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Two new cases of parthenogenesis in moths.

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With the exception of psychids, which include several parthenogenetically reproducing species or races, parthenogenesis is extremely rare among lepidopterans (cf. e.g. Vandel 1931, Robinson 1971). There are three parthenogenetic species of *Orgyia* (Lymantriidae). *O. dubia* Tauscher is normally bisexual, but in one area in southern Russia males are unknown. Only parthenogenetically reproducing females are found there (Rangnow 1912). Pictet (1924) reports that in Switzerland two forms of female *O. antiqua* (Linnaeus) occur, namely, a small one which mates normally and produces both male and female offspring, and a large one, which reproduces parthenogenetically. No males have been reported for a South African *Mesocelis* sp. (Lasiocampidae). The females reproduce parthenogenetically (Taylor 1950). Emmet (1976) has observed that *Trifurcula argyropeza* (Zeller) (Nepticulidae) is an apparently parthenogenetic species at least in England. Amongst a total of over 300 specimens, not a single male has been found. According to Heath (1976) this species appears to be parthenogenetic, too. *T. argyropeza* is apparently parthenogenetic in Finland, too. At least the 20 specimens in my collection, originating from six localities in southern Finland, are all female.

It is to be noted that in so large an order as Lepidoptera (with about 165 000 recorded species) no more instances of parthenogenesis are known. – It may be added that accidental and experimental parthenogenesis has been reported for many Lepidoptera.

Parthenogenesis in the studied new cases

The following two species of moths reproduce parthenogenetically at least in a part of their area of occurrence.

1. *Nemophora cupriacella* (Hübner) (Incurvariidae)

This species is found in southern Fennoscandia, in England, in central and south-east Europe and the U.S.S.R. The species is rare and limited to certain localities only in Finland. I know of only three localities in Finland: U: Kirkkonummi, about 50 ♀♀ (V. J. Karvonen); U: Porvoo: Kaarenkylä, 12 ♀♀ (E. and T. Suomalainen, R. Tynni); ES: Imatra, 6 ♀♀ (O. Nybom). V. J. Karvonen has furthermore collected two females of this species at Vaaseni on the river Svir in the U.S.S.R. – The about 70 specimens found in Finland and adjacent regions are, accordingly, all female.

According to O. Karsholt (Praestø, Denmark) only females of *N. cupriacella* have been found in Denmark (I. Svensson, Österslöv, Sweden, *in litt.*). I have not found any references to a possible absence of males in England and central Europe. Apparently *N. cupriacella* is bisexual there, since the male or male genitalia

have been described in many central European and English handbooks (e. g. Heinemann 1877, Spuler 1913, Meyrick 1927, Pierce & Metcalfe 1935, Heath 1976).

2. *Ypsolopha lucella* (Fabricius) (Yponomeutidae)

The species is spread over Europe with the exception of northernmost parts as well as over Asia Minor. In Finland it is rather common in the oak woods of southwestern Finland. The material covered in this study comprises the collections of the University of Helsinki Entomological Museum, the collections of the Insect Exchange Society and of the following persons: A. Aalto, V. J. Karvonen, H. Krogerus, E. Laasonen, E. T. Linnaluoto, K. Mikkola, E. Suomalainen and R. Teriaho. The species was found as follows:
A: „Åland" 3♀♀, Eckerö 5♀♀, Föglö 8♀♀, Lemland 3♀♀.
V: Bromarf 95♀♀ (most of them from Kadermo), Karjalohja 3♀♀, Korpo 4♀♀, Lohja 36♀♀, Parainen 11♀♀, Turku with environs 90♀♀ (68 of which from Ruissalo).
U: Kirkkonuomi 4♀♀, Tammisaari: Gullö 3♀♀, Vantaa: Tammisto 25♀♀.
All individuals studied, totalling 290, are, accordingly, female.

All specimens of *Y. lucella* known from Sweden are female (I. Svensson, oral communication). According to Palm (1974) there are apparently no males of the species in Denmark. Nolcken (1871) states that he has seen females of *Y. lucella* only in the Baltic countries. According to Pierce & Metcalfe (1935) the male of *Y. lucella* "seems almost unknown" and they present no illustration of the male genitalia. E. Jäckh (Bidingen, Germany, *in litt.*) has likewise found females of *Y. lucella* only in the environs of Bremen in northwestern Germany. Likewise, Povolny & Gregor (1948) report that they could not find any male of *Y. lucella* in Czechoslovakia though they had many individuals at their disposal and saw many collections. They suppose that *Y. lucella* is there probably parthenogenetic. The only *Y. lucella* males known to me have been captured by E. Jäckh *(in litt.)* in Italy and France (Piemonte, Val Susa, the southern slope of Rocciomelone at an altitude of 1000 m, 14 ♂♂ and 11♀♀ and Basses Alpes, Digne, Vallée Miraux, 1♂).

