*

Macrosila Carolina and *M. quinque-maculata* occasionally injure tomato, potato or tobacco plantations. In California their destructions do not amount to much: in the Atlantic States, nevertheless, the damage done may be more serious. The insect seems to prefer tobacco to all other *Solanaceæ* and, therefore, in districts where a onesided agriculture excludes, to a considerable degree, cereals and fodder plants, the *Macrosila* species may develop up to insect pests. These pests probably will be of an epidemic, not an endemic character, as all Sphinges are rather unsteady in their quarters and of a nomadic turn. They generally crowd in one season and cannot be found in the next. Like *Ph. Achæmon* and its own near European relative, *M. convolvuli*, these species propagate only by the indviduals developed next summer, the numerous individuals developed the same season having their sexual organs imperfect and unfit for propagation.

I have read that *Ceratomia quadricornis* infests the elm trees of the Atlantic States sufficiently to disfigure avenues, but I did not find any statement that these shade trees suffered permanently. As far as I know the European *Sph. Pinastri* is the only insect of this tribe that, in certain seasons, inflicts permanent injury to vegetation, but the scourge of this species appears in the same district only after a lapse of years, never in two consecutive years, but when it occurs, the destruction sometimes is as if a forest fire had swept the region.

A forest infested by the larva of *Sph. Pinastri* exhibits even to the unexperienced eye striking peculiarities. Upon entering the invaded district a peculiar acrid, but not exactly disagreeable, smell is perceived; the ear is struck by a grating monotonous sound, caused by the feeding of innumerable larvæ; on the ground crawl gaily colored larvæ on a layer formed of fallen leaves, tops of branchlets and the cubic excrements of the caterpillar, some trying to hide under ground for transformation, others to regain a tree and climb up the trunk, from whose top some accident had thrown them. Large sized *Ichneumons*, and *Ophiones*, minute but shining *Chalcides* bury themselves around the larvæ, while lazy *Tachinæ* wait for an opportunity to drop a few eggs on those which are nervously seeking to hide for transformation. The larva and parasite are persecuted alike by *Carabus auratus* and *Calosoma Sycophanta*, whose metallic bodies

shine round the roots of the pines like golden coats of arms.

This entomological landscape is enlivened by villagers of all ages and sexes, under the command of some government forester, shaking trees, collecting caterpillars by broom and shovel into baskets and throwing them into fires kindled at different spots in the forest.

Modern forest culture has abandoned this system of warfare. Experience has shown that the *Pinastri* epidemic does not recur in the same district, even if nothing has been done. Science has demonstrated, that the enormous accumulation of parasitic *Hymenoptera* and *Diptera* would more than decimate the destructive insect without human aid. Besides this, insects, with enormous power of locomotion like *Sph. Pinastri*, never become endemic pests.

But the chief cause of a change in the forest tactics was the danger of fire, caused by the burning of the baskets amidst dry leaves, withered branches and dying pine trees.

Sphinx Pinastri is, as far as I know, the only *Sphinx* that occasionally causes serious damages, the harm done by the *Macrosilas* to cultivated *Solanaceæ* being scarcely worth mentioning.

If the Sphinges have but little power to harm vegetation, they nevertheless play an important part in their economy, for they are he carriers of pollen from flower to flower. Many of those flowers whose narrow tubular corolla contains anthers in a position that the pollen never could reach their own stigma nor that of a sister flower, are only fertilized by the interference of the *Sphinges*. The enormous length of the trunk of some of the *Macrosilas* is quite in proportion to the narrow, deep tube of the Tobacco flower and other *Solanaceæ* and *Apocynaceæ*, families not only patronized by the larvae, but also by the perfect *Sphinx*. And so it happens, that the precocious autumnal brood, whose imperfect sexual development prevents them from propagating their own species, contribute largely to the propagation of the plant that serves for food to the larvæ of their later born brethren and sisters. Looking for the nectar at the base of the cup they charge their trunks with the pollen and carrying in this way kisses from flower to flower, they are the means of fecundating the ovula, v hose growth will serve as food for the offspring of their hybernating relatives.

There is a curious instance to be mentioned in regard to the mutual relation of some *Sphinges* and an *Asclepiadaceous* plant, the *Physianthus*. The pollen of all the *Asclepiadaceæ* being of a waxy, instead of a mealy substance, is not apt to be carried by the wind like the pollen of other plants nor is the position of the pollinea always such, that without interference of a third party, their contents can possibly reach the stigma. *Physianthus*, especially, is a genus, whose anthers are constructed on a plan that would impede communication between pollinia and

stigma, and therewith fecundation and propagation of the species, if it were not for the agency of insects, and especially *Sphinges*, which, attracted by the copious nectar in the deep grooves that surround the tubus stamineus, insert their trunks into these cavities, where the narrow entrance is guarded by the anthers. There is a rim between the lower parts of the loculi of the anther, large enough to admit the trunk of a *Sphinx*, but gradually closing towards the upper portion of the loculi. This rim will catch the insect by its trunk and will keep it prisoner till the loculi have discharged their pollinia and fecundation has taken place. It is easily understood, that where the point of maturity, when the pollinia are discharged, is distant, the poor *Sphinx* has to choose between remaining prisoner for life or losing its trunk.

We may plant the *Physianthus* near tobacco plantations. Not that I think it of much practical use in protecting the plantation; it is merely to get even with a good number of *Macrosilæ* that have injured other tobacco plantations when in the larva state.

As to the object that nature had in view in this arrangement, I am at a loss to offer any explanation, if it is not the opinion, that nature sometimes is fond of very practical jokes.

