STUDIES IN FOODPLANT SPECIFICITY.

1. THE SUITABILITY OF SWAMP WHITE CEDAR FOR *MITOURA GRYNEUS* (LYCÆNIDÆ)

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INTRODUCTION

The processes of evolution of foodplant specificity in insects are very little understood. It is difficult to bring out more than thinly supported hypotheses because of the scantiness of precise knowledge of even the most essential details of insect-foodplant relations. The task of discovering a usefully large body of such knowledge could be in no better hands than those of several lepidopterists, in any or all parts of the world, carrying on their favorite pastime of rearing Lepidoptera but with the guidance of the experimental method and comparative observation.

As DETHIER (1953, 1954) has explained, an unsuitable foodplant may be 1) nutritionally inadequate and not have all the components required for normal growth of the insect, or 2) it may contain toxic substances which poison the insect, or 3) it may be physically inedible—too hard, too dry, etc., or 4) it may have repellent odors or tastes which drive away the ovipositing female or the larva. Once a plant has been proved unsuitable, the cause should be determined; one might expect toxicity to be the quality in most instances. First, however, the suitability of any plant as food for an insect species should be fully explored. There are various points in the life-history of an insect at which unsuitability may be expressed. 1) The first instar larvæ might simply refuse to feed. 2) These larvæ might feed but soon die. 3) Some growth might occur, but death results before the larva becomes fully grown. 4) The foodplant might cause death during pupation or emergence from the pupal shell. 5) The species might develop fully on the plant, but the resultant males or/and females are sterile. **A full test of the suitability of a plant requires that the larva be reared solely on that plant and that the adults be induced to mate and lay eggs which then hatch.**

Among the most fascinating and potentially illuminating instances of foodplant specificity are the pairs or groups of extremely closely related species ("sibling species") in which each species is confined to one exclusive foodplant. The sibling pair, *Mitoura gryneus* (Hübner) and *M. hesseli* Rawson & Ziegler, is one of the newest to become known. *M. gryneus* is widespread in North America (including its probable western races *M. siva* (Edwards) and allies) and is only known to feed on Red Cedars, *Juniperus* spp.; a report of *Smilax* appears to be incorrect. Its sibling, *M. hesseli,* is known only from the eastern coastal area of the U.S.A., always near swamps full of Swamp White Cedar, *Chamæcyparis thyoides* (L.) BSP., and in confinement it has been reared successfully on *C. thyoides* (Rawson, Ziegler, & Hessel, 1952). Larvæ of *M. gryneus* have been found on *Juniperus,* but wild larvæ or ovipositing females of *M. hesseli* have not yet been reported. An opportunity to gather certain new data on *M. gryneus* was accepted, and the results are set out below.

A FOODPLANT EXPERIMENT WITH *M. GRYNEUS*

A female *Mitoura gryneus* was collected on *Juniperus virginiana* L. at New Britain, Connecticut, on 30 April 1954. The next day it was confined over a sprig of *J. virginiana* and soon laid a number of eggs. The larvæ emerged 16-17 May, and on 18 May eight of the new larvæ were placed on fresh *Chamæcyparis thyoides.* The remaining larvæ (about fifty) were left on the *Juniperus.* No special attention was given to the larvæ on *Juniperus,* and on 14 June, when the first larva pupated, there were only seven others alive and healthy; the low survival was probably due to an occasional lack or poor condition of the foodplant. By 14 June none of the larvæ on *Chamæcyparis* had pupated, but six of the original eight were still alive and healthy. In all, eight *Juniperus* larvæ and six *Chamæcyparis* larvæ proceeded to pupate.

Our next precise record of these *Mitoura* was made on 10 July 1954, when imagoes had emerged from all six of the *Chamæcyparis* pupæ (four ♂♂, two ♀♀) and from seven of the eight *Juniperus* pupæ (three ♂♂, three ♀♀, and one which escaped). The other *Juniperus* pupa failed to hatch at all. By this point it had been shown clearly that Swamp White Cedar (*Chamæcyparis*), the normal larval food of *Mitoura hesseli,* is essentially as suitable for the development of *M. gryneus* as is its normal foodplant, Red Cedar (*Juniperus*).

This result in itself was perplexing to us, and it became important to test the possibility of nutritional sterility in the *M. gryneus* reared on *Chamæcyparis.* Apparently very little has been done with mating of Lycænidæ in the laboratory, and we had no precedent or experience to guide us in attempting to induce copulation. However, a simple system, which is consistently successful with *Colias,* was used with the *Mitoura.* The four males and two females reared on *Chamæcyparis* were confined together in bright sunlight late in the morning on 8 July. At 12:20 P.M. (Eastern Daylight Time) a pair was found *in copulo* and was separated from the other *Mitoura.* The pair was seen to separate at 12:39. This female was confined with a fresh sprig of *Chamæcyparis* in a small bottle (about 420 cc.), and from 9 to 13 July it laid approximately 55 ova on the plant. Ten ova were selected at random and isolated for observation. From nine of these, larvæ emerged; the tenth was found to contain a fully developed but dead larva. Thus it had been proven that at least in Connecticut there is probably no nutritional sterility in *Mitoura gryneus* caused by *Chamæcyparis.* The only male and female tested each must have been fully fertile. No effort was made to test fertility in *M. gryneus* reared on *Juniperus,* since the abundant field and laboratory experience of the writers and many other lepidopterists, with *M.*

gryneus females which had undoubtedly developed on Red Cedar, served as satisfactory proof of the suitability of *Juniperus*.

CONCLUSIONS

The above experiment, begun as a simple test which was confidently expected to show the unsuitability of *Chamæcyparis* as a larval food for *M. gryneus*, has produced results entirely unexpected to us. It underlines many more questions than it answers. The case of *M. hesseli* and *M. gryneus* had appeared to be an almost diagramatic example of sibling species in which the most important Natural Selection factor guaranteeing their reproductive isolation was a basic physiological intolerance in each species of the foodplant of the other. Since we have found that no such intolerance exists, at least for *M. gryneus*, a number of additional aspects of the biology of these two species take on new interest. Some of the obvious questions to be answered may be stated as follows. 1) What is the fertility status of the F_1, F_2, F_3, and backcross hybrids between *M. hesseli* and *M. gryneus?* 2) Is *Juniperus* as suitable a laboratory foodplant for *M. hesseli* as *Chamæcyparis* is for *M. gryneus?* 3) In choice tests, both in the laboratory and in field observations without confinement, do ovipositing females of *M. hesseli* and *M. gryneus* choose one or the other foodplant oftenest when both trees are equally available? 4) And, more generally, does *M. hesseli* occur only with *Chamæcyparis* and, conversely, *M. gryneus* only with *Juniperus*, and if so, why?

References

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