When collecting bisexual *Nemophora* and *Ypsolopha* species one usually finds more males than females, the evidence favors the view that both *Nemophora cupriacella* and *Ypsolopha lucella* reproduce parthenogenetically at least in certain parts of their area of distribution.

The chromosome relationships of the studied species.

The cytologically studied *Nemophora cupriacella* individuals originated from Porvoo in southern Finland and the *Ypsolopha lucella* material from Eckerö in the Åland Islands.

Ovaries with mature eggs taken from the females were fixed in Carnoy's fluid (6 : 3 : 1) and sectioned at a thickness of 15 µ. The ovaries were embedded in paraffin via butyl alcohol. The preparations were stained by the Feulgen method.

The eggs of parthenogenetic *Ypsolopha lucella* undergo chromosome conjugation. The first metaphase plate shows 30 bivalents of about equal size (Fig. 1), which represent the achiasmatic type peculiar to lepidopteran females (Fig. 2). As the chromosome numbers (n) of five bisexual *Ypsolopha* species studied by me range from 28 to 31 (Suomalainen, unpublished), the parthenogenetic *Y. lucella* is diploid.

The chromosomes of the first metaphase of *Nemophora cupriacella* were so tightly packed that counting the exact chromosome number was rendered impossible. Apparently the chromosomes of this species pair to form bivalents.

As the parthenogenetic eggs of both species undergo reduction (even though the evidence for *N. cupriacella* is slightly incomplete) they exhibit the automictic mode of parthenogenesis. The mechanism by which the diploid chromosome number is restored following reduction remains to be elucidated.

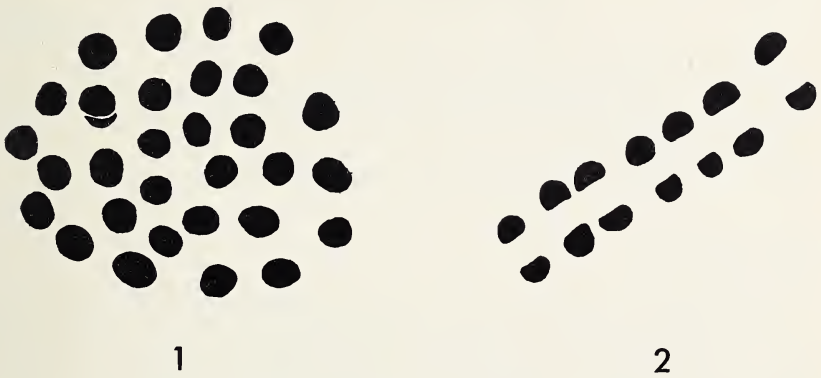

Fig. 1 & 2. First meiotic metaphase of the female of *Ypsolopha lucella* in polar view (1) and in side view (2). In fig. 2 part of the bivalents omitted. – × 2700.

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Zusammenfassung

Von *Nemophora cupriacella* (Hübner) (Incurvariidae) sind aus Finnland und Dänemark überhaupt keine Männchen bekannt, und desgleichen sind von *Ypsolopha lucella* (Fabricius) (Yponomeutidae) in Finnland, Schweden, Dänemark, England und zumindest in einem Teil von Mitteleuropa nur Weibchen gefunden worden. Von beiden Arten kennt man anderwärts auch Männchen. Diese Schmetterlinge pflanzen sich in den genannten Gebieten somit parthenogenetisch fort. In den parthenogenetischen Eiern finden Konjugation und Reduktion statt, so daß die Parthenogenese also automiktisch ist. Die parthenogenetische *Ypsolopha lucella* ist diploid (n = 30).

Résumé

De *Nemophora cupriacella* (Hübner) (Incurvariidae) on n'a pas trouvé des mâles en Finlande et pas en Danemark. De même on connait d'*Ypsolopha lucella* (Fabricius) (Yponomeutidae) seulement les femelles de la Finlande, de la Suede, de Danemark, de l'Angleterre et d'une grande partie de l'Europe centrale. D'autre part on peut trouver aussi les mâles de ces deux espèces. Mais dans les régions citées elles se reproduisent par parthénogénèse. Dans les oocytes parthénogénétiques se passe la conjugaison et la réduction. L'espèce parthénogénétique *Ypsolopha lucella* est diploide (n = 30).

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