Small and transitory as the influence of the *Sphinges* may be on the household of organic life, their scenic effect is considerable. And it is not only their size, elegance of form and harmony of colors; it is also their extraordinary powers of locomotion. A single specimen may enliven a flower garden in such a way that it creates the impression that the whole region was swarming with the species. Suddenly the insect will dart away like a humming bird, leaving the garden quiet and lonely, but repeating the same nervous activity on flowers in a different latitude.

It is a well known fact that the larvæ of *Ph. Nerii* are found nearly every year in different countries of northern Europe, where its food plant, *Nerium Oleander*, is cultivated in glass houses. Now those larvæ are brought there by females that are fecundated in a country where *Oleander* grows in the open air. The most northern place,[3] where the larvæ of *Nerii* has been found is St. Petersburg. It is more than possible that the female *Ph. Nerii*, that found her way into a Russian glass house, breakfasted on nectar of Oleander flowers on the borders of the Mediterranean.

And this is not an isolated occurrence. The very fact that the professional gardeners are wide awake to the financial advantages of having larvæ of this kind on their Oleanders, and that they do not kill them, but sell them, is the best proof of the frequently repeating occurrence. Some gardeners, induced by the prices paid by amateurs and collectors, have tried to cultivate *Ph. Nerii*, but all their efforts have been frustrated by the disinclina-

tion or disability of the specimens raised in northern climes to propagate. This is another proof of the frequency of such invasions, as each colony of larvæ is the product of an imigrated female, not of a female born in the northern region.

Modern investigations have also demonstrated that *Acherontia Atropos* and *Deilephila Celerio* do not propagate in Europe, and, consequently cannot be considered as indigenous species.

A French gentleman in San Francisco has shown me a little collection of insects, caught on board a vessel after a heavy gale, fifty-four geographic miles from the coast of Brazil. All these insects were *Sphinges*. They were ten in number; five *Macrosila Cingulata*, three *Philampelus Jussieuæ* and two specimens of a *Chærocampa*.

I could quote here a great many other instances that prove the wonderful powers of flight of these insects and their disposition to make use of them, but I consider the different facts mentioned here sufficient to demonstrate the impossibility to take measures against an invasion of such enemies. At the same time such measures, even if successful, would do very little good, because, in the few cases, where these insects inflict perceptible harm, the harm is but transitory, the enemy taking leave as abruptly as he appeared unexpectedly.

The advice to catch and kill the Sphinges hovering over flowers is as impracticable as to divert the course of a river by pailing. But if some people, not minding practical advantages, only wish to get even with the uninvited guests, let them plant *Physianthus*, and the torn off trunks sticking out of the flowers will satisfy the most revengeful disposition.

We would expect that the eminent power of flight in this group would produce a considerable number of cosmopolitan species, but there are comparatively but few. Two courses combine to restrict the majority to local distribution.

1. Their larvæ never are truly polyphagous. Most of them feed exclusively on a genus, many are even restricted to a single species whose geographical limits, of course, must comprise in that case the geographical limits of the *Sphinx*. The adaptability of their larvæ to the other kinds of food generally does not pass the limits of the botanical family, frequently, as mentioned above, does not extend even to species of the same genus. So *Deilephila Euphorbiæ* lives in quantities on *Euphorbia Esula*, rarely on *E. Cyparissias* and even in captivity it scarcely can be prevailed upon to feed on any other species and rather will die than touch most of the species of the Genus *Euphorbia*.

Its congener *D. Lineata* possesses of all the Sphinges known to me the greatest powers of adaptation. *Onagraceæ*, *Rubiaceæ* *Vitaceæ*, *Portulacaceæ* and *Polygonaceæ* will serve as food for its larva.

In consequence this species is to a considerable extent cos-

mopolitan. It is amphigeic, for it extends from California through America beyond the Atlantic into Mediterranean Europe and Asia, while *D. Euphorbiæ* is scarcely ever found beyond the limits of the most central part of Europe, but there in great numbers. In fact its habitat coincides with the habitat of *Euphorbia Esula*.

D. Galii adapts itself to plants of different families. It forms, therefore, part of the fauna of Europe, Asia and North America, and is, besides *D. Lineata*, the only instance of an amphigeic *Sphinx*.

D. Nicæa, *Dahlii*, *Hippophaes*, and *Vespertilio* are restricted in their food plants, consequently they are restricted in their habitat too.

Notwithstanding the roaming propensities of the individuals and their power to bear changes of temperature, the species themselves are strictly enclosed between certain isothermæ and isochimenæ, because the larvæ do not possess the same power of endurance in regard to climatic changes as the imago does. And this is perhaps the cause that all the immigrations of *Acherontia Atropos* before alluded to never succeeded in forming colonies.

Another peculiarity in the geograhical distribution of Sphinges may be derived from the same cause. The species of the Northern and of the Southern temperate zones are almost always distinct. Although these species invade the tropics from both sides, they never seem to be able to cross them so far as to reach the opposite temperate zone. The geographical distribution of some *Macrosila* and *Chaerocampa* is not a real exception, for their original home is the tropics, from whence they extend north and south. Perhaps some exception from this rule may be discovered in South Africa. The specimens of a so-called *M. Convolvuli*, which I have received from New Zealand, differ very materially from the European and North African insect and, are evidently the type of a new species.

As to the tropical species themselves, none of them are amphigeic. It may be, that in the course of time *M. quinquemaculata*, now beginning to form colonies on the Sandwich Islands, will reach the Australian continent, a feat that has been accomplished by one of our Diurnals (*Danais Archippus*).

The extratropical species of the Southern Hemisphere, at least so far as they are known, are distinct, each continent producing its own species.